

Biological Opinion and Conference Opinion

Eastern Collier Multi-Species Habitat Conservation Plan

Section 7 Consultation Code: 41420-2010-F-0297

Conservation Planning Activity Code: 41420-2008-FA-0786



Prepared by:

U.S. Fish and Wildlife Service
South Florida Ecological Services Field Office
1339 20th Street
Vero Beach, Florida 32960-3559

[NAME, TITLE]

Date

TABLE OF CONTENTS

CONSULTATION HISTORY.....	i
BIOLOGICAL OPINION and CONFERENCE OPINION.....	1
1 INTRODUCTION.....	1
2 PROPOSED ACTION.....	12
3 TRAFFIC PREDICTIONS AND SOURCES OF CUMULATIVE EFFECTS	Error!
Bookmark not defined.	
4 Florida Bonneted Bat.....	43
5 Florida Panther	69
6 Big Cypress Fox Squirrel	149
7 Florida Sandhill Crane	156
8 Florida scrub-jay.....	164
9 Florida Burrowing Owl.....	179
10 Red Knot.....	188
11 Little Blue Heron.....	193
12 Tricolored Heron	200
13 Wood Stork.....	207
14 Red-cockaded Woodpecker.....	224
15 Roseate Spoonbill	232
16 Audubon's Crested Caracara	239
17 Everglade Snail Kite	263
18 Eastern Diamondback Rattlesnake.....	273
19 Eastern Indigo Snake.....	282
20 Gopher Tortoise	294
21 INCIDENTAL TAKE STATEMENT.....	304
22 CONSERVATION RECOMMENDATIONS	309
23 REINITIATION NOTICE.....	313
24 LITERATURE CITED	314

1 **CONSULTATION HISTORY**

2

3 The review of the East Collier Multi-Species Habitat Conservation Plan (HCP) for Incidental
4 Take Permit (ITP) decisions under Endangered Species Act (ESA) §10(a)(1)(B) involved three
5 offices of the U.S. Fish and Wildlife Service (Service):

- 6 • South Florida Ecological Services Field Office (SFESO);
7 • Southeast Regional Office, Ecological Services (RO); and
8 • Program Supervisor for Ecological Services in Florida (Florida State Office, or FSO).

9

10 The SFESO provided technical assistance to the East Collier Property Owners (ECPO, or the
11 Applicants) during the development of their HCP and applications for ITPs. The Deputy
12 Regional Director in the RO has the authority to issue ITPs in the Service's Southeast Region.
13 The RO assigned the role of consulting office for this intra-Service consultation under ESA
14 §7(a)(2) to the FSO, which is responsible for the findings reported in this Biological Opinion and
15 Conference Opinion (BO/CO). Service biologists of the SFESO and the RO contributed to the
16 supporting analyses for the findings documented herein.

17

18 The SFESO holds the record of technical assistance with the Applicants prior to receipt of the
19 final version of the HCP. The FSO holds the record of this consultation, *i.e.*, all data and
20 documents supporting this opinion. The RO holds the record of the pending decisions for the ITP
21 applications, including the record of compliance with the National Environmental Policy Act
22 (NEPA).

23

24 The following chronological list identifies key events in the evolution of the HCP, NEPA
25 compliance, and the formulation of this BO/CO.

26

27 **May 20, 2009** – ECPO informed the Service of its intention to prepare an HCP and seek
28 Incidental Take Permits (ITPs).

29

30 **June 3, 2010** – ECPO members became the Applicants by submitting a draft Habitat
31 Conservation Plan (HCP) summary and ITP Applications.

32

33 **July 5, 2010** – Service acknowledged receipt of the HCP summary and ITP applications,
34 informing the Applicants that:
35

- 1) their applications are considered incomplete until the HCP satisfies all statutory
36 requirements; and
- 2) the Service will likely need to prepare an Environmental Impact Statement (EIS).

37 **March 15, 2012** – Service and Applicants met to discuss the status of the HCP.

38 **April 21, 2015** – Applicants submitted a draft HCP.

39 **October 6, 2015** – Service provided preliminary comments on the HCP.

40 **March 14–17, 2016** – Service met with the Applicants to visit the Plan Area and to discuss the
41 HCP.

42 **March 25, 2016** – Service published in the Federal Register a Notice of Intent (NOI) to prepare
43 an EIS, requesting public comments within 30 days (81 FR 16200).

43 **April 12, 2016** – Service held a public scoping meeting to inform interested parties about the
44 EIS.

45 **April 19, 2016** – Service held an on-line inter-agency scoping meeting to inform interested
46 agencies about the EIS, to which other interested parties from the public could listen.

47 **April 25, 2016** – Comment period for the NOI closed.

48 **May 16, 2016** – Service requested the U.S. Army Corps of Engineers (Corps) participation as a
49 Cooperating Agency in the EIS process.

50 **May 17, 2016** – Service met with the Applicants to discuss EIS public scoping comments and
51 HCP comments.

52 **May 25, 2016** – U.S. Army Corps of Engineers (Corps) agreed to serve as a Cooperating
53 Agency.

54 **April 26, 2017** – Service and Applicants met to discuss the HCP.

55 **April 27, 2017** – Department of the Interior (DOI) issued Secretarial Order (SO) 3355, which
56 directed all bureaus to complete an EIS-supported decision within 1 year of publishing
57 the NOI.

58 **August 11, 2017** – The Service advised ECPO that consultation for the red knot (*Calidris canutus*
59 *rufa*) would be necessary.

60 **August 31, 2017** – DOI provided additional information for implementing SO 3355.

61 **October 24, 2017** – Applicants submitted a revised HCP.

62 **December 11, 2017** – Service met with the Applicant's consultant to discuss deconstruction of
63 the activities described in the HCP.

64 **February 28, 2018** – Service and Applicants met to visit the Plan area.

65 **March 1, 2018** – Service and the Applicants met to discuss the HCP.

66 **April 6, 2018** – Applicants submitted a revised HCP.

67 **April 23, 2018** – Applicants submitted a revised HCP.

68 **May 23, 2018** – Service and Applicants conducted a site visit of the HCP area.

69 **June 13, 2018** – Service provided comments to the Applicants on the draft HCP.

70 **August 2, 2018** – Applicants submitted a revised HCP.

71 **September 14, 2018** – Service briefed DOI officials about the draft EIS and requested
72 permission to publish a Notice of Availability (NOA) in the Federal Register.

73 **September, 2018** – The RO assigned responsibility for the intra-Service BO/CO to the Panama
74 City, FL, Field Office.

75 **October 10, 2018** – Hurricane Michael devastated Panama City and other areas, which
76 precluded the Panama City Field Office from working further on the East Collier HCP
77 BO/CO. The RO subsequently reassigned responsibility for the BO/CO to the FSO.

78 **October 19, 2018** – Service published a NOA for the draft EIS in the Federal Register,
79 requesting public comments within 45 days (83 FR 53078–53080).

80 **December 3, 2018** – Comment period for the NOA closed.

81 **December 22, 2018**—January 25, 2019 – Furlough for all non-essential Service personnel, which
82 suspended all work related to the East Collier ITPs.

83 **March 8, 2019** – Applicants submitted a revised HCP.

84 **March 25, 2019** – Applicants submitted a revised HCP.

85 **April 1, 2019** – DOI granted the Service a 60-day extension of the SO 3355 deadline for
86 reaching a decision on the ITPs.

87 **June 5, 2019** – Service placed the project on pause with respect to the SO 3355 deadline for
88 reaching a decision on the ITPs to allow ECPO to review and comment on the BO/CO
89 traffic analyses.

90 **August 27, 2019** – Service published revised section 7 regulations.

91 **September 10, 2019** – The RO received a complete application from the 12th Applicant
92 (Gargiulo, Inc. Application # TE54442D-0).

93 **December 10, 2019** – The Service completed an update of the BO/CO to reflect the revised
94 section 7 regulations.

95 **January 23, 2020** – Service published a NOA for the draft EIS in the Federal Register to inform
96 the public about the addition of the 12th Applicant and requested comments within 30
97 days (85 FR 3941-3943).

98 **January 28, 2020** – ECPO sent a new Plan Area map after changing some development acreages
99 to preserve acreages to expand the northern corridor.

100 **February 21, 2020** – Comment period for the NOA closed.

101 **May 11, 2020** – BO/CO circulated for internal Service review.

102 **May 21, 2020** – Service ended the pause on the SO 3355 deadline for reaching a decision on the
103 ITPs.

104 **June 10, 2020** – Proposed critical habitat for the Florida bonneted bat was noticed in the Federal
105 Register for a 60-day comment period.

106 **June 26, 2020** – An analysis of effects of the HCP on Florida bonneted bat proposed critical
107 habitat was incorporated into the BO/CO.

108 **June 26, 2020** – Service sent BO/CO to Regional Solicitor’s Office for review.

109 **July 27, 2020** – Regional Solicitor’s Office provided comments on the BO/CO.

110 **July 29, 2020** – RO and SFESO met with Applicants to discuss adaptive management and
111 monitoring.

112 **November 11, 2020** – ECPO transmitted their contracted review of panther vehicle mortality
113 analysis (Higgs Report)

114 **December 30, 2020** – Service provided draft BO/CO to ECPO for review

115 **February 11, 2021** – ECPO met with Service leadership to discuss BO/CO and project status

116 **February 24, 2021** – ECPO provided comments on the draft BO/CO

117 **April 15, 2021** – Service received U.S. Geological Survey review of Higgs Report and PVM
118 estimation analysis in the draft BO/CO.

119 **BIOLOGICAL OPINION and CONFERENCE OPINION**

120 **1. INTRODUCTION**

123 A biological opinion (BO) is the document that states the opinion of the U.S. Fish and Wildlife
124 Service (Service) under section 7 of the Endangered Species Act of 1973, as amended (ESA), as
125 to whether a Federal action is likely to:

126 a) jeopardize the continued existence of species classified as endangered or threatened; or
127 b) result in the destruction or adverse modification of designated critical habitat.

129 The proposed Federal action addressed in this BO is the Service's issuance of Incidental Take
130 Permits (ITPs) to the proponents (Applicants) of the Eastern Collier Multiple Species Habitat
131 Conservation Plan (HCP) (the Action). This document is also a conference opinion (CO) that
132 applies the analytical framework of a BO to the review of Action effects on species covered in
133 the HCP that are not classified at present as endangered or threatened and to proposed critical
134 habitat.

135 The HCP describes "Covered Activities" for which the proponents seek incidental take
136 authorization on lands located in the northeast corner of Collier County (Figure 1-1) (note: with
137 some exceptions, tables and figures in this BO/CO appear in a separate section that follows the
138 major section in which we reference them). These activities may occur on designated portions of
139 a 159,489-acre area owned mostly by the Applicants, but also by other parties (collectively, the
140 Plan Area). We more fully describe the Plan Area and the Action Area (all areas to be affected
141 by the Covered Activities) for this consultation in section 2.1 (the Glossary in
142 Appendix A explains these and other terms used throughout this document).

144 The Service evaluated the likely effects to the natural, physical, and human environments
145 resulting from the issuance of ITPs for the Covered Activities in a Draft Environmental Impact
146 Statement (EIS) (USFWS 2018) released October 19, 2018 (notice of availability 83 FR 53078-
147 53080). The EIS discloses the environmental impacts of no action, the proposed action, and
148 reasonable alternatives to the proposed action. The Service will consider the EIS and public
149 comments in making its decision whether to issue ITPs for the proposed HCP. This BO/CO
150 evaluates only the proposed action (issuance of ITPs for the HCP as proposed) for compliance
151 with ESA §7(a)(2), which is a permit issuance criterion among several. The Service received
152 several iterations of the HCP from the Applicants during the course of its development (see
153 Consultation History), most recently on January 28, 2020. This latest version of the HCP plus
154 subsequent addenda provides the description of the Covered Activities that prompt the Federal
155 Action we evaluate in this BO/CO.

157 The Applicants for this Federal Action are the following twelve landowners, collectively known
158 as the Eastern Collier Property Owners, LLC (ECPO):

<u>Owner</u>	<u>Application #</u>
Alico Land Development, Inc.	TE05647D-0
Barron Collier Companies	TE04440D-0
Collier Enterprises Management, Inc.	TE04443D-0

165	Consolidated Citrus Limited Partnership	TE04471D-0
166	English Brothers Partnership	TE04152D-0
167	Gargiulo, Inc.	TE54442D-0
168	Half Circle L Ranch, LLP	TE05238D-0
169	Heller Bros. Packing Corp.	TE05668D-0
170	JB Ranch I, LLC (formerly John E. Price, Jr. Trust)	TE04473D-0
171	Owl Hammock Immokalee LLC	TE06114D-0
172	Pacific Land, Ltd.	TE05665D-0
173	Sunniland Family Limited Partnership	TE04472D-0

174
175 The Service will disclose its decision under ESA §10(a)(1)(B) whether to issue the requested
176 ITPs in a separate findings memorandum that will rely, in part, on the findings of this BO/CO,
177 including its estimation of the amount or extent of anticipated incidental take for each species
178 and whether proposed critical habitat is adversely modified.

179
180 The Applicants prepared the HCP with technical assistance from the Service's South Florida
181 Ecological Services Office (SFESO). An HCP must describe:

- 182 • the impacts of the proposed activities that require take authorization;
- 183 • the measures proposed to minimize and mitigate such impacts;
- 184 • the funding available to implement such measures;
- 185 • alternatives considered to the activities that require take authorization and the reasons for
186 not adopting such alternatives; and
- 187 • other measures that the Service may require as necessary or appropriate for purposes of
188 the plan.

189
190 An ITP authorizes the take caused by Covered Activities described in an HCP, not the Covered
191 Activities themselves. This BO/CO analyzes the likely effects of the Covered Activities on the
192 Covered Species, which we identify in the following section. The Deputy Regional Director of
193 Service's Southeast Regional Office (RO) is the official responsible for deciding whether to
194 issue ITPs for the proposed HCP. The RO requested the Florida State Supervisor for Ecological
195 Services in Florida (Florida State Office, or FSO), who oversees the SFESO and two other Field
196 Offices, to independently review the Action for compliance with ESA §7(a)(2), which is a permit
197 issuance criterion. This was done in conjunction with the RO Division of Environmental Review
198 regarding policy, especially in the areas of scope of the Federal action and the effect analysis.
199 For this intra-Service consultation and conference, the RO is proposing the Federal Action, and
200 the Florida State Office is providing the opinion for the Action.

201
202 **1.1 Covered Species**

203
204 ESA §9(a)(1) and regulations issued under §4(d) prohibit the take of endangered and threatened
205 fish and wildlife species without special exemption. The term "take" in the ESA means "to
206 harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in
207 any such conduct" (ESA §3). The Applicants request that the Service authorize take of 8 ESA-
208 protected species, and prospectively address take of 11 species that are not presently protected
209 under the ESA, that is incidental to (not the purpose of) activities proposed under the HCP. Table
210 1-1 identifies these species.

211 **Table 1-1.** Species assessed in the proposed HCP.
212

Common Name	Scientific Name	Status ^a
Mammals		
Florida bonneted bat	<i>Eumops floridanus</i>	F-E
Everglades mink	<i>Neovison vison evergladensis</i>	S-T
Florida panther	<i>Puma concolor coryi</i>	F-E
Big Cypress fox squirrel	<i>Sciurus niger avicennia</i>	S-T
Birds		
Florida sandhill crane	<i>Antigone canadensis pratensis</i>	S-T
Florida scrub jay	<i>Aphelocoma coerulescens</i>	F-T
Florida burrowing owl	<i>Athene cunicularia floridana</i>	S-T
Little blue heron	<i>Egretta caerulea</i>	S-T
Tricolored heron	<i>Egretta tricolor</i>	S-T
Southeastern American kestrel	<i>Falco sparverius paulus</i>	S-T
Wood stork	<i>Mycteria americana</i>	F-T
Red-cockaded woodpecker	<i>Picoides borealis</i>	F-E
Roseate spoonbill	<i>Platalea ajaja</i>	S-T
Audubon's crested caracara	<i>Polyborus plancus</i>	F-T
Everglade snail kite	<i>Rostrhamus sociabilis plumbeus</i>	F-E
Reptiles		
Eastern diamondback rattlesnake	<i>Crotalus adamanteus</i>	F-Under Review
Eastern indigo snake	<i>Drymarchon corais couperi</i>	F-T
Gopher tortoise	<i>Gopherus polyphemus</i>	F-C
Gopher frog	<i>Lithobates capito</i>	F-Under review

213 ^a F = Federal; S = State of Florida; E = endangered; T = threatened; C = candidate
214215
216 The Service has reliable information that an additional ESA-listed species, the red knot (*Calidris*
217 *canutus rufa*) (threatened), seasonally uses portions of the HCP area that are proposed for
218 development. Although the SFESO advised the Applicants of this information on August 11,
219 2017, the HCP does not assess effects to this species. The Service may not issue a permit for an
220 action that may affect a listed species without demonstrating compliance with ESA §7(a)(2);
221 therefore, this BO/CO includes an analysis of the effects of the proposed HCP on the red knot.
222223 The red knot is not a “Covered Species” for ITP purposes, because the Applicants have not
224 requested incidental take authorization for the red knot. For intra-Service consultation purposes,
225 we include the red knot with the species listed in Table 1-1. Hereafter in this document, unless
226 we indicate otherwise, our use of the term “Covered Species” refers to 20 species collectively:
227 the 19 species listed in Table 1-1 plus the red knot, recognizing that any Service-issued ITPs will
228 not include the red knot.
229230 **1.2 Species Dismissed from Further Analysis**
231

232 Our analyses of the 20 Covered Species identified in section 1.1 revealed that three are not
233 reasonably certain to occur in the Plan Area, either presently or in the foreseeable future: gopher
234 frog, Southeastern American kestrel, and Everglades mink. Because these three species are not
235 protected under the ESA, its incidental take prohibitions do not apply. When best available data
236 do not support a determination that a species is likely present in the area that an action will
237 affect, all subsequent steps in effects analysis are moot; therefore, we do not address these
238 species further in this BO/CO. Although the Applicants' request prospective incidental take
239 authorization for these species, the amount or extent of take resulting from the Action as
240 proposed that we anticipate is none. The remainder of this section provides the data and
241 reasoning that support our determination that these species are not present in the Plan Area.
242

243 **Gopher Frog**

244
245 Western Collier County is the southwestern limit of the range of the gopher frog (FWC 2013a),
246 which does not include the eastern half of the county (Figure 1-2). Krysko *et al.* (2011) report a
247 single record for gopher frog in Collier County, dated before 1980 and located more than 30
248 miles (mi) west of the Plan Area. Humphries and Sisson (2012) report that gopher frogs may
249 travel distances of up to 3 mi for breeding purposes; therefore, dispersal into the Plan Area from
250 more distant occupied areas is unlikely. The Applicants did not conduct surveys designed to
251 detect gopher frogs, and do not report in the HCP any records of the species from the Plan Area.
252 We have no data that suggest the range of the gopher frog is likely to expand to the south or east
253 into the Plan Area during the foreseeable future.
254

255 **Southeastern American Kestrel**

256
257 The Southeastern American kestrel is closely associated with longleaf pine/wiregrass
258 communities, which do not occur in the Plan Area. Although this subspecies of the American
259 kestrel will use other habitat types that are present in the Plan Area, Collier County is outside its
260 current breeding range (FWC 2013b). The nearest known population inhabits the Lake Wales
261 Ridge, outside of the Action Area (Figure 1-3). The nearest confirmed breeding location was
262 recorded along the Caloosahatchee River on the border of Lee and Hendry Counties,
263 approximately 14 mi north of the Plan Area (FWC 2013b). The subspecies does not migrate
264 seasonally and demonstrates limited dispersal ability, typically less than 5 mi (Miller and
265 Smallwood 1997). The Applicants did not conduct surveys designed to detect the Southeastern
266 American kestrel, and do not report in the HCP any records of the subspecies from the Plan
267 Area. We have no data that suggest the range of the Southeastern American kestrel is likely to
268 expand into the Plan Area during the foreseeable future.
269

270 **Everglades Mink**

271
272 The Everglades mink is a south-Florida subspecies of the American mink. The current
273 distribution of the subspecies is poorly understood. FWC (2011) describes its current range and
274 habitat as the shallow freshwater marshes of the Everglades and Big Cypress Swamp regions.
275 The Plan Area is located north of the Everglades mink's estimated distribution (Figure 1-4).
276 Occurrence records during the past 10 years come from Fakahatchee Strand Preserve State Park,
277 which is 12 mi south of the Plan Area, and the Picayune Strand State Forest, which is west of

278 Fakahatchee Strand (M. Owen, FSPSP, and J. Gore, FWC, personal communication). There have
279 been no recent mink sightings in the Florida Panther National Wildlife Refuge, which borders
280 the Plan Area to the south (C. Winchester, FWC, personal communication). The Applicants did
281 not conduct surveys designed to detect the mink, and do not report in the HCP any records of the
282 subspecies from the Plan Area. We have no data that suggest the current or reasonably
283 foreseeable range of the Everglades mink includes the Plan Area.

284

285 **1.3 Biological Opinion and Conference Opinion Framework**

286

287 This BO/CO considers the effects of activities proposed in the Applicants' HCP, for which the
288 Applicants seek take authorization from the Service. The term "take" in the ESA means "to
289 harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in
290 any such conduct" (ESA §3(19)). In regulations at 50 CFR §17.3, the Service further defines:

291

- a. "harass" as "an intentional or negligent act or omission which creates the likelihood of
292 injury to wildlife by annoying it to such an extent as to significantly disrupt normal
293 behavioral patterns which include, but are not limited to, breeding, feeding, or
294 sheltering;"
- b. "harm" as "an act which actually kills or injures wildlife. Such act may include
295 significant habitat modification or degradation where it actually kills or injures wildlife
296 by significantly impairing essential behavioral patterns, including breeding, feeding or
297 sheltering;" and
- c. "incidental take" as "any taking otherwise prohibited, if such taking is incidental to, and
298 not the purpose of, the carrying out of an otherwise lawful activity."

299

300 By memorandum dated April 26, 2018, the Service's Principal Deputy Director issued guidance
301 about the "trigger for an incidental take permit" under ESA §10(a)(1)(B)

302 (<https://www.fws.gov/endangered/esa-library/pdf/Guidance-on-When-to-Seek-an-Incidental-Take-Permit.pdf>). The requirement for an ITP applies when ESA-prohibited take of wildlife is

303 reasonably certain to occur incidental to, and not the purpose of, otherwise lawful non-Federal
304 activities. The guidance memo clarified that harass is not a form of incidental take permitted
305 under §10(a)(1)(B), because the definition of harass applies to intentional or negligent acts or
306 omissions. Disturbance (e.g., noise, odors, vibrations) that is incidental to an otherwise lawful
307 activity may constitute significant habitat modification under the definition of harm, but is
308 inconsistent with the definition of harass. Our analyses in this BO/CO identify the reasonably
309 certain consequences for the Covered Species caused by activities included in the proposed
310 Action, and by other activities that would not occur but for the proposed Action, and we estimate
311 the amount or extent of take that is incidental to these activities.

312

313 The take prohibitions of ESA §9 apply to four species named in Table 1-1 that are classified as
314 endangered. Take prohibitions adopted by regulation under ESA §4(d) apply to another four
315 species named in Table 1-1 that are classified as threatened, plus the red knot. At this time, the
316 protections of the ESA do not extend to the remaining 11 non-listed Covered Species; therefore,
317 a permit that authorizes incidental take of these species is not required under the ESA. However,
318 an applicant's HCP may request the Service to include non-listed species in an ITP for take
319 authorization later during the permit's effective period when the Service may classify such
320 species as endangered or threatened. The Applicants have requested a 50-year permit duration.

321

324

325 The Service may grant prospective take authorization for non-listed species, provided the
326 proposed HCP satisfies the same ITP issuance criteria that apply to listed species. These criteria
327 include a finding that the activities proposed under the HCP are not likely to jeopardize the
328 continued existence of a covered species. This document provides BOs for 9 listed species, and
329 COs for 11 non-listed species, to address this issuance criterion.

330

331 “*Jeopardize the continued existence* means to engage in an action that reasonably would be
332 expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and
333 recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of
334 that species” (50 CFR §402.02). The Service determines in a BO/CO whether we expect an
335 action to satisfy this definition using the best available relevant data in the following analytical
336 framework (see 50 CFR §402.02 for the regulatory definitions of *action*, *action area*,
337 *environmental baseline*, *effects of the action*, and *cumulative effects*).

338

- *Proposed Action.* Review the proposed Federal action and describe the environmental
339 changes its implementation would cause, which defines the action area.
- *Status of the Species.* Review and describe the current range-wide status of the species.
- *Environmental Baseline.* Describe the condition of the listed species in the action area,
340 without the consequences to the listed species caused by the proposed action. The
341 environmental baseline includes the past and present impacts of all Federal, State, or
342 private actions and other human activities in the action area, the anticipated impacts of all
343 proposed Federal projects in the action area that have already undergone formal or early
344 section 7 consultation, and the impacts of State or private actions which are
345 contemporaneous with the consultation.
- *Effects of the Action.* Predict all consequences to listed species that are caused by the
346 proposed action, including the consequences of other activities that are caused by the
347 proposed action. A consequence is caused by the proposed action if it would not occur
348 but for the proposed action and it is reasonably certain to occur. Effects of the action may
349 occur later in time and may include consequences occurring outside the immediate area
350 involved in the action.
- *Cumulative Effects.* Predict all consequences to listed species that are caused by future
351 State or private activities, not involving Federal activities, which are reasonably certain to
352 occur within the action area.
- *Conclusion.* Add the effects of the action and cumulative effects to the environmental
353 baseline and in light of the status of the species, formulate the Service's opinion as to
354 whether the action is likely to jeopardize the continued existence of listed species.

355

356 We accomplish step “a” above in section 2 of this BO/CO. In section 3, we provide data about
357 sources of cumulative effects and other information that are common to multiple species-specific
358 analyses. We provide the remaining basis of our opinion for each species identified in section 1.1
359 (steps “b–f” above) in a separate level-1 section thereafter that addresses the species’ status,
360 environmental baseline, effects of the Action, cumulative effects, and conclusion.

361

362 ESA §10(a)(1)(B) does not apply to designated CH. However, a Federal action that is likely to
363 destroy or adversely modify designated CH is not lawful; therefore, our CO also evaluates the
364

369 effects of the Action to proposed CH. Within the areas that are included in the HCP, the Service
370 has proposed CH for the Florida bonneted bat.

371
372 “*Destruction or adverse modification*” means a direct or indirect alteration that appreciably
373 diminishes the value of designated CH for the conservation of a listed species (50 CFR §402.02,
374 [https://www.ecfr.gov/cgi-bin/text-
375 idx?SID=09d66537a14e73fe80204273d86de222&node=pt50.11.402&rgn=div5#se50.11.402_10
376 2](https://www.ecfr.gov/cgi-bin/text-idx?SID=09d66537a14e73fe80204273d86de222&node=pt50.11.402&rgn=div5#se50.11.402_102)).
377

378 A Service opinion that concludes a proposed Federal action is *not* likely to jeopardize species
379 and is *not* likely to destroy or adversely modify critical habitat fulfills the action agency’s
380 responsibilities under ESA §7(a)(2).

381
382 **1.4 Future Federal Actions Related to the Proposed Action**
383

384 Future Federal actions unrelated to the proposed action are not considered in this BO/CO
385 because they require separate consultation pursuant to section 7 of the Act. Future Federal
386 actions may include activities proposed by landowners of Eligible Lands that choose not to be
387 included in the HCP.

388 Some of the Applicants’ Covered Activities may involve the discharge of dredged or fill material
389 into waters of the United States. The State of Florida has assumed administration of section 404
390 of the Clean Water Act of 1977 (CWS, 33 U.S.C. § 1344) for certain waters of the U.S (referred
391 to as assumed waters. The waters of the U.S. within the Plan area are assumed-waters under the
392 States’ 404 program. Therefore, discharges will require a permit from the Florida Department of
393 Environmental Protection (FDEP). If the discharge may affect federally listed species, FDEP
394 must coordinate with the Service in accordance with the State’s 404 Program Rule (Florida Code
395 of Administration [FAC] 62-331,

396 <https://www.flrules.org/gateway/ChapterHome.asp?Chapter=62-331>), a memorandum of
397 understanding between the Service, FDEP, and Florida Fish and Wildlife Conservation
398 Commission (FWC, [https://floridadep.gov/ogc/ogc/documents/appendix-2-fdep-fwc-fws-404-
399 mou-final-full-signatures](https://floridadep.gov/ogc/ogc/documents/appendix-2-fdep-fwc-fws-404-mou-final-full-signatures)), and the Service’s programmatic BO issued to the Environmental
400 Protection Agency regarding their approval of the State’s request to assume the CWS 404
401 program

402 [http://publicfiles.dep.state.fl.us/dwrm/404_Assumption_Application/USFWS_Biological_Opin
403 on/](http://publicfiles.dep.state.fl.us/dwrm/404_Assumption_Application/USFWS_Biological_Opinion/)) FDEP cannot issue a 404 permit if the proposed activity would jeopardize the continued
404 existence of a Federally listed species or result in the adverse modification of a species’
405 designated critical habitat.
406

407 Through our review of the HCP, preparation of this BO/CO, and issuance of any ITPs, the
408 Service has analyzed the anticipated impacts on the Covered Species of ITP issuance for the
409 Covered Activities described in the HCP. We expect many of the Covered Activities would
410 require 404 permits in order to lawfully continue, even if we determine that they would not result
411 in jeopardy or adverse modification. Because of the HCP’s programmatic approach, we do not
412 know specific plans or locations of the covered activities, so FDEP cannot review wetland
413 impacts at this time.
414

415
416 As the applicants prepare specific project proposals under the HCP, they would apply to the
417 FDEP for wetland review and a 404 permit as required by FDEP procedures. FDEP would then
418 coordinate with the Service. A covered activity, however, would have already received incidental
419 take authority via an ITP. This would negate the need for the FDEP to add additional permit
420 conditions to minimize the amount of incidental take, but would not excuse the Corps from
421 consulting with the Service, under ESA section 7, for any 404 permit they issue.
422
423 In order to avoid duplicative section 7 consultations, the Service and the Corps have prepared a
424 Memorandum of Understanding (MOU) to establish procedures to expedite and streamline future
425 section 7 interagency consultations between the Service and Corps on Applicants' applications for
426 404 permits associated with the Covered Activities of the HCP. The MOU would be executed
427 after the Service concludes its review of the HCP and only if the Service decides to issue ITPs.
428 This MOU was drafted before FDEP's assumption of permitting. The Service and the Corps still
429 intend to execute the MOU to cover the contingency, as provided by FDEP's Assumption, to
430 address wetland permit reviews that FDEP may refer back to the Corps. The Service has
431 introduced the HCP to FDEP and explained the draft MOU. To date, FDEP has not expressed
432 interest in joining the MOU.
433 The MOU relies on project-specific coordination between the Service and an Applicant that would
434 be required for any project to be conducted under the HCP. If the Service concurs with an
435 Applicant that a proposed project is consistent with the HCP, it would provide the Applicant
436 written concurrence to that effect.
437 Under the terms of the MOU, the Service would affirm to the Corps that a concurrence letter issued
438 to an Applicant/Permittee would certify that the proposed project is consistent with the Covered
439 Activities analyzed in this BO/CO and that the Corps may rely on such certification in satisfying
440 its ESA section 7 obligations associated with processing Applicant's 404 permit application.
441 These project-specific coordination procedures are essentially equivalent to those established
442 under the FDEP Assumption; therefore, we do not believe it is necessary for FDEP to join the
443 MOU. As needed to update the MOU, we would coordinate with the Corps and FDEP if their
444 respective positions change.
445

446 **1.5 Tables and Figures**

447



448

449

450 **Figure 1-1. Location of the proposed Eastern Collier Multiple Species Habitat Conservation**
451 **Plan.**

452

453

454
455
456
457
458

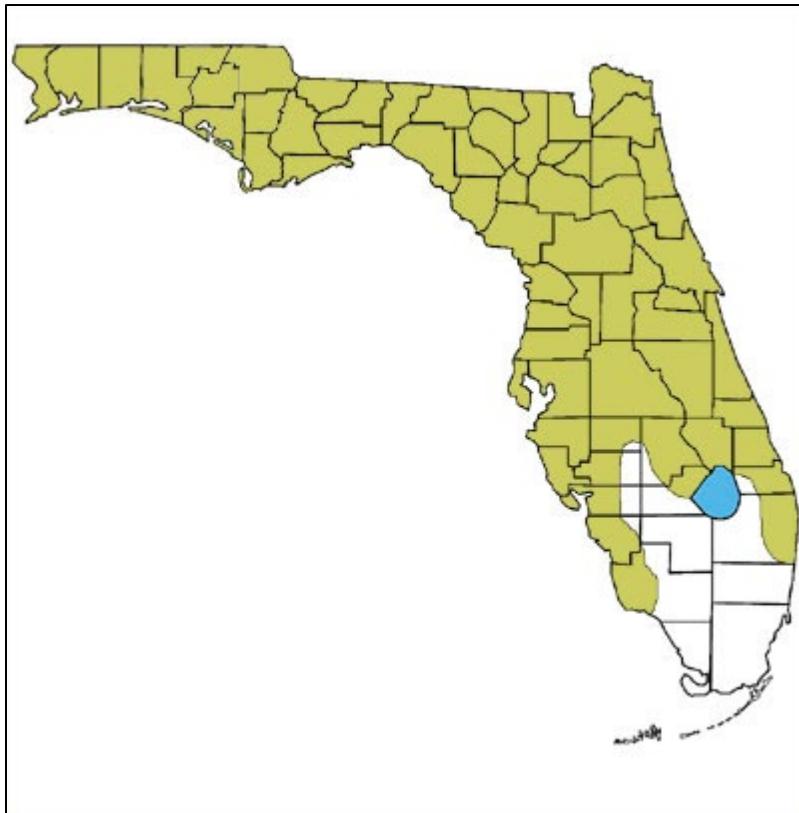
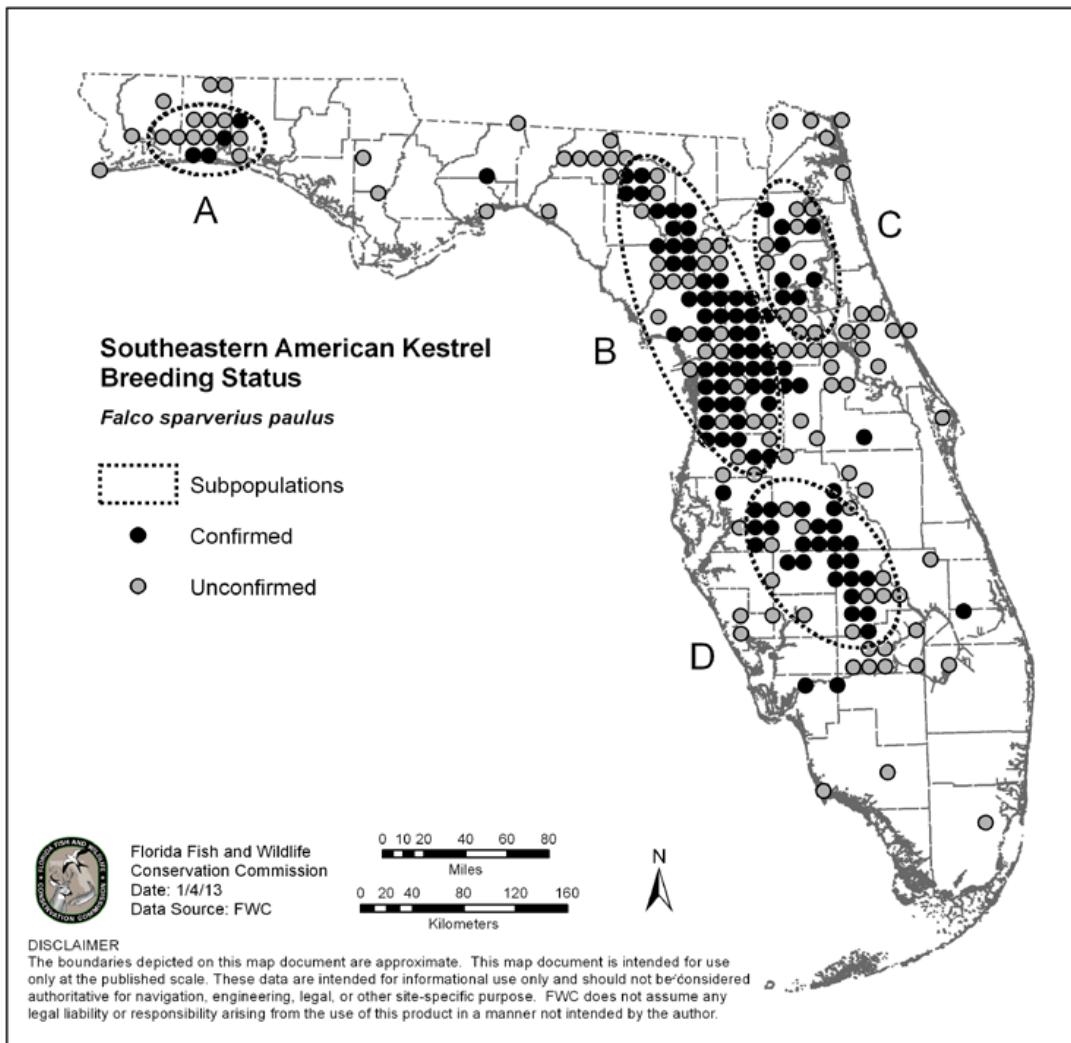
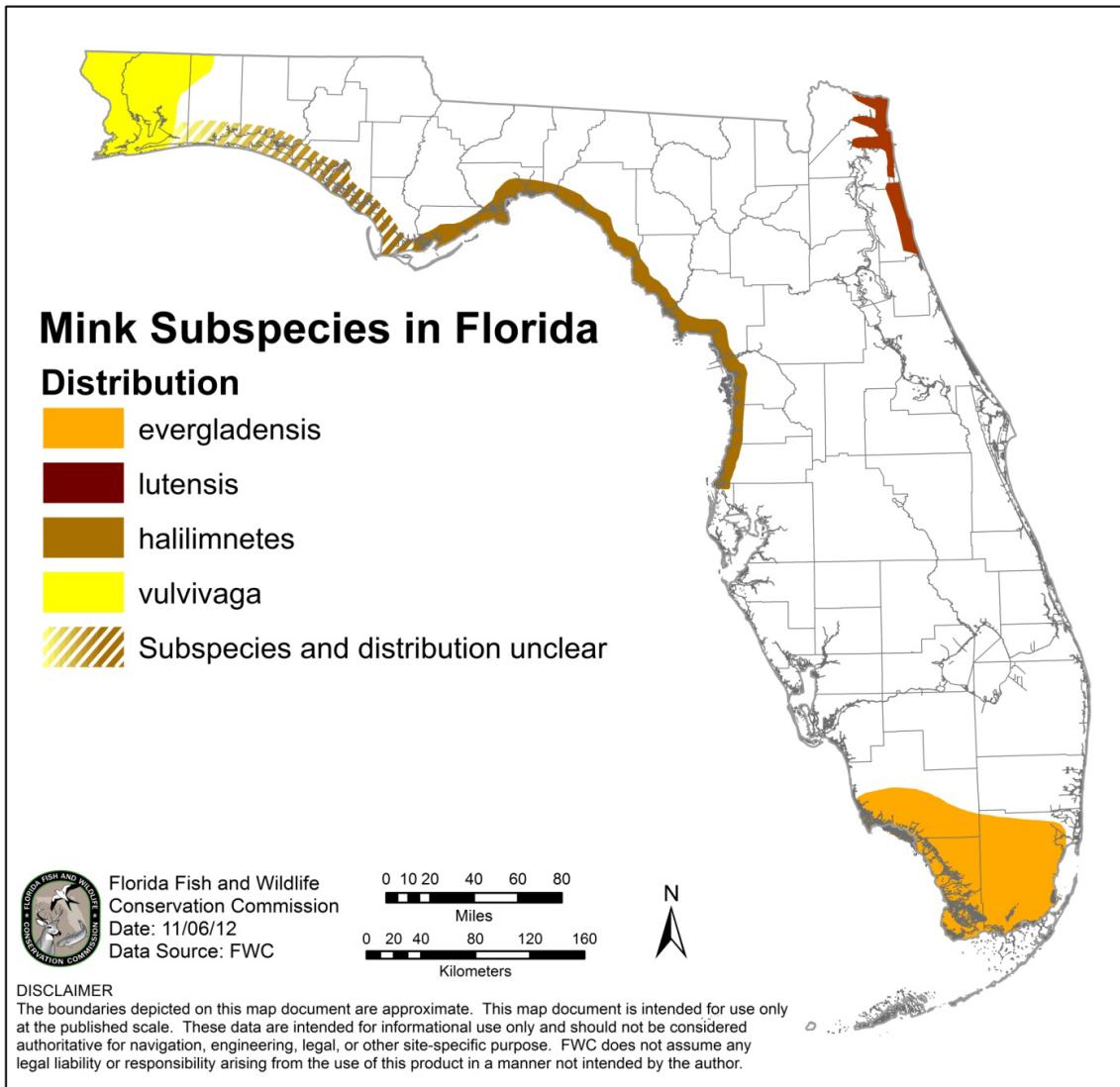


Figure 1-2. Range of the gopher frog in Florida based on historical records and the location of suitable habitat (map credit: Monica McGarrity, University of Florida).



459
460
461
462
463
464
465
466
467

Figure 1-3. Distribution of the Southeastern American kestrel. The four largest regional subpopulations are: (A) Western Panhandle; (B) Brooksville Ridge and vicinity; (C) Trail Ridge and vicinity; and (D) Lake Wales Ridge and vicinity. Points represent locations where breeding activity was recorded during Florida's Breeding Bird Atlas (FWC 2003) (map source: FWC 2013b).



468
469 **Figure 1-4.** Geographic distribution of mink subspecies in Florida (source: FWC 2013c).
470
471

472 **2. PROPOSED ACTION**

473
474 Twelve landowners in Collier County, Florida, (East Collier Property Owners [ECPO], or the
475 Applicants) have applied to the Service for 50-year ITPs (see application numbers listed in
476 section 1) covering activities described in the Eastern Collier Multiple Species HCP (ECPO
477 2019; hereafter cited in this document as the “HCP”). The proposed Federal action addressed in
478 this BO/CO is the Service’s issuance of ITPs in response to these applications in accordance with
479 50 CFR 17.22 and 17.32 (the Action). The Applicants request incidental take authorization for
480 the 19 species of wildlife identified in Table 1-1. As we noted in section 1.1, we add a twentieth
481 species, the red knot, to the Covered Species for purposes of this BO/CO only. Otherwise, our
482 description of the Action throughout section 2 of this BO/CO is based on the HCP.
483
484

485 The HCP proposes a program that addresses both development and conservation in a large
486 portion (159,489 acres) of Collier County (the Plan Area). The Applicants propose an acreage
487 cap (39,973 acres) on the extent of development (development cap) within designated areas and
488 an assured reservation of natural areas and agricultural lands in which further development is
489 precluded by permanent easements (the Preserve Area). These easements, executed as lands are
490 developed, would cover about 56% of the Plan Area upon reaching the development cap. This
491 collaboration among 12 landowners seeks to integrate ESA regulatory requirements with the
492 County's Rural Lands Stewardship Area (RLSA) program, under which landowners exchange
493 conservation debits and credits for actions on particular properties. Presently, ESA technical
494 assistance with the FDEP, unless referred to U.S. Army Corps of Engineers (Corps), on wetlands
495 permits associated with individual development projects provides the mechanism for ESA
496 compliance, and often provides us with an opportunity to request minimization and
497 compensation. Landowners can choose not to participate in the RLSA because it is a voluntary
498 program. If landowners choose not to participate, much of the Preserve Area could be developed,
499 to some degree. The programmatic approach of the HCP establishes a framework via ESA
500 section 10 for development and preservation at the scale of the Plan Area, instead of project-by-
501 project.

502

503 The HCP describes residential and commercial development (section 2.3 of the HCP), earth
504 mining (section 2.3 of the HCP), oil and gas exploration (section 2.2 of the HCP), ongoing
505 agricultural land uses (section 2.2 of the HCP), land management (sections 2.2 and 2.3 of the
506 HCP), very low density development (section 2.2 of the HCP), wildlife habitat preservation and
507 enhancement (section 2.2 of the HCP), and existing recreational land uses (section 2.2 of the
508 HCP) (collectively, the "Covered Activities") on 139,442 acres of northeastern Collier County
509 owned by the Applicants. The larger Plan Area for the HCP includes also an additional 20,047
510 acres of lands "Eligible for Inclusion" in the HCP, which the Applicants do not own. The
511 provisions of the HCP would apply to Eligible lands only when owners of such lands elect to
512 participate in the HCP and receive ITPs. The HCP does not specify the timing, location, and
513 other details of particular developments or projects. Instead, the Applicants propose to carry out
514 the Covered Activities within identified portions of the Plan Area over the requested 50-year
515 permit period according to applicable provisions of the HCP (*i.e.*, Best Management Practices
516 [BMPs], species-specific conservation measures, conservation easements, *etc.*).

517

518 This BO/CO predicts the reasonably certain consequences to Covered Species caused by the
519 Action, including the consequences of other activities caused by the Action (effects of the
520 action), and the reasonably certain consequences caused by future non-Federal activities in the
521 Action Area (cumulative effects). Following an identification and description of the Action Area
522 in section 2.1, we organize our description of the Action and our analysis of effects to the
523 Covered Species according to the broad classes of land use designation under the HCP:

524

- Development and Mining (section 2.2);
- Preservation (section 2.3);
- Base Zoning (section 2.4);
- Very Low Density Development (section 2.5); and
- Eligible for Inclusion (section 2.6).

529

530 The HCP's description of land use that may occur in the Base Zoning Area includes
531 contingencies for low- or high-density development, preservation, or some combination thereof.
532 For reasons we explain in section 2.4, our effects analyses in sections 4 through 20 of this
533 BO/CO include the Base Zoning Area among the lands designated for up to 39,973 acres of
534 residential and commercial/ development under the Development and Mining designated use. In
535 a similar manner, we include the 20,047 acres of the lands Eligible for Inclusion as potentially
536 contributing to the development cap (see section 2.6). In section 2.8, we consider whether other
537 activities would not occur but for the proposed Federal Action, and if so, identify them for
538 analysis in this BO/CO.

539

540 1. Throughout this BO/CO, we cite and summarize aspects of the Applicants' HCP document
541 that are relevant to formulating the Service's BO/CO for the Action. If necessary for clarity
542 in this document, we repeat data reported in the HCP. We evaluate only the Applicants'
543 preferred alternative among the five described in the HCP, which is the proposal the Service
544 is considering for permits issuance. Please refer to the HCP for additional details about the
545 East Collier proposal.

546

547

548 **2.1 Action Area and Effects of the Action**

549

550 The regulations at 50 CFR §402.02 define "action," "action area," and "*effects of the action*" as
551 follows:

552

553 "Action means all activities or programs of any kind authorized, funded, or carried out, in whole
554 or in part, by Federal agencies in the United States or upon the high seas. Examples include, but
555 are not limited to:

- 556 • actions intended to conserve listed species or their habitat;
- 557 • the promulgation of regulations;
- 558 • the granting of licenses, contracts, leases, easements, rights-of-way, permits, or
559 grants-in-aid; or
- 560 • actions directly or indirectly causing modifications to the land, water, or air."

561

562 "Action area means all areas to be affected directly or indirectly by the Federal action and not
563 merely the immediate area involved in the action."

564

565 Defining the action area is necessary to determine whether listed species or designated critical
566 habitats may occur in that area, which necessarily precedes any subsequent analyses of the
567 effects of the action to particular species or critical habitats. It is practical and consistent with the
568 regulatory language cited above to treat the action area for a proposed Federal action as the
569 spatial extent of its direct and indirect modifications to the land, water, or air. Under the
570 regulatory definition of "effects of the action," such changes include those caused by activities
571 that would not occur but for the action under consultation.

572

573 The action area establishes the bounds for an analysis of a species' exposure to action-caused
574 changes, but the subsequent consequences of such exposure are not limited to the action area.
575 For example, habitat modifications may reduce food resources (an action-caused change to land),

576 which causes reduced fitness of individuals wintering in the action area, which then causes
577 reduced reproductive success in a nesting area far removed from the action area. When each link
578 in a predicted causal chain between a change in the action area (that would not occur but for the
579 action) and a predicted consequence of that change is reasonably certain to occur, we determine
580 that the action would cause the consequence. Similarly, habitat modifications may displace
581 individuals from an action area into other areas where essential feeding, breeding, and sheltering
582 behaviors are impaired. We rely upon best available data to identify any consequences of an
583 action to listed species that are reasonably certain to occur later in time outside of the action area,
584 but such effects do not alter the bounds of the action area. The action area does not expand to
585 include a distant breeding area or an area receiving displaced animals. Finally, the action area
586 establishes the bounds for an analysis of cumulative effects, *i.e.*, consequences caused by future
587 non-Federal actions that are reasonably certain to occur in the action area.
588

589 “*Effects of the action* are all consequences to listed species or critical habitat that are caused by
590 the proposed action, including the consequences of other activities that are caused by the
591 proposed action. A consequence is caused by the proposed action if it would not occur but for the
592 proposed action and it is reasonably certain to occur. Effects of the action may occur later in time
593 and may include consequences occurring outside the immediate area involved in the action. (See
594 § 402.17).”
595

596 The regulations at 50 CFR §402.17 define “activities that are reasonably certain to occur” and
597 “consequences caused by the proposed action” as follows:
598

599 “*Activities that are reasonably certain to occur*. A conclusion of reasonably certain to occur
600 must be based on clear and substantial information, using the best scientific and commercial data
601 available. Factors to consider when evaluating whether activities caused by the proposed action
602 (but not part of the proposed action) or activities reviewed under cumulative effects are
603 reasonably certain to occur include, but are not limited to:

- 604 (1) Past experiences with activities that have resulted from actions that are similar in scope,
605 nature, and magnitude to the proposed action;
- 606 (2) Existing plans for the activity; and
- 607 (3) Any remaining economic, administrative, and legal requirements necessary for the activity to
608 go forward.”
609

610 “*Consequences caused by the proposed action*. To be considered an effect of a proposed action,
611 a consequence must be caused by the proposed action (*i.e.*, the consequence would not occur but
612 for the proposed action and is reasonably certain to occur). A conclusion of reasonably certain to
613 occur must be based on clear and substantial information, using the best scientific and
614 commercial data available. Considerations for determining that a consequence to the species or
615 critical habitat is not caused by the proposed action include, but are not limited to:

- 616 (1) The consequence is so remote in time from the action under consultation that it is not
617 reasonably certain to occur; or
- 618 (2) The consequence is so geographically remote from the immediate area involved in the action
619 that it is not reasonably certain to occur; or
- 620 (3) The consequence is only reached through a lengthy causal chain that involves so many steps
621 as to make the consequence not reasonably certain to occur.”

622 When we assess the consequences of this Action, we must take into account that the HCP Plan
623 Area encompasses a mixture of other landowners, land uses, municipalities and other regulatory
624 jurisdictions that will interact with the Applicants' activities over the 50-year requested permit
625 term. The Applicants, along with all those who use, regulate, or somehow affect conditions in
626 the Plan Area generally act independently of each other in accordance with their own purposes,
627 abilities, or authorities. These independent influences complicate our identification of this
628 HCP's consequences, especially where consequences that might be attributable to the Applicants
629 interact with the consequences of other independent actions. The most challenging consequence
630 in this regard has been the issue of vehicle traffic volume and its relation to wildlife vehicle
631 mortality. We discuss in detail in sections 5.3.1.4 and 5.6 (??), below, how we address the
632 increased risk of wildlife vehicle mortality in this context.
633

634 **2.1.1 The Plan Area**

635 The immediate area involved in this Action is the 159,489-acre Plan Area located in the
636 northeast corner of Collier County, Florida (Figure 2-1). The Plan Area is comprised of 139,442
637 acres owned by the ECPO Applicants, and another 20,047 acres owned by others that the
638 Applicants designate in the HCP as lands Eligible for Inclusion. The Covered Activities of the
639 HCP would affect the Plan Area by:

- 640 • converting existing land cover to residential, commercial, and earth mining uses on up to
641 39,973 acres in the areas designated as Development and Mining (and possibly in the
642 Base Zoning and Eligible for Inclusion areas);
643 • converting existing land cover to accommodate low-density occupancy (1 unit per 50
644 acres) in the Very Low Density use areas;
645 • converting existing land cover to accommodate residential development at a density of 1
646 unit per 5 acres in the Base Zoning area; and
647 • implementing various conservation practices while continuing existing land uses on the
648 designated Preservation Areas and on the remaining undeveloped acreage of the
649 Development, Very Low Density, and Base Zoning areas.
650 • implementation of activities assisted by the Marinelli Fund: the effects of most of these
651 activities have not been analyzed quantitatively and consultation may be required when
652 the action(s) are proposed by the project proponent: however, to the extent possible, these
653 activities have been described in a qualitative manner.
654

655 The Eligible lands are not included in these proposals at this time; however, the Applicants
656 describe in section 2.4 of the HCP how owners of these lands may elect to participate in the plan.
657 We describe in section 2.6 how the enrollment of Eligible lands could contribute to the 39,973-
658 acre development cap or supplement the designated Preservation lands. Although some or all of
659 the Eligible lands may or may not participate in the HCP, we include these lands in the Plan Area
660 as parts of the immediate area involved in this Action.
661

662 The Plan Area lies entirely within the boundaries of Collier County's "Rural Land Stewardship
663 Area" (RLSA), which is comprised of about 195,000 acres surrounding, but not including, the
664 unincorporated Town of Immokalee. The Plan Area covers more than three quarters of the
665

667 RLSA. As depicted in Figure 2-1, portions of the RLSA that are *not* included in the Plan Area
668 are either:

- 669 (a) presently designated/managed for conservation purposes;
- 670 (b) addressed in prior Federal permits (three tracts); or
- 671 (c) County and State roads.

672
673 The three tracts addressed in prior Federal permits (“b” in the list above) are the Hogan Island
674 Quarry, Immokalee Sand Mine, and Town of Ave Maria. These lands are under the Applicants’
675 ownership, but are not included in the Plan Area. The ESA §7 consultation associated with
676 Federal permits for these mining and development actions are concluded. The wetland mitigation
677 associated with these projects was removed from the HCP Preservation lands.

678
679 The Applicants adopted a 45,000-acre development cap during the development of the HCP that
680 included the 5,027-acre Town of Ave Maria, which is located south of Immokalee near the
681 center of the RLSA. Because permitting for Ave Maria was completed before the HCP, it is now
682 removed from the Plan Area of the HCP that we consider in this BO/CO. The removal of Ave
683 Maria:

- 684 • reduces the development cap of 45,000 acres by 5,027 acres to 39,973 acres; and
- 685 • reduces the extent of HCP Preservation lands that would receive conservation easements
686 by 6,779 acres, because these commitments are already completed.

687
688 Nothing proposed in the HCP controls future actions within Ave Maria; therefore, Ave Maria is
689 outside the immediate area involved in the Action. Our use of the term “Plan Area” in this
690 BO/CO refers collectively to the 159,489.0 acres comprised of the following HCP land
691 designations:

- 692 1) Development and Mining (43,767.2 acres);
- 693 2) Preservation (90,576.3 acres);
- 694 3) Very Low Density (2,667.4 acres);
- 695 4) Base Zoning (2,431.1 acres); and
- 696 5) Eligible for Inclusion (20,0470. acres).

697
698 These acreages are presented here and in Tables 2.1 and 2.2 to the first decimal place to
699 demonstrate that they add up to 159,489.0 acres. From this point forward, the acreages in the
700 text will be presented as whole numbers.

701
702 The Plan Area is adjacent to several large tracts of public lands that are managed for
703 conservation purposes. Figure 2-2 shows these tracts, which include the Corkscrew Regional
704 Ecosystem Watershed to the west, Okaloachoochee Slough State Forest to the north, and Big
705 Cypress National Preserve and Florida Panther National Wildlife Refuge to the south.

706
707 State and County roads are not included in the plan area as they are not controlled by/under the
708 purview of the Applicants. They are designed, maintained, and controlled by the Florida
709 Department of Transportation and Collier County, respectively.

710
711 **2.1.2 Areas Beyond the Plan Area Affected by the Action**

713 Whether the action area for a consultation extends beyond the immediate area involved in the
714 action depends on the nature and context of changes to land, water, and air caused by the action,
715 including those caused by other actions that would not occur but for the action under
716 consultation. When we can meaningfully predict changes beyond the immediate area involved in
717 the action, we expand the action area accordingly.

718

719 Changes that may reach beyond the Plan Area include:

720 • noise, odors, and runoff emanating from construction and mining sites;
721 • smoke from burning piles of cleared vegetation and prescribed fires;
722 • altered surface- and ground-water flows and levels; and
723 • altered patterns or volume of human activity (e.g., vehicular traffic to/from the action
724 footprint).

725

726 We do not expect noise and odors from construction and mining activity (“a” above) to extend
727 more than 300 meters from a project site, which would extend beyond the Plan Area only when a
728 project is located along the Plan Area perimeter. These changes are temporary, and limited in
729 scope to the location of particular projects. The HCP does not specify the location or timing of
730 projects; therefore, we cannot reasonably extend the action area to account for noise and odors.
731 We do not expect significant amounts of construction runoff outside the Plan Area, because a
732 purpose of project-level permitting under other Federal, State, and local authorities is to ensure
733 that such runoff is captured onsite.

734

735 Similarly, smoke from burning cleared vegetation and prescribed fires (“b” above) is temporary
736 and limited in scope to the location of particular construction projects or burn areas. The HCP
737 does not specify the location or timing of construction projects or prescribed fires; therefore, we
738 cannot reasonably extend the action area to account for smoke. A purpose of permits under State
739 and local authorities for burning cleared vegetation or conducting prescribed fires is to ensure
740 that the risk of severe off-site modifications to land and air is limited to safe levels.

741

742 Plan Area development may alter surface- and ground-water flows and levels (“c” above) by
743 increasing the extent of impervious surfaces. However, we have no information about the extent
744 or location of new impervious surfaces that may occur on 39,973 acres within a 66,245-acre
745 potential development envelope. We are unable to predict with reasonable certainty specific
746 hydrologic modifications that would extend beyond the Plan Area resulting from this land
747 modification within the Plan Area.

748

749 Residential and commercial development as proposed by the HCP is also reasonably certain to
750 increase vehicular traffic throughout the Plan Area and into adjacent areas. Specifically, traffic
751 volume is a measurable, predictable, and long-term change influenced by the construction of
752 homes and businesses that serve as origins or destinations of vehicle trips (described in this
753 document as internal capture rate). Additionally, roadway construction may change traffic
754 volume indirectly or encourage additional development. Section 3 and Appendices B.1 and B.2
755 of this BO/CO describe the traffic analyses and modeling we conducted to predict traffic volume
756 and how that informed our determination of the Action Area for this project.

757

758 Based on our analysis of the spatial extent of activities associated with development proposed in
759 the HCP, and subsequent traffic modeling, the Action Area for this analysis consists of the Plan
760 Area (159,489 acres) plus 5,072 discrete road segments totaling 1,825 mi (Figure 2-2). The
761 Appendix B.2 lists all the road segments included in the Action Area. On these road segments we
762 also estimate the volume of traffic from other sources for our analyses of cumulative effects.
763

764 **2.1.2.1 Habitat Types**

765
766 In this section, we report the acreage of habitat types in the Plan Area. These data come from an
767 overlay of the land use designations of the HCP (a geographic data file we obtained from the
768 Applicants) and the Cooperative Land Cover (CLC) classes of the Florida Fish and Wildlife
769 Conservation Commission (FWC) and Florida Natural Areas Inventory (FNAI) (2016). This
770 overlay provides the spatial extent of habitat changes to which the Covered Species may be
771 exposed for our analyses in sections 4–20 of the BO/CO. Chapter 3 of the HCP provides
772 additional information about environmental conditions in the Plan Area, which we cite as
773 necessary throughout this BO/CO.
774

775 Table 2-1 lists the land cover types and corresponding acreage within the Plan Area. We
776 organize the CLC classes by general categories (e.g., Active Agriculture, Native Wetland), and
777 within each category, sort the CLC classes in descending order of total acreage. Columns of the
778 table provide an acreage breakdown within the five land-use designations of the HCP:
779

- 780 (a) Development and Mining (see section 2.2);
- 781 (b) Preservation (see section 2.3);
- 782 (c) Base Zoning (see section 2.4)
- 783 (d) Very Low Density (see section 2.5); and
- 784 (e) Eligible for Inclusion (land-use designation subject to “certificates of inclusion;” see
785 section 2.1.1).

786 Table 2-2 consolidates the CLC data in Table 2-1 by general land use/land cover categories:
787 active agriculture, native wetland, native upland, existing development, and other types. Active
788 agriculture is the largest category, covering almost half (48.3%) of the Plan Area, followed by
789 native wetlands (36.7%), and native uplands (8.3%). The “Other” land use category in Table 2-2
790 consists mostly of open rural lands that are not in active agricultural use.
791

792 **2.1.2.2 Methods for Estimating the Extent of Development by Habitat Types**

793 Our predictions of the effects of HCP development activity on Covered Species must deal with
794 the uncertainties that arise from the Applicants’ HCP development on up to 39,973 acres (the
795 development cap) within a 66,245-acre portion (development envelope) of the Plan Area. The
796 full extent of the potential development envelope is comprised of three land-use designations of
797 the HCP:

- 798 • Development and Mining (43,767 acres);
- 800 • Base Zoning (2,431 acres); and
- 801 • Lands Eligible for Inclusion (20,047 acres).
802

803 In this section, we explain two methods (“Proportional” and “Reasonable Maximum Impact”)
804 that we use for making inferences about which 60.3% of the development envelope (39,973 of
805 the 66,245 acres) we attribute to development in our species-specific effects analyses. The
806 analysis for each species uses only one of the two methods.
807

808 For both methods, we first reduce the size of the potential development envelope by removing
809 the areas of existing development and open water from further consideration, because these
810 cover classes are highly unlikely to host new development subject to the HCP development cap.
811 Table 2-3 reports the acreages for the three development land-use designations in the columns
812 labeled A, B, and C, with the acreages for existing development and open water segregated to the
813 bottom of the table with a corresponding subtotal. The cover classes listed above the first
814 subtotal represent the remaining portion of the development envelope for our analyses of
815 development effects. Removing existing development and open water classes reduces size of the
816 potential new development envelope from 66,245 to 64,757 acres. The development cap of
817 39,973 acres is 61.7% of this smaller envelope, instead of 60.3% of the larger envelope.
818 Following this reduction of the development envelope, our two analysis methods diverge, as
819 explained below.
820

821 **Proportional Method**

822

823 Our “Proportional” method for estimating the extent of each cover class that new development
824 could affect is a proration of the acreages reported in columns A–C of Table 2-3. Because the
825 development cap is 61.7% of the potential development envelope, we expect that 61.7% of each
826 cover class will support development. We cannot identify the properties that will comprise this
827 61.7%; therefore, our analyses using the Proportional method cannot make firm predictions of
828 effects based on available site-specific species data. This method merely estimates the acreage of
829 development within particular cover classes.
830

831 We can identify plans for the Rural Lands West (RLW) development as the type of project that
832 would fill the HCP development cap. The owners of the RLW properties submitted development
833 plans to the Corps for necessary Federal permits (Passarella & Associates, Inc. 2017). Although
834 the owners subsequently withdrew these plans, we consider the proposals mature enough to
835 warrant identification in our analyses as areas that are more likely than not to satisfy part of the
836 HCP development cap. The relative abundance of cover classes in RLW is different from that of
837 the development envelope as a whole. For example, Orchards/Groves cover 40.5% of the
838 development envelope (excluding existing developed areas and open water), but none are present
839 in RLW. Because we know that the foreseeable development of RLW does not include any
840 Orchards/Groves, we can expect development of less than 61.7% of all Orchards/Groves in the
841 full development envelope. Similarly, we should expect development of more than 61.7% of
842 cover classes that are relatively more abundant in RLW. We adjust our proration of cover class
843 acreages in the full development envelope using the likely disposition of the RLW area as
844 follows:

845 (a) Column D of Table 2-3 lists the acreages of cover classes within RLW. Proposed
846 development in RLW (excluding 61 acres of existing development and 2 acres of open
847 water) will account for 4,011 acres (column D, first subtotal) of the development cap.

848 (b) Column E sums the acreages for the full development envelope (columns A, B, and C)
849 and subtracts the RLW acreage from this total.
850 (c) Column F computes the prorated acreage for development within the column E total.
851 (d) Column G returns the RLW acreage to the column F total. Column G is the acreage of
852 each cover class that we attribute to development under the Proportional method. Note
853 that the total acreage for all cover classes in column G is the development cap of 39,973
854 acres.
855 (e) Column H represents the undeveloped acreage following full development of 39,973
856 acres for each cover class that we expect under the Proportional method. Permittees
857 (ECPO and the owners of any eligible lands enrolled in the HCP) would secure these
858 undeveloped lands with conservation easements.

859 We use the Proportional method when:

860 (1) the species may occur on many cover classes, and the relative importance of most of
861 these is not sufficiently different to warrant the Reasonable Maximum Impact method
862 (described in the following subsection); or
863 (2) the species is associated primarily with native wetland cover classes.

864 The additional difficulties and permitting requirements associated with development in native
865 wetlands, which cover 8,115 acres (12.5%) of the 64,757-acre development envelope, makes
866 them less likely to host development than other cover classes. It is possible, but highly unlikely,
867 for the development cap to avoid entirely native wetlands within the development envelope.
868 Native wetlands within the proposed RLW development and the permitted Ave Maria
869 development cover 5.0 and 2.6%, respectively, of these areas, compared to the 12.5% wetlands
870 coverage in the full development envelope of the HCP. This suggests some degree of, but not
871 complete, wetlands avoidance in these developments. Rather than choose an arbitrary
872 development percentage for wetlands less than 61.7%, we apply the Proportional method in the
873 same manner to all cover classes, and consider it a modest overestimate of impacts to wetlands
874 and species associated with wetlands, but not a maximum impact scenario.

875 **Reasonable Maximum Impact Method**

876 We use the Reasonable Maximum Impact (RMI) method for species associated with cover
877 classes that could receive a disproportionate share of the development cap in the development
878 envelope (*i.e.*, more than 61.7%). As discussed in the previous subsection, we do not use this
879 method for species associated primarily with native wetlands, because wetlands are highly
880 unlikely to receive a disproportionate share of the development cap. Under the RMI method, we
881 rank the cover classes that the species uses as habitat in order of importance and attribute
882 development to the full acreage of each class in rank order up to the 39,973-acre development
883 cap. If the resulting attribution of development to cover classes is feasible under the HCP and not
884 otherwise unreasonable, the RMI method represents a plausible development scenario that would
885 have the greatest impact on the species.

886 When justified, an analytical advantage of the RMI method is that the spatial distribution of
887 development on cover classes that the species uses, and which collectively have a lesser
888 abundance than the development cap, becomes spatially explicit. Under the Proportional method,

894 the location of the approximately 61.7% of each cover class in the development envelope that
895 will support development is not determinable.

896
897 Under the RMI method, the likely disposition of lands within RLW, which affected the proration
898 of cover classes under the Proportional method, is not relevant. We attribute all the acreage of a
899 particular cover class in the development envelope with which a species is associated to
900 development, including any acreage within RLW. Table 2-4 is an example of the RMI method
901 for a hypothetical species that is associated with a mix of agricultural and native upland cover
902 classes.

903
904 **2.1.3 Development and Mining**

905
906 The HCP designates 43,767 acres of the Plan Area as the primary area (along with lands Eligible
907 for Inclusion and possibly Base Zoning) for up to 39,973 acres of residential/commercial
908 development and mining (labeled as the “Covered Activities” in the HCP) (see Figure 2-1). The
909 Applicants propose to continue their current land uses (agriculture, silviculture, recreation, exotic
910 and nuisance species control, oil and gas exploration/production) in the Development Areas until
911 they convert tracts for commercial/residential uses or earth mining. After reaching the 39,973-
912 acre development cap on HCP-enrolled lands in the Plan Area, permittees would add any
913 remaining undeveloped portions of the Development Areas (at least 3,794 acres; more if Eligible
914 lands are enrolled and developed) to the Preservation Areas (see section 2.3).

915
916 As we discussed in section 2.1.1, the ECPO Permittees may agree with owners of lands “Eligible
917 for Inclusion” in the HCP to substitute such lands for those designated for Development and
918 Mining in the HCP. Such inclusion would not alter the development cap that applies to the HCP
919 and any ITPs issued.

920
921 **2.1.3.1 Sub-Activities and Stressors**

922
923 Appendix A of the HCP contains the Applicants’ deconstruction (parsing of major components
924 into constituent parts) of the HCP development and mining activity. The deconstruction
925 identifies stressors (changes to the environment) associated with various sub-activities, and notes
926 the spatial and temporal distribution (radius and duration/frequency) for the Covered Species’
927 potential exposure to each stressor.

928
929 Commercial/residential development is divided into three phases: (1) pre-construction; (2)
930 horizontal construction; and (3) vertical construction. Earth mining is divided into four phases:
931 (1) pre-construction; (2) mining; (3) conversion to development; and (4) reclamation activities.
932 Each of these phases is comprised of various activities (e.g., surveys, vegetation clearing,
933 building construction) and sub-activities (e.g., vegetation piling/burning, road bed grading). Each
934 sub-activity would introduce one or more stressors to which the Covered Species may respond, if
935 exposed.

936
937 The Applicants deconstruct the HCP development and mining into 49 and 44 unique sub-
938 activities, respectively, which we list in Tables 2-5 and 2-6. Stressors identified for 91 of these
939 sub-activities are noise and human disturbance. Habitat loss is a general stressor identified for

940 the vegetation clearing activity during the pre-construction phase of both development and
941 mining. Vegetation clearing is parsed further into sub-activities according to the type of habitat
942 cleared (e.g., citrus orchard, pasture, native forest). Other stressors identified include the
943 introduction of smoke from burning piles of vegetation debris and fuel/oil/odor from equipment
944 use.

945

946 **2.1.4 Preservation Activities**

947

948 The HCP designates 90,576 acres of the Plan Area for eventual preservation under permanent
949 conservation easements (collectively, the Preservation Areas) (see Table 2-2). Permittees would
950 execute conservation easements under the County's Rural Lands Stewardship Program's
951 crediting system as they convert portions of the Development Area (along with enrolled lands
952 Eligible for Inclusion and possibly Base Zoning) to commercial/residential or mining, and
953 possibly enhance over time the value of the land as wildlife habitat and a corridor for regional
954 wildlife movement. Fees collected from the development activity would fund habitat
955 maintenance and enhancement activities (see section 2.7). The easements would preclude future
956 commercial/residential development and earth mining, but would allow a continuation of the
957 existing agricultural land uses.

958

959 Until landowner Permittees execute easements on properties within the Preservation Areas, the
960 HCP prescribes a continuation of existing land uses, which include:

961 1 crop cultivation;
962 2 ranching/livestock operations;
963 3 forestry and silviculture;
964 4 recreation;
965 5 exotic and nuisance species control; and
966 6 oil and gas exploration and production.

967

968 Permittees under the HCP would annually document the proportion of landcover in the
969 Preservation Areas that consists of native habitats and the proportion used for agricultural
970 purposes. The HCP seeks to maintain 100% of the current extent of native habitats and
971 agricultural uses in the Preservation Areas, but stipulates a 95% standard to "allow a degree of
972 flexibility in accomplishing restoration of land cover as needed" (HCP section 2.2).

973

974 Upon reaching the 39,973-acre development cap on enrolled lands in the Plan Area, permittees
975 would place remaining undeveloped portions of the Development Areas under conservation
976 easements. At that time, the total area under such easements would then encompass 90,576 plus
977 at least 3,794 acres (the total acreage of the Development areas minus the cap), depending on
978 whether some Eligible lands and/or Base Zoning lands substitute for designated Development
979 areas. The final ratio of Preservation to Development acreage in the Plan Area would equal or
980 exceed $(90,576 + 3,794) \div 39,973 = 2.36$.

981

982 In addition to authorization for take of the Covered Species in the Development areas, the
983 Applicants also seek authorization for take that is incidental to land management activities within
984 the Preservation and Very Low Density Use areas. These activities include:
985 prescribed burning;

986 mechanical control of groundcover (e.g., roller chopping, brush-hogging, mowing);
987 ditch and canal maintenance;
988 mechanical and/or chemical control of exotic vegetation;
989 soil tillage; and
990 similar activities that maintain or improve land quality.

992 **2.1.5 Base Zoning**

994 The HCP designates a single property, the Half Circle L Ranch, as “Base Zoning.” This 2,431-
995 acre ranch (1.5% of the Plan Area) is located on the northeast edge of the Plan Area (see Figure
996 2-1). Base Zoning means that development at a density of up to 1 dwelling unit per 5 acres,
997 and/or ongoing agricultural uses, may occur consistent with current land use zoning for the
998 RLSA. The Applicants would account for any development of the Base Zoning Area, including
999 possible development at densities greater than 1 unit per 5 acres, in the 39,973-acre effective
1000 development cap for the Plan Area. Higher-density development in the Base Zoning Area would
1001 displace an equivalent acreage from the areas designated for Development, and place an acreage
1002 into the areas designated for Preservation according to provisions of the RLSA, as adopted in the
1003 HCP. Until the owner of the Half Circle L Ranch decides whether to develop some or all of the
1004 property, it is *not* included in the HCP acreage for the Development, Preservation, or Very Low
1005 Density Use areas.

1006 At this time, the owner of the Half Circle L Ranch has placed it for sale on the open market. The
1007 current or the future owner may choose to participate in or withdraw from the HCP, and may
1008 choose to develop the property or to continue current agricultural practices. Regardless whether
1009 its owner develops the Base Zoning Area under the HCP or withdraws it from the HCP
1010 altogether, the development cap for the HCP is 39,973 acres.

1011 We cannot consider the Base Zoning Area among the lands designated for Preservation, because
1012 it is not. We cannot consider that it is limited to a development density of 1 unit per 5 acres,
1013 because the HCP allows Base Zoning lands to substitute for Development lands that do not have
1014 this restriction. Therefore, we conservatively treat the Base Zoning Area in this BO/CO as
1015 contributing up to 2,431 acres to the development cap, the same as other lands within the
1016 Development Area.

1017 Treating the Base Zoning Area as available for high-density development is consistent with
1018 purpose of this BO/CO, which is to determine whether the Action is likely to jeopardize the
1019 continued existence of any of the Covered Species. If the Action satisfies this permit issuance
1020 criterion under this scenario, it will do so whether the Half Circle L Ranch is preserved or
1021 developed at lower densities than the Development areas. Therefore, our effects analyses in
1022 sections 4 through 20 of this BO/CO include the Base Zoning Area among the lands designated
1023 for up to 39,973 acres of commercial/residential development.

1024 **2.1.6 Very Low Density Development**

1025 The Applicants designate three areas, located on the southern and eastern edges of the Plan Area,
1026 for “Very Low Density” (VLD) uses (see Figure 2-1). These parcels have a combined acreage of

1032 2,667 acres (1.7% of the Plan Area). VLD uses include isolated residences, lodges, and
1033 hunting/fishing camps, as well as a continuation of existing agricultural (primarily cattle grazing)
1034 and silvicultural activities. The HCP limits dwellings in the VLD areas to no more than one unit
1035 per 50 acres, and limits vegetation clearing to no more than 10% of the existing native vegetation
1036 (HCP chapter 2.2).

1037
1038 About 668 acres (25.0%) of the VLD areas are open water (see Table 2-2). Native vegetation
1039 types cover 1,180 acres (44.2%), of which 447 acres are upland types and 733 acres are wetland
1040 types. Within the native cover types, Covered Activities include, but are not limited to:

- 1041 1) exotic and nuisance species control;
- 1042 2) prescribed burning;
- 1043 3) mechanical control of excessive forest understory/fuel loads;
- 1044 4) tree thinning to improve native forest productivity;
- 1045 5) mechanical, hydrologic, and/or chemical control of vegetation to improve community
1046 structure and/or plant species diversity;
- 1047 6) construction and maintenance of surface water management structures for preservation or
1048 enhancement of existing/natural hydrologic function; and
- 1049 7) scouting and monitoring of lands on foot, horseback, or by vehicle (HCP Chapter 2.2).

1050
1051 The HCP does not specify where clearing up to 10% of the native vegetation types would occur.
1052 Clearing 10% of the native vegetation would reduce their total extent by 118 acres. The
1053 maximum density of 1 unit per 50 acres over the full extent of the VLD areas (2,667 acres) for
1054 the construction of residences, lodges, and hunting/fishing camps corresponds to $2,667 \div 50 = 53$
1055 units. If located entirely within 118 acres of cleared native cover types, 53 units would occupy an
1056 average of 2.2 acres each.

1057
1058 The construction of up to 53 dwelling units within the VLD areas could occur mostly or entirely
1059 on land cover types besides native uplands and wetlands (e.g., on 502 acres of improved pasture
1060 or on 241 acres of rural open lands). However, we must evaluate the HCP as proposed, which
1061 stipulates clearing of up to 10% of the native vegetation within the VLD areas. Consistent with
1062 our proportional method for distributing the development cap among cover types (see section
1063 2.1.4), we allocate the effects of land clearing among all cover types represented in the VLD
1064 areas. Table 2-7 provides calculations for the maximum extent of potential clearing (10%
1065 removal of each native cover type), which we represent as a conversion of 118 acres of the native
1066 cover types to the land cover class “Rural Structures.”

1067
1068 **2.1.7 Eligible for Inclusion**
1069
1070 The Applicants identify 20,047 acres in the Plan Area that they do not own as lands “Eligible for
1071 Inclusion” in the HCP (see Figure 2-1, and Tables 2-1 and 2-2). Owners of properties within the
1072 lands “Eligible for Inclusion” could elect to participate in the HCP during its implementation.
1073 Such enrollment could not increase the total amount or extent of incidental take authorized under
1074 ITPs issued to the ECPO Applicants for the HCP, and all relevant conservation commitments of
1075 the HCP would apply to any new lands covered. We explain in section 2.1.1 how the possibility
1076 of substituting Eligible lands for those assigned to the Development and Mining uses, or adding
1077 to those assigned to the Preservation uses, expands the immediate area involved in the Action. In

1078 section 2.1.4, we explain our methods for including the Eligible lands in the scope of our
1079 species-specific effects analyses.

1080
1081 The ECPO Applicants do not describe a specific process for admitting eligible lands to the HCP.
1082 Whatever process they may adopt, at the time of a new enrollment, the ECPO permit holders
1083 would need to demonstrate that the amount or extent of take authorized for the HCP has not been
1084 exceeded (*i.e.*, actions in the HCP that the Service expected to cause the authorized take have not
1085 yet occurred). Satisfying this condition would allow the permit holders to share with an owner of
1086 eligible lands the authorization for take that has not yet occurred. The enrollee would need to
1087 apply for, and the Service would need to issue, a separate ITP for the eligible lands. The ITP
1088 would replicate all previous requirements for take authorization associated with the HCP.
1089 Similarly, the owners of eligible lands within the Plan Area could sell lands to an ECPO or other
1090 enrolled permittee. That permittee could conduct Covered Activities on a newly-acquired
1091 property in accordance with their existing, an amended, or a new permit depending on
1092 circumstances.

1093
1094 The addition of Eligible lands to the HCP is uncertain. Owners of the Eligible lands are under no
1095 obligation to participate in the HCP. All persons under U.S. jurisdiction are subject to the take
1096 prohibitions of the ESA, and non-Federal entities may seek authorization for incidental take
1097 caused by their actions through an HCP/ITP. If private landowners seek Federal funding or
1098 permits for actions that may affect listed species or designated critical habitat, the Federal agency
1099 assumes responsibility for ESA compliance, including compliance with the take prohibitions.
1100 Owners of Eligible lands that choose to participate in the HCP to obtain take authorization would
1101 need to negotiate with the ECPO permittees for any substitution of their lands for ECPO lands
1102 assigned to the Development and Mining land use category of the HCP and any associated
1103 addition of their lands to those assigned to the Preservation category. Regardless whether
1104 Eligible lands enter the HCP, the development cap of the HCP evaluated in this BO/CO is 39,973
1105 acres.

1106
1107 **2.1.8 Other Activities Caused by the Action**

1108
1109 A BO/CO evaluates the consequences to species or critical habitat that are caused by the
1110 proposed Federal action, including the consequences of other activities that are caused by the
1111 proposed action and are reasonably certain to occur (see definition of “effects of the action” at 50
1112 CFR §402.02). Regulations at 50 CFR §402.17(a) specify criteria for identifying such activities:

1113 (a) *Activities that are reasonably certain to occur.* A conclusion of reasonably certain to occur
1114 must be based on clear and substantial information, using the best scientific and
1115 commercial data available. Factors to consider when evaluating whether activities caused
1116 by the proposed action (but not part of the proposed action) or activities reviewed under
1117 cumulative effects are reasonably certain to occur include, but are not limited to:

1118 (1) Past experiences with activities that have resulted from actions that are similar in
1119 scope, nature, and magnitude to the proposed action;
1120 (2) Existing plans for the activity; and
1121 (3) Any remaining economic, administrative, and legal requirements necessary for the
1122 activity to go forward.

1124 The Applicants own the properties included in the Development, Preservation, Base Zoning, and
1125 Very Low Density designations of the HCP, but not the Eligible lands. The HCP describes
1126 activities for which the Applicants (and owners of Eligible lands that agree to participate in the
1127 HCP) seek authorization for incidental taking of listed species, and describes activities intended
1128 to minimize and mitigate the impacts of such taking. Development on the Eligible lands may occur
1129 independent of the HCP, and we are unaware of any third-party development proposals that
1130 would not occur but for the activities described in the HCP. Because the Applicants propose the
1131 possible addition of Eligible lands to the HCP, we include the Eligible lands in the Action Area.
1132 The Applicants propose to use the Marinelli Fund, in part, to assist conservation, research,
1133 education, and other activities beneficial to panther and regional natural resource conservation.
1134 These include habitat acquisition, improved highway wildlife crossings, support of research field
1135 activities, educational facilities, and others as described in the HCP, section 9.5. These activities
1136 are expected to be directly implemented by third-party State or county agencies, non-
1137 governmental conservation groups, academic researchers, etc, so this is part of the proposed
1138 Action.
1139

1140 Third-party activities that are not a part of, but would be caused by, the development activity of
1141 the HCP, are the collective activities of future residents of the new developments. An increase in
1142 human habitation within the Plan Area is reasonably certain to occur, because creating the
1143 conditions (residences, commercial buildings, infrastructure) for such habitation is the intended
1144 outcome of the HCP development activity. Following changes caused by the Covered Activities
1145 (clearing, construction, land management, *etc.*), new residents of the Plan Area would cause
1146 additional changes. When relevant, we consider whether other changes caused by increased
1147 human habitation of the Plan Area are sources of reasonably certain consequences to Covered
1148 Species in each species-specific effects analysis. We also consider how avoidance,
1149 minimization, and mitigation measures proposed by the applicants would reduce these effects to
1150 Covered Species.
1151

1152 **2.1.9 Goals for Species**

1153

1154 The HCP Handbook (USFWS and NMFS 2016) addresses how biological goals and objectives
1155 are to be established in Habitat Conservation Plans. The biological goals and objectives
1156 established in the plan must be consistent with the conservation and recovery goals established
1157 by the Service for the species. The goals are intended to provide an understanding of why
1158 specific conservation measures are necessary. These goals are developed based on the species'
1159 biology, threats to the species, the potential effects of the Covered Activities, and the
1160 conservation scope of the plan.
1161

1162 Because of the landscape scale of the HCP and the large areas of habitat used by panthers, the
1163 HCP incorporates specific biological goals for panthers. It also includes biological goals for the
1164 other Covered Species. The biological goals for panthers, as described in Section 4.3 of the HCP,
1165 are the following:

- 1166 1) Preserve and maintain large, interconnected blocks of Florida panther habitat
1167 (approximately 100,000 acres as calculated by GIS)
- 1168 2) Enhance Florida panther habitat and facilitate panther movement across the landscape

1169 3) Provide funding to the Marinelli Fund that can be used to enhance, restore, and/or
1170 establish panther habitat to facilitate panther movements across the landscape within the
1171 HCP Area. While impacts to panther habitat (predominantly previously-cleared areas) are
1172 fully offset through the preservation and maintenance of approximately 100,000 acres of
1173 land by the permittees, this funding is expected to provide additional conservation
1174 benefits. Benefits include enhancing an existing corridor that has been historically
1175 traversed by panthers crossing SR-29, and establishing a corridor to facilitate dispersal of
1176 panthers northward from the Corkscrew Marsh area.
1177

1178 The general biological goals for the other Covered Species, as described in Section 7.1 of the
1179 HCP, are the following:

- 1180 (a) Preserving and maintaining a landscape mosaic of native habitats, pastures, and rural
1181 open space within the lands designated under the Plan for Preservation/Plan-Wide
1182 Activities and Low Density Use that provides major conservation benefits to the Covered
1183 Species, including the regional wildlife corridors that provide landscape-scale linkages
1184 between existing public conservation lands;
- 1185 (b) Providing in-kind mitigation for permanent losses of other Covered Species habitat
1186 associated with implementation of the Covered Activities, including habitat preservation,
1187 and habitat restoration, enhancement, and/or creation; and
- 1188 (c) Contributing to the Marinelli Fund, which will be used to fund initiatives and activities
1189 that provide conservation benefits to the Florida panther and the other Covered Species.
1190

1191 For the objectives and measures related to panther biological goals, refer to Section 4.3.1 in the
1192 HCP. For the objectives and measures related to other species biological goals, refer to Section
1193 7.2 in the HCP.

1194 2.1.10 The Marinelli Fund and Proposed Conservation Measures

1195 **Marinelli Fund**

1196 ECPO collaborated with several environmental groups to develop the Florida Panther Protection
1197 Program (FPPP), which seeks to assist panther recovery (2008 FPPP MOU). To finance panther
1198 protection and habitat enhancement activities, the FPPP committed themselves to establish the
1199 Marinelli Fund and specified its purposes and objectives (2008 FPPP MOU). Chapter nine of the
1200 HCP updates and translates those initial commitments of Marinelli Fund governance, funding
1201 sources, purposes, principles, and funding priorities. Issuance of the requested ITPs would
1202 require implementation of the Marinelli Fund in accordance with the HCP.
1203

1204 The Marinelli Fund will receive contributions on a per-acre basis as Permittees initiate
1205 development projects within the Plan Area under the HCP and will receive transfer fees
1206 thereafter on a per-unit basis as homes are sold and re-sold. While a portion of the Marinelli
1207 Fund would assure HCP implementation monitoring and reporting costs during implementation
1208 (HCP section 9.4), its major purpose is to assist with panther conservation and recovery activities
1209 throughout the Plan Area (HCP section 9.5). In the absence of the HCP, future contributions to
1210 the Marinelli Fund would be less certain.
1211

1215 The activities financed by the Marinelli Fund may include (from Section 9.5 of the HCP for the
1216 full range):

- 1217 • design and construction of wildlife underpasses and fencing along roadways to prevent
1218 wildlife/vehicle collisions;
- 1219 • panther habitat acquisition, management, restoration and/or enhancement; and
- 1220 • other activities that are consistent with the goals of the FPPP or that benefit other
1221 Covered Species of the HCP.

1222 The HCP proposes to dedicate \$12.5 million of the first \$13 million of the Marinelli Fund to
1223 wildlife roadway crossings that specifically target benefits to the Florida panther (HCP section
1224 9.5). Over the requested 50-year permit term, the Applicants anticipate the Fund would generate
1225 \$150 million (HCP section 9.2).

1226 **Conservation Measures**

1229 The HCP's primary measure to avoid and minimize impacts to the Florida panther and other
1230 Covered Species is the designation of contiguous lands for Preservation and Very Low Density
1231 (VLD) uses. The goal of these designations is to maintain or enhance over time the proportions
1232 and quality of native habitats in these areas, while continuing existing agricultural land uses.
1233 The Preservation and VLD areas contain the majority (85%) of Plan Area native habitats (see
1234 Table 2-2).

1235 The HCP describes conservation measures that apply to particular Covered Species in Section 4
1236 (Florida Panther) and Section 7 (Conservation Plan for Other Covered Species). Such measures
1237 include pre-construction surveys, buffer zones around identified burrows/roosts, *etc.* We
1238 consider how these measures would influence the consequences to Covered Species resulting
1239 from Covered Activities under the HCP in the species-specific effects analysis sections of this
1240 BO/CO.

1242 The Applicants have committed (HCP section 7.6.1.2) to the following project-level planning
1243 measures and best management practices (BMPs) in order to further enhance the conservation
1244 value of the HCP, including the northern and southern wildlife corridors. These measures,
1245 described in the bullet points below, will be required for developments under the HCP.

1246 c) Prescribed Fire and Smoke Notice. As applicable, final development plans, associated
1247 homeowner's documents, and other documentation associated with residential and
1248 commercial development projects within the HCP Area will provide notice of the use of
1249 prescribed fire in the area, irrespective of the previous or planned use of prescribed fire
1250 on the site of the development itself. This notice will be provided and recorded in a
1251 manner such that initial and subsequent residents and owners shall be aware of the use
1252 of prescribed fire in and around the HCP Area to manage wildland fuels and maintain
1253 fire-adapted ecological communities within preserve areas. The following notice
1254 concerning the use of prescribed fire will be provided:

- 1255 • Periodic prescribed burning is a recognized land management tool and a
1256 recommended method of fuel management within and around the HCP Area
1257 for minimizing wildfire hazards and maintaining healthy fire-adapted
1258 ecological communities. Homeowners acknowledge that they have received

1260 notice that prescribed burning may result in the periodic occurrence of
1261 temporary smoke and ash that drifts through developed areas.

1262 d) Environmental Education and BMPs for Living with Wildlife. The materials contained
1263 in Appendix B of the HCP document will be included with the Homeowners'
1264 Association (HOA) documents for each residential development community within the
1265 HCP Area at the time of HOA incorporation. Decisions regarding which educational
1266 materials and BMPs will be implemented within each community are left to the HOA
1267 and community residents, but the materials will be transferred to the developer(s) and
1268 HOA(s).

1269 e) Securing and Vaccinating Pets. HOA and/or homeowners' documents for residential
1270 developments within the HCP Area will state that pets within those developments
1271 should be kept indoors, on leash when outdoors, or secured within a secure covered
1272 kennel. Residents will be informed that vaccinating cats for feline leukemia virus (FLV)
1273 can prevent disease transmission from house cats to Florida panthers. As there is no
1274 definitive cure for FLV, community-wide vaccination of all pet cats protects
1275 homeowners' pets from illness, as well as preventing illness in Florida panthers.

1276 f) Development Lighting Adjacent to the Northern and Southern Corridors. Plans for
1277 commercial and residential developments within the HCP Area that are submitted to
1278 Federal and State regulatory agencies will detail the lighting plans and proposed
1279 restrictions adjacent to the northern and southern wildlife corridors (Figure 4-9).
1280 Lighting plans will address (i) distance of fixtures to the corridor edge(s); (ii) fixture
1281 types; (iii) degree of fixture shielding (to limit skyglow, light trespass and glare); (iv)
1282 light sources, including low-pressure sodium (LPS), high-pressure sodium (HPS), and
1283 metal halide and light emitting diodes (LEDs); (v) brightness; (vi) correlated color
1284 temperature (in degrees Kelvin); and (vii) use of passive lighting (e.g., roadway
1285 reflectors; unlighted road signs). These lighting plan details will form a technical basis
1286 for the developer and the Service to perform a HCP/ITP consistency check as to
1287 whether the lighting plan adequately minimizes artificial light at the corridor edge(s)
1288 and maintains the functionality of the corridor for crepuscular and nocturnal wildlife
1289 movement.

1290 g) Open Space Buffers. Commercial and residential developments within the HCP Area
1291 will comply with Policy 4.13 of the Collier County Future Land Use Element for the
1292 RLSP, which states as follows: "Open space within or contiguous to a SRA shall be
1293 used to provide a buffer between the SRA and any adjoining FSA, HSA, or existing
1294 public or private conservation land delineated on the Overlay Map. Open space
1295 contiguous to or within 300 feet (ft) of the boundary of a FSA, HSA, or existing public
1296 or private conservation land may include: natural preserves, lakes, golf courses provided
1297 no fairways or other turf areas are allowed within the first 200 ft, passive recreational
1298 areas and parks, required yard and set-back areas, and other natural or manmade open
1299 space. Along the west boundary of the FSAs and HSAs that comprise Camp Keais
1300 Strand, i.e., the area south of Immokalee Road, this open space buffer shall be 500 ft
1301 wide and shall preclude golf course fairways and other turf areas within the first 300 ft." Under
1302 the RLSP, development plans must conform to this policy to gain development
1303 approvals from Collier County.

1305 The Applicants have stated objectives for (HCP section 7.6.1.3) project-level planning measures
1306 and best management practices (BMPs) in order to further enhance the conservation value of the
1307 HCPs wildlife corridors. These objectives will be incorporated into developments under the
1308 HCP.

1309

- 1310 5. Designing master plans that (i) concentrate more intensive land uses within the center of
1311 mixed-use residential/commercial developments (town centers), located at a distance from
1312 habitat Preservation Areas outside the development area, and (ii) diminish land use
1313 intensities adjacent to habitat Preservation Areas (e.g., providing transitions from mixed-
1314 use town centers, to residential neighborhoods, to community open space areas, to surface
1315 water management (lakes), to project boundaries and project perimeter buffers);
- 1316 6. Minimizing impacts to native habitats within project boundaries that occur along the
1317 interface with habitat Preservation Areas external to the project;
- 1318 7. Utilizing a combination of design elements, including surface water management lakes,
1319 berms, structural buffers, fencing, and directional and/or low-level lighting along the
1320 periphery of Covered Activities to minimize the effects of light, noise, and human activity
1321 on areas outside the project boundaries, and to minimize human interactions with Covered
1322 Species;
- 1323 8. Designing internal roadway networks and roadway elements to minimize the potential for
1324 wildlife-vehicle collisions within the lands designated for Covered Activities. These
1325 elements may include strategic selection of key road segments for wildlife crossing
1326 structures such as box culverts, small animal culverts, wildlife pipes, amphibian tunnels;
1327 the use of landscaping, curbs, fencing, and other barriers to direct wildlife to safe road
1328 crossing areas; wide, open road shoulders near crossings to maximize visibility for wildlife
1329 and motorists; and wildlife crossing signage (Kautz et al. 2010);
- 1330 9. Providing a sustainable mix of residential, commercial, retail, office, civic, and recreational
1331 land uses where these non-residential components minimize the need for residents to leave
1332 the development for basic needs (maintaining a high internal capture rate), thereby
1333 minimizing travel on the regional transportation network; and
- 1334 10. In the case of earth mining, establishing perimeter berms to separate the mine areas from
1335 adjacent Preservation Areas (where present adjacent to the mine), and limiting offsite
1336 transport of mining products to daylight hours.

1338
1339
1340
1341
1342

2.2 Tables and Figures for Proposed Action

Table 2-1. Land cover class acreage within the Plan Area by designated use under the HCP.
Percentages reported are row or column totals divided by the grand total (159,489 acres).

GENERAL CATEGORY	COOPERATIVE LAND COVER CLASS	DEVELOP- MENT	PRESER- VATION	VERY LOW DENSITY	BASE ZONING	ELIGIBLE FOR INCLUSION	ROW PERCENT	
							ROW TOTAL	PERCENT
Agriculture	Orchards/Groves	18,481.80	8,784.00	0	0	7,772.00	35,037.80	22.0%
	Cropland/Pasture	14,548.60	9,158.70	0	698.4	2,496.00	26,901.70	16.9%
	Improved Pasture	4,392.60	7,599.40	501.8	1,082.40	1,546.00	15,122.30	9.5%
	Other Agriculture	0	1.1	0	0	0	1.1	0.0%
Native Wetland	Marshes	1,007.20	14,232.80	123.9	0	1,335.00	16,698.90	10.5%
	Cypress	141.2	11,549.80	17.4	0	1,270.00	12,978.40	8.1%
	Prairies and Bogs	708.4	8,205.10	97.6	0	1,152.00	10,163.10	6.4%
	Freshwater Forested Wetlands	110.1	4,094.30	357.2	0	662	5,223.60	3.3%
	Isolated Freshwater Swamp	168.1	3,681.40	40.4	0	173	4,062.90	2.6%
	Wet Flatwoods	134.8	2,300.20	3.2	53.3	20	2,511.50	1.6%
	Cypress/Tupelo	142.4	1,787.10	69.7	0	262	2,261.20	1.4%
	Isolated Freshwater Marsh	9.4	1,156.10	1.7	536.5	102	1,805.70	1.1%
	Strand Swamp	0	1,742.80	0	1.1	14	1,758.00	1.1%
	Other Hardwood Wetlands	4.3	437	22.1	0	53	516.3	0.3%
	Dome Swamp	0	279.4	0	37.2	0	316.5	0.2%
	Hydric Hammock	0	116.8	0	1.8	0	118.6	0.1%
	Freshwater non-Forested Wetlands	5.7	99.4	0	0	0	105.1	0.1%
	Other Coniferous Wetlands	11	12.8	0	0	0	23.7	0.0%
Native Upland	Mesic Flatwoods	938.4	6,026.00	112.3	0	314	7,390.60	4.6%
	Mixed Hardwood-Coniferous	240.2	2,240.70	135	0	165	2,780.90	1.7%
	Mesic Hammock	417.2	1,129.30	61.4	16.3	167	1,791.20	1.1%
	Shrub and Brushland	206.6	658.9	138	0	88	1,091.50	0.7%
	Palmetto Prairie	1.5	127	0	0	0	128.4	0.1%
	Scrubby Flatwoods	0	29.4	0	0	0	29.4	0.0%
	Scrub	0	9.3	0	0	0	9.3	0.0%
Other	Rural (Rural Open Lands)	1,414.80	4,154.80	240.9	0.3	1,153.00	6,963.80	4.4%
	Exotic Plants	291.7	528	1.9	0	59	880.6	0.6%
	Fallow Orchards	0	39.1	0	0	102	141.1	0.1%
	Extractive	0	8.2	61.2	0	34	103.3	0.1%
	Cultural - Terrestrial	0	7.4	0	0	15	22.4	0.0%
	Bare Soil/Clear Cut	0	7.1	0	0	0	7.1	0.0%
Existing Development	Low Intensity Urban	178.8	51.9	0.4	0	303	534.1	0.3%
	Transportation	105.4	84.2	13.8	3.9	200	407.3	0.3%
	High Intensity Urban	33.2	10.4	0	0	48	91.7	0.1%
	Utilities	0.5	1.7	0	0	0	2.3	0.0%
	Communication	3	0	0	0	0	3.1	0.0%
Open Water	Cultural - Lacustrine	45.2	63	657.1	0	419	1,184.40	0.7%
	Cultural - Riverine	25.1	92.5	0	0	42	159.6	0.1%
	Lacustrine	0	48.4	9.3	0	75	132.7	0.1%
	Natural Lakes and Ponds	0	20.9	1.2	0	6	28.1	0.0%
	COLUMN TOTAL	43,767.2	90,576.3	2,667.4	2,431.1	20,047.0	159,489.0	
	COLUMN PERCENT	27.4%	56.8%	1.7%	1.5%	12.6%		

1343
1344

1345
1346
1347

Table 2-2. General land cover (acres) within the Plan Area by designated use under the HCP.
Percentages reported are row or column totals divided by the grand total (159,489 acres).

CATEGORY	DEVELOPMENT	PRESERVATION	VERY LOW DENSITY	BASE ZONING	ELIGIBLE FOR INCLUSION	ROW TOTAL	ROW PERCENT
Active Agriculture	37,423.0	25,543.2	501.8	1,780.8	11,814.0	77,062.8	48.3%
Native Wetland	2,442.4	49,695.0	733.1	629.8	5,043.0	58,543.3	36.7%
Native Upland	1,803.9	10,220.5	446.6	16.3	734.0	13,221.3	8.3%
Other	1,706.5	4,744.6	304.0	0.3	1,363.0	8,118.4	5.1%
Existing Development	321.0	148.3	14.2	3.9	551.0	1,038.4	0.7%
Open Water	70.3	224.8	667.6	0.0	542.0	1,504.7	0.9%
COLUMN TOTAL	43,767.2	90,576.3	2,667.4	2,431.1	20,047.0	159,489.0	
COLUMN PERCENT	27.4%	56.8%	1.7%	1.5%	12.6%		

1348
1349

1350 **Table 2-3.** Calculations for prorating the distribution of up to 39,973 acres of development (the
 1351 development cap in the HCP) among cover classes using the Proportional method for some
 1352 species-specific effects analyses (see section 2.1.4). Column "G" reports the acres of each cover
 1353 class that we attribute to development for such analyses.
 1354

GENERAL CATEGORY	COOPERATIVE LAND COVER CLASS	A	B	C	D	E	F	G	H
		DEVELOP- MENT & MINING	BASE ZONING	ELIGIBLE LANDS	RURAL LANDS WEST	A + B + C - D	E*(({Cap- D _{total} })/E _{total}))	D + F	A + B + C - G
Active Agriculture	Orchards/Groves	18,482	0	7,772	0	26,254	15,542	15,542	10,711
	Cropland/Pasture	14,549	698	2,496	2,923	14,820	8,774	11,697	6,046
	Improved Pasture	4,393	1,082	1,546	600	6,421	3,801	4,401	2,620
	Other Agriculture	0	0	0	0	0	0	0	0
Native Wetland	Marshes	1,007	0	1,335	60	2,282	1,351	1,411	931
	Cypress	141	0	1,270	22	1,389	822	844	567
	Prairies and Bogs	708	0	1,152	64	1,796	1,063	1,127	733
	Freshwater Forested Wetlands	110	0	662	8	764	452	460	312
	Isolated Freshwater Swamp	168	0	173	15	326	193	208	133
	Wet Flatwoods	135	53	20	10	198	117	127	81
	Cypress/Tupelo	142	0	262	20	384	228	248	157
	Isolated Freshwater Marsh	9	536	102	0	648	384	384	264
	Strand Swamp	0	1	14	0	15	9	9	6
	Other Hardwood Wetlands	4	0	53	0	57	34	34	23
	Dome Swamp	0	37	0	0	37	22	22	15
	Hydric Hammock	0	2	0	0	2	1	1	1
	Freshwater non-Forested Wetlands	6	0	0	0	6	3	3	2
	Other Coniferous Wetlands	11	0	0	0	11	6	6	4
Native Upland	Mesic Flatwoods	938	0	314	36	1,216	720	756	496
	Mixed Hardwood-Coniferous	240	0	165	0	405	240	240	165
	Mesic Hammock	417	16	167	1	600	355	356	245
	Shrub and Brushland	207	0	88	56	239	141	197	97
	Palmetto Prairie	1	0	0	0	1	1	1	1
	Scrubby Flatwoods	0	0	0	0	0	0	0	0
	Scrub	0	0	0	0	0	0	0	0
Other	Rural (Rural Open Lands)	1,415	0	1,153	124	2,444	1,447	1,571	997
	Exotic Plants	292	0	59	72	279	165	237	114
	Fallow Orchards	0	0	102	0	102	60	60	42
	Extractive	0	0	34	0	34	20	20	14
	Cultural - Terrestrial	0	0	15	0	15	9	9	6
	Bare Soil/Clear Cut	0	0	0	0	0	0	0	0
SUBTOTAL		43,376	2,427	18,954	4,011	60,746	35,962	39,973	24,784
Existing Development	Low Intensity Urban	179	0	303	31				
	Transportation	105	4	200	30				
	High Intensity Urban	33	0	48	0				
	Utilities	1	0	0	0				
	Communication	3	0	0	0				
Open Water	Cultural - Lacustrine	45	0	419	2				
	Cultural - Riverine	25	0	42	0				
	Lacustrine	0	0	75	0				
	Natural Lakes and Ponds	0	0	6	0				
SUBTOTAL		391	4	1,093	63				
COLUMN TOTAL		43,767	2,431	20,047	4,074				

1355
1356

1357 **Table 2-4.** Example of the Reasonable Maximum Impact method for attributing up to 39,973
 1358 acres of development among cover classes in some species-specific effects analyses. This
 1359 example is for a hypothetical species associated with a mix of agricultural and native
 1360 upland cover classes, which are ranked in order of importance to the species. The right-
 1361 most column tallies the cumulative acreage of potential development in rank order. We
 1362 would not attribute full development to the 11th ranked cover class in this example,
 1363 because its acreage in the development envelope, plus that of the higher-ranked classes,
 1364 exceeds the 39,973-acre cap by 16,167 acres.
 1365

COOPERATIVE LAND COVER CLASS	DEVELOP- MENT & MINING	BASE ZONING	ELIGIBLE LANDS	TOTAL	RANK	CUMULATIVE CONTRIBUTION TO DEVELOPMENT CAP
Improved Pasture	4,393	1,082	1,546	7,021	1	7,021
Palmetto Prairie	1	0	0	1	2	7,023
Scrubby Flatwoods	0	0	0	0	3	7,023
Mesic Flatwoods	938	0	314	1,252	4	8,275
Shrub and Brushland	207	0	88	295	5	8,570
Mixed Hardwood-Coniferous	240	0	165	405	6	8,975
Mesic Hammock	417	16	167	601	7	9,575
Scrub	0	0	0	0	8	9,575
Rural (Rural Open Lands)	1,415	0	1,153	2,568	9	12,143
Cropland/Pasture	14,549	698	2,496	17,743	10	29,886
Orchards/Groves	18,482	0	7,772	26,254	11	39,973
ALL OTHER CLASSES	3,125	634	6,346	10,105		
COLUMN TOTAL	43,767	2,431	20,047	66,245		

1366
 1367

Table 2-5. Phases, activities, sub-activities, and stressors associated with development activity under the HCP (source: HCP Appendix A).

PHASE	ACTIVITY	SUB-ACTIVITY	STRESSOR(S)
Pre-construction	Listed species surveys	Pedestrian transects ATV/ORV surveys	Disturbance; noise Disturbance; noise
	Land surveying	Pedestrian transects ATV/ORV vehicle use	Disturbance; noise Disturbance; noise
	Geotechnical investigations	Small drill rig driving Small drill rig operation	Disturbance; noise Disturbance; noise; fuel/oil
Construction (horizontal)	Land/vegetation clearing	Row crop "clearing" Citrus clearing Pasture clearing Native herbaceous clearing Native forested clearing Exotic vegetation clearing Vegetation piling/burning	No replanting; disturbance; noise Habitat loss; disturbance; noise Habitat loss; disturbance; noise Habitat loss; disturbance; noise Habitat loss; disturbance; noise Disturbance; noise Disturbance; noise; smoke
	Earth moving/grading	Excavation Bulldozing Grading Compacting Sedimentation control berms Sedimentation control fencing	Noise; human disturbance Noise; human disturbance Noise; human disturbance Noise; human disturbance Noise; human disturbance Noise; human disturbance
	Dewatering	Excavation (receiving reservoir) Construction excavation Pumping	Noise; human disturbance Noise; human disturbance Noise; human disturbance
	General Construction	Small vehicle traffic Delivery trucks/vehicles Heavy equipment (cranes, etc.) Staging areas Fuel/oil storage Concrete batch plants Asphalt paving (parking)	Noise; human disturbance Noise; human disturbance Noise; humans; fuel/oil Noise; humans; fuel/oil Noise; humans; fuel/oil; odor Noise; humans; fuel/oil Noise; humans; fuel/oil
	Internal road construction	Road bed grading Road drainage grading Road bed compaction Road paving Bridges (wetland crossings)	Noise; humans; fuel/oil Noise; humans; fuel/oil Noise; humans; fuel/oil Noise; humans; fuel/oil Noise; humans
	Electrical utilities	High-voltage transmission lines Electrical substations Electrical distribution lines Underground electrical	Noise; human disturbance Noise; human disturbance Noise; human disturbance Noise; human disturbance
	Water and sewer utilities	Water supply wells Water treatment plants Water supply lines Sanitary sewer lines Stormwater sewers	Noise; humans; fuel/oil Noise; human disturbance Noise; human disturbance Noise; human disturbance Noise; human disturbance
Construction (vertical)	Building construction	Framing Interior construction Exterior construction	Noise; human disturbance Noise; human disturbance Noise; human disturbance
	Road lighting/signage	Streetlights, signals installation	Noise; human disturbance
	Recreational construction	Recreational fencing (fields) Recreational lighting install	Noise; human disturbance Noise; human disturbance

1372
1373
1374**Table 2-6.** Phases, activities, sub-activities, and stressors associated with mining activity under the HCP (source: HCP Appendix A).

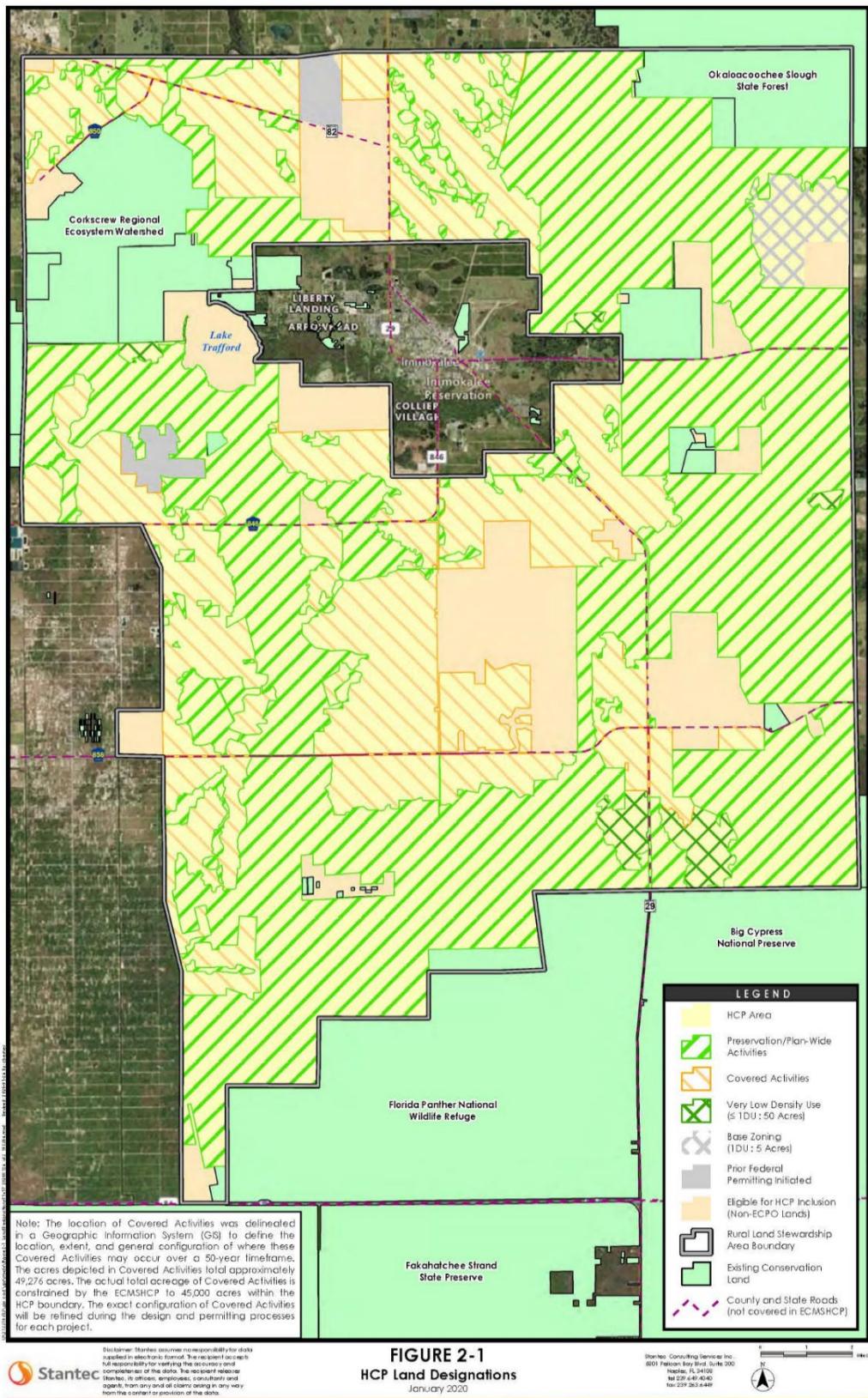
PHASE	ACTIVITY	SUB-ACTIVITY	STRESSOR(S)
Pre-construction	Listed species surveys	Pedestrian transects	Disturbance; noise
		ATV/ORV surveys	Disturbance; noise
	Land surveying	Pedestrian transects	Disturbance; noise
		ATV/ORV vehicle use	Disturbance; noise
	Geotechnical investigations	Drill rig driving	Disturbance; noise
		Drill rig operation	Disturbance; noise; fuel/oil
Mining	Land/vegetation clearing	Row crop "clearing"	No replanting; disturbance; noise
		Citrus clearing	Habitat loss; disturbance; noise
		Pasture clearing	Habitat loss; disturbance; noise
		Native herbaceous clearing	Habitat loss; disturbance; noise
		Native forested clearing	Habitat loss; disturbance; noise
		Exotic vegetation clearing	Disturbance; noise
	Earth materials excavation	Vegetation piling/burning	Disturbance; noise; smoke
		Use of explosives (if necessary)	Noise (sudden)
		Excavation	Noise; human disturbance
		De-watering/pumping	Noise; human disturbance
		Onsite hauling	Noise; human disturbance
		Stockpiling	Noise; human disturbance
	Processing plant construction	Sedimentation control berms	Noise; human disturbance
		Sedimentation control fencing	Noise; human disturbance
		Heavy equipment (cranes, etc.)	Noise; humans; fuel/oil
		Delivery trucks/vehicles	Noise; humans
		Staging areas	Noise; humans; fuel/oil
		Small vehicle traffic	Noise; humans
	Internal mine road construction	Fuel/oil storage	Noise; humans; fuel/oil; odor
		Road bed grading	Noise; humans; fuel/oil
		Road drainage grading	Noise; humans; fuel/oil
		Road bed compaction	Noise; humans; fuel/oil
		Paving	Noise; humans; fuel/oil
	Electrical utilities	Bridges (wetland crossings)	Noise; humans
		High-voltage transmission lines	Noise; human disturbance
		Electrical substation	Noise; human disturbance
		Electrical distribution lines	Noise; human disturbance
Conversion to Development	Earth moving/grading	Excavation	Noise; human disturbance
		Bulldozing	Noise; human disturbance
		Grading	Noise; human disturbance
		Compacting	Noise; human disturbance
		Sedimentation control berms	Noise; human disturbance
	Construction	See Table 2-3	
Reclamation activities	Earth moving/grading	Grading	Noise; human disturbance
		Redistribute soils	Noise; human disturbance
	Revegetate per reclamation plan	Planting	Noise; human disturbance
	Post-reclamation monitoring	Onsite monitoring per plan	Human disturbance

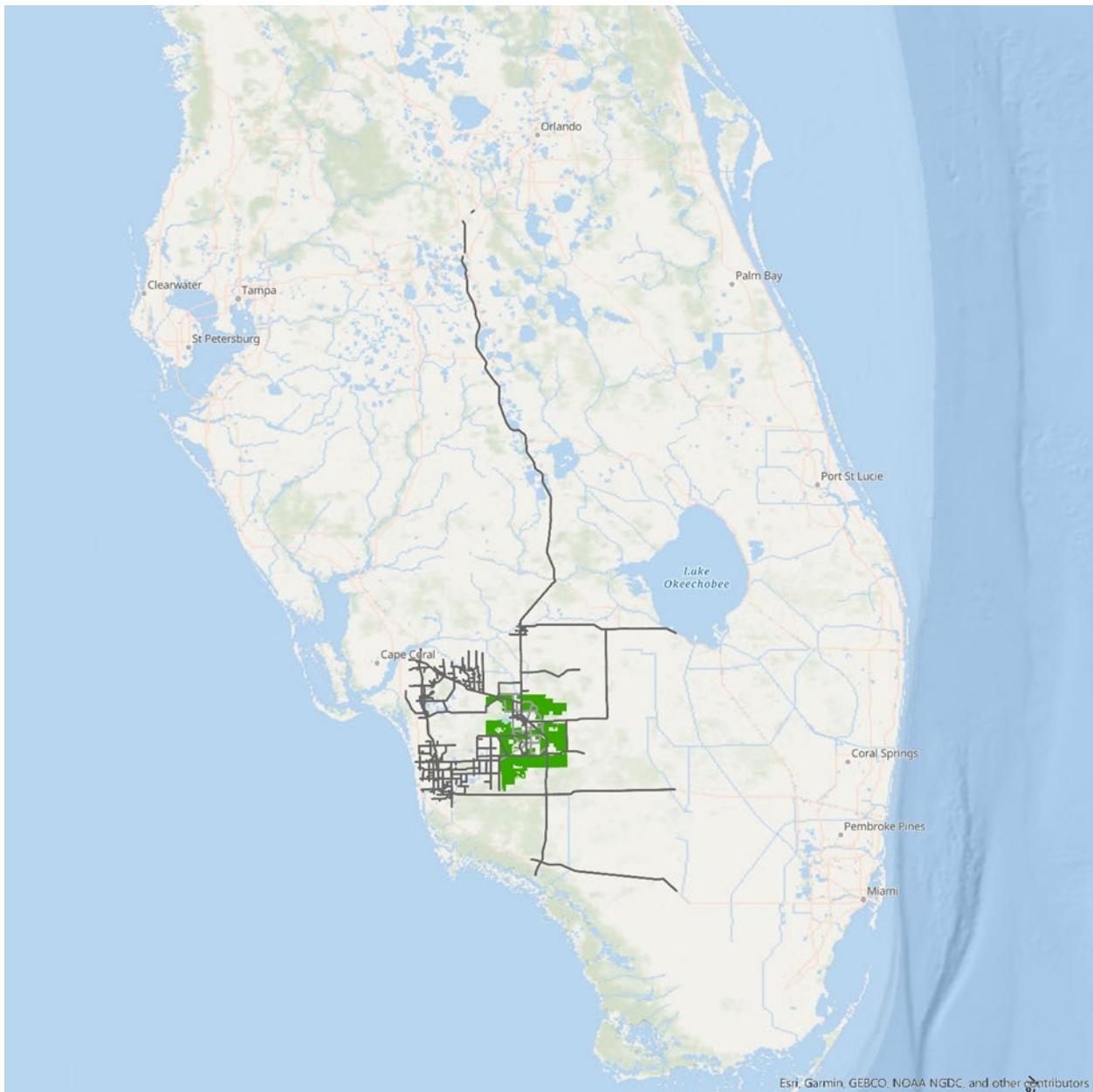
1375
1376

1377 **Table 2-7.** Calculations for prorating the distribution of up to 10% clearing of native land cover
 1378 in the Very Low Density use areas, which we show as a conversion to Rural Structures.
 1379

GENERAL CATEGORY	COOPERATIVE LAND COVER CLASS	Existing Acres	Acres following up to 10% clearing	Acres Cleared
Agriculture	Improved Pasture	501.8	501.8	
Native	Marshes	123.9	111.5	12.4
Wetland	Cypress	17.4	15.7	1.7
	Prairies and Bogs	97.6	87.8	9.8
	Freshwater Forested Wetlands	357.2	321.5	35.7
	Isolated Freshwater Swamp	40.4	36.4	4.0
	Wet Flatwoods	3.2	2.9	0.3
	Cypress/Tupelo	69.7	62.7	7.0
	Isolated Freshwater Marsh	1.7	1.5	0.2
	Other Hardwood Wetlands	22.1	19.9	2.2
Native	Mesic Flatwoods	112.3	101.0	11.2
Upland	Mixed Hardwood-Coniferous	135.0	121.5	13.5
	Mesic Hammock	61.4	55.2	6.1
	Shrub and Brushland	138.0	124.2	13.8
Other	Rural (Rural Open Lands)	240.9	240.9	
	Rural Structures	0.0	118.0	
	Exotic Plants	1.9	1.9	
	Extractive	61.2	61.2	
Existing Development	Transportation	13.8	13.8	
Open Water	Cultural - Lacustrine	657.1	657.1	
	Lacustrine	9.3	9.3	
	Natural Lakes and Ponds	1.2	1.2	
	COLUMN TOTAL	2,667.0	2,667.0	118.0

1380
 1381





1384

1385

1386 **Figure 2-2.** Extent of the Action Area for this consultation, which includes:

1387 1. the 159,489-acre Plan Area (green); and
1388 2. 5,072 discrete road segments through and extending beyond the Plan Area (black).
1389 Together the road segments equal 1,825 mi.

1390

1391

1392 **3. TRAFFIC MODELING**

1393

1394 In this BO we use estimates of traffic change to delineate the action area, as a component of our
1395 analysis of barrier effects to species movement, and the risk of wildlife/vehicle collisions. It is
1396 logical and intuitive that commercial and residential development in the Plan Area will produce a

1397 quantifiable increase in traffic, and this increased traffic would affect species movement and
1398 wildlife/vehicle collisions throughout the Action Area. However, we note in advance there are
1399 sources of uncertainty in our analysis and we did not rely solely on estimates of changes in
1400 traffic volume or road use in determining effects to panthers that may result from implementation
1401 of the HCP.

1402
1403 Specifically, traffic models and our subsequent analysis of roadway mortality influenced by
1404 traffic volume only include the central tendency of a measure to produce a simulated result.
1405 Where this is the case, models used to analyze Effects of the Action for individual species should
1406 be treated as deterministic in nature. We caution the reader to treat reported estimates produced
1407 by such models as “averages” with the recognition that true present or future values may be more
1408 or less than is estimated and reported, even when the body of text doesn’t otherwise explicitly
1409 state this.

1410
1411 In this chapter we introduce the traffic modeling we used to delineate the action area. Vehicle
1412 mortality and panther population viability are found in chapter 5 addressing the panther.

1413
1414 For example, a traffic model such as that described in this BO, may use average “daily trips per
1415 household” as an input to the simulation of future traffic volume on a roadway. However, this
1416 average is usually derived from a sampling of households in the area or an area analogous to it.
1417 As is often the case in any study sampling bias, sample size, and assumptions made when the
1418 data were collected can and do influence the accuracy of the average to represent the whole.
1419 Thus, there’s a chance the true number of “daily trips per household” in present or future
1420 communities are, or will be, greater or less than the average used as an input, or produced as the
1421 output of, the simulation. Other inputs to the traffic model are similarly derived, such as the
1422 average number of people per dwelling and the average number of dwellings per acre.

1423
1424 Baseline traffic volumes used as the foundation for estimating the volume of future traffic
1425 attributable to the actions of the Applicants are generated from a 5-year average of traffic volume
1426 observed on area roadways. Like all averages, though, it is possible the actual value for traffic
1427 volume on a given roadway, in a given year, may be more or less than the average computed.
1428 Were the true value to be more or less than the average assigned to a roadway it is possible the
1429 true future traffic volume for that road segment will be similarly more or less than we’ve
1430 estimated, and that the amount of traffic caused by the developments proposed by the Applicants
1431 will vary, similarly.

1432
1433 Likewise, baseline values for roadway mortality of individual species represent the 5-year
1434 average of mortality observed on a given road segment. As noted above true future roadway
1435 mortality estimated for that road segment will likely be more or less than we’ve estimated based
1436 on averages.

1437
1438 In addition to the relationship between traffic volume and wildlife/vehicle collisions, there are
1439 other sources of uncertainty. For example, wildlife/vehicle collisions could increase or decrease
1440 because of changes in the number of animals, the number of cars, or both. Another source of
1441 uncertainty is on a less travelled roadway, the likelihood an individual wildlife/collision will be
1442 detected and reported may be lower. On the other hand, on a busier roadway, the probability a

1443 wildlife/vehicle collision being detected and reported may be higher. This disparity in detection
1444 and reporting can make less travelled roads look safer and more travelled roads appear more
1445 dangerous than they are. Lastly, the presence of habitat that brings wildlife close to roadways
1446 may change over time, and the configuration and condition of habitat near roadways is difficult
1447 to predict far into the future.

1448
1449 Our analyses represents the likely effects of traffic volume on wildlife and the sources of
1450 uncertainty inherent to modeling affect all scenarios equally. The possible effects of different
1451 traffic volumes and sources of traffic volume due to the implementation of the HCP and how
1452 those changes might influence the risk of wildlife/vehicle collisions, is discussed in more detail
1453 in the appropriate species' chapters of this BO.

1454
1455 **3.1 Traffic Analyses**
1456
1457 As a part of our study of the effected environment in the Environmental Impact Statement for
1458 this proposed HCP, we contracted with a private biological consulting firm to simulate future
1459 traffic volume and distribution if development proposed in the HCP is implemented. Because
1460 this product was readily available, as a component of our analysis, we incorporated the model
1461 output into our description of the Action Area and Effects of the Action, where appropriate. A
1462 detailed description of the traffic model and a summary of the outputs are included in
1463 Appendices B.1 and B.2 of this BO. **Likely impacts** of traffic volume to individual species via
1464 wildlife/vehicle collisions and barrier effects are reported in the appropriate, respective species
1465 chapters of this BO.

1466
1467 To estimate the changes in traffic volume caused by activities proposed in the HCP we altered
1468 the base-year socioeconomic data for Florida Department of Transportation (FDOT) District 1
1469 Regional Planning Model (D1RPM) to reflect development proposed in the HCP. We based this
1470 simulation on the Applicants' description of the Proposed Action in the HCP. Specifically, we
1471 assumed such metrics as future housing density, number of people per dwelling, employment,
1472 and daily vehicle trips per household would be similar to what is currently exists in the Town of
1473 Ave Maria.

1474
1475 Based on these inputs, the model estimated development proposed in the HCP would generate
1476 about 72,200 residential units and 21,300 jobs. The results of our model also indicated the
1477 combination of residences and businesses proposed in the HCP will in turn generate an
1478 approximate Annual Aveage Daily Traffic (AADT) of 1,157,139 trips/day, to and from the Plan
1479 Area, on existing roadways. This is more than 3 times the traffic volume observed on the same
1480 roadways in 2017 (AADT = 330,813 trips/day).

1481
1482 We then used these data to identify the Action Area for this project. To do so we subtracted the
1483 2017 baseline traffic volume and future projected trips that did not begin or end in the Plan Area
1484 from the HCP simulation. We then filtered road segments based on a threshold of gain or loss of
1485 100 vehicle trips per day relative to 2017 to identify road segments on which meaningful effects
1486 are reasonably certain to occur (based on Charry and Jones (2009)). Of the 65,265 road segments
1487 described in the D1RPM, 5,072 segments met the 100 AADT, or larger, traffic volume change

1488 threshold for inclusion in the Action Area (Table 3-1). Figure 2-2, which we referenced in
1489 section 2.1 (“Action Area”), is a map showing the 5,072 road segments that meet these criteria
1490 (see D1RPM 2040 attribute table in the Service’s public-facing administrative record repository:
1491 <https://ecos.fws.gov/ServCat/Reference/Profile/111968>).

1492
1493 The full geospatial data representation of the FDOT 2040 D1RPM road segment volume
1494 predictions, including a table of the road segment attributes, can be downloaded from the
1495 following internet location in the Service’s public-facing administrative record repository:
1496 <https://ecos.fws.gov/ServCat/Reference/Profile/111968>. This geospatial data can be viewed in Esri
1497 ArcMap-compatible applications. The FDOT 2040 D1RPM road segments are also viewable on
1498 computers and smart phones, via Esri’s Arc GIS Online web mapping service, at the following
1499 internet location:
1500 <https://fws.maps.arcgis.com/apps/webappviewer/index.html?id=66e4a31663c54ca9b9f6591f4b8b8683>

1501
1502 Other important considerations influence the actual impacts of the proposed action. Methods of
1503 limiting increases in actual traffic volume are included in the HCP such as “capturing” traffic
1504 within developed areas by providing amenities and necessities within developed areas to reduce
1505 the need for residents to travel on external roadways. Further, traffic impacts to wildlife may be
1506 reduced by constructing wildlife crossings on new roads as a component of HCP
1507 implementation including contributions to the Mainelli Fund.

1508
1509 **Table 3-1.** Summary table of the number and total distance of D1RPM road segments included
1510 in the Action Area.

D1RPM segments	Number of segments	Total distance in miles
Non-Action Area	60,193	20,185
Action Area	5,072	1,835
Grand Total	65,265	22,020

1511
1512
1513
1514 **4. Florida Bonneted Bat**

1515
1516 This section provides the Service’s biological opinion of the Action for the Florida bonneted bat
1517 (FBB) in sections 4.1 through 4.5 and the Service’s conference opinion of the Action for the
1518 Florida bonneted bat proposed critical habitat in sections 4.6 through 4.10.

1519
1520 **4.1 Status of Florida Bonneted Bat**

1521
1522 This section summarizes best available data about the biology and current condition of the FBB
1523 (*Eumops floridanus*) throughout its range that are relevant to formulating an opinion about the
1524 Action. The Service published its decision to list the FBB as endangered on October 3, 2013 (78
1525 FR 61004). Please refer to the final rule for additional information about the status of the FBB.

1526
1527 **4.1.1 Species Description**

1529 The FBB is a member of the Molossidae (free-tailed bats) family within the order Chiroptera,
1530 and is the largest bat in Florida. The common name “bonneted bat” refers to the species’ large
1531 broad ears, which project forward over the eyes, and join at the midline of the head. Wings of the
1532 members of the genus *Eumops* are among the narrowest of all molossids and are well-adapted for
1533 rapid, prolonged flight (Freeman 1981). The FBB’s fur is short and glossy, with hairs sharply
1534 bicolored with a white base (Timm and Genoways 2004). Primary pelage color is highly
1535 variable, from black to brown to brownish-gray or cinnamon brown with ventral pelage paler
1536 than dorsal (Timm and Genoways 2004).

1537 4.1.2 Life History

1539 The FBB does not seasonally hibernate or enter short-term periods of torpor. Active year-round,
1540 the species is likely dependent upon a constant food supply to maintain its high metabolism.
1541 FBBs feed on flying insects of the following orders: Coleoptera (beetles), Diptera (true flies),
1542 Hemiptera (true bugs), and Lepidoptera (moths) (Belwood 1981; Belwood 1992; Marks 2013).
1543 Foraging in open spaces, the FBB uses echolocation to detect prey at relatively long range,
1544 roughly 10–16 ft (Belwood 1992). Individuals leave roosts to forage after dark, seldom occur
1545 below 33 ft in the air, and produce loud, audible calls when flying (Belwood 1992; Best *et al.*
1546 1997; Marks and Marks 2008a).

1547 Like other molossids, the FBB is capable of low-energy, swift, long-distance travel from roost
1548 site to foraging areas (Norberg and Rayner 1987). Data from a few satellite tagged FBB
1549 indicated that individuals foraged several mi (maximum 24 mi) from their roosts and covered
1550 long distances in one night (maximum 56 mi) (Ober 2016; E. Webb, pers. comm. 2018a-b).

1551 Habitat for the FBB consists of foraging areas and roosting sites, both of which may occur in a
1552 broad array of land cover types. Researchers have recorded echolocation calls in the following
1553 land cover types:

- 1554 • pine flatwoods, including wet, mesic, and scrubby flatwoods, and pine rocklands
1555 (Belwood 1981; Arwood 2012, F. Ridgley, pers. comm. 2013a–d; 2014a–c);
- 1556 • freshwater forested wetlands, including cypress, mangrove, and other swamps (Smith
1557 2010; Arwood 2012);
- 1558 • mesic and rockland hardwood hammocks (Smith 2010);
- 1559 • lakes, ponds, rivers, and canals (Marks and Marks 2008b);
- 1560 • rural and agriculture lands, including groves, tropical gardens, crop-based agriculture
1561 (Bailey *et al.* 2017);
- 1562 • urban landscapes, including residential areas, disturbed nonnative areas, and developed
1563 park lands (S. Snow, pers. comm. 2011a–b; Timm and Genoways 2004; Gore *et al.*
1564 2015).

1565 Bailey *et al.* (2017) detected FBB in all major land cover types surveyed by acoustic methods
1566 (agriculture, developed, upland, and wetland). This study developed occupancy models to
1567 explain the influence of various environmental factors on FBB detection rates. The researchers
1568 found that the extent of developed areas at acoustic monitoring locations had the largest effect on
1569 bat occupancy probabilities among the variables tested, with occupancy probability decreasing
1570 with increasing amount of developed land. Agriculture had a positive effect on occupancy, with
1571

1575 occupancy increasing with the amount of crop-based agriculture. This study found that FBB did
1576 not make preferential use of pine forests.

1577
1578 Female bats rear flightless young in their day roosts, which provide protection from predators
1579 (Marks and Marks 2008b). For most bats, the availability of suitable roosts is an important and
1580 limiting factor (Humphrey 1975). FBBs roost in various sheltered situations well above the
1581 ground; therefore natural roosting habitat may include any area with tall live or dead trees
1582 (snags) that have cavities, hollows, deformities, decay, crevices, or loose bark. FBB will also use
1583 artificial structures for roosts, such as bat houses, utility poles, and buildings. Bat houses
1584 typically support small numbers of FBB, but emergence counts at two houses sharing a single
1585 pole detected 44 individuals (J. Myers, pers. comm. 2014a, 2014c).

1586
1587 Natural FBB roosts are difficult to locate. At this time, we are aware of only 19 natural roost
1588 sites. At these sites, FBBs roost singly or in colonies consisting of a male and several females
1589 (sometimes called a harem in the literature), in live or dead pines, cypress, and palms (Belwood
1590 1992; R. Arwood, pers. comm. 2015; Ober et al. 2018). Ober et al. (2017) suggest that FBB
1591 colony sizes are generally small, so that males can successfully defend them.

1592
1593 At a roost located on the Florida Panther National Wildlife Refuge, which is adjacent to the Plan
1594 Area, Braun de Torrez et al. (2016) counted 12 FBB during evening emergence counts, but
1595 suspected that others remained in the cavity. Ober et al. (2017) investigated the social
1596 organization of FBBs roosting in bat houses in southwest Florida. The average roost size was 10
1597 individuals, with a persistent (multiple seasons) harem social structure (1 male, multiple
1598 females).

1599
1600 The maternity season for most bat species in Florida occurs from mid-April through mid-August
1601 (Marks and Marks 2008a). The FBB is a subtropical species, and available data suggest the
1602 species is polyestrous (having more than one period of estrous in a year) (Timm and Genoways
1603 2004; Florida Bat Conservancy 2005; Ober et al. 2017). Energy demands on females increase
1604 during the maternity season, as females make multiple foraging excursions to support lactation
1605 (Kurta et al. 1989; Kurta et al. 1990; Kunz et al. 1995; Marks and Marks 2008a; H. Ober, pers.
1606 comm. 2014a). Observations of pregnant and post-lactating females in late August suggest a
1607 longer maternity season for FBB compared to other Florida bats (H. Ober, pers. comm. 2014b; J.
1608 Myers, pers. comm. 2014a–c). Reduced insect populations in urban areas may make it difficult
1609 for females to successfully rear offspring in urban areas (Kurta et al. 1990; Kurta and Teramino
1610 1992).

1611
1612 The FBB has low fecundity with a litter size of one pup annually (Florida Bat Conservancy
1613 2005; Timm and Arroyo-Cabral 2008). Wilkinson and South (2002) suggest a lifespan of 10–
1614 20 years for bats the size of FBBs, and Gore et al. (2010) estimate an average FBB generation
1615 time of 5–10 years. The FBB is not migratory, but may seasonally shift roosting sites and
1616 foraging areas (Timm and Genoways 2004; FWC, pers. comm. 2018).

1617
1618 **4.1.3 Numbers, Reproduction, and Distribution**

1620 Unlike most bat species, with ranges spanning several states or entire continents, the FBB occurs
1621 only within south and south-central Florida, which is one of the smallest distributions of any
1622 species of bat in the western hemisphere (Belwood 1992; Timm and Genoways 2004).

1623
1624 Numerous acoustic surveys for the FBB conducted in the past decade suggest that where the
1625 species is detected, abundance is low (Marks and Marks 2008a; 2012; FWC 2011a; FWC 2011b;
1626 Timm *in litt.* 2012). Bailey *et al.* (2017) conducted acoustic surveys for FBB in 15 of 16 Florida
1627 counties of “known or suspected” occurrence (no points surveyed in Monroe County). This study
1628 detected the species at 60 of 330 points monitored sunset to sunrise for several months in 2014
1629 and 2015. Using an occupancy model that explained detection probability as a function of
1630 environmental variables, this study estimated that FBB were likely present in > 20% of the 16-
1631 county, 18,401-mi² study area (>3,680 mi²). The local abundance of developed areas had the
1632 strongest effect among the environmental variables examined; occupancy probability decreased
1633 with increasing amount of developed land. Occupancy probability increased with increasing
1634 amount of crop-based agriculture in the local area. Figure 4-1 shows the results of the occupancy
1635 model.

1636
1637 NatureServe (2019) classifies the FBB as a G1 species, *i.e.*, critically imperiled globally due to
1638 extreme rarity (5 or fewer occurrences, or fewer than 1,000 individuals), or due to extreme
1639 vulnerability to extinction by natural or manmade factors. Based upon inferences from publicly
1640 available data, the 2016 IUCN Red List of Threatened Species list the species as “vulnerable”
1641 with a population size in the low hundreds to the low thousands (well below 10,000) (Solari
1642 2016). Some FBB researchers suggest a population size of less than 1,000 individuals (Marks
1643 and Marks 2008a; FWC 2011b; Marks and Marks 2012).

1644
1645 New information about the species’ range, roost colony sizes, and occurrence data (FWC and
1646 other sources, unpublished data) suggests that 1,000 individuals is likely an underestimate. The
1647 Service estimates the range-wide number of mature individuals at about 2,000 adults and the
1648 extent of occurrence at 8,734 km² (3,372 mi²), or an overall density of 0.6 FBB per mi² (Ziewitz
1649 2019).

1650
1651 **4.1.4 Conservation Needs and Threats**

1652
1653 Habitat loss

1654
1655 Due to the critical importance and limited availability of roost sites, the loss of forest habitat is
1656 considered a threat to the FBB (Belwood 1992; Timm and Arroyo-Cabralles 2008). Removing
1657 dead or live trees with cavities during forest management (*e.g.*, thinning, pruning), prescribed
1658 fire, exotic species treatment, or trail maintenance may inadvertently remove roost sites. Loss of
1659 an active roost, especially when occupied by pregnant or lactating females, can strongly affect a
1660 small local population with low fecundity (probably 1 pup per mature female annually).
1661 Accordingly, managing landscapes to supply suitable roosting sites is the species’ primary
1662 conservation need.

1663
1664 In urban areas, removing or modifying buildings or trees that provide roost sites may also harm
1665 FBB (Timm and Arroyo-Cabralles 2008). Robson (1989) lists routine landscaping, removing

1666 dead pine or royal palm trees, pruning or trimming trees (especially cabbage palms), sealing
1667 barrel-tile roof shingles with mortar, destroying abandoned buildings, and clearing native
1668 vegetation as potential causes of roost destruction.

1669

1670 Belwood (1992) stated that tree cavities were rare in southern Florida and that competition for
1671 available cavities from native wildlife (e.g., southern flying squirrel, red-headed woodpecker,
1672 corn snake) was intense. Competition for cavities has probably increased since 1992, due to a
1673 continued loss of cavity trees and a continued influx of non-native or introduced species, which
1674 also vie for limited cavities for roosting or nesting.

1675

1676 Pesticides and contaminants

1677

1678 The impacts of pesticides and other environmental contaminants on bats are largely unstudied,
1679 including the FBB. The FBB forages at dusk and after dark, and its range includes urban areas
1680 that receive airborne mosquito control treatments, where direct exposure to these pesticides or
1681 through consuming insects with pesticide residues is likely to occur. Likewise, the use of
1682 pesticides by homeowners and agricultural operators may also expose FBB to various chemicals
1683 directly or through diet. In addition to the possible harmful effects of pesticide exposure, Robson
1684 (1989) suggested that mosquito control programs are contributing to reduced food availability for
1685 the FBB. Although adverse effects to FBB resulting from direct and indirect chemical exposure
1686 are plausible, we have no data that estimates the impact to FBB numbers, reproduction, or
1687 distribution.

1688

1689 Extreme weather and climate change

1690

1691 This species is vulnerable to weather events such as extreme cold and hurricanes, which may
1692 increase in frequency as the climate changes. Members of the *Molossidae* family that inhabit the
1693 warmer temperate and subtropical zones incur much higher energetic costs for thermoregulation
1694 during cold weather events than those inhabiting northern regions (Arlettaz *et al.* 2000).

1695

1696 The high winds and falling trees of intense storms and hurricanes may directly kill FBB, destroy
1697 roost sites, expose individuals displaced from roost sites to predation following the storm, and
1698 reduce food availability (Timm and Genoways 2004; Marks and Marks 2008a; W. Kern, Jr. *in*
1699 *litt.* 2012; R. Timm, *in litt.* 2012). The hurricane season overlaps with the FBB's extended
1700 breeding season, which increases the likelihood of reduced recruitment as an additional impact of
1701 storms (Marks and Marks 2008a). However, storms of lesser intensity may also create new
1702 roosting opportunities, if dead or damaged trees remain on the landscape afterwards.

1703

1704 Sea level rise is expected to shrink habitat availability for many south Florida species (Saha *et al.*
1705 2011). Three subpopulations of the FBB occur in at-risk coastal locations (Gore *et al.* 2010).
1706 Within the species' range, low-lying areas in Collier, Lee, Miami-Dade, and Monroe Counties
1707 appear most vulnerable to inundation and saltwater intrusion.

1708

1709 4.1.5 Tables and Figures

1710

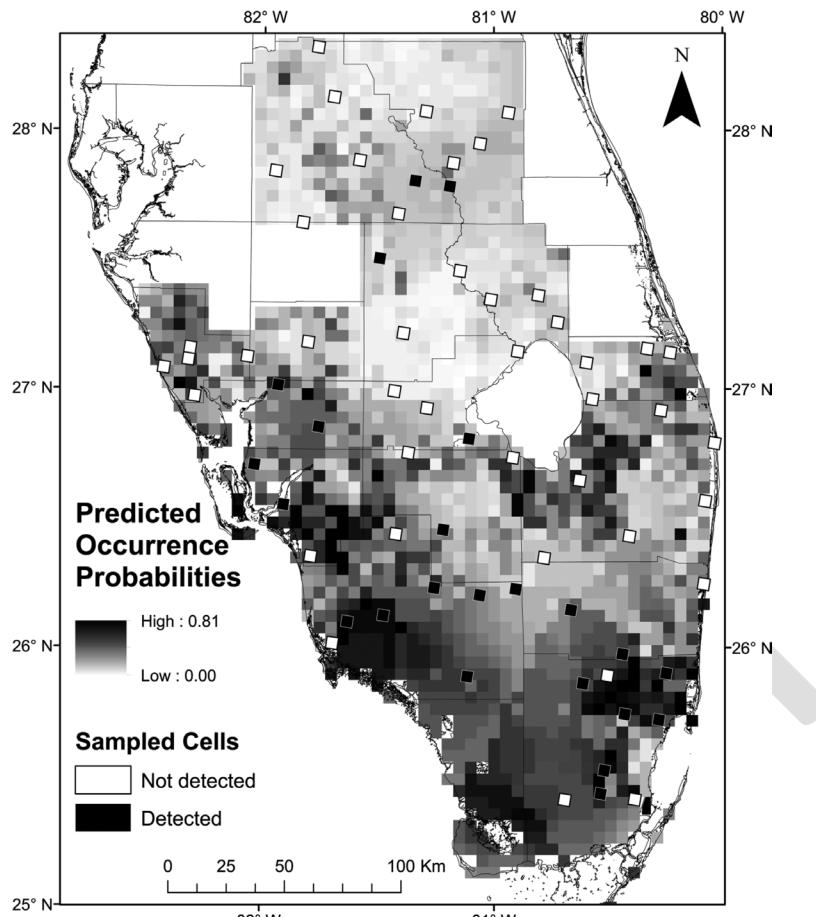


Figure 4-1. Map showing predicted probability of FBB occurrence in 16 Florida counties, and areas sampled by acoustic methods for FBB presence. Black- and white-outlined cells show where FBB were and were not detected, respectively. Source: Bailey *et al.* (2017).

4.2 Environmental Baseline for Florida Bonneted Bat

This section describes the current condition of the FBB in the Action Area without the consequences to the listed species caused by the proposed Action.

4.2.1 Action Area Numbers, Reproduction, and Distribution

All natural or vegetated land cover classes present in the Plan Area may support FBB foraging activity, including native uplands, wetlands, open waters, and agricultural areas (Table 2-1). Using our range-wide density estimate of 1 adult FBB per 1,079 acres (section 4.1.3), the 159,489-acre Plan Area would support about 148 adult FBB. Foraging may also occur in existing developed areas to some extent. Forested land cover types, both upland and wetland, are the most likely to support natural roost sites. We have no data about FFB roosts in bat houses or buildings in the Plan Area. The Plan Area contains approximately 41,763 acres of roosting habitat (Table 4-1), mostly (84.7%) within the designated Preservation Areas.

1734 The Applicants did not conduct FBB surveys of the Plan Area during the development of the
1735 HCP; however, individuals have been detected through acoustic monitoring within and
1736 immediately outside of the Plan Area. Available data includes 3 locations within the
1737 Development and Mining designation of the Plan Area and over 50 detections within 5 mi of the
1738 Plan Area (various sources, unpublished data). Nearby, the FBB is known to occur in the Florida
1739 Panther National Wildlife Refuge, Corkscrew Swamp, and Okaloacoochee Slough State Forest.
1740

1741 The model of Bailey et al. (2017) attributes a variable, but generally moderate, probability of
1742 occurrence to portions of the Plan Area based on an analysis of acoustic detections and habitat
1743 conditions (Figure 4-1). The acoustic monitoring station located within the Plan Area for this
1744 range-wide study did not detect FBBs. Known roost sites occur within 1 mi of the Plan Area
1745 (e.g., Braun de Torrez et al. 2016), but not within the Plan Area. Lacking data about roosts or
1746 other concentrations of FBB activity in the Plan Area, we attribute the same probability of
1747 occurrence to all areas of suitable habitat in the Plan Area.
1748

1749 FBB may roost singly or in harems of a single male and several females, and may shift roosts
1750 seasonally (section 4.1.2). Using a sex ratio of 1:1, the estimated Plan Area abundance of 148
1751 FBB would consist of 74 females. Using an average harem size of 1 male and 9 females (Ober et
1752 al. 2017), 74 adult females would occupy about 8–9 colonial roosts. Smaller colonies would use
1753 more roosts, and larger colonies would use fewer roosts. Roosting singly, 148 FBB could use up
1754 to 148 roosts at any given time, but this is unlikely, given the current understanding of the
1755 species' social organization.
1756

1757 **4.2.1 Action Area Conservation Needs and Threats**

1758
1759 We expect current threats to the species range-wide, such as loss of active roosts and roosting
1760 habitat, to increase with increased development in the Plan Area. Maintaining native wetland and
1761 upland forested habitats to provide roost sites, as well as vegetated and open water areas to
1762 provide foraging opportunities, is the species' primary conservation need in the Plan Area.
1763

1764
1765
1766
1767
1768

4.2.2 Tables and Figures

Table 4-1. Acreage of FBB roosting habitat within the Plan Area.

COOPERATIVE LAND COVER CLASS (Florida bonneted bat roosting habitat)	DEVELOPMENT	PRESERVATION	VERY LOW DENSITY	BASE ZONING	ELIGIBLE FOR INCLUSION	Plan Area Total
Cypress	141	11,550	17	0	1,270	12,978
Freshwater Forested Wetlands	110	4,094	357	0	662	5,224
Isolated Freshwater Swamp	168	3,681	40	0	173	4,063
Wet Flatwoods	135	2,300	3	53	20	2,512
Cypress/Tupelo	142	1,787	70	0	262	2,261
Strand Swamp	0	1,743	0	1	14	1,758
Other Hardwood Wetlands	4	437	22	0	53	516
Dome Swamp	0	279	0	37	0	317
Hydric Hammock	0	117	0	2	0	119
Other Coniferous Wetlands	11	13	0	0	0	24
Mesic Flatwoods	938	6,026	112	0	314	7,391
Mixed Hardwood-Coniferous	240	2,241	135	0	165	2,781
Mesic Hammock	417	1,129	61	16	167	1,791
Scrubby Flatwoods	0	29	0	0	0	29
COLUMN TOTAL	2,308	35,427	819	110	3,100	41,763
COLUMN PERCENT	5.5%	84.8%	2.0%	0.3%	7.4%	

1769
1770
1771

4.3 Effects of the Action on Florida Bonneted Bat

1772
1773

1774 This section describes all reasonably certain consequences to the FBB that we predict the
1775 proposed Action would cause, including the consequences of other activities not included in the
1776 proposed Action that would not occur but for the proposed Action. Such effects may occur later
1777 in time and may occur outside the immediate area involved in the Action.

1778
1779

4.3.1 Development and Mining, Base Zoning, and Lands Eligible for Inclusion

1780

1781 The designated Development and Mining, Base Zoning, and Lands Eligible for inclusion
1782 (collectively, the development envelope of the HCP) encompass 66,245 acres, or 42% of the
1783 Plan Area. The cap on total development within the development envelope is 39,973 acres, or
1784 25% of the Plan Area. We estimate Plan Area FBB numbers at about 148 adult FBBs (section
1785 4.2.1), and expect the development footprint to support about $0.25 \times 148 = 37$ adults.

1786
1787

1788 FBBs may forage in virtually all of the vegetated and open water cover classes of the Plan Area.
1789 FBB detections along Florida's east coast have declined as development has converted native
1790 and agricultural cover to residential/commercial uses (Gore 2010). FBB detection probability
1791 decreases with the local abundance of developed areas and increases with the local abundance of
1792 agricultural areas (Bailey *et al.* 2017; see section 4.1.3). Consistent with these observations, we
1793 expect that the conversion of vegetated land cover, both native and agricultural, to urban or
1794 mining uses would reduce FBB numbers in the Plan Area to some extent. However, the
1795 availability of suitable roosts is likely the key factor that limits FBB abundance on the landscape
(see section 4.1.4).

1796

1797 FBBs are most likely to find natural roost sites in the forested cover classes of the Plan Area,
1798 both upland and wetland. Table 4-2 shows our application of the “proportional method”
1799 described in section 2.1.4, which estimates that development of up to 39,973 acres within the
1800 development envelope would convert up to 3,316 acres of forested habitats to residential,
1801 commercial, or mining uses. The designated Development and Mining areas contain 2,357 acres
1802 of forested habitats, which is the maximum loss of forest cover that could occur if development
1803 is confined entirely to these areas (*i.e.*, no substitution of Base Zoning or Eligible lands in the
1804 development cap).

1805

1806 The loss of 2,357–3,316 acres of forest cover from the development envelope would reduce Plan
1807 Area forest cover by 5.6–7.9 percent. We expect Plan Area forests to support 8–9 colonial roost
1808 sites for a reproductive harem (1 male, multiple females) (section 4.2.1). The percentage loss of
1809 forest cover applied to 8 or 9 roost sites is less than 1, but conservatively, we estimate that 1
1810 maternity colony would occur in the development footprint. The loss of 2,357–3,316 acres of
1811 forest cover is more likely to remove solitary roosts and alternate roosts that individuals who are
1812 not part of a harem may use throughout the year.

1813

1814 The Applicants propose to follow the *Consultation Guidelines for the Florida Bonneted Bat*,
1815 which the Service has recently updated (USFWS 2019b). These guidelines recommend acoustic
1816 surveys, roost surveys, and various avoidance and minimization strategies. Application of these
1817 guidelines should avoid killing or injuring FBBs when surveys identify an active roost. However,
1818 locating a FBB roost is difficult, and we expect tree removal associated with the development
1819 activities to remove some active roosts. Such removal would kill or injure any non-volant pups in
1820 the roost and, at minimum, displace any adults present. Pregnant females displaced from an
1821 established roost are more likely to fail to reproduce that year, due to the diversion of foraging
1822 time to searches for an alternate roost suitable for birthing and rearing a pup.

1823

1824 Bats are vulnerable to predation by diurnal birds (*e.g.*, hawks and falcons). Mikula *et al.* (2016)
1825 estimated that the diurnal predation rate on bats is 100–1,000 times higher than the nocturnal
1826 predation rate when standardized relative to the duration of day versus night bat activity. The
1827 proportion of bats that actually survive fleeing diurnal disturbance at a roost site is
1828 undeterminable, but survival is more likely if alternative shelter is available nearby.

1829

1830 Using the average harem size of 1 adult male and 9 adult females (section 4.1.2), we expect that
1831 the removal of 1 active maternity roost would, at minimum, displace the adults and kill or injure
1832 9 pups. The predation rate of adult FBBs displaced by roost removal is undeterminable, but we
1833 believe most would survive. FBB are likely to occupy areas undergoing development until roosts
1834 are removed by construction activity; however, we believe FBBs are more likely to persist long-
1835 term in the native habitats of the Preservation and Very Low Density Development areas (see the
1836 following sections 4.3.2 and 4.3.3), where forest cover providing potential roosts is more
1837 abundant.

1838

1839 The use of pesticides and other chemicals within developed areas could reduce the prey available
1840 for bats and sicken or kill any FBBs that consume treated insects. The HCP does not provide
1841 information on the types of pesticides and other chemicals planned for use in the Development

1842 areas. We expect that mosquito and other chemical pest-control practices would occur with a
1843 frequency similar to other towns and cities in the region. Although pesticide use is a plausible
1844 threat to FBB in the Plan Area, we are unable to estimate the amount or extent of adverse effects
1845 such use may cause.

1846

1847 **4.3.2 Preservation Activities**

1848

1849 The Preservation Areas contain 56.5% of the land cover in the Plan Area (Table 2-2), virtually
1850 all of which may support foraging activity for the 148 FBBs we estimate occupy the Plan Area
1851 (section 4.2.1). The Preservation Areas contains 85% of the forest cover in the Plan Area (Table
1852 4-1), which we expect to support 85% of the roosts (solitary and group) in the Plan Area. We
1853 estimate the Plan Area supports 8–9 maternity roosts (section 4.2.1); therefore, the Preservation
1854 Areas likely contain 6–8 of these.

1855

1856 Covered Activities in the Preservation Areas include prescribed burning, mechanical control of
1857 groundcover, ditch and canal maintenance, mechanical and chemical control of exotic
1858 vegetation, soil tillage, cattle grazing, pesticide and herbicide applications, and other activities
1859 that maintain or improve land quality and agricultural uses. Conservation easements placed in
1860 these areas as other areas are developed would preclude future commercial and residential
1861 development and earth mining, but would allow a continuation of the existing agricultural land
1862 uses and other activities listed above.

1863

1864 Preservation Areas will serve as mitigation for most or all of the covered species. The HCP does
1865 not specify habitat restoration measures in its FBB conservation plan, however, the FBB is
1866 expected to benefit from habitat enhancement or restoration as mitigation proposed for several
1867 other covered species. In addition, Preservation Areas are probable sites for mitigation of
1868 wetland fill.

1869

1870 Fire can have short-term beneficial effects on FBB foraging (Braun de Torrez *et al.* 2018).
1871 However, prescribed fire can kill or injure FBB through heat or smoke inhalation, and damage or
1872 destroy active and potential roosts. To minimize FBB impacts, the Applicants propose to retain
1873 large cavity trees and snags and to implement the Ecological Land Management BMPs of the
1874 *Consultation Guidelines for the Florida Bonneted Bat* (USFWS 2019b) in the Preservation
1875 Areas. These BMPs include buffers for heavy equipment use, guidelines for prescribed fires, and
1876 other recommendations for conserving FBB roosting and foraging habitat. If properly applied,
1877 the BMPs should avoid, or limit to a discountable probability, FBB death or injury caused by
1878 these various land management activities.

1879

1880 Exposure to chemicals (*i.e.*, pesticides, rodenticides, insecticides, fungicides and/or herbicides)
1881 associated with agricultural uses could kill or sicken bats. The HCP does not provide specific
1882 information regarding the types of chemicals used or the frequency of use. Although pesticide
1883 use is a plausible threat to FBB in the Plan Area, we are unable to estimate the amount or extent
1884 of adverse effects such use may cause.

1885

1886 We do not expect the management of Preservation Areas to reduce the numbers, reproduction, or
1887 distribution of the FBB in the Preservation Areas, because these activities would, at minimum,

1888 maintain current conditions. Long-term management of the Preservation Areas could increase
1889 FBB densities and the Plan Area population, especially if mitigation for other covered species
1890 results in forest habitat enhancement and restoration. However, lacking more detailed
1891 information about FBB in the Plan Area and specific performance measures in the HCP for
1892 improving FBB habitat, we are unable to estimate the extent of potential benefits.
1893

1894 **4.3.3 Very Low Density Development**

1895
1896 The Very Low Density (VLD) use areas contain 1.7% of the land cover in the Plan Area (Table
1897 2-2), virtually all of which may support foraging activity for the estimated 148 FBBs that reside
1898 in the Plan Area. The VLD areas contain 2.0% of the forest cover in the Plan Area (Table 4-1),
1899 which we expect to support 2% of the roosts (solitary and group) for about 148 FBBs in the Plan
1900 Area. We estimate the Plan Area supports 8–9 maternity roosts (section 4.2.2); therefore, it is
1901 unlikely that the VLD areas contain a maternity roost.
1902

1903 Land uses in the VLD areas are similar to the Preservation Areas, but may also include isolated
1904 residences, lodges, and hunting/fishing camps, at a density of no more than one dwelling unit per
1905 50 acres. The Applicants would continue current ranching/livestock operations and other
1906 management activities as described for the Preservation Areas (e.g., exotic species control,
1907 prescribed burning). As in the Preservation Areas, we do not expect continuing the existing land
1908 management regimes to harm FBBs. The Applicants propose to follow the *Consultation*
1909 *Guidelines for the Florida Bonneted Bat* (USFWS 2019b), which include acoustic and roost
1910 surveys and avoidance and minimization strategies.
1911

1912 The HCP does not specify a footprint for the isolated residences, lodges, and hunting/fishing
1913 camps, but indicates that their construction could clear up to 10% of the existing native
1914 vegetation (see section 2.5). New dwelling development could occur within any of the cover
1915 types present besides open water and existing development. It is possible that dwelling
1916 development in the VLD areas could entirely avoid forested areas, but we conservatively
1917 estimate an 82-acre habitat loss (10% of these types, Table 2-7). We consider the probability that
1918 a FBB maternity roost occurs in the footprint of VLD residence development as discountable
1919 (the removal of 82 acres from 41,763 forest acres in the Plan Area that support 8–9 maternity
1920 roosts). The predation rate of adult FBBs displaced by removal of solitary or non-maternity
1921 roosts is undeterminable, but we believe that most would survive. In general, we expect a minor
1922 reduction in FBB roosting and foraging habitat in the VLD use area, but no harm that is
1923 reasonably certain to occur.
1924

1925 **4.3.4 Tables and Figures**

1926

1927 **Table 4-2.** Acreage of FBB roosting habitat within the development envelope of the Plan Area.

1928

COOPERATIVE LAND COVER CLASS (Florida bonneted bat roosting habitat)	DEVELOPMENT BASE ZONING		ELIGIBLE FOR INCLUSION	Development Envelope (Total)	Estimated Extent of Development
	DEVELOPMENT	BASE ZONING			
Cypress	141	0	1,270	1,411	844
Freshwater Forested Wetlands	110	0	662	772	460
Isolated Freshwater Swamp	168	0	173	341	208
Wet Flatwoods	135	53	20	208	127
Cypress/Tupelo	142	0	262	404	248
Strand Swamp	0	1	14	15	9
Other Hardwood Wetlands	4	0	53	57	34
Dome Swamp	0	37	0	37	22
Hydric Hammock	0	2	0	2	1
Other Coniferous Wetlands	11	0	0	11	6
Mesic Flatwoods	938	0	314	1,252	756
Mixed Hardwood-Coniferous	240	0	165	405	240
Mesic Hammock	417	16	167	601	356
Scrubby Flatwoods	0	0	0	0	0
COLUMN TOTAL	2,308		110	3,100	5,517
COLUMN PERCENT	41.8%		2.0%	56.2%	3,311

1929

1930 ¹ Prorated acreages according to the “proportional method” taken from column “G” of Table 2-3.

1931

1932

1933 **4.4 Cumulative Effects on Florida Bonneted Bat**

1934

1935

1936 For purposes of consultation under ESA §7, cumulative effects are those caused by future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future 1937 Federal actions that are unrelated to the proposed action are not considered, because they require 1938 separate consultation under §7 of the ESA.

1939

1940

1941 We identified in section 3 of this BO/CO a projected increase in traffic on public roads as the 1942 sole source of effects that are consistent with the definition of cumulative effects for this Action. 1943 FBB generally fly high (>33 ft) above the ground (see section 4.1.2), which minimizes the risk of 1944 collisions with vehicles. We have no information that vehicles are a predictable cause of FBB 1945 injury, mortality, or significant behavioral modification.

1946

1947

1948 **4.5 Conclusion for Florida Bonneted Bat**

1949

1950

1951

1952

1953 In this section, we summarize and interpret the findings of the previous sections for the FBB (status, baseline, effects, and cumulative effects) relative to the species-specific purpose of a BO under §7(a)(2) of the ESA, which is to determine whether the proposed action is likely to jeopardize the continued existence of a species.

1953 **Status**
1954
1955 The FBB is endemic to south and south-central Florida. In areas where the species is detected,
1956 abundance is generally low. The species forages in a wide range of habitat types, and roosts in
1957 the cavities/crevices of live and dead trees. FBBs also use artificial structures as roosts (*e.g.*, bat
1958 houses, buildings). Detection probability is negatively correlated with the local extent of
1959 developed (urban) land, but the species does occur in some urban areas. The Service currently
1960 estimates range-wide abundance of about 2,000 adults, an extent of occurrence of 3,372 mi², and
1961 an overall density of about 0.6 FBB per mi² (1 adult per 1,079 acres).
1962
1963 The loss of roost sites is the primary known threat to the FBB. Trees with features that provide
1964 suitable roosting conditions are limited, and competition with other species for available cavities
1965 is likely intense. Accordingly, managing landscapes to supply suitable roosting sites is the
1966 species' primary conservation need. In both urban and rural areas, FBB and their insect prey are
1967 exposed to various pesticides and contaminants, but the impacts of such exposure are unknown.
1968 The species is vulnerable to severe cold weather and storm events and to habitat loss resulting
1969 from sea-level rise associated with climate change.
1970
1971 **Baseline**
1972
1973 All vegetated and open-water land cover classes present in the Plan Area are potential foraging
1974 habitats for the FBB, and all forested cover classes, both upland and wetland, are potential
1975 roosting habitats. The Plan Area contains 41,763 acres of forested habitat. Acoustic monitoring
1976 has detected FBB within and immediately outside of the Plan Area. Documented roosts occur
1977 less than 1 mi from the Plan Area. Using the range-wide density of 1 adult FBB per 1,079 acres,
1978 we estimate FBB numbers in the Plan Area at about 148 adults. Using the average documented
1979 harem size of 1 male and 9 females, we estimate that the Plan Area contains 8–9 maternity
1980 colonies.
1981
1982 Threats to the FBB in the Plan Area include habitat loss, especially loss of roosting habitat, roost
1983 site competition from native and exotic species, and exposure to pesticides and other
1984 contaminants. Managing natural areas to supply suitable roosting sites is the species' primary
1985 conservation need in the Plan Area.
1986
1987 **Effects**
1988
1989 The loss of 2,357–3,311 acres of forest cover from the Development, Base Zoning, and Eligible
1990 lands (depending on the actual distribution of the development cap in these land use
1991 designations) would reduce the 41,763 acres of forest cover in the Plan Area by 5.6–7.9%. We
1992 expect the Plan Area forests to support 8–9 colonial roost sites. The expected loss is less than 1
1993 colonial roost, but conservatively, we estimate that 1 maternity colony would occur in the
1994 development footprint. The destruction of 1 active maternity roost would, at minimum, displace
1995 10 adults (average harem size) and kill or injure 9 pups, if present. The predation rate of adult
1996 FBBs displaced by roost removal is undeterminable, but we believe most would survive.
1997

1998 We do not expect the management of Preservation and VLD use areas to reduce the numbers,
1999 reproduction, or distribution of the FBB in these areas, because these activities would, at
2000 minimum, maintain current conditions. The applicants propose to retain large cavity trees and
2001 snags in the management of these areas. With the addition of specific actions that benefit the
2002 FBB, long-term management of these areas could increase FBB densities and the Plan Area
2003 population. We consider the probability that a FBB maternity roost occurs in the footprint of
2004 VLD residence development as discountable.

2005

Cumulative Effects

2006

2007 We have no information that suggests collisions with vehicles are a predictable cause of FBB
2008 injury, mortality, or significant behavioral modification.

2009

Opinion

2010

2011 The primary impact of the Action to the FBB is the possible removal of a maternity roost during
2012 construction activity. We expect this impact to occur only once, affecting the average number of
2013 pups and adults in a colony (9 pups and 10 adults). The implementation of the *Consultation*
2014 *Guidelines for the Florida Bonneted Bat* may avoid this impact. The death of all adults in a roost
2015 destroyed incidental to construction activities, which is not likely, would represent a 0.5%
2016 reduction in the estimated range-wide abundance of about 2,000 adults.

2017

2018 The conversion of land cover that provides foraging areas would add an increment to the overall
2019 impact of urbanization in the range of the FBB. The Action's increment of urbanization, 39,973
2020 acres (62.5 mi²) of new development, would represent a 1.9% reduction of the estimated range-
2021 wide FBB extent of occurrence (3,372 mi²).

2022

2023 We believe that most FBB individuals present during development activity are likely to survive
2024 displacement caused by a gradual loss of habitat in the Development areas, because suitable
2025 habitat would remain in the Preservation Areas and is available on adjacent conservation lands.
2026 Easements in the Preservation Areas executed as portions of the Development areas are
2027 converted from existing uses would protect both native habitats and agricultural lands from
2028 future development. The likely survival of most FBB affected by development activity and the
2029 assured continuation of existing habitat conditions in the Preservation Areas, which may improve
2030 under management and protection, supports an interpretation that the scale of the Action-caused
2031 reduction in numbers, reproduction, and distribution we predict does not appreciably reduce
2032 species' likelihood of survival and recovery.

2033

2034 After reviewing the current status of the species, the environmental baseline for the Action Area,
2035 the effects of the Action and the cumulative effects, it is the Service's biological opinion that the
2036 Action is not likely to jeopardize the continued existence of the FBB.

2037

4.6 Status of Florida Bonneted Bat Proposed Critical Habitat

2038

2039 This section summarizes best available data about the current condition of all units of proposed
2040 critical habitat (pCH) for the FBB that are relevant to formulating an opinion about the Action.

2044 The Service published its proposal to designate CH for the FBB on June 10, 2020 (85 FR 35510–
2045 35544).

2046 2047 **4.6.1 Description of Florida Bonneted Bat Critical Habitat Geographic Extent**

2049 Proposed CH for FBB is comprised of 1,478,333 acres in 4 separate units located in 10 Counties
2050 in Florida (Figure 4-2). A breakdown of units by counties is as follows:

- 2051 (1) Unit 1: Peace River and surrounding areas (Charlotte, DeSoto, Hardee, and Sarasota
2052 Counties);
- 2053 (2) Unit 2: Babcock-Webb WMA, Babcock Ranch, and surrounding areas (Charlotte,
2054 Lee, and Glades Counties);
- 2055 (3) Unit 3: Big Cypress and surrounding areas (Collier, Monroe, and Hendry Counties);
2056 and
- 2057 (4) Unit 4: Miami-Dade natural areas (Miami-Dade County).

2059 Table 4-3 lists these units and identifies the acreage of each that is under Federal, State, County,
2060 or private ownership.

2061 2062 **4.6.2 Physical and Biological Features**

2064 In this CO for FBB pCH, we use the term physical and biological features (PBFs) to label the
2065 key components of pCH that provide for the conservation of the FBB. Our pCH rule identified
2066 seven PBFs (85 FR 35510–35544):

- 2068 • Representative forest types (all age classes) that support the Florida bonneted bat by
2069 providing roosting and foraging habitat within its core areas (i.e., Polk, Charlotte, Lee,
2070 Collier, Monroe, and Miami-Dade Counties), including:
 - 2071 (a) Pine flatwoods;
 - 2072 (b) Scrubby pine flatwoods;
 - 2073 (c) Pine rocklands;
 - 2074 (d) Royal palm hammocks;
 - 2075 (e) Mixed or hardwood hammocks;
 - 2076 (f) Cypress;
 - 2077 (g) Mixed or hardwood wetlands;
 - 2078 (h) Mangroves (mature and pristine);
 - 2079 (i) Cabbage palms; and
 - 2080 (j) Sand pine scrub.
- 2081 (2) Habitat that provides for roosting and rearing of offspring; such habitat provides
2082 structural features for rest, digestion of food, social interaction, mating, rearing of young,
2083 protection from sunlight and adverse weather conditions, and cover to reduce predation
2084 risks for adults and young, and includes forest and other areas with tall or mature trees
2085 and other natural areas with suitable structures, which are generally characterized by:
 - 2086 (a) Tall or mature live or dead trees, tree snags, and trees with cavities, hollows,
2087 crevices, or loose bark, including, but not limited to, trees greater than 10 m (33 ft)
2088 in height, greater than 20 cm (8 in) diameter at breast height, with cavities greater
2089 than 5 m (16 ft) high off the ground;

2090 (b) High incidence of tall or mature live trees with various deformities (e.g., large
2091 cavities, hollows, broken tops, loose bark, and other evidence of decay);
2092 (c) Sufficient open space for Florida bonneted bats to fly; areas may include open or
2093 semi-open canopy, canopy gaps and edges, or above the canopy, which provide
2094 relatively uncluttered conditions; and/or
2095 (d) Rock crevices.

2096 (3) Habitat that provides for foraging, which may vary widely across the Florida bonneted
2097 bat's range, in accordance with ecological conditions, seasons, and disturbance regimes
2098 that influence vegetation structure and prey species distributions. Foraging habitat may
2099 be separate and relatively far distances from roosting habitat. Foraging habitat consists
2100 of:

2101 (a) Sources for drinking water and prey, including open fresh water and permanent or
2102 seasonal freshwater wetlands, in natural or rural areas (non-urban areas);
2103 (b) Wetland and upland forests, open freshwater wetlands, and wetland and upland
2104 shrub (which provide a prey base and suitable foraging conditions (i.e., open habitat
2105 structure));
2106 (c) Natural or semi-natural habitat patches in urban or residential areas that contribute to
2107 prey base and provide suitable foraging conditions (i.e., open habitat structure);
2108 and/or
2109 (d) The presence and abundance of the bat's prey (i.e., large, flying insects), in
2110 sufficient quantity, availability, and diversity necessary for reproduction,
2111 development, growth, and survival.

2112 (4) A dynamic disturbance regime (natural or artificial) (e.g., fire, hurricanes) that
2113 maintains and regenerates forested habitat, including plant communities, open habitat
2114 structure, and temporary gaps, which is conducive to promoting a continual supply of
2115 roosting sites, prey items, and suitable foraging conditions.

2116 (5) Large patches (more than 40,470 ha (100,000 ac)) of forest and associated natural or
2117 semi-natural habitat types that represent functional ecosystems with a reduced influence
2118 from humans (i.e., areas that shield the bat from human disturbance, artificial lighting,
2119 habitat loss and degradation).

2120 (6) Corridors, consisting of roosting and foraging habitat, that allow for population
2121 maintenance and expansion, dispersal, and connectivity among and between geographic
2122 areas for natural and adaptive movements, including those necessitated by climate
2123 change.

2124 (7) A subtropical climate that provides tolerable conditions for the species, such that normal
2125 behavior, successful reproduction, and rearing of offspring are possible.

2126 FBB pCH does not include human-made structures (such as buildings, aqueducts, runways,
2127 roads, and other paved areas) and the land on which they are located existing within the legal
2128 boundaries.

2129 All pCH units are occupied by the FBB. The Service determined that designating unoccupied
2130 units was not essential the conservation of the FBB.

2134 **4.6.3 Conservation Value of Florida Bonneted Bat Proposed Critical Habitat**

2135
2136 The PBFs of pCH listed in section 4.6.2. address the various aspects habitat that supports the
2137 FBB. Not all pCH units contain all seven PBFs. Each pCH unit was selected for its
2138 conservation value with respect the PBFs which it does contain.

2139
2140 Unit 1 contains five of the seven PBFs for the bonneted bat (*i.e.*, PBFs 2, 3, 4, 6, and 7). While
2141 this unit contains representative forest types that support the species by providing roosting and
2142 foraging habitat, it consists of area primarily outside of the bat's core areas (*i.e.*, does not possess
2143 all features described in PBF 1). Because of its relatively small size, this unit also does not
2144 possess all features described in PBF 5. However, Unit 1 encompasses a known movement
2145 corridor (generally connecting individuals between Unit 2 and Avon Park Air Force Range) and
2146 adds ecological diversity (a natural river corridor) to the overall proposed designated areas. In
2147 addition, the Peace River and adjacent forested lands maintain high habitat suitability, providing
2148 open water and likely abundant prey.

2149
2150 Unit 2 represents the westernmost portion of the species' core areas. This unit was occupied at
2151 the time of listing, is currently occupied, and contains all seven PBFs for the FBB. Babcock-
2152 Webb WMA and surrounding areas support the largest abundance known (approximately 79
2153 bonneted bats), and the bulk of all known roost sites (Myers, pers. comm. 2015; Gore, pers.
2154 comm. 2016; Ober, pers. comm. 2014; Braun de Torrez, pers. comm. 2016).

2155
2156 Unit 3 represents the southwestern portion of the species' core areas. The species has been
2157 documented to use many locations throughout the unit (specifically, within BCNP, PSSF,
2158 FSPSP, and FPNWR) (see table 1 of the final listing rule (78 FR 61004, October 2, 2013)). The
2159 discoveries of three natural roosts in 2015 and 2016 further demonstrate the relevance and
2160 importance of Unit 3. This unit contains all seven of the PBFs for the FBB.

2161
2162 Unit 4 represents the eastern portion of the species' core areas and includes the bulk of the
2163 remaining high-quality natural habitat in the species' former strongholds on the east coast
2164 (Belwood 1992, pp. 216–217, 219; Timm and Genoways 2004, p. 857; Timm and Arroyo-
2165 Cabrales 2008, p. 1; Solari 2016, pp. 1–2; see *Historical Distribution*, proposed listing rule (77
2166 FR 60750, October 4, 2012)). This area may be the last remaining predominantly natural
2167 occupied habitat on the east coast of Florida. This unit contains all seven of the PBFs for the
2168 FBB.

2169
2170 **4.6.4 Conservation Needs for Florida Bonneted Bat Proposed Critical Habitat**

2171
2172 The PBFs essential to the conservation of the Florida bonneted bat in Unit 1 may require special
2173 management considerations or protection due to the following: habitat loss, fragmentation, and
2174 degradation resulting from development (including oil and gas exploration) and land conversion;
2175 impacts from land management practices (e.g., timber management and fuels reduction,
2176 prescribed fire, management of nonnative and invasive species, habitat restoration) or lack of
2177 suitable habitat management; impacts from climate change and coastal squeeze; and pesticide
2178 use.

2180 The PBFs essential to the conservation of the Florida bonneted bat in Unit 2 may require special
2181 management considerations or protection due to the following: habitat loss, fragmentation, and
2182 degradation resulting from development (including oil and gas exploration) and land conversion;
2183 impacts from land management practices (e.g., timber management and fuels reduction,
2184 prescribed fire, management of nonnative and invasive species, habitat restoration) or lack of
2185 suitable habitat management; impacts from coastal squeeze; and pesticide use.
2186

2187 The PBFs essential to the conservation of the Florida bonneted bat in Unit 3 may require special
2188 management considerations or protection due to the following: habitat loss, fragmentation, and
2189 degradation resulting from development (including oil and gas exploration) and land conversion;
2190 impacts from land management practices (e.g., timber management and fuels reduction,
2191 prescribed fire, management of nonnative and invasive species, habitat restoration) or lack of
2192 suitable habitat management; impacts from climate change and coastal squeeze; and pesticide
2193 use.
2194

2195 The PBFs essential to the conservation of the Florida bonneted bat in Unit 4 may require special
2196 management considerations or protection due to the following: habitat loss, fragmentation, and
2197 degradation resulting from development and land conversion; impacts from land management
2198 practices (e.g., timber management and fuels reduction, prescribed fire, management of
2199 nonnative and invasive species, habitat restoration) or lack of suitable habitat management;
2200 impacts from climate change and coastal squeeze; and pesticide use.
2201

2202 **4.6.5 Tables and Figures**

2203

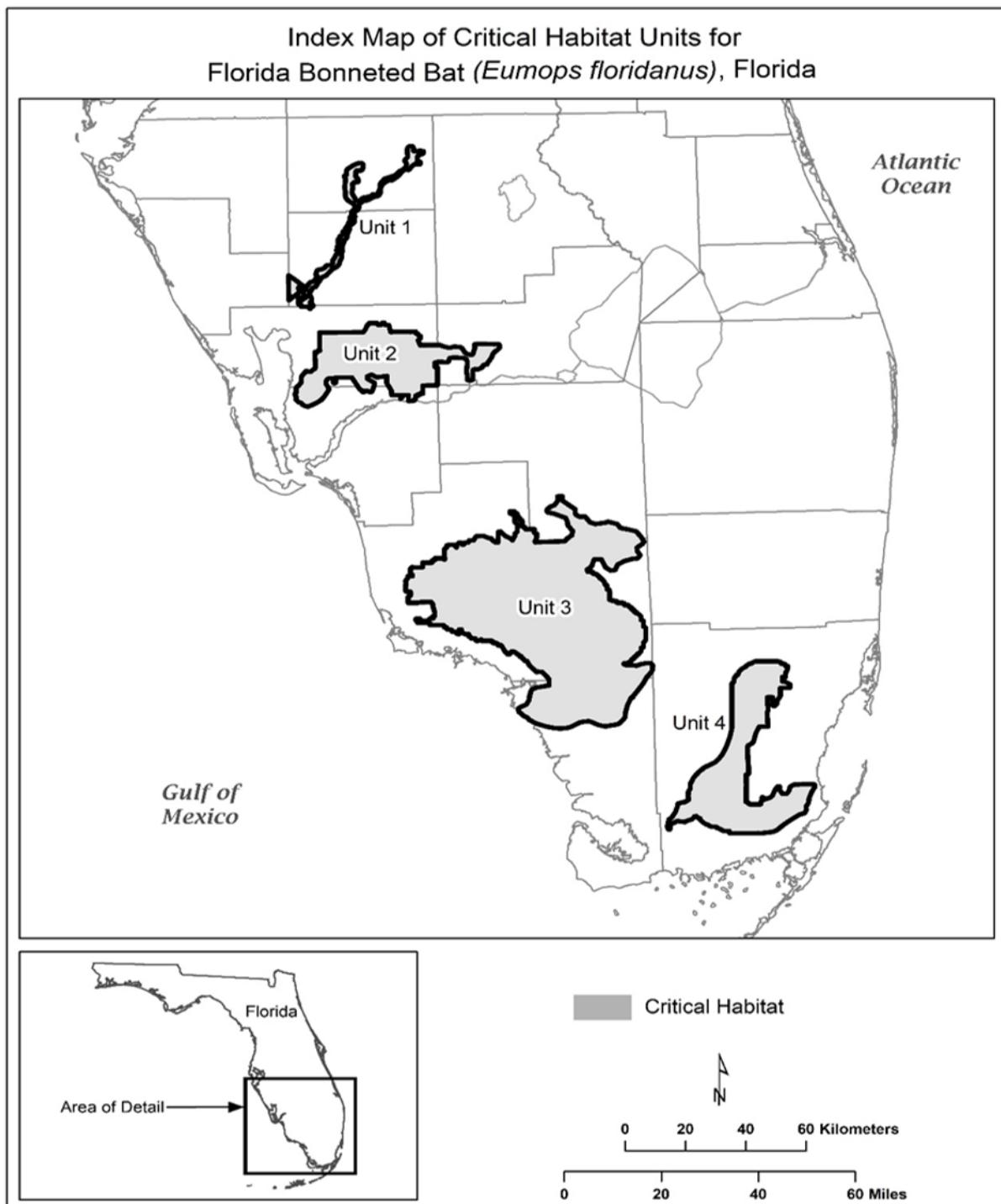
2204 **Table 4-3.** Florida bonneted bat proposed critical habitat units, including acres by land
2205 ownership type, and co-occurring listed species and designated critical habitat found in each unit.
2206 Note: WMA = Wildlife Management Area.

2207

Unit	Ownership	Area (acres)
Unit 1—Peace River and surrounding areas	State	11,212
	County	295
	Local	32
	Private and Other	34,810
	Unidentified	1,960
	Total	48,310
Unit 2—Babcock-Webb WMA, Babcock Ranch, and surrounding areas	Federal	3
	State	151,050
	County	9,203
	Local	21
	Private and Other	79,077
	Unidentified	1,587
	Total	240,941
Unit 3—Big Cypress and surrounding areas	Federal	619,573
	Tribal	26,012
	State	152,882
	County	8,362
	Local	427
	Private and Other	94,460
	Unidentified	4,745
Unit 4—Miami-Dade natural areas	Total	906,462
	Federal	176,395
	Tribal	805
	State	64,639
	County	10,404
	Total	282,620
	TOTAL	1,478,333

2208

2209



2210
2211

2212 **Figure 4-2.** Florida bonneted bat proposed critical habitat in central and south Florida. Each
2213 proposed critical habitat unit is identified by number from north to south.
2214

2215 **4.7 Environmental Baseline for Florida Bonneted Bat Proposed Critical Habitat**

2216
2217 This section is an analysis of the effects of past and ongoing human and natural factors leading to
2218 the current status of FBB pCH within the Action Area. The environmental baseline is a
2219 “snapshot” of the condition of PBFs that are essential to the conservation of the species within
2220 the pCH overlapping the Action Area at the time of the consultation, and does not include the
2221 effects of the Action under review.

2222
2223 **4.7.1 Action Area Conservation Value of Florida Bonneted Bat Proposed Critical Habitat**

2224
2225 The Action Area consists of the Plan Area and existing roads surrounding the Plan Area (section
2226 2.1). Because pCH does not include existing roads, the Action Area discussion here will be
2227 limited to the Plan Area. The southern portion of the Plan Area, totaling 30,730 acres (Table 4-
2228 4), is within pCH Unit 3 (Big Cypress and surrounding areas (Figure 4-3). This portion is
2229 3.4 percent of Unit 3 (906,462 acres).

2230
2231 Proposed CH within the Plan Area consists of 13,206 acres of habitats listed in PBF 1 (Table 4-
2232 5). This part of the Plan Area contains 16,641 acres of habitat that could be used for roosting and
2233 rearing of offspring (PBF 2) and 30,078 acres of habitat that could be used for foraging (PBF 3)
2234 (Table 4-5). This area is subject to dynamic disturbance (PBF 4) in the form of hurricanes and
2235 periodic fires. While the portion of Unit 3 within the Plan Area is not greater than 100,000 acres
2236 (PBF 5), it is part of a patch larger than 100,000 ac. This portion is also located in the northern
2237 part of this pCH unit and serves as a corridor (PBF 6) for FBBs moving from the southern part of
2238 this unit to Unit 2 to the north. Lastly, FBB pCH within the Plan Area is located in a subtropical
2239 climate (PBF 7).

2240
2241 **4.7.2 Action Area Conservation Needs for Florida Bonneted Bat Proposed Critical Habitat**

2242
2243 The Plan Area within FBB pCH Unit 3 has the same conservation needs as rest of Unit 3.
2244 Namely, special management considerations or protection due to the following: habitat loss,
2245 fragmentation, and degradation resulting from development (including oil and gas exploration)
2246 and land conversion; impacts from land management practices (e.g., timber management and
2247 fuels reduction, prescribed fire, management of nonnative and invasive species, habitat
2248 restoration) or lack of suitable habitat management; impacts from climate change and coastal
2249 squeeze; and pesticide use.

2251 **4.7.3 Tables and Figures**

2252

2253 **Table 4-4.** Habitat types in the Florida bonneted bat proposed critical habitat within the Plan
2254 Area of the Eastern Collier Multiple Species Habitat Conservation Plan.

2255

Cooperative Land Cover Type	Covered Activities	Eligible Lands	Very Low Density		
			Preserve	Use	Total
Cropland/Pasture	1,320	128	3,559	0	5,007
Cultural - Lacustrine	0	0	8	447	455
Cultural - Riverine	4	4	33	0	40
Cypress	22	228	6,965	15	7,229
Cypress/Tupelo(incl Cy/Tu mixed)	0	14	1,102	51	1,168
Exotic Plants	0	5	56	0	61
Extractive	0	0	8	44	52
Freshwater Forested Wetlands	0	371	1,521	277	2,169
Freshwater Non-Forested Wetlands	0	0	0	0	0
High Intensity Urban	0	11	0	0	11
Improved Pasture	157	0	1,087	81	1,325
Isolated Freshwater Marsh	0	11	612	0	622
Isolated Freshwater Swamp	0	17	1,244	6	1,267
Lacustrine	0	0	1	0	1
Low Intensity Urban	0	0	18	0	18
Marshes	17	248	2,101	40	2,406
Mesic Flatwoods	30	52	2,140	112	2,334
Mesic Hammock	0	6	105	3	114
Mixed Hardwood-Coniferous	64	0	957	16	1,037
Natural Lakes and Ponds	0	0	5	0	5
Orchards/Groves	0	0	186	0	187
Other Hardwood Wetlands	0	53	421	8	481
Palmetto Prairie	0	0	89	0	90
Prairies and Bogs	18	221	2,541	53	2,833
Rural	18	67	291	123	499
Shrub and Brushland	41	13	257	95	406
Transportation	0	61	7	4	72
Utilities	0	0	0	0	0
Wet Flatwoods	21	11	809	1	842
	Total	1,712	1,519	26,123	1,375
					30,730

2256

2257

2258

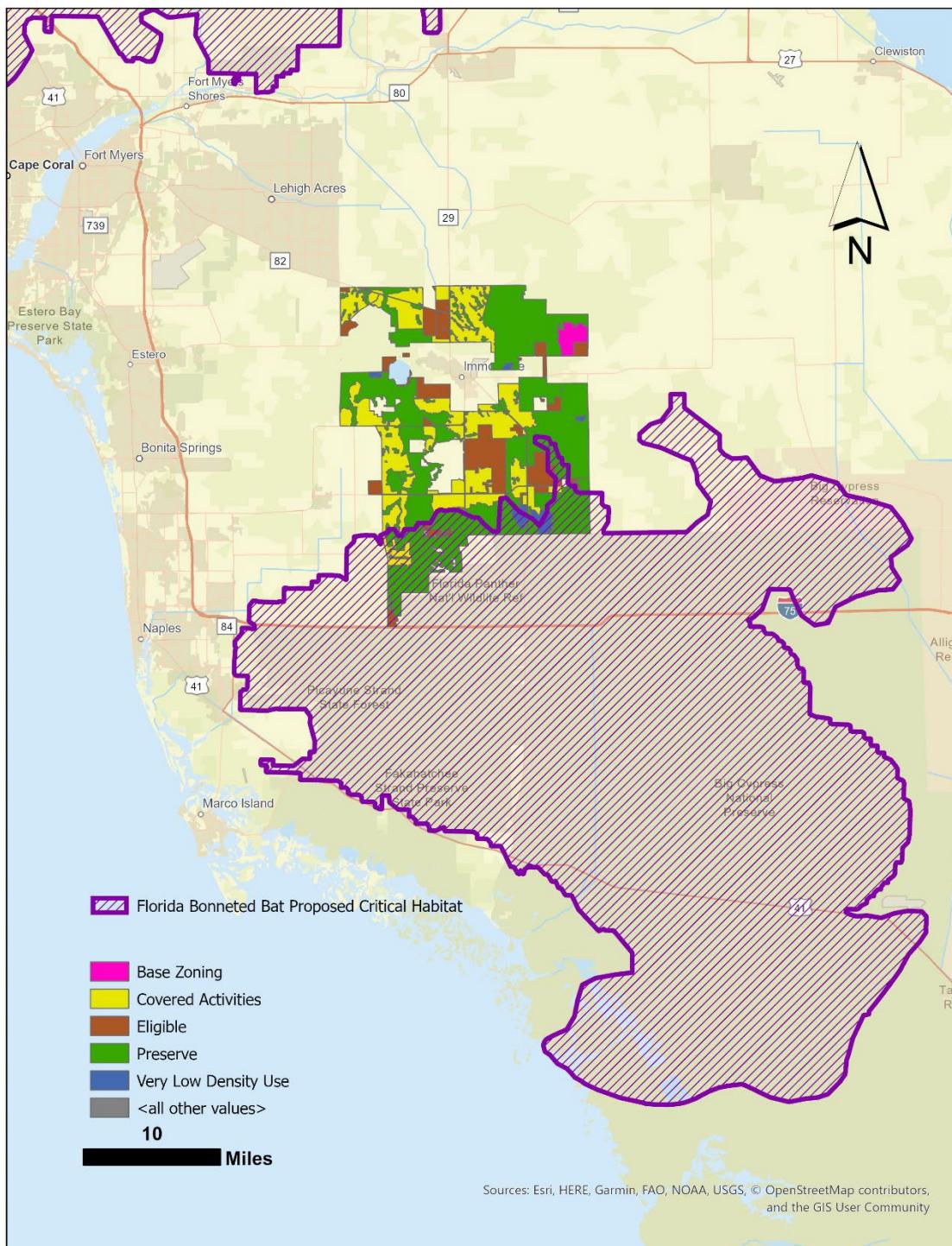
2259 **Table 4-5.** The acreage of each land use category of Florida bonneted bat proposed critical
2260 habitat within the Eastern Collier Multiple Species Habitat Conservation Plan that contains
2261 physical and biological features 1 through 3.

2262

PBF	Development and Mining, Base Zoning, and Lands Eligible for Inclusion			Very Low Density Use	
	Preserves		Total		
1	501	12,078	205	13,206	
2	889	15,264	488	16,641	
3	3,074	25,799	1,205	30,078	

2263

2264



2267 **Figure 4-3.** Florida bonneted bat proposed critical habitat (pCH) overlaid on the Plan Area of
 2268 the Eastern Collier Multiple Species Habitat Conservation Plan in Collier County, Florida. A
 2269 portion of the Plan Area is within pCH Unit 3.
 2270

2271 **4.8 Effects of the Action on Florida Bonneted Bat Proposed Critical Habitat**

2272
2273 This section analyzes the direct and indirect effects of the Action on pCH for the FBB. Direct
2274 effects are caused by the Action and occur at the same time and place. Indirect effects are caused
2275 by the Action, but are later in time and reasonably certain to occur. Our analyses are organized
2276 according to the land-use designations of the HCP found in the description of the Action in
2277 section 2 of this BO/CO.

2278
2279 **4.8.1 Development and Mining, Base Zoning, and Lands Eligible for Inclusion**

2280
2281 The Development and Mining, Base Zoning, and Lands Eligible for Inclusion (lands that make
2282 up the Development Envelope) within FBB pCH Unit 3 contain 501 acres of habitats that are
2283 listed in PBF 1 (Table 4-5). This acreage is 3.8 percent of PBF1 habitats within the Plan Area
2284 portion of Unit 3. These same Development Envelope lands contain 889 acres (6.7 percent) of
2285 habitats that support PBF 2 (habitat that provides for roosting and rearing of offspring). Finally,
2286 there are 3,074 acres (10.2 percent) of habitat that support PBF 3 (Habitat that provides for
2287 foraging) in the Development Envelope within Unit 3.

2288
2289 Lands in the Development Envelope within Unit 3 will likely be developed because development
2290 proposals have already been submitted for the areas in the southwest portion of the Plan Area
2291 which is most of the Development Envelope lands in Unit 3. Once developed, they will lose
2292 these PBFs 1 through 3. They will also lose some of PBF 4 (dynamic disturbance) except for
2293 hurricanes. They will no longer be part of a large patch of forested or natural habitat (PBF 5) and
2294 they will no longer have the characteristics of PBF 6 (corridors). PBF 7 (subtropical climate)
2295 will remain.

2296
2297 Given that the Development Envelope FBB pCH habitats make up at most 10 percent (PBF 3) of
2298 Plan Area lands in Unit 3, and that Plan Area lands in Unit 3 make up 3 percent of Unit 3, it is
2299 unlikely that development of these lands will significantly alter the PBFs of Unit 3.

2300
2301 **4.8.2 Preservation Activities**

2302
2303 The Preservation Areas within FBB pCH Unit 3 contain 12,078 acres of habitats that are listed in
2304 PBF 1 (Table 4-5). This acreage is 91.4 percent of PBF1 habitats within the Plan Area portion of
2305 Unit 3. These Preservation Areas contain 15,264 acres (91.7 percent) of habitats that support
2306 PBF 2 (habitat that provides for roosting and rearing of offspring). Finally, there are 25,799 acres
2307 (85.8 percent) of habitat that support PBF 3 (Habitat that provides for foraging) in the
2308 Preservation Areas within Unit 3.

2309
2310 The Preservation Areas will be maintained in their current state which is mostly native habitats
2311 and some agriculture within Unit 3. Landowners will continue to manage this land as they
2312 always have. Therefore, we expect the Preservation Areas to maintain PBFs 1-4. The
2313 Preservation Areas within Unit 3 maintain connectivity to large acreages of Unit 3 to the south
2314 and outside of the Plan Area, preserving PBF 5. The HCP includes permanent protection of two
2315 north/south wildlife linkages that begin in the pCH and extend to the north outside of the pCH.
2316 These linkages preserve connectivity (PBF 6) for FBBs to move north toward Unit 2. PBF 7

2317 (subtropical climate) also will remain. Preservation Areas may be restored or enhanced which
2318 would improve PBFs 1 through 6.

2319
2320 Because the Preserve Areas are expected to be maintained or improved, and they make up from
2321 86 percent (PBF 3) to 91 percent (PBFs 1 and 2) of the habitats supporting PBFs in the Plan Area
2322 portion of Unit 3, we expect activities in the Preserve Areas of Unit 3 will maintain or possibly
2323 improve the PBFs of Unit 3.

2324
2325 **4.8.3 Very Low Density Development**

2326
2327 The VLD Areas within FBB pCH Unit 3 contain 205 acres of habitats that are listed in PBF 1
2328 (Table 4-5). This acreage is 1.6 percent of PBF1 habitats within the Plan Area portion of Unit 3.
2329 These VLD Areas contain 488 acres (2.9 percent) of habitats that support PBF 2 (habitat that
2330 provides for roosting and rearing of offspring). Finally, there are 1,205 acres (4.0 percent) of
2331 habitat that support PBF 3 (Habitat that provides for foraging) in the Preservation Areas within
2332 Unit 3.

2333
2334 The VLD Areas will be developed at a ratio of 5 acres per 50 acres (10 percent). If this 10
2335 percent of development of VLD all occurred in habitats supporting PBFs, then 20.5 acres (0.2
2336 percent) of habitats listed for PBF 1 would be lost, 48.8 acres (0.3 percent) of habitats supporting
2337 PBF 2 would be lost and 120.5 acres (0.4 percent) of habitats supporting PBF 3 would be lost.
2338 The undeveloped acreage is expected to be maintained as it has been in the past and therefore
2339 maintain PBFs 1 through 3 in these areas. Therefore, dynamic disturbance (PBF 4) is expected to
2340 continue in the remaining acreage. The small and scattered acreages expected to be developed in
2341 the VLD Areas are not expected to disconnect these areas from the larger habitat blocks (PBF 5),
2342 nor are they expected to significantly reduce the connectivity (PBF 6) of the VLD Area. PBF 7
2343 (subtropical climate) also will remain.

2344
2345 Since the VLD Areas have a very small percent (up to 0.4 percent for PBF 3) of habitats
2346 supporting PBFs in the Plan Area of Unit 3, the remainder of the VLD lands are expected to
2347 retain many PBFs, and the Plan Area lands in Unit 3 make up 3 percent of Unit 3, we expect the
2348 development of the VLD areas to have an insignificant effect on the PBFs of Unit 3.

2349
2350 **4.8.4 Summary**

2351
2352 The loss of habitats supporting PBFs of FBB pCH in Unit 3 is expected to be 889 acres in the
2353 Development Envelope and 120.5 in the VLD Areas, or a total of 1,009.5 acres. This is 0.1
2354 percent of Unit 3. Undeveloped portions of VLD Areas are expected to retain most of their PBFs
2355 and, Preserve areas may be restored or enhance which could improve the PBFs.

2356
2357 **4.9 Cumulative Effects**

2358
2359 As discussed in section 4.7.1, the only part of the Action Area that contains FBB pCH is the Plan
2360 Area. We are unaware of other non-federal actions in the Plan Area that are reasonably certain to
2361 occur and that may affect the FBB pCH. Therefore, there are no cumulative effects related to
2362 FBB pCH.

2363

2364 **4.10 Conclusion for the Florida Bonneted Bat Proposed Critical Habitat**

2365

2366 In this section, we summarize and interpret the findings of the previous sections for FBB pCH
2367 (status, baseline, effects, and cumulative effects) relative to the purpose of a CO under
2368 §7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

2369

2370 1) jeopardize the continued existence of species listed as endangered or threatened; or
2371 2) result in the destruction or adverse modification of designated CH.

2372

2373 “*Destruction or adverse modification*” means a direct or indirect alteration that appreciably
2374 diminishes the value of pCH for the conservation of a listed species. Such alterations may
2375 include, but are not limited to, those that alter the PBFs essential to the conservation of a species
2376 or that preclude or significantly delay development of such features (50 CFR §402.02).

2377

2378 **Status**

2379

2380 Proposed CH for the FBB is comprised of 1,478,333 acres in 4 units located in 10 counties in
2381 central and southern Florida. Seven PBFs have been proposed that relate to habitats necessary for
2382 FBBs to roost, rear offspring, and forage; and to conditions needed to maintain these habitats and
2383 FBB populations (disturbance, large patches of habitat, corridors, and subtropical climate).

2384

2385 **Baseline**

2386

2387 The acreage of the Action Area within pCH Unit 3 is 30,730 acres, and its percent of Unit 3 is
2388 small (3.4 percent). This area does include all seven PBFs and consists mostly of native habitats.
2389 Unit 3 is 906,462 acres.

2390

2391 **Effects**

2392

2393 Development within the Development Envelope located in Unit 3 will cause the loss of up to 889
2394 acres that support PBFs. The Development Envelope FBB pCH habitats make up at most 10
2395 percent (PBF 3) of Plan Area lands in Unit 3, and the Plan Area lands in Unit 3 make up 3
2396 percent of Unit 3. Considering these factors, it is unlikely that development of these lands will
2397 significantly alter the PBFs of Unit 3.

2398

2399 The Preserve Areas are made up of 25,799 acres of habitats supporting Unit 3 PBFs. Because the
2400 Preserve Areas are expected to be maintained or improved, and they make up from 86 percent
2401 (PBF 3) to 91 percent (PBFs 1 and 2) of the habitats supporting PBFs in the Plan Area portion of
2402 Unit 3, we expect activities in the Preserve Areas of Unit 3 will maintain or possibly improve the
2403 PBFs of Unit 3.

2404

2405 Up to 120.5 acres of land supporting PBFs within the VLD Areas could be lost to development.
2406 Since the development expected within the VLD Areas would cause the loss of a very small
2407 percent (up to 0.4 percent for PBF 3) of habitats supporting PBFs in the Plan Area of Unit 3, the
2408 remaining VLD lands are likely to retain many PBFs, and the Plan Area lands in Unit 3 make up

2409 3 percent of Unit 3, we expect the development of the VLD areas to have an insignificant effect
2410 on the PBFs of Unit 3.

2411

Cumulative Effects

2412

2413 We are unaware of other non-federal actions in the Action Area that are reasonably certain to
2414 occur and that may affect the FBB pCH.

2415

Opinion

2416

2417 Although the Action would reduce the acreage that can support the PBFs of FBB pCH in Unit 3
2418 by about 0.1 percent, we believe the action would not significantly decrease the PBFs within
2419 Unit 3. The PBFs may be improved if Preserve Areas are restored or enhanced.

2420

2421

2422 After reviewing the current status of the pCH, the environmental baseline for the Action Area,
2423 the effects of the Action, and the cumulative effects, it is the Service's conference opinion that
2424 the Action is not likely to destroy or adversely modify pCH for the FBB.

2425

5. Florida Panther

2426

2427 This section provides the Service's biological opinion of the Action for the Florida Panther.

2428

5.1 Status of Florida Panther

2429

2430 This section summarizes best available data about the biology and current condition of the
2431 Florida panther (*Puma concolor coryi*) (panther) throughout its range that are relevant to
2432 formulating an opinion about the Action. The Service published its decision to list the panther as
2433 endangered on March 11, 1967 (32 FR 4001). In addition, the Florida Panther Act (Florida
2434 Statute 372.671), a 1978 Florida State law, made killing a panther a felony. The panther is listed
2435 as endangered by the States of Florida, Georgia, Louisiana, and Mississippi in addition to its
2436 Federal listing. Critical habitat has not been designated for the panther.

2437

2438 The following Service documents, cited in this section as necessary, provide additional details
2439 about the status of the panther:

2440

- 2441 (a) Florida Panther Recovery Plan (3rd Edition, 2008)
- 2442 (b) Annual Report on the Research and Management of Florida Panthers: 2018–2019 (FWC
2443 2019)
- 2444 (c) Species Status Assessment for the Florida Panther (USFWS Draft 2020)

2445

5.1.1 Species Description

2446

2447 An adult panther is unspotted and typically rusty reddish-brown on the back, tawny on the sides,
2448 and pale gray underneath. Adult males can reach a total length of 7 ft (2.1 meters [m]) and
2449 weight more than 161 pounds (lbs) (73 kilograms [kg]). Typically, adult males average around
2450 116 lbs (52.6 kg) and stand about 24 to 28 inches (in) (60 to 70 centimeters [cm]) at the shoulder
2451 (Roelke 1990). Female panthers are smaller with an average weight of 75 lbs (34 kg) and length
2452

2455 of 6 ft (1.8 m) (Roelke 1990). Panther kittens are gray with dark brown or blackish spots and
2456 five bands around the tail. The spots gradually fade as the kittens grow older and are almost
2457 unnoticeable when 6 months old. At this age, their bright blue eyes slowly turn to the light-
2458 brown straw color of the adult (Belden 1988).

2459

2460 **5.1.2 Life History**

2461

2462 Panthers require large areas to meet their needs. Mean home range size of females >24 months-
2463 of-age between 2004 and 2018 was 217.04 km² (48.38–765.35 km²; n = 43). Mean home range
2464 size of adult males >36 months-of-age during the same time period was 428.35 km² (91.16–
2465 1987.60 km²; n = 34). Numerous factors influence panther home range size including habitat
2466 quality, prey density, interrelationships with other panthers, and landscape configuration (Belden
2467 1988, Comiskey et al. 2002, Sunquist and Sunquist 2002, Logan and Swenor 2010). All these
2468 factors can fluctuate over time and can change panther densities across the landscape. In turn,
2469 these fluctuations make it difficult to determine the amount of habitat necessary to sustain the
2470 panther population.

2471

2472 Male panthers are polygynous, maintaining large, overlapping home ranges containing several
2473 adult females and their dependent offspring. Breeding activity peaks from December to March
2474 (Shindle et al. 2003). Litters (n = 82) are produced throughout the year, with 56 to 60 percent of
2475 births occurring between March and June (Jansen et al. 2005; Lotz et al. 2005). The greatest
2476 number of births occurs in May and June (Jansen et al. 2005; Lotz et al. 2005). Average litter
2477 size is 2.4 ± 0.91 (standard deviation) kittens. Seventy percent of litters are comprised of either
2478 two or three kittens.

2479

2480 Panther dens are usually located closer to upland hardwoods, pinelands, and mixed wet forests
2481 and farther from freshwater marsh-wet prairie (Benson et al. 2008). Most den sites are in dense
2482 saw palmetto (*Serenoa repens*), shrubs, or vines (Maehr 1990a; Shindle et al. 2003, Benson et al.
2483 2008). Den sites are used for 6 to 8 weeks by female panthers and their litters from birth to
2484 weaning (Benson et al. 2008). Independence and dispersal of young typically occurs at
2485 14 months, but may occur as early as 9 months (Maehr et al. 2002).

2486

2487 Adult females and their kittens interact more frequently than any other group of panthers.
2488 Interactions between adult male and female panthers last from 1 to 7 days and usually result in
2489 pregnancy (Maehr et al. 1991). Aggressive interactions between males often result in serious
2490 injury or death. Independent subadult males have been known to associate with each other for
2491 several days and these interactions do not appear to be aggressive in nature. Based on radio-
2492 collared panthers, aggression between males is the most common cause of male mortality (FWC
2493 2014) and an important determinant of male spatial and recruitment patterns (Maehr et al. 1991;
2494 Shindle et al. 2003).

2495

2496 Dispersal is the movement an animal makes from its birthplace to where it reproduces or would
2497 have reproduced if it had survived (Howard 1960). Dispersal is an important driver of Florida
2498 panther range expansion into otherwise suitable, but presently unoccupied habitats in its former
2499 range and gene flow within the range. It is an important mechanism by which recovery of the
2500 species can be achieved through natural population growth over time. Panther dispersal begins

2501 after a juvenile becomes independent from its mother and continues until it establishes a home
2502 range. Dispersal distances are greater for males than females (Maehr et al. 2002). The
2503 maximum dispersal distance recorded for a young male was 500 mi (805 km; FWC 2009).
2504 Maehr et al. (2002) found males disperse an average distance of 42.5 mi (68.4 km) and females
2505 typically remain in or disperse short distances from their natal ranges. Female dispersers
2506 establish home ranges less than one average home range width from their natal range (Maehr et
2507 al. 2002a). Maehr et al. (2002a) reported all female dispersers (n = 9) were successful at
2508 establishing a home range whereas only 63 percent of males (n = 18) were successful.
2509 Dispersing males usually go through a period as transient (non-resident) subadults, moving
2510 through the fringes of the resident population and often occupying suboptimal habitat until an
2511 established range becomes vacant (Maehr 1997).
2512

2513 Female use areas smaller areas and males compete for access to as many females as possible by
2514 establishing home ranges that intersect with those of numerous females. Subordinate males are
2515 excluded from breeding in natal areas so dispersal may help increase their mating probability
2516 (Greenwood 1980). Because of competition for home ranges and exclusion from mating in natal
2517 ranges young male panthers often use unfavorable habitats, such as highly urbanized areas. As
2518 the panther population has grown since 1995 more panthers have appeared in such areas
2519 (Interagency Florida Panther Response Team 2014, Interagency Florida Panther Response Team
2520 2015).
2521

2522 Panther dispersal is constrained geographically by human activities, fragmented habitat, and the
2523 fact that the population exists on a peninsula. Major urban areas are found on both the Atlantic
2524 and Gulf coasts restricting the current breeding population of panthers to the southern interior of
2525 the peninsula. Additionally, it is likely that the small size of the panther population in early
2526 years of the recovery effort, combined with the philopatric behavior of females slowed range
2527 expansion into unoccupied suitable habitat. As the panther population increased in size
2528 following genetic introgression in 1995, females were increasingly found further from the core
2529 population. It took about 20 years for dispersing females to repopulate areas 40 km north of core
2530 population, and over 40 years for female panthers to expand to areas north of the Caloosahatchee
2531 River, approximately 60 km north of the core population.
2532

2533 Male Florida panthers have longer daily movement distances than females (van de Kerk et al.
2534 2015, Criffeld et al. 2018). Movement patterns of panthers are generally constrained within
2535 home ranges except when dispersing (van de Kerk et al. 2015). Telemetry data indicate that
2536 panthers typically do not return to the same resting site day after day, except for females with
2537 dens or panthers remaining near kill sites for several days (USFWS 2008).
2538

2539 Activity levels for Florida panthers are greatest at night with peaks around sunrise and after
2540 sunset (Maehr et al. 1990b, USFWS 2008, Onorato et al. 2011, Criffeld et al. 2018). Panthers
2541 primarily rest during the day and travel during the night (van de Kerk et al. 2015). Panthers
2542 move extensively within home ranges, visiting all parts of the range regularly while hunting,
2543 breeding, and other activities (Maehr 1997; Comiskey et al. 2002) and can move large distances
2544 in short periods of time. Nightly panther movements of 12 mi (20 km) are not uncommon
2545 (Maehr et al. 1990a).
2546

2547 When moving during the day, panthers select forested habitats within their home range. (Belden
2548 et al. 1988, Cox et al. 2006, Kautz et al. 2006, Land et al. 2008, Onorato et al. 2011). At night
2549 panthers prefer to move along the forest edges, which they use as stalking cover to ambush
2550 white-tailed deer or feral hogs feeding in open areas. Once locating prey panthers often move
2551 into open areas to make the kill, and then drag the prey into forest cover to feed (Onorato et al.
2552 2011). Panther movement into and use of open habitats is greater during nighttime than during
2553 daytime (Onorato et al. 2011).

2554

2555 Seasonal rainfall patterns have a strong influence of Florida panther movements (Criffeld et al.
2556 2018). South Florida is characterized by a tropical climate, a topographically flat landscape that
2557 includes permanent and ephemeral wetlands, and abundant rainfall during the hotter summer
2558 months (May–October) followed by relatively dry cooler winters (October–May). Both sexes
2559 travel faster and farther during the dry season than the wet season (van de Kerk et al. 2015,
2560 Criffeld et al. 2018). Males cover approximately 26 percent of their home range each week in
2561 the winter dry season compared to approximately 11 percent of their home range in the summer
2562 wet season. Females cover approximately 12 percent of their home range in the dry season
2563 compared to 4 percent in the wet season.

2564

2565 Movements of females are dictated by their reproductive chronology and are influenced by the
2566 presence of young (Criffeld et al. 2018). Pregnant females establish a den within their home
2567 range just prior to giving birth. Females move less when caring for kittens and stay near their
2568 dens for about 8 weeks after giving birth. Kittens older than about 8 weeks can follow their
2569 mothers, but their limited mobility may constrain movement speed of their mothers. Movements
2570 become progressively longer until young disperse at approximately 14 months-of-age (Maehr et
2571 al. 2002b). Once young disperse, females may move more until they mate again and the cycle
2572 repeats (Criffeld et al. 2018).

2573

2574 Florida panthers consume a wider variety of prey, and greater abundance of small prey panther
2575 (*Puma concolor*) in western North America, Central America, and South America (Iriarte et al.
2576 1990). Maehr et al. (1990b) found the proportion of prey consumed by Florida panthers included
2577 feral hog (42 percent); white-tailed deer (28 percent); raccoon (12 percent); nine-banded
2578 armadillos (8 percent); marsh rabbit (4 percent); and domestic livestock (2 percent). The
2579 remaining 4 percent of prey included various mammals, reptiles, and birds. Panthers may prey on
2580 different species in different areas due to habitat conditions that favor one prey species over
2581 another.

2582

2583 Panthers can live up to 20 years in the wild, but the mean age at death for panthers radio-collared
2584 at ≥ 1 year-of-age are 7.7 years and 5.5 years for females ($n = 68$) and males ($n = 91$),
2585 respectively (FWC unpublished data). Survival rates are higher for females than for males with
2586 subadult females exhibiting the highest annual survival (Benson et al. 2009). These estimates
2587 follow the same pattern as other *Puma* studies with average annual female and male survival
2588 rates of 0.798 and 0.691, respectfully (female range: 0.586 – 0.86; male range: 0.33 – 0.91),
2589 across 8 different studies (Logan and Sweanor 2010, Lambert et al. 2006, Laundré et al. 2007,
2590 Clark et al. 2014, Robinson et al. 2014, Vickers et al. 2015).

2591

2592 **5.1.3 Habitat**

2593
2594 Our Florida Panther Recovery Plan and Species Status Assessment for the Florida Panther
2595 provide a description of Panther habitat characteristics, from which we summarize information
2596 that is relevant to this consultation here. Radio-collar data and ground tracking indicate that
2597 panthers use the mosaic of habitats available to them as resting and denning sites, hunting
2598 grounds, and travel routes. The majority of telemetry locations and natal den sites occur within,
2599 or very close to, forested cover types. These include cypress swamp, pinelands, hardwood
2600 swamp, and upland hardwood forests (Belden 1986; Belden et al. 1988; Maehr 1990c; Maehr et
2601 al. 1991; Maehr 1992; Smith and Bass 1994; Kerkhoff et al. 2000; Comiskey et al. 2002, Cox et
2602 al. 2006, Kautz et al. 2006, Land et al. 2008; Benson et al. 2008). Analysis of Global Positioning
2603 System (GPS) tracking data likewise finds panthers ($n = 12$) primarily select forested habitat
2604 types, then all other habitat types in proportion to availability (Land et al. 2008). Onorato et al.
2605 (2010) provided further analysis of this data set and found panthers selected upland forest,
2606 wetland forest, marsh-shrub-swamp, and prairie-grassland habitats, and use agriculture and
2607 “other” habitat types relative to their availability and their proximity to a forest patch. Our own
2608 analysis of all records (Radio telemetry, GPS tracking, locations of panther-vehicle collisions,
2609 locations of confirmed depredation events, confirmed den locations, and confirmed observations)
2610 found 95.7 percent of all panther records occur within a forest habitat type or within another
2611 habitat type within 984 ft (300 m) of forest cover.

2612
2613 Kautz et al. (2006) found forest extent and patch size is also important to panthers. Specifically,
2614 panthers prefer smaller forest patches in their home ranges (*i.e.*, 9 to 26 ac [3.6 to 10.4 ha]). This
2615 is likely because small forest patches have a higher edge-to-area ratio, making them most
2616 suitable for panthers stalking and ambushing prey (Belden et al. 1988; Cox et al. 2006, Frakes et
2617 al. 2015). Panthers mostly use those with dense understory vegetation comprised of saw
2618 palmetto for resting and denning (Maehr 1990a; Benson et al. 2008). On a landscape scale
2619 Frakes et al. (2015) found low human population density, high abundance of forest edge, low dry
2620 season water depth, and low wet season water depth also strongly predict panther presence.

2621
2622 Based on their South Florida Random Forest Panther (RFP) model, Frakes et al. (2015) estimated
2623 5,579 km² of habitat remain available to panthers south of the Caloosahatchee River. However, a
2624 shortcoming of the RFP model (Frakes et al. 2015) is that it did not use the full record of panther
2625 occurrence and instead relied exclusively on telemetry data to construct their model. To address
2626 this shortcoming the Service and FWC include additional GPS and telemetry data, vehicle
2627 mortality locations, depredation locations, and confirmed sightings in conjunction with the RFP
2628 modeling technique to delineate a more inclusive area of occupancy. The Service defines these
2629 two areas as Zones A and B (Figure 5-1). Zone A covers 6,103 km² and is largely coincident
2630 with the areas of suitable habitat identified by the South Florida RFP model (Frakes et al. 2015)
2631 with a probability of presence ≥ 0.30 and an average 0.667 probability of presence [on a scale of
2632 0 (low) to 1 (high)]. Approximately 4,357 km² (71 percent) of Zone A is [redacted] within existing
2633 conservation lands. Zone A is known to support breeding female panthers and encompasses
2634 much of the original Primary Zone based on Kautz et al. (2006). Zone B, which covers 2,991
2635 km², is comprised of generally lower quality habitat that nevertheless provides connectivity with
2636 habitats in Zone A. This zone is used by dispersing panthers, and occasionally supports breeding
2637 females, but with substantially less frequency than Zone A. Zone B consists of panther habitat

2638 with a probability of presence ranging from 0.1 to 0.29 and an average 0.158 probability of
2639 presence. Approximately 1,339 km² (45 percent) of Zone B is within existing conservation
2640 lands. Zone B encompasses much of the original Secondary Zone based on Kautz et al. (2006).
2641 The combined area of Zones A and B is defined by the Service as the “Functional Zone,” and its
2642 extent encompasses approximately 9,094 km² (USFWS Draft 2020). These zones comprise
2643 areas of suitable habitat identified by the South Florida RFP model (Frakes et al. 2015) and
2644 additional areas of habitat known to support panthers based on existing occurrence data. In all,
2645 approximately 5,696 km² (63 percent) of the Functional Zone is protected by existing
2646 conservation lands and this Functional Zone remains the only area known to support a population
2647 of panthers (Frakes and Knight in preparation; Hostetler et al. 2013; Frakes et al. 2015; van de
2648 Kerk et al. 2019, USFWS Draft 2020).

2649

2650 **5.1.4 Travel and Dispersal Corridors**

2651

2652 As discussed in 5.1.2. panther dispersal is constrained geographically by human activities,
2653 fragmented habitat, and the fact that the population exists on a peninsula. Maintaining a
2654 permeable, connected landscape for panthers requires dispersal corridors that meet their needs
2655 and is essential for the conservation of panthers. In the absence of direct field
2656 observations/measurements, Harrison (1992) suggested landscape corridors for wide-ranging
2657 predators should be half the width of an average home range size. Following Harrison’s (1992)
2658 suggestion, corridor widths for panthers would range from 6.1 to 10.9 mi (9.8 to 17.6 km)
2659 depending on whether the target animal was an adult female or a transient male. Beier (1995)
2660 suggested that corridor widths for transient male puma in California could be as small as 30
2661 percent of the average home range size of an adult panther; however, topography in California is
2662 dramatically different from that in Florida. Without supporting empirical evidence, Noss (1992)
2663 suggests regional corridors connecting larger hubs of habitat should be at least 1.0 mi (1.6 km)
2664 wide. Beier (1993, 1995) makes specific recommendations for very narrow minimum corridor
2665 widths based on short corridor lengths in a California setting of wild lands completely
2666 surrounded by urban areas; he recommended corridors with a length less than 0.5 mi (0.8 km)
2667 should be more than 328 ft (100 m) wide, and corridors extending 0.6 to 4 mi (1 to 7 km) should
2668 be more than 1,312 ft (400 m) wide.

2669

2670 An earlier effort to map areas of South Florida important for panther habitat conservation
2671 resulted in three distinct regions of panther habitat (Kautz et al. 2006): Primary Zone, Secondary
2672 Zone, and Dispersal Zone. The Dispersal Zone was defined as a small wildlife corridor east of
2673 LaBelle, Florida, intended for protection to facilitate long-term movements of panthers out of
2674 South Florida and into potentially suitable habitats in Central Florida north of the
2675 Caloosahatchee River. The Dispersal Zone encompasses 44 mi² (113 km²) with a mean width of
2676 3.4 mi (5.4 km) (Figure 5-2). Although it is not large enough to encompass an entire panther
2677 home range, the Dispersal Zone is strategically located and expected to function as an important
2678 landscape linkage to south-central Florida (Kautz et al. 2006). Panthers currently use this zone
2679 as they disperse northward into south-central Florida. Part of at least one female panther home
2680 range has been documented inside the dispersal zone, and female panthers recently documented
2681 north of the Caloosahatchee River are presumed to have used the Dispersal Zone in their
2682 northward expansion.

2683

2684 **5.1.5 Numbers, Reproduction, and Distribution**

2685
2686 Historically occurring throughout the southeastern United States (Young and Goldman 1946),
2687 today the panther is restricted to less than 5 percent of its historical range. Currently, the only
2688 breeding population is south of the Caloosahatchee River in south Florida. Female panthers have
2689 been documented in eight Florida counties since 1973 (USFWS 2020). From 1980 through
2690 October 2016, all occurrence data indicated that female panthers were present only south of the
2691 Caloosahatchee River and most reproduction occurred in Collier, Hendry, Lee, and Miami-Dade
2692 counties (USFWS 2020). In November 2016, an adult female panther was documented on the
2693 Babcock Ranch Preserve in Charlotte County (FWC 2017), the first time since 1973 that a
2694 female panther has been confirmed north of the Caloosahatchee River (USFWS 2020). A
2695 minimum of three adult female panthers and at least four litters of kittens have been documented
2696 north of the Caloosahatchee River between November 2016 and June 2020 (Kelly and Onorato
2697 2020, USFWS 2020).

2698
2699 As of June 2020, there is no evidence that successful recruitment, i.e., offspring born and
2700 surviving to enter the breeding population as adults, has occurred north of the Caloosahatchee
2701 River (Kelly and Onorato 2020), and until that evidence is documented, we do not conclude that
2702 the breeding range of Florida panthers has expanded beyond South Florida (USFWS 2020).

2703
2704 Since its listing the panther population has increased from an estimated 12-20 adults in the early
2705 1970s to an estimated 120-230 adults in 2015 (Figure 5-3; FWC and Service 2017, USFWS
2706 Draft 2020). The lower bound is based on the number of adults and subadults documented
2707 during the most recent annual minimum count (2015). The upper bound of 230 is calculated
2708 using annual count data from core (very good) panther habitat to derive a density of panthers for
2709 that area. The density value is then multiplied by the total number of acres of habitat in the
2710 primary zone as identified by Kautz et al. (2006) to come up with an upper range of 230.
2711 Because this method does not account for sampling effort, imperfect detection of animals, or
2712 provide a margin of error, it can't be categorized as a scientific population estimate. Even with
2713 these shortcomings, this methodology has provided agencies with a reliable means of monitoring
2714 the population with the best data currently available (FWC and Service 2017).

2715
2716 Maehr et al. (1991) provided the earliest estimate of panther population density at 0.91/100 km²
2717 at a time when the number of panthers was thought to be 30–50 animals. This estimate was
2718 based on counting marked (radiocollared) and unmarked panthers in a given area (Capture, mark,
2719 recapture (CMR). This technique has been described as the “gold standard” for estimating puma
2720 density even though it lacks a measure of variance and is in fact, nothing more than a simple
2721 count (Cougar Management Working Group 2005). Twenty years later, and following genetic
2722 restoration, new techniques have been developed that utilize a CMR framework on data collected
2723 from camera trap grids. These spatial mark-resight (SMR) models account for detection
2724 probabilities and effort and provide measures of uncertainty associated with estimates. Sollmann
2725 et al. (2013) used an SMR model to estimate panther density in the Picayune Strand Restoration
2726 Project area at 1.5/100 km². Similar SMR models were later applied to data generated from
2727 camera trap grids on three 225-km² study areas that included public and private land in South
2728 Florida (Dorazio and Onorato 2018, Onorato et al. 2020). Panther density in the Addition Lands
2729 of Big Cypress National Preserve (BCNP) was estimated at 1.37/100 km² in 2014. Panther

2730 density in a study area that included FPNWR and adjoining areas of Picayune Strand State Forest
2731 (PSSF) and Fakahatchee Strand Preserve State Park (FSPSP) was estimated 4.03/100 km² in
2732 2014. Panther density in the Immokalee Ranch (IMR) study area was estimated at 3.90/100 km²
2733 over a 14-month study period in 2017–2018. IMR encompassed privately-owned land in Collier
2734 and Hendry counties that included a mosaic of native cover and active agricultural land uses
2735 (e.g., improved and semi-improved pastures for cow-calf operation and a variety of row crops).
2736 These results suggest that the increasing size of the panther population post-introgression has
2737 resulted in higher densities in the range of 1.37–4.03/100 km² in occupied habitats on public and
2738 private lands in South Florida. However, densities in other areas within the range of panthers
2739 have not been studied.

2740
2741 **5.1.6 Conservation Needs and Threats**
2742
2743 There are a variety of threats that have long been identified as affecting the viability of the
2744 panther population. The most substantial threats include habitat loss, fragmentation, and
2745 degradation from development and climate change, and mortality from vehicle collisions. Other
2746 stressors include illegal shootings; exposure to infectious disease; exposure to contaminants; and
2747 small population size, but the effects of these stressors to the population are not well documented
2748 (Harris 1984, Maehr 1992, 2008, Onorato et al. 2010, van de Kerk et al. 2019, FWC 2017,
2749 USFWS Draft 2020). In addition, the most recent population viability analysis (PVA) performed
2750 by van de Kerk et al. (2019) found that maintaining the genetic health of the panther population
2751 is important to long term viability.

2752
2753 Conservation needs that address the most substantial threats listed above include the following:
2754
2755 Conserving, restoring, and managing lands that are capable of maintaining and expanding
2756 panther population(s) throughout Florida (Federal, State, Local, and other). Land conservation
2757 measures include public acquisition of conservation lands and conservation easements,
2758 establishment of panther conservation banks, protection of panther habitats by wetland
2759 mitigation banks, NRCS purchase of easements to protect wetlands, and management efforts of
2760 Native American tribes. As mentioned in section 5.1.3., 63 percent (5,696 km²) of the panther
2761 Functional Zone is in conservation. Management actions that affect panthers include prescribed
2762 fire, exotic plant removal, population monitoring, hydrologic restoration, vegetation plantings,
2763 silvicultural operations, public outreach and education, recreation management, and maintenance
2764 of utility corridors.

2765
2766 Maintenance of wildlife linkages that allow for a permeable landscape and that connect
2767 conservation lands that can support panthers. The maintenance of wildlife linkages is a major
2768 consideration in determining where to seek land acquisition, conservation easements, and to use
2769 other methods to secure conservation lands. The Dispersal Zone (section 5.1.3) is an important
2770 wildlife linkage for the panther because it provides access to areas where the panther population
2771 could expand north of the Caloosahatchee River. Other important linkages in southwest Florida
2772 (e.g., Camp Keais Strand and Okaloacoochee Slough) maintain connectivity between areas of
2773 protected panther habitat. Wildlife underpasses with fencing have become an important tool to
2774 help offset projected increases in panther mortalities resulting from increases in traffic within
2775 panther habitat. Based on demonstrated use of wildlife crossings by panthers and prey, over 60

2776 crossings and enhancements to existing bridges have been completed in other locations where
2777 panther vehicle mortalities have been frequent (USFWS Draft 2020). When wildlife underpasses
2778 are used to minimize effects of a development project, they also reduce effects of other sources
2779 of traffic using the same road.

2780

2781 **5.1.6.1 Habitat Loss**

2782

2783 Habitat loss is the complete loss of suitable habitat for a given species, or the functional loss of
2784 otherwise suitable habitat through the loss of the species' access to it. In the former case,
2785 humans can cause habitat loss by converting suitable habitat to human use, while in the latter
2786 case habitat loss occurs when barriers close off a remnant of access to otherwise suitable habitat
2787 during the process of fragmentation (SECTION 5.1.6.2). Habitat degradation, on the other hand,
2788 refers to the qualitative reduction of habitat services for a species that continues to have access to
2789 it, though it is possible to degrade habitat to such an extent it is effectively lost to the species
2790 (SECTION 5.1.6.3).

2791

2792 Habitat loss has been identified as a key factor affecting the long-term viability of the panther
2793 population (Maehr 1992, USFWS 2008, Onorato et al. 2010, van de Kerk et al. 2019). Survey
2794 data of land use/land cover in Florida have been available since 1936 when the U.S. Forest
2795 Service completed their first forest inventory for Florida (Kautz 1998). More detailed statewide
2796 vegetation data derived from satellite imagery have been collected since the late 1980s through
2797 as recent as 2015 (Kautz et al. 1994, Kautz et al. 2007, FWC 2016). These data have been used
2798 for the draft Florida Panther Species Status Assessment (SSA) (USFWS Draft 2020) to estimate
2799 historical loss of panther habitat in Florida during three time periods: 1936–1987; 1987–2003;
2800 and 2003–2015.

2801

2802 Forest cover has been demonstrated repeatedly as a key component of landscapes used by
2803 panthers in Florida (Belden et al. 1988, Maehr and Cox 1995, Comiskey et al. 2002, Cox et al.
2804 2006, Kautz et al. 2006, Land et al. 2008, Onorato et al. 2011). Using forest cover as an index to
2805 panther habitats, Kautz (1998) reported that 17,677 km² of Florida forests were converted to
2806 agricultural or urban uses between 1936 and 1987, which was a total loss of 20.8 percent and a
2807 rate of loss of 0.41 percent per year. During the same period, forests declined by 3966 km² (33
2808 percent) in 10 South Florida counties, a rate of loss of 0.65 percent per year (Kautz 1994). Kautz
2809 et al. (2007) reported the results of a change detection analysis that compared land use/land cover
2810 in Florida between 1987 and 2003 and found a total of 367 km² of natural habitats in the Primary
2811 Zone (4.4 percent of the Primary Zone) was converted to other uses at a rate of loss of 0.28
2812 percent per year. Lastly, Dr. Robert Kawula (FWC, unpublished data) completed a change
2813 detection analysis of South Florida habitats by comparing 2003 land cover data (Kautz et al.
2814 2007) with a land cover database from 2015 (FWC 2016) and found a total of 144 km² of natural
2815 and semi-natural habitats in the Primary Zone (1.56 percent of the Primary Zone) was converted
2816 to other uses between 2003 and 2015, a rate of loss of 0.13 percent per year.

2817

2818 Between 1987 and 2003 just over half of the conversions of natural areas in the Primary Zone
2819 (55–57 percent) were to agricultural uses. Between 2003 and 2015, 41–42 percent of natural and
2820 semi-natural panther habitats lost were to urban development, while 25–27 percent were lost to
2821 conversions to agricultural use. Whether lands converted to agricultural use constitute a loss or

2822 degradation of habitat for panthers is a function of the proximity of agricultural lands to forest
2823 edges. Specifically, Land et al. (2008) and Onorato et al. (2010) found that panthers will use
2824 agricultural lands within 300 m of a forest edge in proportion to their availability but will avoid
2825 agricultural lands farther than 300 m from a forest edge.

2826
2827 Panthers can also temporarily lose the use of otherwise suitable habitat because of temporary or
2828 periodic events that prevent panthers from accessing them, such as might occur during high
2829 water events in the South Florida rainy season or because of periods of temporary human
2830 disturbance (Janis and Clark 2002, Sweanor et al. 2008, McCarthy and Fletcher 2015, Criffeld et
2831 al. 2018, McCarthy and Fletcher 2015, Abernathy et al. 2019). Additionally, panthers may
2832 permanently lose use of otherwise suitable habitat when human presence and activity near them
2833 become permanent, because panthers tend to avoid areas of sustained, high density human
2834 activity and may face high risk of mortality if they don't (Frake et al. 2015, Moss et al. 2016b,
2835 Blecha et al. 2018).

2836
2837 Loss of habitat that supports prey important to panthers is also problematic because prey
2838 abundance, distribution, and behavior dictates these same attributes among populations of *Puma*
2839 *concolor* everywhere they occur (Smith and Bass 1994, Dalrymple and Bass 1996, Riley and
2840 Lalecki 2001, Grigione et al. 2002, Laundre et al. 2007, Laundre et al. 2009). Loss of habitat
2841 supporting prey can have secondary effects that may intensify intraspecific competition
2842 (competition within a species); intensify interspecific competition (competition between species)
2843 (Murphy et al. 1995, Allen et al. 2013, Elbroch and Wittmer 2013, Allen 2014, Elbroch et al.
2844 2015); increase rates of depredation; and increase instances of prey switching (Moss et al. 2016a
2845 & b, Robins et al. 2019). Depredation and the consumption of lesser-preferred prey by panthers
2846 have become more prevalent as the population has grown (Tables 5-1 & 5-2, Caudill et al. 2019).
2847

2848 These secondary effects of habitat loss may increase the likelihood of mortality among
2849 individual panthers from all causes, such as interspecific aggression, predation from bears or
2850 coyotes, disease, bioaccumulation of toxins, illegal shootings, vehicle collision, and management
2851 removal (Vickers et al. 2015, Moss et al. 2016b, Blecha 2015, Blecha et al. 2018). We provide a
2852 more precise description of these effects to panthers in separate, appropriate sections of this
2853 chapter.

2854
2855 **5.1.6.2 Habitat Fragmentation**
2856

2857 Habitat fragmentation is defined as the subdivision of larger contiguous patches of habitat into
2858 smaller patches by the emergence of barriers that severely restrict or preclude the ability of
2859 individuals to access the habitat fragment (Lindenmayer and Fischer 2006). Such is the case
2860 with the panther, whose range has been systematically fragmented by a combination of road
2861 networks, residential development, and canals (USFWS Draft 2020). Roadways with high
2862 volumes of traffic create the principle barriers between these fragments. Charry and Jones (2009)
2863 found traffic volume of 100-500 trips/day began affecting all taxa, including large carnivorous
2864 mammals like *Puma concolor*, that impacts increased in severity up to 10,000 vehicles per day,
2865 and that at 10,000 or more vehicles/day, traffic levels often observed on interstates and multi-
2866 lane highways, created a near complete barrier to all taxa except for birds (Appendix C).
2867

2868 Schwab and Zandbergen (2011) found that when it comes to panthers, specifically, major roads
2869 present a stronger barrier to movement than minor roads, with females being significantly more
2870 reluctant to cross roads than males even when wildlife underpasses are present for them to use.
2871 Furthermore, Schwab and Zandbergen (2011) observed these roadways frequently serve as
2872 boundaries of female panther home ranges and their analysis of telemetry records indicated many
2873 of these individuals may spend a great deal of time near roadways without attempting to cross
2874 them. Schwab and Zandbergen (2011) concluded, “Road networks in south Florida have
2875 essentially segregated the movement of the sexes and have fragmented the limited remaining
2876 habitat of the Florida panther.” Wildlife crossings produce relief from fragmentation caused by
2877 road networks, but this relief does not fully offset the barrier effect generated by these roadways.
2878 Smaller habitat patches, once isolated by fragmentation, may be too small to support an
2879 independent, viable population or subpopulation of individuals (Crooks 2002, Vickers et al.
2880 2015), and inbreeding depression and/or reduction in population viability could result (Ernest et
2881 al. 2003, Seth et al. 2014, Vickers et al. 2015, Benson et al. 2019).

2882 2883 **5.1.6.3 Habitat Degradation**

2884
2885 Habitat degradation is a process that makes habitat less suitable or less available to such an
2886 extent that a species breeding, feeding, or sheltering behavior is impaired (Lindenmayer and
2887 Fischer 2006). This means a species may still inhabit an area where habitat degradation occurs,
2888 but certain life history functions, such as reproduction, may no longer be as successful. Under the
2889 Endangered Species Act habitat degradation constitutes “Harm” whenever “significant habitat
2890 modification or degradation actually kills or injures wildlife by significantly impairing essential
2891 behavioral patterns including breeding, feeding or sheltering” (USFWS 1998).

2892 2893 Decline in Prey Availability

2894
2895 Degradation of habitat that supports populations of prey important to panthers is a threat to their
2896 survival and recovery because prey abundance, distribution, and behavior influences these same
2897 attributes among populations of *Puma concolor* (Smith and Bass 1994, Riley and Lalecki 2001,
2898 Riley and Lalecki 2001, Grigione et al. 2002, Laundre et al. 2007). One form of habitat
2899 degradation occurs in response to introductions of invasive species, their introduction into
2900 natural systems largely being a function of human presence on the landscape and trade between
2901 regions (Hulme 2008). For example, the presence of invasive species like the Burmese python
2902 can degrade the value of otherwise suitable habitat to panthers by preying on species important
2903 to panthers or by preying on panthers, directly (Dorcas et al. 2012, Wilson 2017, Caudill et al.
2904 2019). Conversely, the introduction of other invasive species has been beneficial for the Florida
2905 panther. In the 1500s European wild hogs were introduced near Big Cypress and wild pigs were
2906 well established by the 1900s (Belden and Frankenberger 1977). This alternative source of prey,
2907 along with the introduction of armadillos in 1924 (Taulman and Robbins 1996), may have
2908 allowed the panther population to persist during the period of general deer population decline
2909 that took place at this time.

2910
2911 **Current Prey Availability and Recent Declines:** In general, deer populations in South Florida
2912 are characterized by lower density and fecundity than in other areas of the state, primarily due to
2913 seasonal flooding, climatic stress, and the thin, nutrient poor soils that contribute to the low

2914 nutritional value of available forage and overall poor habitat quality (Harlow and Jones 1965,
2915 Fleming et al. 1994, Labisky et al. 1995, Garrison et al. 2011). Market, subsistence and trade
2916 hunting of deer pre-1900 were substantial in the area and similar to areas in eastern U.S. and
2917 throughout the southeast, likely contributed to the decline of prey and the imperilment of the
2918 panther population (Schortemeyer et al. 1991, Gill 2010). The white-tailed deer herd in Florida
2919 reached its lowest point near the end of the 1930s (FWC 2007). A white-tailed deer eradication
2920 program that began in Florida during the late 1930s to control the cattle-fever tick resulted in the
2921 extermination of 9478 deer between 1939 and 1943, including 8428 deer killed in Collier County
2922 (Davis 1943, Game and Fresh Water Fish Commission 1946, Alvarez 1993). The introduction of
2923 New World screwworm fly (*Cochliomyia hominivorax*) in 1933 also undoubtedly had an impact
2924 on deer populations in Florida. Concomitant with the reduced deer populations was a reported
2925 increase in panther livestock depredation and persecution of panthers in the region (Hamilton
2926 1941). The low point was followed with decades of harvest regulations and their enforcement,
2927 reduction of subsistence hunting, screwworm eradication in 1958, re-introduction of deer from
2928 other states, increased habitat availability and quality (due to logging and drainage program), and
2929 habitat protection through the creation of state wildlife management areas. And despite the
2930 substantial increase in human activity and development during this period, the deer herd
2931 flourished. Prey management was recognized as important, evident in the conservative hunting
2932 regulations (e.g., buck-only harvest) and land acquisition (e.g., purchase of the FPNWR).
2933

2934 Deer herds in the southeastern portions of the panther's occupied range have a history of extreme
2935 population fluctuations and have been subjected to severe, weather-related mortality events
2936 (Loveless 1959, Forrester 1992, Maehr and Lacy 2002). Although extreme water events are rare,
2937 the hydrological changes in the last decades in general have resulted in the increased depth and
2938 duration of hydroperiods. This change in hydrology, along with other landscape-level changes,
2939 has potentially impacted both deer and wild hog populations. Harvest and aerial monitoring data
2940 suggest both ungulate species have experienced population declines in portions of South Florida.
2941 For example, feral swine harvest on BNCP averaged 125.7 head/year during 1993–2003 and 2.4
2942 head/year during 2004–2015, with no harvest in recent years (FWC 2020a). Deer harvest has
2943 followed a similar declining trend in some management units, while elsewhere harvest appears to
2944 be stable or increasing.
2945

2946 The most drastic declines in the white-tailed deer populations have been observed in the southern
2947 portions of BCNP (south of U.S. Highway 41 [US 41]) since the early 2000s. Recent survey and
2948 harvest data indicate a near complete population crash in this region (FWC unpublished data).
2949 Further south in ENP, based on anecdotal evidence, deer and other mammals have declined since
2950 2000, or even earlier (Garrison et al. 2011). This drastic population decline in white-tailed deer
2951 has undoubtedly impacted the quality and suitability of habitat for panthers in this region. The
2952 causes for this decline are unknown, but analyses of hydrological data suggest that increasing
2953 water levels since 1995 have had a negative effect on the deer population (Garrison et al. 2011).
2954 However, the authors caution that the decline is likely due to a combination of factors that
2955 interact with high water levels, including predation, disease, and habitat degradation (Garrison et
2956 al. 2011). Extreme fluctuations in hydrological conditions caused by seasonal flooding, weather
2957 events (e.g., tropical storms), and manmade water impoundments, can increase stress and
2958 vulnerability to predation, diseases, malnutrition, and negatively influence reproduction,

2959 recruitment of fawns, and adult deer survival (Loveless 1959, Fleming et al. 1994, Labisky et al.
2960 1995, MacDonald-Beyers and Labisky 2005, Garrison et al. 2011).

2961
2962 The role that predation by panthers or other predators played in the severe deer declines in
2963 southeastern Florida is not fully understood as it is unlikely that a single predator-prey model
2964 accurately represents the predator-prey system in southeastern BCNP and ENP at all times (Gese
2965 and Knowlton 2001). This area has traditionally supported fluctuating deer and panther
2966 populations and it is likely that panther numbers “reflect the relative abundance and stability of
2967 local prey populations” (Maehr and Lacy 2002). Maehr and Lacy (2002) postulated that severe
2968 deer population nadirs in South Florida may prevent continuous occupation of a large carnivore
2969 population. The authors characterized the predator-prey system in South Florida as a stable-limit
2970 cycling model (Ballard et al. 2001) and further cautioned that the deer herd in southeastern
2971 Florida could be reduced or a herd increase neutralized by an artificial and rapid increase in a
2972 large predator population (Maehr and Lacy 2002). However, the recurrent fluctuations model
2973 (Gese and Knowlton 2001) may better approximate the relationship between panthers and deer in
2974 South Florida as the deer herd may never reach a state of equilibrium due to the interactive
2975 effects of a nutrient poor habitat, fire, seasonal flooding, and predation.
2976

2977 **Burmese Python Impacts on Prey Availability:** Burmese pythons (*Python bivittatus*), a non-
2978 native invasive apex predator from southeast Asia, are well-established in South Florida and
2979 have been associated with declining mammal populations due to predation and resource
2980 competition (Holbrook and Chesnes 2011, Dorcas et al. 2012, McCleery et al. 2015). Burmese
2981 pythons were likely first introduced in the southern portions of ENP prior to 1985 via releases or
2982 escapees from private ownership (Wilson et al. 2011). Pythons were encountered regularly in
2983 the region beginning in the mid-1990s; however, it was not until the early 2000s that they were
2984 first recognized as being established in ENP (Meshaka et al. 2000, Wilson et al. 2011). As of
2985 2018, breeding populations of Burmese pythons have been documented across South Florida,
2986 including areas within the occupied range of the Florida panther in ENP, BCNP, and areas within
2987 and surrounding Collier Seminole State Park, PSSF, and Rookery Bay National Estuarine
2988 Research Reserve.
2989

2990 Burmese pythons are habitat generalists and radio-tracked pythons in ENP used a mosaic of
2991 habitat types and exhibited frequent use of elevated tree islands within a freshwater wetland
2992 matrix (Hart et al. 2015). Pythons are large, ambush predators that can grow up to 20 ft in length
2993 and have few natural predators. Free-ranging Burmese pythons in Florida are generalist
2994 predators that consume a variety of prey species, including birds, mammals, reptiles, amphibians
2995 and fish (Snow et al. 2007, Rochford et al. 2010, Dove et al. 2011). Burmese pythons have been
2996 correlatively associated with severe declines of mammals in ENP, including marsh rabbit
2997 (*Sylvilagus palustris*), raccoon, and white-tailed deer (Holbrook and Chesnes 2011, Dorcas et al.
2998 2012). McCleery et al. (2015) empirically demonstrated that pythons caused reductions in marsh
2999 rabbit populations in ENP. All these species are prey for Florida panthers, and thus the presence
3000 of Burmese pythons may be having an adverse effect on the panther prey base.
3001 Python predation on white-tailed deer has been confirmed throughout the established breeding
3002 range of this invasive constrictor (Rochford et al. 2010, Boback et al. 2016, Bartoszek et al.
3003 2018). Although the extent of the impact of python predation on white-tailed deer population is
3004 unknown or speculative, some noteworthy python predation events on deer have been reported

3005 that illustrate the potential threat that pythons pose as a non-native competitor to panther prey
3006 resources in South Florida. These noteworthy events include a single adult python (4.32 m in
3007 length, 48.3 kg) consuming one adult deer and two fawns within a period of several months in
3008 ENP (Boback et al. 2016) and a comparatively smaller python (2.94 in length, 14.3 kg) in Collier
3009 County consuming a fawn (15.9 kg) that was 111.1 percent of the mass of the snake (Bartoszek
3010 et al. 2018). Burmese pythons represent a novel predatory threat to the native prey populations
3011 of the panther in South Florida, including white-tailed deer (Boback et al. 2016).
3012

3013 **Disease Impacts on Prey Availability:** White-tailed deer in Florida are at risk to infectious
3014 disease outbreaks that could reduce white-tailed deer populations and adversely affect the
3015 availability of panther prey. These diseases include bluetongue and epizootic hemorrhagic
3016 disease viruses (collectively referred to as hemorrhagic disease viruses), both considered to be
3017 the most important infectious diseases of white-tailed deer in Florida and the southeastern U.S.
3018 (Forrester 1992). White-tailed deer populations in Florida are also at risk from the New World
3019 screwworm (NWS) fly larvae. The negative effect of this infestation was demonstrated when
3020 NWS eradication efforts initiated in southeastern U.S. in 1958 resulted in dramatic increases in
3021 the white-tailed deer herds in South and Central Florida in the 1960s (Forrester 1992). A recent
3022 NWS infestation detected in the Lower Florida Keys in 2016 impacted the population of Florida
3023 Key deer (*O. v. clavium*) but was successfully managed and contained with no infestations
3024 detected in deer herds on the Florida peninsula (Lopez et al. 2016, Parker et al. 2017, Skoda et al.
3025 2018). The recent NWS infestation in the Florida Keys highlights the need for continued
3026 surveillance to detect future occurrences and for rapid response plans to contain and eradicate
3027 future infestations (Forrester 1992).
3028

3029 Of greater concern would be the introduction of chronic wasting disease (CWD) or heartwater
3030 disease—either of which could have long-term, negative impacts on deer populations. Chronic
3031 wasting disease is a transmissible spongiform encephalopathy of cervids that is slowly spreading
3032 across North America. Management efforts to contain or eradicate the disease in areas where it
3033 occurs have largely been ineffective, and in some regions the disease is negatively impacting
3034 deer densities. Although CWD has not yet been detected in Florida it has recently been found in
3035 TN and MS. Heartwater disease is caused by the bacteria *Ehrlichia ruminantium*. This bacteria
3036 is vectored by ticks, and in the southeastern United States, the Gulf Coast tick (*Amblyomma*
3037 *maculatum*) is a competent vector. Prevalence of infections is associated with proximity of deer
3038 to human development (Farnsworth et al. 2005).
3039

3040 **Land Management Impacts on Prey Availability:** Habitat management via prescribed fire is a
3041 critical conservation tool that has a positive influence on increased prey availability (Garrison
3042 and Gedir 2006). Large areas of the most important habitats occupied by panthers are on
3043 publicly owned conservation lands, including BCNP, FPNWR, FSPSP, PSSF, ENP, OSSF,
3044 Dinner Island Wildlife Management Area (WMA), Spirit of the Wild WMA, and others. How
3045 public lands are managed has the potential to affect panther habitat and prey populations via:
3046 prescribed fire, hydrologic alterations, levels of recreational uses, prevalence of invasive exotic
3047 plant communities, conversions from natural to plantation forests, and other activities. However,
3048 a prime goal in the management plans for most of these lands is to restore and maintain the areas
3049 in a natural state, which ultimately favors panther habitats and prey.
3050

3051 **Summary:** Habitat degradation affects panthers presently and is likely to continue in the absence
3052 of habitat restoration and management. Human degradation or alteration of habitats through
3053 logging and land clearing, oil and gas development, recreational use, or overhunting of prey
3054 species important to panthers degrade the value of habitat for panthers by decreasing the
3055 abundance of prey (Paviolo et al. 2009, Logan and Sweanor 2010). Additionally, the
3056 introduction of new urban and exurban can degrade the value of habitat by concentrating prey
3057 species away from areas of otherwise suitable habitat through supplemental feeding (Storm et al.
3058 2007). Such concentration increases their exposure to diseases which can negatively impact the
3059 prey population well beyond the wildland/urban interface to the detriment of panthers (Edmunds
3060 et al. 2016, Bradley and Altizer 2007). Urban and exurban development also typically cause a
3061 shift in prey availability, from larger prey to smaller prey, that can also diminish the value of
3062 otherwise suitable habitat in adjacent areas for panthers (Burdett et al. 2010, Moss et al. 2016a,
3063 Smith et al. 2016). Lastly, prey populations may also decline through natural processes that
3064 permanently or temporarily make habitat less suitable for them. These include, but are not
3065 limited to: forest succession, forest dieback and pathology, seasonal flooding, and drought.
3066

3067 Human Activity

3068

3069 The absence of human development and activity is one of the strongest predictors of panther
3070 presence and abundance (Dickson and Beier 2002, Paviolo et al. 2009, Burdett et al. 2010,
3071 Frakes et al. 2015) because panthers tend to avoid human activity or face a high risk of mortality
3072 if they don't (Markovchick-Nicholls 2008, Sweanor et al. 2008, Sweanor and Logan 2010,
3073 Foster et al. 2010, Schwab and Zandbergen 2011, Morrison et al. 2014, Wilmers et al. 2015,
3074 Burdett et al. 2010, Moss et al. 2016a). At all phases of development (clearing, construction,
3075 use, and maintenance) human activities produce noise, dust, and smoke, and these can penetrate
3076 panther habitat by as much as 300 to 1,000 meters (Draft HCP 2019), depending on the source.
3077 Typically, the effect of human activity on panthers and other *Pumas* is initially behavioral in
3078 nature, with panthers avoiding areas of human activity or changing their predatory behavior in
3079 the presence of it (Blecha et al. 2015, Smith et al. 2015, Benson et al. 2016, Moss et al. 2016a,
3080 Moss et al. 2016b, Blecha et al. 2018). The extent and duration of their avoidance of areas of
3081 human activity is typically proportional to its duration, extent, and intensity. Specifically, short-
3082 term, localized, low intensity human disturbances usually result in similarly short-term,
3083 localized, habitat avoidance among panthers (Janis and Clark 2002, Sweanor et al. 2008,
3084 McCarthy and Fletcher 2015, Criffield et al. 2018, Abernathy et al. 2019) whilst long-term,
3085 spatially expansive, high intensity human activities typically cause near permanent, functional,
3086 landscape-scale loss of otherwise suitable for panthers (Frakes et al. 2015, Wilmers et al. 2015,
3087 Blecha et al. 2018). Wherever the presence of human activity becomes permanent otherwise
3088 suitable habitat for panthers can be regarded as degraded because their use is limited by the
3089 behavioral response of panthers to noise and other manifestations of human activity that lead to
3090 their avoidance.

3091 Human presence on the landscape also indirectly degrades habitat by impairing habitat
3092 management activities beneficial to panthers or their prey by reversing habitat degradation via
3093 natural processes, discussed in the previous section (Section 5.1.6.3.). Specifically, the presence
3094 of residential and commercial development often makes it difficult for management agencies to
3095 use prescribed burning to manage habitat for the benefit of species like white-tailed deer and

3097 panther, or to allow natural fires to run their course without suppression. In the absence of
3098 smaller-scale, prescribed burning at fixed intervals of time or naturally occurring fires allowed to
3099 burn without suppression, the mosaic of forest cover, open-canopy forest, and patches of early
3100 succession rich in forbs optimal for the deer population would be lost through natural processes
3101 of forest succession (Dees et al. 2001, Main and Richardson 2002). Thus, the reduction of this
3102 form of human activity could constitute habitat degradation that is ultimately detrimental to
3103 panthers.

3104
3105 In less developed areas human activity can lead to locally high concentrations of panther prey
3106 and panthers that are also, ultimately, detrimental to both. Specifically, lands managed to
3107 maximize the abundance of species such as white-tailed deer, wild hog, wild turkey, and
3108 raccoons undoubtedly increase the availability of prey for panthers and this, in turn, increases
3109 ability of landscapes to sustain high densities of panthers (FWC unpublished data). Such is often
3110 the case on lands owned or leased for the purpose of hunting, where habitats are managed to
3111 benefit these species and supplemental feeding is provided to attract and sustain species desirable
3112 for hunting. Likewise, livestock operations where cow-calf operations or other livestock species
3113 amenable to panther depredation are present, such as goats or sheep, may attract and sustain a
3114 large number of panthers (Interagency Florida Panther Response Team, 2017). However, as
3115 mentioned in Section 5.1.6.6. supplemental feeding and other forms of resource provisioning can
3116 concentrate prey species in high densities typically not found in nature, and this may cause them
3117 to be more susceptible to the spread diseases that ultimately, negatively impacts their population
3118 (Bradley and Altizer 2007). Likewise, reliance of panthers on livestock for their needs increases
3119 the chances they may be subject to illegal shootings or management removal. Furthermore, the
3120 concentration of panthers near either human activity may bring panthers into closer proximity to
3121 one another, increasing the possibility for interspecific aggression or disease transmission
3122 between individuals. Where these risks are more often realized than the benefits associated with
3123 these activities, their net effect on the value of affected habitat could only be characterized as a
3124 form of degradation.

3125
3126 Environmental Contaminants

3127 Environmental contaminants are chemicals that accidentally or deliberately enter the
3128 environment, often because of human activities. Environmental contaminants present a potential
3129 threat to panther health, reproduction and survivorship, and many have been detected in panthers
3130 (Facemire et al. 1995). Environmental contaminants detected in panthers include mercury, poly-
3131 chlorinated biphenols (PCB), organochlorides (OCs), and anticoagulant rodenticides (Jordan
3132 1990, Newman et al. 2004, Brandon 2011, Cunningham 2012). Though no panther deaths to
3133 date are attributed solely to contaminant exposure, it is likely contamination with one or more
3134 environmental toxins can and have caused subclinical health effects. The effects of
3135 environmental contaminants in panthers are an ongoing area of research and monitoring and is
3136 required as the subtle long-term effects of contaminant exposure is often challenging to prove
3137 until population declines occur (World Health Organization and United Nations and
3138 Environment Program 2013).

3139
3140 Panthers may have a higher risk of exposure to contaminants because they consume a wider
3141 variety of prey than is typical of *Puma concolor*, generally, (Iriarte et al. 1990) and this broader

3143 generalization of prey creates many pathways of exposure (Roelke et al. 1991). Furthermore,
3144 because panthers are apex predators, they are at higher risk of toxin bioaccumulation that leads to
3145 serious impairment of life functions, behavior, or death (Cleckner et al. 1998). Lastly, panther
3146 exposure to contaminants can vary by time and place (Cunningham 2012) because the
3147 availability of prey species varies in response to environmental and demographic stochasticity,
3148 seasonal weather cycles, rare major events, proximity of panthers to development, and human
3149 activity (Richter and Labisky 1985, Roelke et al. 1991, Fleming et al. 1994).

3150
3151 In 1993, the Service issued a programmatic BO to the Environmental Protection Agency (EPA)
3152 finding common poisons used to kill rats, the anticoagulant rodenticides (AR) chlorophacinone,
3153 diphacinone, pival, and sodium cyanide, jeopardized the continued existence of panther and
3154 several other South Florida listed species (USFWS 1993). However, in 2012, Mark Cunningham
3155 (FWC) reported that the tissues of 20.6 percent (7 of 34) panthers tested post-mortem contained
3156 2 ARs not addressed with respect to panthers in the 1993 BO: brodifacoum and bromadiolone.
3157 Though they were killed in vehicle collisions, the concentrations of these ARs in 2 of the
3158 affected panthers was comparable to concentrations measured in 4 *Puma concolor* killed by AR
3159 toxicosis in the Santa Monica Mountains National Recreation Area (SMMNRA; Riley pers
3160 com), and the concentration of these in Florida panthers appears to be increasing over time and
3161 in proximity to areas of human development (Appendix D).

3162 3163 **5.1.6.4 Motor Vehicle Mortality**

3164
3165 Vehicle collisions are a significant source of mortality for panthers (Figure 5-4). This mortality
3166 directly affects the panther population by reducing the panther population size and potential for
3167 population growth and expansion. Panther mortality from vehicle collisions is presently the
3168 highest source of mortality for panthers and has increased significantly since 1972 (Figure 5-5).
3169 Much of the increase in mortality is strongly correlated with an increasing panther population
3170 size, but this trend is also colinear with the growth in the human population and in recent years
3171 the coupling of panther population size and vehicle mortalities has weakened with panther
3172 population size explaining less of the annual variation in panther/vehicle mortality (Figure 5-6).
3173 The FWC documented 351 vehicle-related panther mortalities and 8 vehicle-related panther
3174 injuries from 1972 to 2018 on highways in south Florida. Most of these incidents involve male
3175 panthers (60 percent), while 40 percent of collisions involve female panthers. Collisions with
3176 motor vehicles killed an average of 28 panthers each year over the past five years. Assuming an
3177 adult population size of 120 to 230 individuals, this means vehicle collisions kill between 12 and
3178 23 percent of adult panthers, annually.

3179 3180 **5.1.6.5 Illegal Shooting**

3181
3182 Illegal shootings have been documented, but the magnitude of the problem is unknown. These
3183 illegal takings result in the loss of individuals within the population (USFWS Draft 2020).
3184 Gunshot injuries resulting in immediate death or found at necropsy following death from other
3185 causes are common. The FWC records 34 panthers wounded or killed by gunshot, and one killed
3186 by arrow, between 22 May 1983 and 7 October 2018. Nineteen shootings of the 34 documented
3187 (55.9 percent) occurred within the last 10 years. This suggests shootings of panthers are
3188 increasing, possibly in response to the growth of the panther population. In a number of cases,

3189 evidence of gunshot was discovered during necropsy of an individual that died of collision with a
3190 motor vehicle. It is possible, then, that panthers that survive a gunshot injury may be
3191 predisposed to injury or mortality by other causes (e.g., vehicle strike or intraspecific
3192 aggression). This may be due to incapacitation of the panther because of secondary infections,
3193 lameness, and loss of ability to hunt. Discovery of gunshot wounds after death from other causes
3194 also indicates panthers are shot more often than reported. Therefore, the degree to which
3195 shootings are a threat to the panther population is not known, but shootings resulting in the loss
3196 of individuals from the population could potentially reduce the viability and recovery of the
3197 panther.

3198

3199 **5.1.6.6 Disease**

3200

3201 Several infectious diseases have caused mortality in panthers and their prey, and an outbreak of
3202 these are a threat to the health and recovery of the population (USFWS Draft 2020). Of particular
3203 concern are feline leukemia, rabies, pseudorabies, feline viral rhinotracheitis, feline calicivirus
3204 and feline panleukopenia, feline immunodeficiency virus (FIV), and dermatophytosis
3205 (ringworm), all of which pose a significant risk to individuals and the panther population as a
3206 whole. (FWC 2020a). For example, between 2002 and 2004, an outbreak of FeLV resulted in the
3207 deaths of at least five Florida panthers, and since 2010, infections have been diagnosed in six
3208 additional panthers. Through genetic analyses of the infecting virus, biologists determined the
3209 outbreak likely came from a cross-species transmission from a domestic cat. Panthers are known
3210 to prey upon domestic cats that roam freely outdoors. Similarly, 6 Florida panthers have been
3211 documented as killed by pseudorabies, which they contract from consuming infected prey like
3212 wild hogs.

3213

3214 Roelke (1990) found 65 percent of panthers were exposed to, or infected by, feline
3215 panleukopenia virus, 43 percent were exposed or infected by feline calicivirus; and 23 percent
3216 were exposed or infected by feline enteric corona virus. Roelke (1990) also found 25.6 percent
3217 were exposed to, or infected by, feline immunodeficiency virus; 26 percent exposed to rabies
3218 virus; 33.3 percent were exposed to feline syncytia-forming virus; 8 percent were exposed to
3219 *Toxoplasma gondii*, and 2.4 percent were exposed to *Brucella*. Some of these diseases are
3220 transmitted by domestic animals. Increased development and concentration of prey could
3221 increase the risk to panthers and their prey if domestic animals aren't contained indoors or
3222 properly vaccinated, or if prey species concentrate in areas of human development as a refugia
3223 from predation (Bradley and Altizer 2007, Razgūnaitė et al. 2009). Transmission of vector-
3224 borne diseases and prey choices among felids like panthers may also be influenced by changes in
3225 precipitation and temperature resulting from climate change (Mas-Coma et al. 2008, Khorozyan
3226 et al. 2015, VanWormer et al. 2016).

3227

3228 Panthers in the Action Area also now exhibit feline leukomyelopathy (FLM), a disorder of
3229 unknown origin that evidenced by nerve damage detectable during necropsy. In one case, severe
3230 deterioration of a panther's health with no prognosis of recovery required humane euthanasia. To
3231 date, FWC has confirmed FLM in 2 panthers and 6 bobcats. Trail camera footage has also
3232 captured nine panthers (mostly kittens) and four adult bobcats displaying signs and behavior
3233 consistent with this condition (FWC 2020a). Though the exact cause for feline leukomyelopathy
3234 is still under investigation, the symptoms are generally consistent with neuropathy reported in

3235 response to traumatic injuries, infections, metabolic problems, exposure to toxins, or a
3236 combination of these.

3237

3238 **5.1.6.7 Climate Change**

3239

3240 Our analyses under the Act include consideration of observed or likely environmental effects
3241 related to ongoing and projected changes in climate. As defined by the Intergovernmental Panel
3242 on Climate Change (IPCC), “climate” refers to average weather, typically measured in terms of
3243 the mean and variability of temperature, precipitation, or other relevant properties over time;
3244 thus, “climate change” refers to a change in such a measure which persists for an extended
3245 period, typically decades or longer, due to natural conditions (e.g., solar cycles) or human-caused
3246 changes in the composition of the atmosphere or in land use (IPCC 2013, p. 1450). Because
3247 observed and projected changes in climate at regional and local levels vary from global average
3248 conditions, rather than using global scale projections, we use “downscaled” projections when
3249 they are available. In our analysis, we use our expert judgment to weigh the best scientific and
3250 commercial data available in our consideration of relevant aspects of climate change and related
3251 effects. Based on the observed trends in the climate record gathered from thousands of
3252 temperature and precipitation recording stations around the world and changes observed in
3253 physical and biological systems, the scientific community is certain that the earth’s climate is
3254 changing and a warming trend in the climate is occurring (USGS 2019).

3255

3256 Florida is vulnerable to pulse events and sea level rise as well as to changes in rainfall and
3257 temperatures expected due to changes in environmental trends. NOAA (2017) model
3258 simulations using the more recent Coupled Model Intercomparison Project Phase 5 (CMIP5)
3259 predicts changes in precipitation seasonally for South Florida with increases in dry season
3260 rainfall up to 20 percent and decreases in wet season rainfall up to 30 percent. The change in
3261 timing of rainfall will likely stress ecosystems and cause changes in vegetation types. Sea level
3262 rise (SLR) of 1m by 2070 is projected under NOAA’s Intermediate-High, High, and Extreme
3263 Scenarios and the CARSWG Highest scenario (Noss et al. 2014, Hall et al. 2016, Kirtman et al.
3264 2017, Sweet et al. 2017, USGCRP 2017, USGCRP 2018). SLR of this magnitude will inundate
3265 405,006 acres (1639 km²; 18 percent) of the panther’s current range (Figure 5-7, USFWS Draft
3266 2020). Recent observations indicate SLR rise in the Southeastern United States, and South
3267 Florida in particular, is accelerating at a faster rate than previously estimated (Boon et al. 2012,
3268 Ezer 2019, VIMS 2020). If so, the amount of panther habitat lost through SLR may exceed 18
3269 percent in 2070. In addition, climate change may also alter habitat used by panthers and their
3270 prey, with an increase in dry season rainfall increasing water levels and hydro-periods during
3271 denning and fawning, and plants that serve as food resources being more dormant. A decrease in
3272 wet season rainfall will likely lead to lower water levels and increased droughts during
3273 reproductively sensitive times for panthers and prey. The changes in rainfall will likely affect
3274 our ability to conduct prescribed burns during preferred times of the year.

3275

3276 It is difficult to estimate, with any degree of precision, which species will be affected by climate
3277 change or exactly how they will be affected. The Service will use Strategic Habitat Conservation
3278 planning, an adaptive science-driven process that begins with explicit trust resource population
3279 objectives, as the framework for adjusting our management strategies in response to climate
3280 change (USFWS 2006). Changes in precipitation may alter wildfire patterns (Fill et al. 2019) in

3281 this fire-dependent ecosystem. Changes in precipitation can also alter the distribution and
3282 prevalence of infectious diseases, prey distribution, or temporarily fragment or aggregate panther
3283 populations and/or their prey, which could affect essential life functions and increase exposure to
3284 disease.

3285 3286 **5.1.6.8 Small and Isolated Population**

3287 Historically pumas occurred throughout the southeastern United States. Habitat loss, declining
3288 prey populations, and persecution resulting from European settlement were the primary cause of
3289 the decline of pumas in North America, including the Florida panther. Today the panther is only
3290 found in south Florida in an area that is less than 5 percent of its historical range (Young and
3291 Goldman 1946). This resulted in inbreeding depression of the few remaining panthers and very
3292 low population size that led to the decision to list the panther as endangered (USFWS 2008).
3293 The few panthers that persisted in the 1980s and early 1990s exhibited some of the lowest levels
3294 of genetic variation that had been recorded for wild felids, certainly in comparison to other
3295 populations of pumas in western North America (Driscoll et al. 2002). Populations of animals
3296 — especially those that persist at low densities such as large carnivores — that are small and
3297 isolated from conspecifics invariably begin to be affected by a variety of factors such as altered
3298 sex ratios, reproductive declines, and outbreaks of disease. The prevalence of these issues in
3299 small populations can often be associated with inbreeding depression, which can result in the
3300 expression of deleterious alleles that can contribute to a variety developmental, reproductive and
3301 epidemiological problems (Roelke et al. 1993a, Roelke et al. 1993b). The documentation of
3302 many of these factors in panthers during that time period supported the notion that inbreeding
3303 depression was having a major impact on the population. Genetic augmentation initiated in
3304 1995 contributed to an apparent growth of the panther population in recent years (Hostetler et al.
3305 2013), and recent PVA models (Hostetler et al. 2013 and van de Kerk et al. 2019) suggest that
3306 the panther population grew rapidly, through 2013 ($\lambda > 1$), though other data indicates that
3307 growth may be slowing (McClintock et al. 2015). However, because of the wide confidence
3308 intervals around population size estimates made by McClintock et al. (2015) the possibility the
3309 panther population is actually stable or declining can't be rejected (Martin, 2021).

3310
3311 Though there has been progress in improving the genetic health of the population, this could be
3312 undone by further habitat loss, fragmentation, degradation, mortality or a combination of these
3313 (Ballou et al. 1989, Johnson et al. 2010). The extent to which these threats may influence
3314 genetic health was not analyzed in either PVA. Specifically, these models assumed current
3315 conditions of habitat availability, connectivity, quality, and sources of mortality would remain
3316 constant over time, and the effect these would or could have on future population vital rate
3317 statistics were already captured in the variation observed in current vital rate statistics of the
3318 panther population. Yet despite the failure to consider the effects of a changing environment on
3319 panther vital rates both analyses concluded that as long as the panther population remains
3320 separated from other puma populations (i.e., the nearest puma population is in Texas more than
3321 1500 mi away), the population will nonetheless lose genetic variation even if environmental
3322 conditions remain constant. Reports of these two PVAs indicated this loss of genetic variation
3323 could come about as a result of many factors, for example by genetic drift or restrictions in gene
3324 flow within the population. In all, the most recent of the two analysis of population viability,
3325 that performed by van de Kerk et al. (2019), indicates maintenance of genetic variability in the

3327 population will remain a challenge and that the need for additional genetic augmentation in
3328 future should be considered.

3329

3330 **5.1.7 Tables and Figures**

3331

3332 **Table 5-1.** Percent of the Florida panther's diet by prey type with spatial and temporal
3333 components incorporated. The dividing line between north and south is Interstate 75 (Alligator
3334 Alley).

Percent Prey Occurrence In Diet	Spatial Occurrence 1977- 1989 ^a		Spatial Occurrence 1996-2014 ^b		Temporal Occurrence (North and South)		
	North	South	North	South	1977- 1989 ^a	1989- 2005 ^b	1996- 2014 ^b
SPECIES							
Wild hog (<i>Sus scrofa</i>)	33.9	8.8	29.01	11.24	42	55.93	21.97
Raccoon (<i>Procyon lotor</i>)	9.4	33.9	19.08	28.09	12	27.12	28.03
White-tailed deer (<i>Odocoileus virginianus</i>)	11.7	10.8	16.79	29.21	28	5.08	21.97
Nine-banded armadillo (<i>Dasypus novemcinctus</i>)	11.9	13.8	13.74	4.49	8	3.39	6.82
Rodentia	7.2	11.7	3.05	6.74	2	0	3.79
Rabbit (<i>Sylvilagus</i> spp.)	18.1	20.4	1.53	5.62	4	0	4.55
Livestock	1.7	0	3.05	0	2	6.8	5.3
Other	6.1	0.6	13.75	14.61	2	1.68	7.57

3335 ^a from Maehr et al. 1990b

3336 ^b from Caudill et al. 2019

3339
3340
3341

Table 5-2. Relative biomass consumed by the Florida panther with temporal and spatial components included.

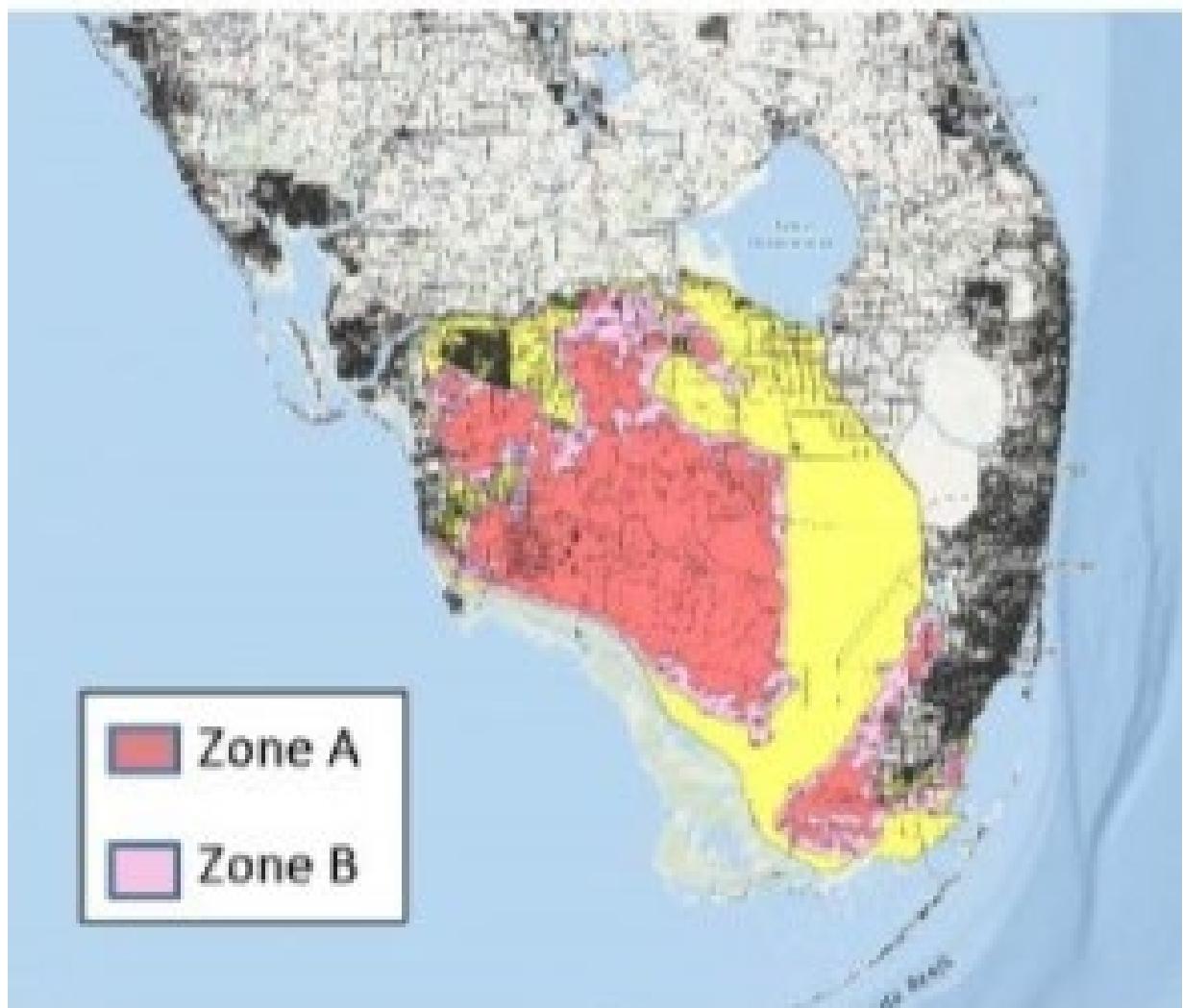
Relative Biomass Consumed ^c	Parameters		Temporal			Spatial 1977-1989 ^a		Spatial 1996-2014 ^b	
	SPECIES	Estimated Weight (kg)	Correction Factor ^{a,c}	1977-1989 ^a	1989-2005 ^b	1996-2014 ^b	North	South	North
Wild hog (<i>Sus scrofa</i>)	23.0	2.8	117.0	155.8	61.2	94.4	24.5	80.8	31.3
Raccoon (<i>Procyon lotor</i>)	5.0	2.2	25.9	58.4	60.4	20.3	73.1	41.1	60.5
White-tailed deer (<i>Odocoileus virginianus</i>)	36.0	3.2	90.7	16.5	71.2	37.9	35.0	54.4	94.6
Nine-banded armadillo (<i>Dasypus ovemcinctus</i>)	6.0	2.2	17.5	7.4	14.9	26.1	30.2	30.1	9.8
Rodentia	0.1	2.0	4.0	0.0	7.5	14.3	23.2	6.0	13.4
Rabbit (<i>Sylvilagus spp.</i>)	1.5	2.0	8.1	0.0	9.2	36.8	41.5	3.1	11.4
Livestock	45.0	3.6	7.1	24.2	18.8	6.0	0.0	10.8	0.0
Other	8.2	2.3	4.5	3.8	17.2	13.8	1.4	31.2	33.1
Total			270.3	262.3	243.3	235.8	227.4	226.4	221.1

3342
3343
3344
3345
3346

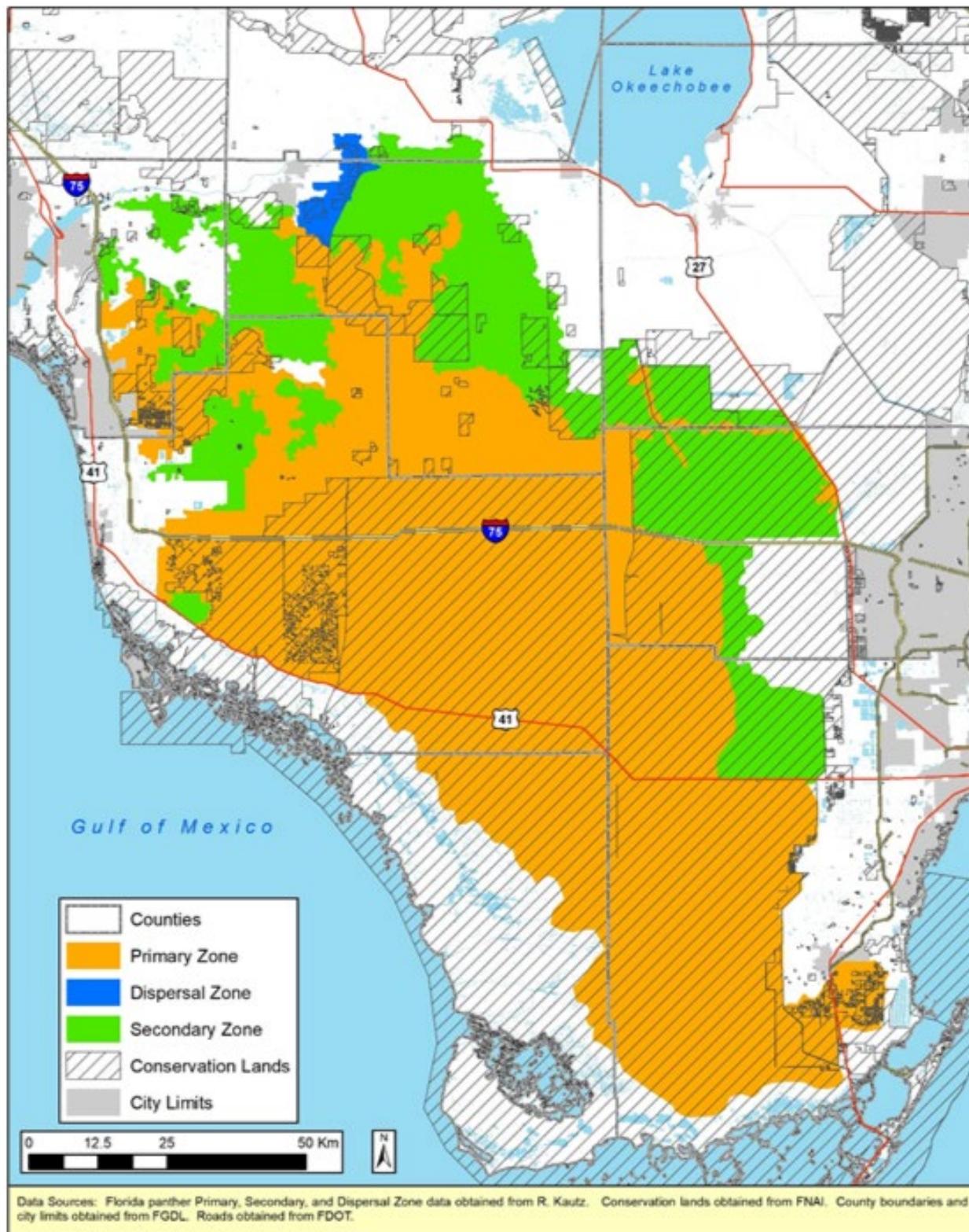
^a from Maehr et al. 1990b

^b from Caudill et al. 2019

^c from Ackerman et al. 1984



3350 **Figure 5-1.** Florida panther Functional Zones as defined by the U.S. Fish and Wildlife Service.
3351 The yellow indicates Zone C, which is defined as an area occasionally used by Florida panthers
3352 and important to dispersal.
3353



3354
3355
3356
3357

Figure 5-2. Florida panther zones based on Kautz et al. 2006.

**Panther Population Size Estimated by the Minimum Annual Count
1985-2015**

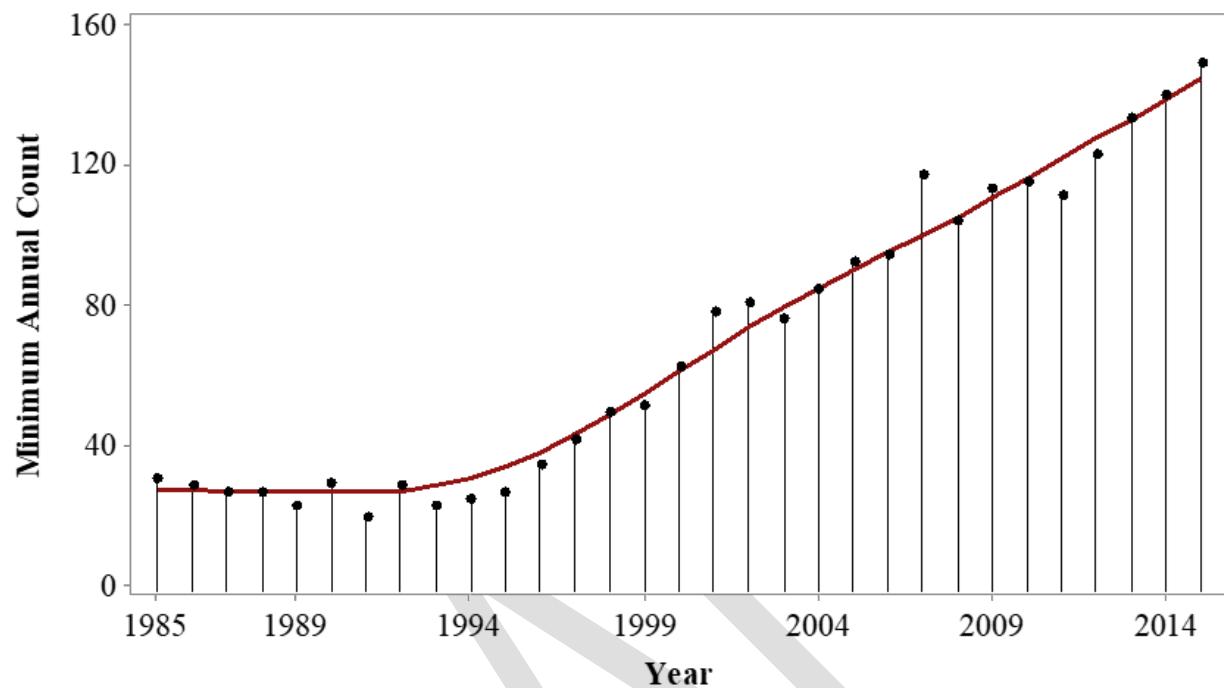
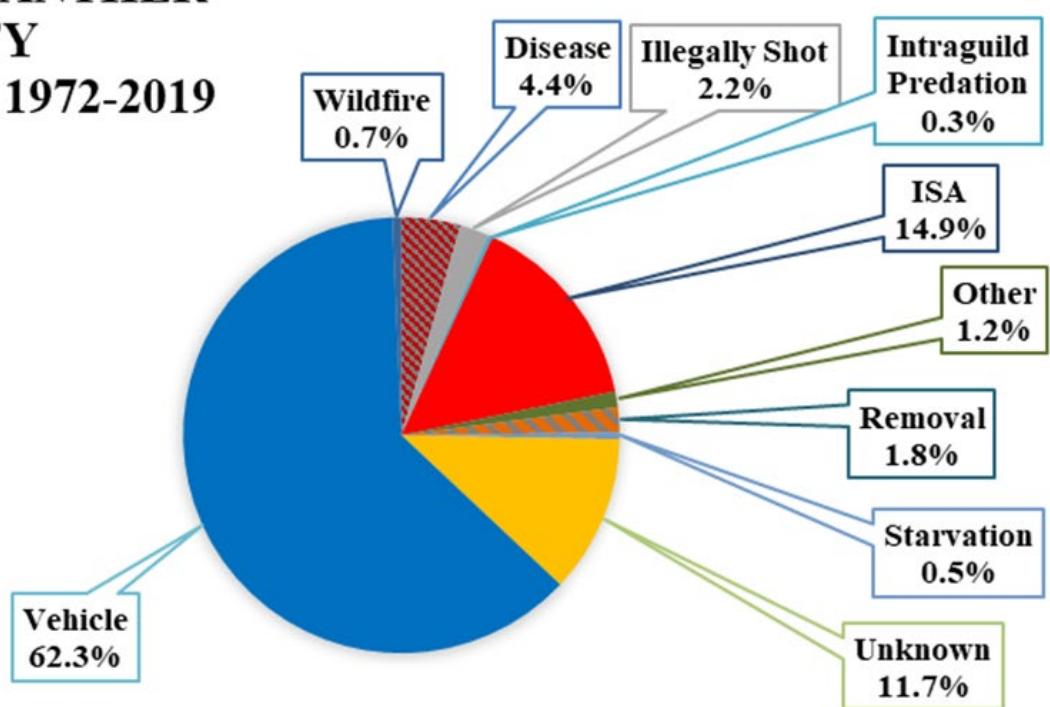


Figure 5-3. Estimated Florida panther population size between 1985 and 2015.

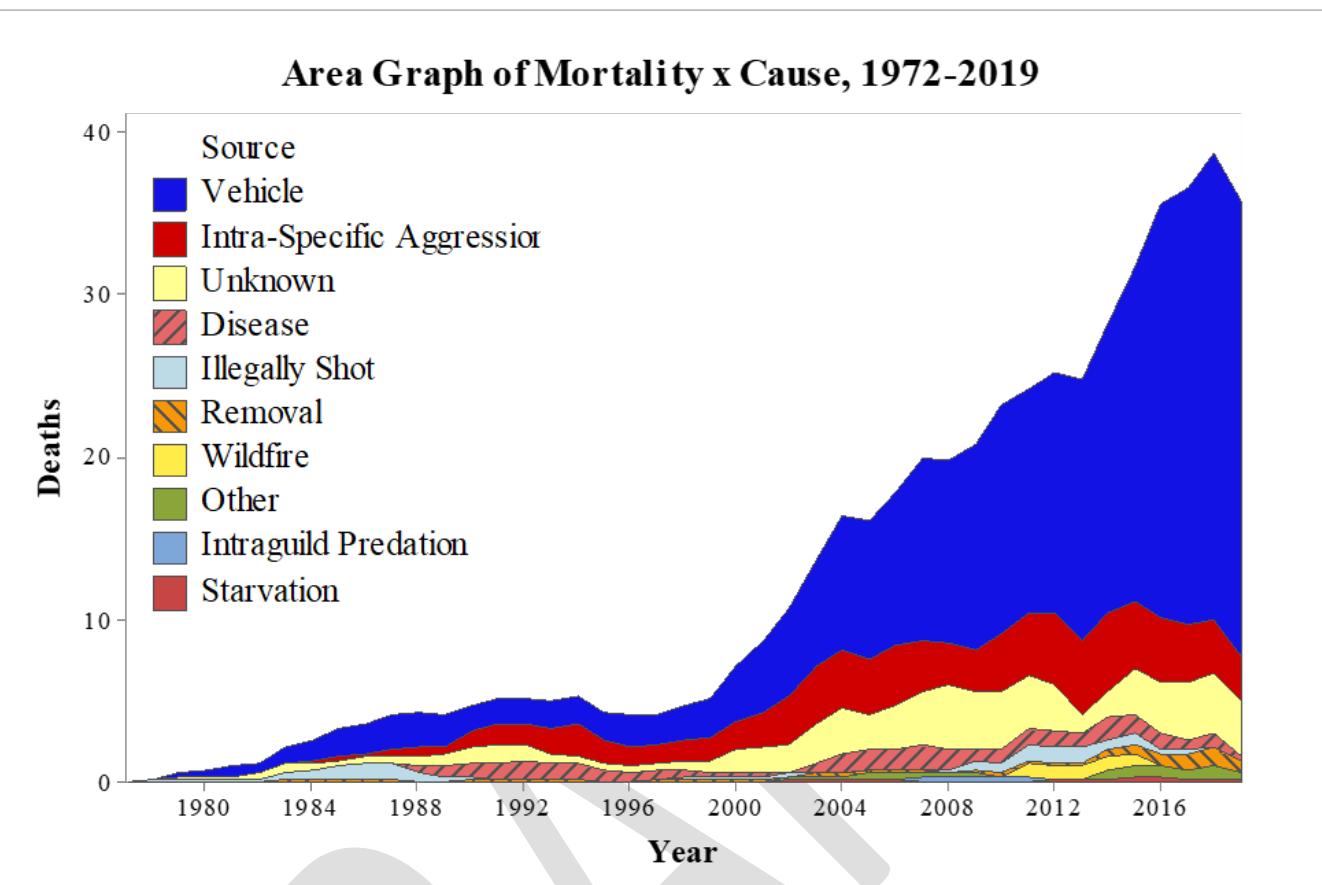
3358
3359
3360

FLORIDA PANTHER MORTALITY BY CAUSE, 1972-2019

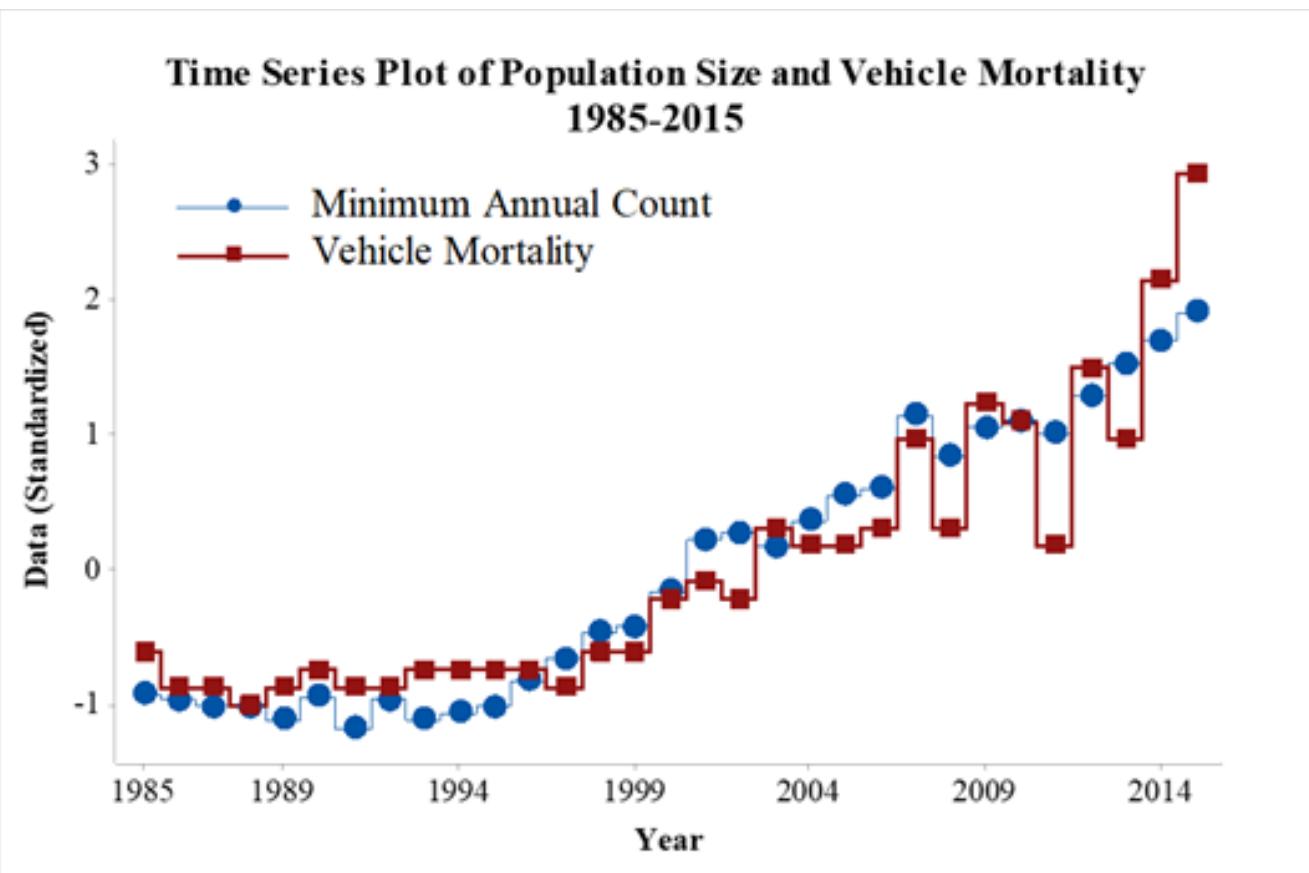


3361
3362
3363

Figure 5-4. Percentage of each cause of Florida panther mortality from 1972 through 2019.

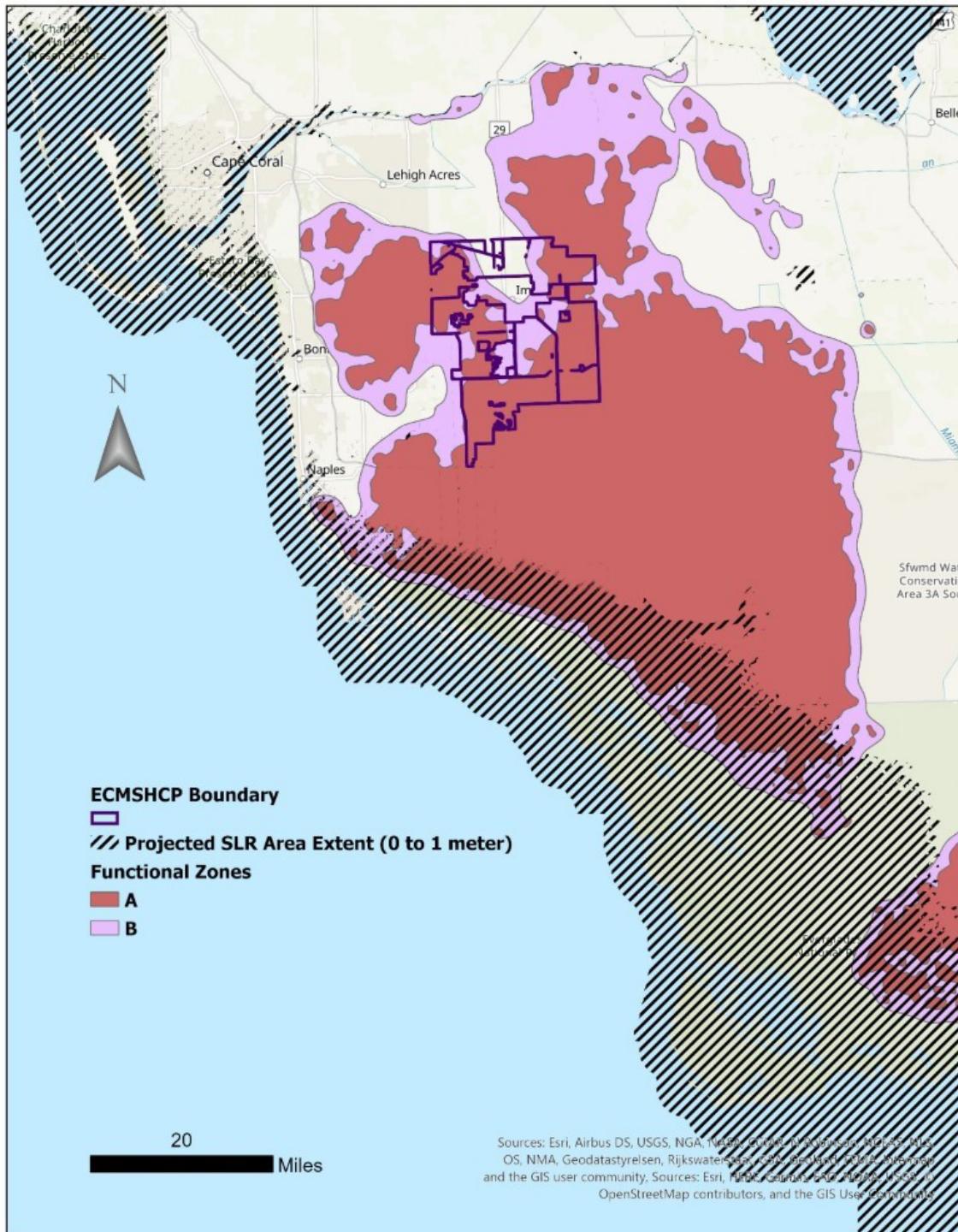


3364
3365
3366
Figure 5-5. Magnitude of each source of Florida panther mortality over time from 1972 through
3367 2019.
3368



3369
3370
3371
3372
3373

Figure 5-6. Standardized plot of Florida panther minimum annual population counts and motor vehicle mortality over time.



3374
 3375
 3376
 3377
 3378

Figure 5-7. Inundation of the Panther Functional Zone predicted to occur with sea level rise of 1 meter.

3379 **5.2 Environmental Baseline for Florida Panther**

3380

3381 This section is an analysis of the effects of past and ongoing human and natural factors leading to
3382 the status of the panther, its habitat, and ecosystem within the Action Area. The environmental
3383 baseline is a “snapshot” of the species’ health in the Action Area at the time of the consultation
3384 and does not include the effects of the Action under review.

3385

3386 **5.2.1 Action Area, Population Size and Distribution**

3387

3388 As explained in Section 2, we define the Action Area as the spatial extent of changes in the
3389 physical environment that will likely occur because of activities proposed in the HCP. Section 3
3390 describes the methods used to estimate changes in traffic volume and infrastructure.

3391

3392 Panthers frequently use the Plan Area and areas immediately adjacent to it for breeding, denning,
3393 and rearing of kittens, with portions of the home range of denning females within or near the
3394 Plan Area overlapping portions of the Action Area. FWC and Service records indicate: 1 den that
3395 produced 3 kittens was located in habitat currently proposed for residential development,
3396 commercial development, and earth mining activities in the HCP; and that another 8 females
3397 established dens that produced a total of 16 kittens in habitat proposed for preservation in the
3398 HCP. Additionally, 13 females established dens that produced 27 kittens within 1 mi of the HCP
3399 boundary, and in nearly all cases their home ranges, the home ranges of their offspring, or the
3400 paths of their offspring during dispersal overlapped the Action Area (FWC unpublished data).

3401

3402 Panthers also regularly use the Plan Area for other purposes. Specifically, 20,196 records of
3403 181,963 total records (11.1 percent) of documented panther occurrences throughout the range
3404 were within the Plan Area (radio-telemetry, GPS, mortality, denning, confirmed observations,
3405 and confirmed depredations). 24.9 percent of panthers (62 of 249) monitored by radio telemetry
3406 between 1981 and 2018 used areas of the HCP designated for future residential development,
3407 commercial development, and earth mining. 36.1 percent (90 of 249) of panthers used areas
3408 designated for future preservation in the HCP. Telemetry data from the past 10 years, for
3409 individuals that wouldn’t be older than 12 years if still alive, indicates approximately 15
3410 individuals currently or previously monitored by radio telemetry likely still use portions of the
3411 Plan Area as a part of their home range, while vehicle mortality data indicates others are young
3412 adults that use the Plan Area temporarily during dispersal. Recent research has also found that
3413 panther densities in the Plan Area range between 3.9/100km² and 4.03/100km² (Onorato et al.
3414 2020). Based on the availability of habitat in the Action Area a density-estimated population size

3415 estimate ranges between 16.2 and 16.6 panthers using the Plan Area (Table 5-3). However, more
3416 panthers than those tracked by radio telemetry or GPS use habitat in the Plan Area. Uncollared
3417 panthers are regularly found among road mortalities in the Plan Area. To estimate a more
3418 precise number of panthers likely using the Plan Area each year that includes uncollared
3419 panthers, as well as collared, we used a combination of telemetry records and mortality records
3420 in a mark/recapture method of population size
3421 estimation for small population sizes: The Chapman
3422 estimator (Chapman, 1951). Using this method, we
3423 estimate an average of 27.6 ± 5.81 adult panthers
3424 (residents inhabiting home ranges plus transient
3425 individuals) used the Plan Area, annually, in the past
3426 five years (Table 5-3, Figure 5-10).

3427 3428 **5.2.2 Action Area Conservation Needs and Threats**

3429 Panthers in the Action Area face the same threats as
3430 those identified in the documents cited above (SSA, 5-
3431 year review, etc. ???) for the species range wide.
3432 Specifically, panthers in the Action Area face impacts
3433 from human disturbance, and human-caused habitat
3434 loss, fragmentation, and degradation from residential
3435 development, commercial development, and climate
3436 change. Sources of human-caused mortality in the
3437 Action Area, such as collision with motor vehicles,
3438 illegal shootings, and increased exposures of panthers to
3439 disease and pollution also threaten growth of the
3440 panther population. Additionally, as the human and
3441 panther populations both grow incidences of human-
3442 panther conflict may also occur to the detriment of
3443 panthers. Lastly, panthers confront many ecological
3444 challenges, such as genetic risks associated with small
3445 population size or declines in prey populations caused
3446 by natural processes or human activity.

3447 Vehicle collisions account for the largest single cause of
3448 injury or death of Florida panthers. Range wide, vehicle
3449 strikes have been responsible for 60 percent of the
3450 panther deaths documented from 1972 to 2018, with
3451 22.4 percent of all documented vehicle mortalities having occurred on roadways in the Action
3452 Area. In the past 5 years an average of 22 panthers were killed in vehicle collisions annually in
3453 the Action Area, while 5.6 ± 0.51 of these 22 panthers are killed by motor vehicle collision on
3454 roadways within and immediately adjacent to the Plan Area.

3455 Other human sources of mortality, such as illegal shootings, exposure to disease, and exposure to
3456 contaminants have also been documented in the Plan Area and areas immediately adjacent to

Chapman's population size estimation for small populations:

$$N_c = \frac{(K + 1)(n + 1)}{k + 1} - 1$$

where,

N_c = Number of animals estimated
in the population

n = Number of animals marked on
the first visit

K = Number of animals captured
on the second visit

k = Number of recaptured animals
that were marked

or more precisely,

N_c = Number of panthers likely
using the Plan Area in any given
year

n = Number of telemetered
animals that visited the Plan Area
in a given year

K = Number panthers killed by
vehicle collision that year

k = Number of panthers killed by
vehicle collision that year that
were monitored by radio
telemetry

3460 either, though the frequency with which they occur and their individual influence on the overall
3461 population trajectory is difficult to determine.

3462
3463 Some aspects of human activity in the Action Area also serve as attractants that increase the local
3464 abundance of panthers over time (FWC, unpublished data) but with detrimental effects to the
3465 panther. These include the introduction of pets, livestock, and feeders that attract prey preferred
3466 by the panther or act as targets of panther depredation. Where prey and panthers concentrate near
3467 areas of human development, the risk of human/panther conflict, interspecific aggression,
3468 disease, panther mortality from vehicle collisions or illegal shootings, and management removal
3469 increases.

3470
3471 Lastly, habitat loss and fragmentation has already occurred within the Action Area, such as
3472 through the construction and use of roads, conversion of former forest lands to agricultural use in
3473 the last century, and via the construction of the Ave Maria residential community and other
3474 smaller-scale residences.

3475
3476 In total, we believe the demographic impact of these threats to baseline panther survival,
3477 reproduction, and population size, as well as the impacts of genetic erosion due to inbreeding in
3478 the Action Area, were captured in the estimation of survivorship and fecundity performed by van
3479 de Kerk et al. (2019).

3480
3481 Because these threats are known and well understood, actions to minimize, offset, or reverse
3482 their impact on panther population viability constitute the conservation needs of the species in
3483 the Action Area. The HCP contains BMPs and design elements to avoid or offset impacts to
3484 panthers, and additional, voluntary conservation measures designed to assist recovery. When
3485 possible, we include these conservation measures in our quantitative analyses. Some of these
3486 measures are difficult to assess quantitatively because we do not yet know the details of “what,
3487 when, where, or how many.” However, these conservation measures are described qualitatively
3488 throughout this assessment and are included in our jeopardy analysis.

3489
3490 As habitat loss continues and sources of mortality, such as vehicle collision, increase alongside
3491 human population growth, more habitat will need to be preserved and panther-vehicle collisions
3492 reduced for the eventual recovery of the Florida panther. Because cattle ranches contain a
3493 substantial amount of the remaining suitable habitat within the panther’s range partnerships
3494 between traditional partners with regional ranching operations are likely to play a growing role in
3495 panther conservation and recovery going forward (Pienaar et al. 2015).

3496
3497 Both the RLSA and the HCP target areas for conservation, including important wildlife linkages.
3498 The HCP includes Camp Keais Strand and the Okaloacoochee Slough as part of the Preservation
3499 Areas and would permanently protect these linkages through conservation easements. This
3500 commitment provides greater assurance that these wildlife linkages will be protected than the
3501 voluntary RLSA program. The type of landscape planning in the HCP also controls where
3502 habitat fragmentation occurs, directing it away from these important habitat linkages. The HCP
3503 conserves about 19,000 acres of additional high quality habitat than under the RLSA alone.

3505 In section 5.1.6., we explained that about 63 percent of the Functional Zone is in conservation.
3506 However, within the Action Area there are no lands currently in conservation. As mentioned in
3507 section 5.1.6., as much as 25 percent of future development projects could occur without
3508 consultation or technical assistance from the Service and may not include minimization or
3509 conservation measures for the panther. Through this HCP, we will consult on all development in
3510 the Plan Area. The rest of the Action Area (*i.e.*, the Plan Area and select roads outside of the
3511 Plan Area) consists of roads on which we will also likely consult. Therefore, the HCP is expected
3512 to increase the number of projects that will consult or receive technical assistance from the
3513 Service, and likely increases minimization and conservation measures that are implemented in
3514 the Action Area.

3515
3516 As discussed in section 5.3.1.4, it is difficult to attribute specific additions to traffic volume to all
3517 parties responsible for the additions. Because we recognize that multiple entities are responsible
3518 for increased traffic volumes that lead to increased risk of panther vehicle mortality, we also
3519 believe that the solution will involve multiple partners working together to implement solutions.
3520 A total of 60 underpasses have been built in the Action Area, and more are anticipated to be
3521 constructed as a result of this HCP and the efforts of local, state, and Federal agencies. Wildlife
3522 crossing facilitated by this HCP will reduce the risk of vehicle mortality from increases in traffic
3523 volumes associated with HCP-related increases and combined with other sources of traffic
3524 throughout the Action Area. See section 15.4.2 (Cumulative Effects) for our analysis.

3525
3526 **5.2.2.1 Habitat Loss**
3527

3528 Habitat loss within the Action Area is a significant threat to panthers that use it. An analysis of
3529 panther locations in the Plan Area showed that most panther telemetry locations in agricultural
3530 areas were within 300 m of forested areas. Our own review found 95.7 percent of all panther
3531 records occur within a forest cover type or within 300 m of one. This is within the distance cited
3532 by Onorato et al. (2010). The forested areas along with the 300 m buffered area are defined as
3533 preferred panther habitat for the remainder of our analysis.

3534
3535 Under the present configuration of the HCP the Plan Area contains 77,063 acres (311.9 km²) of
3536 lands currently used for agriculture (Tables 2-1 and 2-2). The amount of agricultural land that
3537 panthers use differs based on types of agriculture (*e.g.*, ranchland is used more than row crops).
3538 Irrespective of the value of these lands, all their value to panthers is lost when they, or the forest
3539 edges within 300 m of them, are converted from their present land use to urban and exurban
3540 development. Because of their location and relatively lower value to panthers and other wildlife,
3541 to minimize the effects of the action, the HCP proposes to primarily target agricultural areas
3542 beyond 300 m of forest edges for their proposed developments and other covered activities.

3543
3544 The Service acknowledges that future development in eastern Collier County is probable, and
3545 that any form of development will have some effect on panthers. Development in this area can
3546 happen under a variety of scenarios, including this HCP. The Applicants and other non-ECPO
3547 landowners, however, can continue to develop in accordance with Collier County's Rural Lands
3548 Stewardship Program without seeking an ITP. Landowners in the RLSA can choose to continue
3549 the current regulatory approach of project-by-project consultations for wetland fill permitting to
3550 eventually develop an area equal to that proposed by the HCP. Development and activities as

3551 proposed in the HCP will result in the loss of habitat otherwise suitable for panthers and used by
3552 them in the following way. Of the 156,763.7 acres (634.4 km²) of the Functional Zone within the
3553 Plan Area, 42,544 acres (172.2 km²) are forest cover surrounded by 59,808 acres (242.0 km²) of
3554 other habitats within 300 m of forest cover. Based on recent density estimates (3.9 panthers/100
3555 km² (1 panther per 6,336 acres) and 4.03 panthers/100 km² (1 panther per 6,178 acres) within the
3556 Plan Area and telemetry records mentioned previously, we estimate between 9 and 16.6 panther
3557 home ranges can be supported within these 102,352 acres (414.2 km²) of preferred panther
3558 habitat, with the higher end of that range being most likely. (Table 5-3).

3559
3560 As mentioned previously, though, using the Chapman estimator we determined an average of
3561 27.6 ± 5.81 panthers visited the Plan Area each year for the past 5 years (Table 5-3, Figure 5-8).
3562 We believe the discrepancy, the difference between the Chapman estimated number of panthers
3563 actually using the Plan Area annually and the 9 - 16.6 home ranges the Plan Area can support, is
3564 explained by panthers which only use the Plan Area for short periods of time, such as during
3565 dispersal. A closer look at panther/vehicle collision records finds many killed on roadways
3566 within the Plan Area are uncollared, young adults of dispersal age.

3567
3568 Therefore, for this analysis, based on our estimates in Section 5.2.1 and records documenting
3569 past panther presence in the Action Area we accept the following as reasonable estimate of
3570 annual use: on average 27 panthers use the Plan Area each year, and of these, a maximum of 17
3571 likely rely on resources within the Plan Area as part of their home range, while 10 others likely
3572 use the Plan Area for dispersal or other short-term uses. If 27 panthers use the Plan Area each
3573 year, that would mean, on average, between 23 and 12 percent of the panther population
3574 (assuming a population size of 120 or 230 adults, respectively) use habitats in the Plan Area for
3575 feeding, sheltering, denning, or dispersal each year. If 17 panthers use the Plan Area as a portion
3576 of their home range, that would mean, on average, between 14.2 and 7.4 percent of the panther
3577 population use habitat in the Plan Area for that purpose.

3578
3579 **Panther Review Team Analysis:** The PRT analyzed the effects of habitat loss using the
3580 previously recommended Service methodology for assessing impacts to panther habitat from
3581 development. A summary of this analysis and its results can be found in Appendix E.

3582 3583 **5.2.2.2 Habitat Fragmentation**

3584
3585 The growth of the human population and construction of roads are current sources of habitat
3586 fragmentation in the Action Area. The Action Area contains areas of important corridors and
3587 habitat linkages necessary for the movement of panthers from their existing range to the
3588 Caloosahatchee River and beyond. Much of these have already been impacted by the conversion
3589 of native habitats to agricultural use and may be further impacted by conversion of these to
3590 development. Additionally, panthers have been and will likely continue to be deterred from
3591 crossing roadways because of increasing traffic in the Action Area. Panthers also have, and will
3592 continue to be, less likely to successfully cross roadways where municipal and state
3593 improvements add lanes, increase traffic speeds, and attract existing sources of traffic volume to
3594 areas of high panther use.

3596 To mitigate the impact of these, wildlife underpasses have been built to restore the functionality
3597 of these habitat linkages where they've been bisected by roadways, roadway improvements, and
3598 increasing traffic volume. Future road construction that bisects existing habitat blocks, corridors,
3599 and linkages, or traffic volumes that increase the barrier effect of existing roads in the Action
3600 Area, will likely require similar and additional measures to minimize the impact of present and
3601 future habitat fragmentation.

3602

3603 **Panther Review Team Analysis:** The PRT analyzed the effect of landowner proposed
3604 development and traffic generation on landscape connectivity. A summary of their analysis and
3605 findings can be found in Appendix F.

3606

3607 **5.2.2.3 Habitat Degradation**

3608

3609 The legacy of habitat degradation and loss throughout the range of the species draws special
3610 attention to the value of remaining areas of habitat in the Plan Area. Much of the habitat most
3611 preferred by panthers is concentrated in areas designated for preservation in the HCP. Though
3612 these areas are not designated for development in the Rural Lands Stewardship program (which
3613 designates these areas as FSAs, HSAs, and WRAs), or by the Applicants, they nonetheless
3614 remain at risk of degradation through the secondary effects of new development located adjacent
3615 to them, the proliferation of invasive species, and climate change. We summarize the effect of
3616 habitat degradation on panthers and prey species below while both are discussed in more detail
3617 in Section 5.1.6.3.1.

3618

3619 Decline in Prey Abundance

3620

3621 At all phases of development (clearing, construction, use, and maintenance), human activities
3622 produce noise, dust, and smoke, and these can penetrate panther habitat by as much as 300 to
3623 1,000 meters (HCP), depending on the source. As an ongoing activity within the Action Area,
3624 these disturbances likely cause panthers or their prey to avoid areas where these are occurring, or
3625 to use them differently (e.g. changing the time of day they use these areas). Increase in
3626 construction and human occupancy in the future will likely sustain these effects on adjacent areas
3627 of otherwise suitable habitat for long periods of time.

3628

3629 When these disturbances occur, they may result in changes in prey abundance, community
3630 composition, and exposure to disease, invasive species, and domestic species maintained by
3631 residents. The presence of human development may also affect habitat management activities
3632 which benefit the panther's prey, specifically through increased restrictions on prescribed
3633 burning by agencies and the necessity of agencies to suppress naturally occurring wildfires
3634 whenever property is threatened.

3635

3636 Environmental Contaminants

3637

3638 Environmental contaminants in areas of residential and commercial development may enter
3639 the panther's food chain, affecting panthers within the Action Area. Although environmental
3640 contaminants have not been documented as the ultimate cause of death in a panther, it is likely
3641 that contamination with one or more environmental toxins could cause subclinical health effects

3642 and when combined with other stressors (environmental or physical), and that these effects may
3643 reduce fitness and reproductive performance and increase susceptibility to disease.

3644
3645 Specifically, eight of seventeen panthers necropsied after deaths from other causes in the Action
3646 Area, and analyzed post-mortem, showed detectable amounts of Organochlorines in abdominal
3647 fat. Two had detectable amounts of PCB in abdominal fat, and 2 had detectable levels of
3648 anticoagulant rodenticide in their liver. Increasing human presence in the Action Area may
3649 change or increase incidences of disease and contaminant exposure affecting panthers and their
3650 prey.

3651
3652 Lastly, human activities such as hunting can increase the exposure of panthers and other species
3653 to lead via the consumption of wounded prey. There has been at least one case documented in
3654 the U.S. of a *Puma concolor* dying of lead toxicosis after consuming prey that had been
3655 previously shot by hunters (Burco et al. 2012).

3656
3657 All these effects, alone or in concert with other threats, could diminish the value of habitats to
3658 panthers within the WUI without altering the vegetative structure or other ecological features of
3659 the habitat.

3660 3661 **5.2.2.4 Motor Vehicle Mortality**

3662
3663 Vehicle collisions are a significant source of mortality and directly impact the panther population
3664 through reduction in panther numbers and potential for population expansion. Vehicle strikes
3665 have been responsible for 60 percent of the panther deaths documented from 1972 to 2018. 17.9
3666 percent (103 of 547) of panther injuries and mortalities from all causes occurred in the Action
3667 Area. Of these, 82 were killed by collision with motor vehicles while 1 was injured. These 83
3668 individuals represent 22.4 percent of all panthers documented as injured or killed by vehicle
3669 collision range wide. Motor vehicle mortality took an average of 22 panther mortalities/year in
3670 the Action Area, over the past 5 years, and an average of 5.6 ± 0.51 per year within the Plan Area
3671 (Figure 5-11). As mentioned in Section 5.1.6.4, 60 percent of mortalities by vehicle collision are
3672 male and 40 percent are female.

3673
3674 Wildlife underpasses to reduce panther vehicle collisions were first constructed in South Florida
3675 beginning in 1985 and 1986. These crossings successfully allow for the safe movement of
3676 panthers and prey, including white-tailed deer and raccoons beneath busy roadways (Foster and
3677 Humphrey 1995, Land and Lotz 1996). Based on demonstrated use of wildlife crossings by
3678 panthers and prey, the Service, and stakeholders have identified locations where panthers and
3679 other wildlife would benefit from the installation of additional wildlife crossings and wing
3680 fencing.

3681 3682 **5.2.2.5 Illegal Shooting**

3683
3684 Injury due to gunshot is not an uncommon finding in panthers and may result in immediate death
3685 or may be found at necropsy following the death due to other causes. Three panthers with
3686 gunshot wounds were found in the Rural Lands Stewardship Area, and we assume these
3687 individuals were shot in the RLSA or nearby. One panther survived a gunshot wound to the head

3688 and evidence of the gunshot was discovered during necropsy after the animal died from collision
3689 with a motor vehicle. Another panther died as a result of the gunshot (FWC unpublished data).
3690 A third panther was found shot within the Plan Area and later housed at the Naples Zoo. Human
3691 and panther population growth in the Action Area may increase the risk of illegal shootings,
3692 however, we do not have a way to estimate an increase and assume that current vital rates
3693 capture the majority of this threat in our modeling.

3694

3695 **5.2.2.6 Disease**

3696

3697 Disease prevalence is a fluid process dependent on host (panther) susceptibility (e.g., genetics,
3698 health, population density, etc.) pathogen characteristics (virulence, etc.), and environmental
3699 conditions (e.g., contaminants, hydrology, prey availability, etc.). As these factors shift, the risk
3700 of new epizootics (e.g., FeLV) and potentially catastrophic population effects can increase. As
3701 such, continual disease monitoring will be critical to track and identify known and emerging
3702 threats to the panther population.

3703

3704 Two panthers have been documented to die from disease within the Rural Lands Stewardship
3705 Area, representing approximately 8.7 percent of all panthers known to have died of disease,
3706 range wide (FWC unpublished data).

3707

3708 **5.2.2.7 Unknown Causes**

3709

3710 Four panthers died from unknown causes within the Plan Area (5.8 percent of all panthers to die
3711 from unknown cause). We do not have a way to estimate future projections of panthers which
3712 may die from unknown causes, but we assume they are captured in the vital rates reported by van
3713 de Kerk et al. (2019).

3714

3715 **5.2.2.8 Climate Change**

3716

3717 Panthers, their prey, and their habitat are all at risk of impacts from climate change in south
3718 Florida. These include but are not limited to sea level rise and inundation of habitat, habitat
3719 degradation, mortality from extreme weather events, and vector-borne disease. Climate change
3720 will undoubtedly affect precipitation and temperature in the Action Area, likely altering
3721 vegetative community composition over time as well as seasonal water levels. We treat Sea
3722 Level Rise up to 2070 as an effect in the baseline portion of our assessment as it will have range-
3723 wide effects on demographic parameters and habitat availability for panthers within the proposed
3724 permit duration of the HCP. Sea Level Rise of 1m will affect the panther's range and roadways
3725 at the southernmost points of the Action Area, but the Plan Area isn't expected to be inundated
3726 by this level of sea level rise.

3727

3728 **5.2.2.9 Small and Isolated Population**

3729

3730 Since state and Federal laws afforded them legal protections, panther numbers slowly increased
3731 until genetic restoration efforts improved population health thereby allowing a rapid growth of
3732 the population. The current panther population, at least 5-fold larger in size when compared with
3733 the population three decades ago, has greater resiliency today than it has exhibited for likely well

3734 over 100 years. Despite these achievements, the population is still small, and models predict that
3735 it remains at risk from genetic introgression into the future (van de Kerk et al. 2019). Results
3736 from the two most recent PVA models (Hostetler et al. 2013, van de Kirk et al. 2019) reveal that
3737 the south Florida panther population is viable for the next 100 years assuming current conditions.
3738 However, these PVA models did not take into account large-scale habitat loss or other
3739 detrimental anthropogenic activities.

3740

3741 **5.2.3 Tables and Figures**

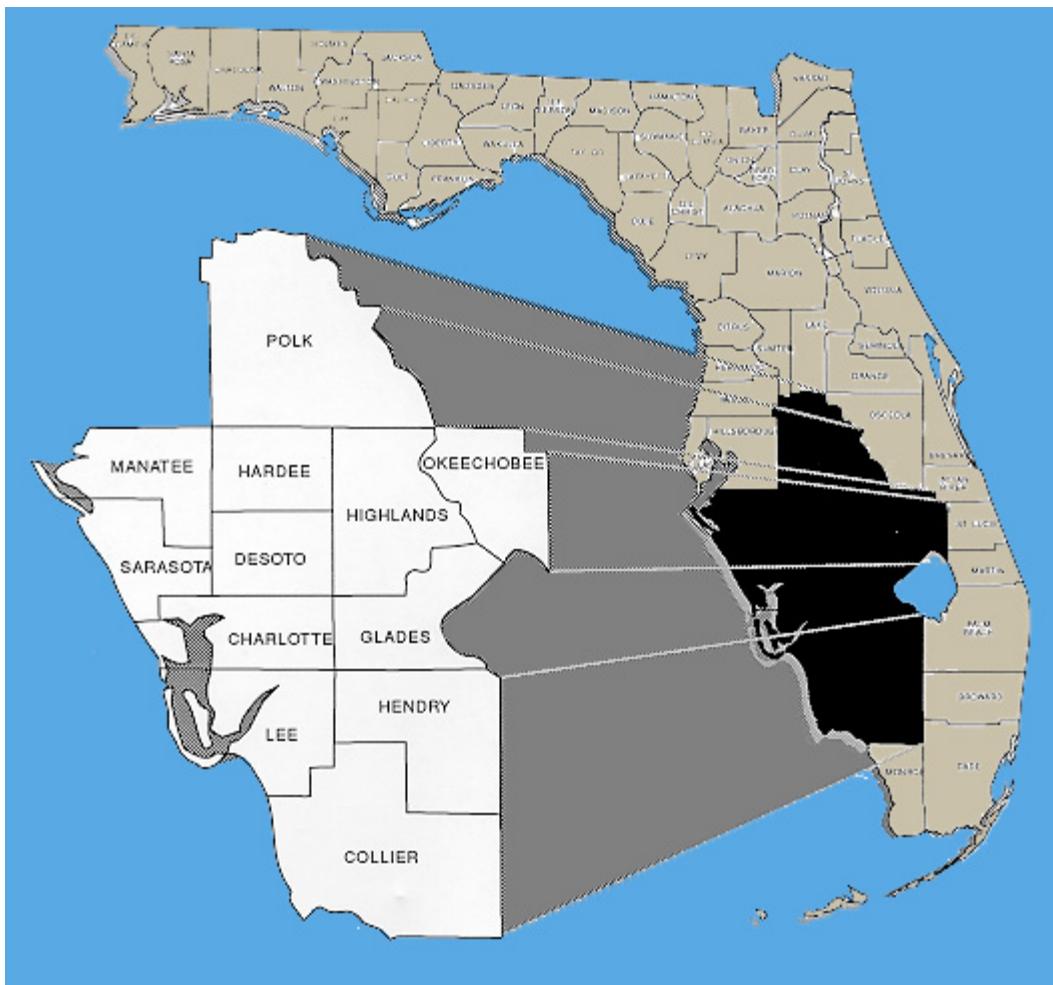
3742

3743 **Table 5-3.** Observations and estimates of Florida panther use of the HCP Plan Area and Action
3744 Area Roads within the RLSA. The advantage of the Chapman's Estimate is that it estimates the
3745 abundance of panthers that weren't tracked with radio telemetry or killed in motor vehicle
3746 collisions that still used the HCP Plan Area in recent years.

3747

	N	Sum	Mean (SE)
Chapman's Estimate (2014-2019)		N/A	27.6 ±5.81
Density Estimate		N/A	16.4±0.20
Observed w/ Radio Telemetry (1982-2018)		97	7.9±0.65
Documented Mortality (1980-2018)		74	5.2±0.34
Dens (1996-Present)		9	N/A
Kittens (1996-Present)		19	2.11±.26

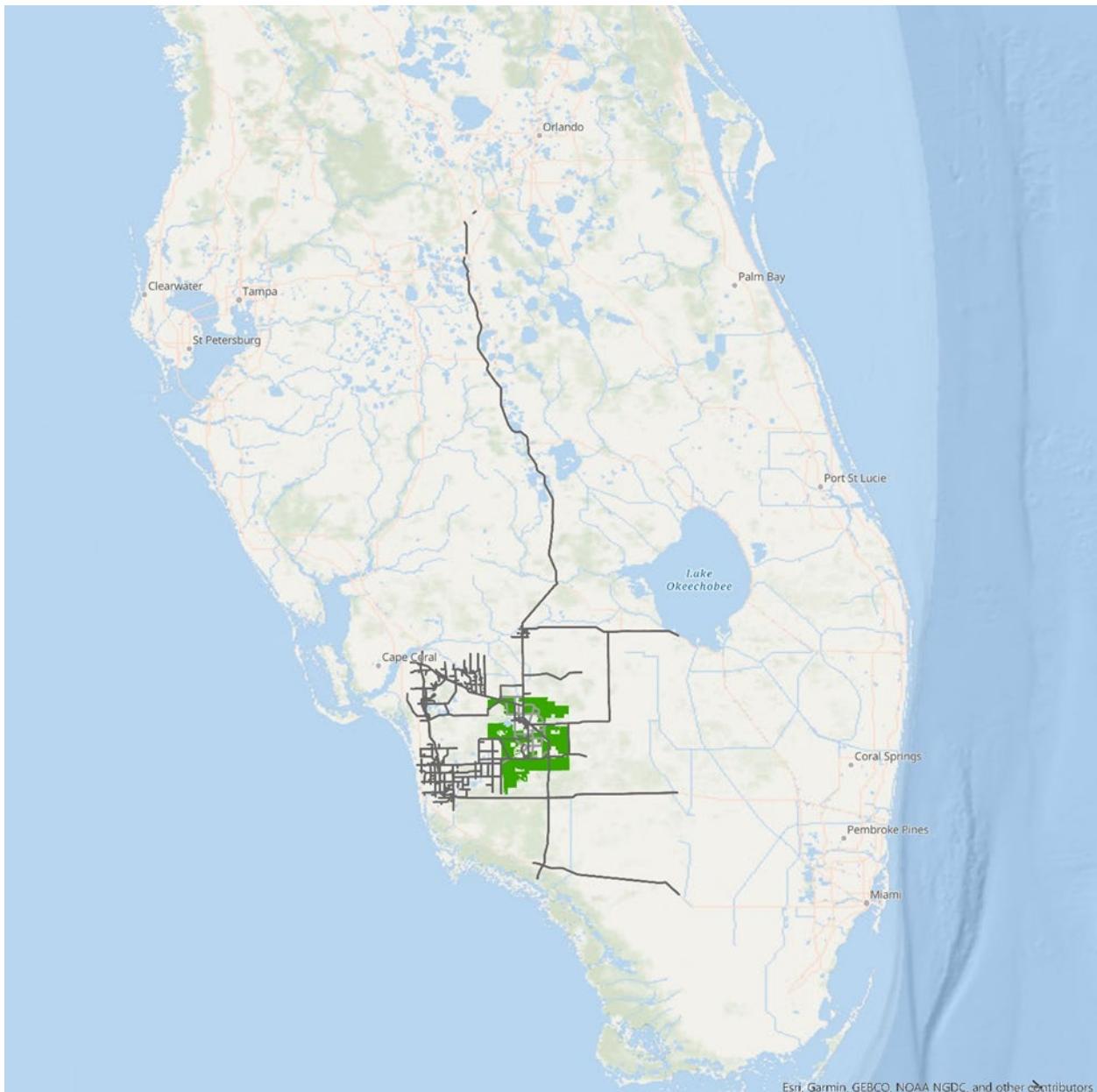
3748



3749
3750
3751
3752
3753
3754
3755

<https://www.fdot.gov/publications/distmap/d1map.shtml>

Figure 5-8. Counties covered in the Florida Department of Transportation's District 1 transportation model.

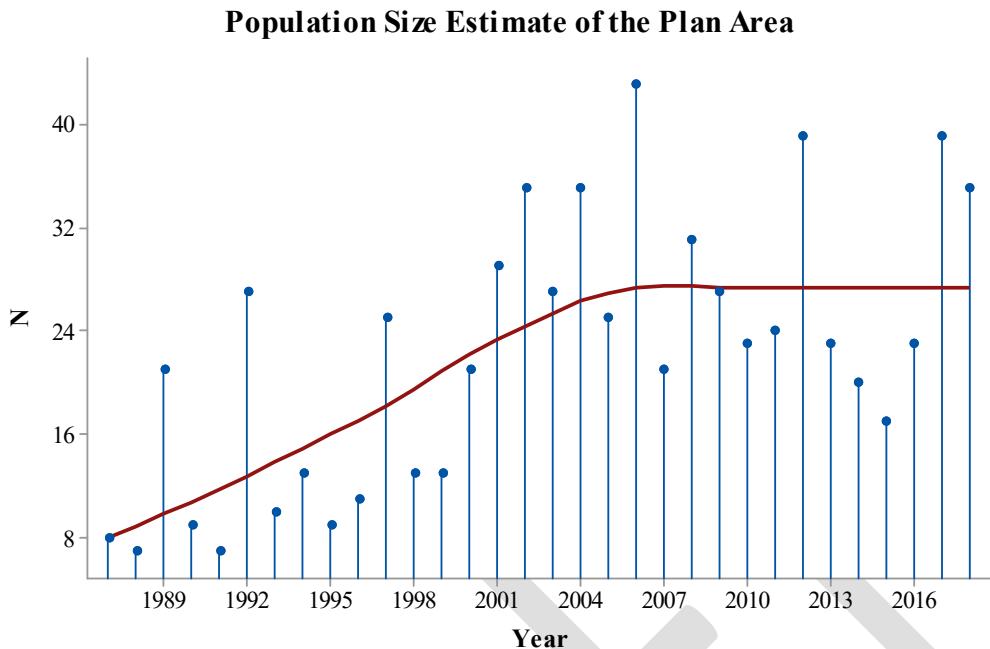


3756

3757

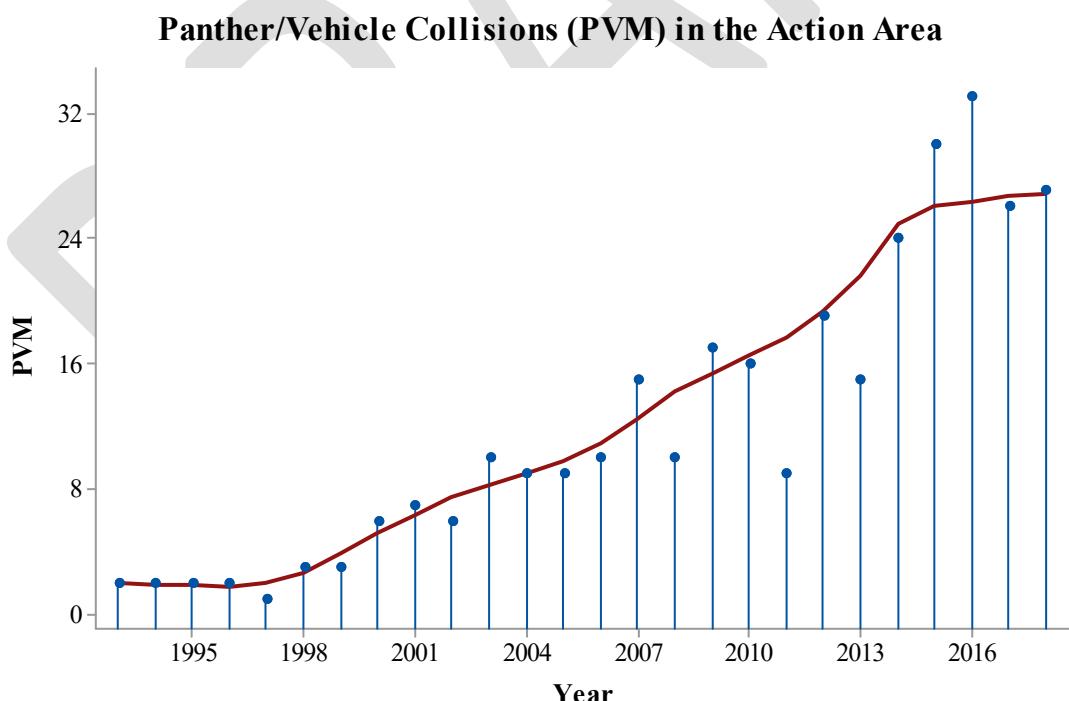
3758 **Figure 5-9.** Extent of the Action Area for this consultation, which includes:

3759 1. the 159,489-acre Plan Area (green); and
3760 2. 5,072 discrete road segments through and extending beyond the Plan Area (black).
3761 Together the road segments equal 1,825 mi.
3762



3763
3764
3765
3766

Figure 5-10. Population size estimate of Florida Panthers using the Plan Area of the Eastern Collier Multiple-species Habitat Conservation Plan.



3767
3768
3769
3770

Figure 5-11. Panther/motor vehicle mortality from 1993 to 2018.

5.3 Effects of the Action on Florida Panther

3771
3772 This section analyzes the effects of the Action on the panther, which includes effects caused
3773 contemporaneously by the Action in addition to those that are reasonably certain to occur as a
3774 consequence of the Action at a later time. Our analyses are organized according to the
3775 description of the Action in Section 2 of this BO/CO. We used a variety of methods to estimate
3776 these potential consequences. Among these, we used a population viability analysis (PVA) to
3777 estimate the potential consequences of threats to the panther population. We recognize that
3778 PVAs require assumptions and inputs of imperfect data, and that these create uncertainties to
3779 consider as we interpret PVA results. We discuss these uncertainties in section 5.6 and in
3780 Appendix XXX?

3781
3782 **5.3.1. Analysis Structure**
3783

3784 We first estimated the effect of individual components of the action likely to affect Florida
3785 panther. These include habitat loss, panther-vehicle collisions, habitat fragmentation, other
3786 stressors such as management removal and disease, as well as the implementation of proposed
3787 conservation measures for which we have specific information about implementation. Each of
3788 these were quantified in the most defensible means using the best scientific and commercial
3789 information available. The methods for the quantification of each are described in respective
3790 subsections of this chapter and subjected to peer review described in XXX.

3791 We next estimated the likely effects of future actions that aren't likely to be subject to future
3792 consultation with the Service (Cumulative Effects). Because the Action Area consists of the Plan
3793 Area and roadways affected by traffic generated by HCP-proposed development our analysis of
3794 cumulative effects was restricted to effects that could be produced on affected roadways, such as
3795 panther-vehicle collision and habitat fragmentation. The methods and results of these analyses
3796 are reported in sections XXX and XXX.

3797
3798 Baseline conditions, Effects of the Action, and Cumulative Effects that were quantifiable were
3799 then incorporated into population viability analysis (PVA) and the results of different scenarios
3800 (Baseline + Cumulative Effects vs. Baseline + Effects of the Action + Cumulative Effects) were
3801 analyzed using the appropriate statistical tests. The methods and results of this are described in
3802 more detail in subsections XXX and appendices XXX and XXX.

3803
3804 Lastly, we considered how conservation measures described in broad, general terms in the HCP
3805 might influence the overall Effects of the Action on Florida panther. Specifically, we performed
3806 a qualitative assessment of how measures described in the HCP, once implemented, would likely
3807 interact with the results of our PVA. We allowed the combination of all available information,
3808 quantitative and qualitative, form our overall impression about how the action will likely affect
3809 the species.

PVA INPUTS = BASELINE + EFFECTS OF THE ACTION + CUMULATIVE EFFECTS

Where:

Baseline =

- Current Population Size of Florida Panther
- Estimated Habitat Carrying Capacity
- Panther Demography (births survivorship etc.)
- Habitat Loss due to Sea Level Rise

Effects of the Action =

- Habitat Loss
- Motor Vehicle Mortality
- "Other" (management removal, disease, environmental toxins, motor vehicle mortality on new roadways etc.)

Cumulative Effects =

- Motor Vehicle Mortality

3810

5.3.2 Development and Mining, Base Zoning, Eligible Lands

3811

3812

3813

39,973 acres of commercial development, residential development, and earth-mining activities will occur within a 43,767-acre development envelope (Covered Activities Area, Base Zoning, and Eligible Lands). This development will take place within and be principally clustered in areas of habitat least valuable to the panther. The approximately 3,794 acres (43,767 acres of Applicant-owned land with 39,973-acre development cap) the Applicants do not develop will be managed in perpetuity in their current land use or become managed to the benefit of Covered Species. The addition of these 3,794 acres to areas to be preserved, and managed to the benefit of species in perpetuity, are already calculated as part of the Preserve Area.

3821

3822

5.3.2.1 Habitat Loss

3823

3824

The Applicants propose to develop 39,973 additional acres in the Plan Area and preserve approximately 90,576 acres in designated Preserve Areas and Very Low Density Use Areas. These two categories of use represent 130,549 of 185,935 acres within the RLSA. Because the community of Ave Maria takes 5,027 acres from Collier County's 45,000-acre development cap, development proposed by the Applicants will take the remaining balance of lands eligible for high density development in the RLSA.

3830

3831

To estimate the effect of this habitat loss on the Florida panther population we 1) estimated the population size of Florida panthers in the Plan Area; 2) relied on more recent analyses of habitat use by panthers to estimate the demographic value of habitats' contribution to overall ecological carrying capacity; and 3) subtracted habitat likely to be lost to Covered Activities to arrive at the equivalent value of carrying capacity loss for Florida panthers.

3832

3833

3834

3835

3836

3837

The HCP assumes it is likely, though not intended, that the "worst case scenario" for development in the Covered Activities Area would impact preferred panther habitat, first. Panther activity is concentrated in native forested cover types and in other habitat types within

3840 300 m around native forest. Therefore, we use the RMI method described in section 2.1.4 to
3841 estimate the extent of development in panther habitats and assumed that all panther-preferred
3842 habitat is taken first in the course of development. Native forested cover types cover 2,418, 110,
3843 and 3,505 acres of the Development and Mining, Base Zoning, and Eligible Lands designations,
3844 respectively (Sum of wetland and upland forests, Table 5-4). These 6,033 of native forest, and
3845 24,583 acres of habitat within 300 m of native forest types, equals a total of 30,616 acres. This is
3846 less than the development cap of 39,973 acres (Tables 5-5 and 5-6).
3847

3848 The conversion of habitat within the development from their current uses to proposed
3849 development will affect the ability of the Plan Area to support panthers. Specifically, 102,352
3850 acres of habitat for panther exist within the Plan Area (forest cover plus all other habitats within
3851 300 m of forest cover) (Table 5-6). As described in the HCP our analysis includes these
3852 assumptions: (1) the Applicants avoid development and earth-mining activities in the most
3853 valuable habitat for panthers whenever possible, and (2) all Lands Eligible for Inclusion do
3854 eventually join the HCP, we estimate the proposed action (Covered Activities Area, Base-Zoning
3855 Area, and Lands Eligible for Inclusion) will permanently remove approximately 2,418 acres of
3856 upland and wetland forest (Column B, Table 5-6). Additionally, 11,342 acres of land used for
3857 agriculture, 1,813 acres of marsh-shrub-swamp, 998 acres of pasture (prairie-grassland), 3,361
3858 acres of Prairie-Grasslands, and 754 acres of lands used for all other purposes within 300 m of
3859 forest will also be converted to residential development, commercial development, or be used for
3860 earth-mining. This will result in the loss of 18,872 acres of total habitat used by Florida panthers
3861 in the Plan Area (Column F, Table 5-6).
3862

3863 To quantify the value of these habitats to panthers and their ability to sustain individual panthers,
3864 based on observed use and habitat availability, we used a Panther Preference Factor, a metric of
3865 panther use of different habitat types, as opposed to the South Florida RFP model (Frakes et al.
3866 2015), which analyzes probability of panther presence on landscapes. Using the Panther
3867 Preference Factor we estimate the Plan Area's actual value to panthers, based on habitat use and
3868 availability is equivalent to 138,848 preference-weighted acres (Column E, Table 5-6).
3869 However, calculating the Post-Development Preference Weighted Habitat Acres that will remain
3870 in the Plan Area after development is complete, is estimated to be 117,330 Preference-Weighted
3871 Acres.
3872

3873 One method of estimating the impact of the action on panthers is identifying the proportion of
3874 area affected by development. To find the extent of area unchanged by the proposed action we
3875 divided 117,330 acres by 138,848 acres, yielding a calculated estimate of 84.5 percent of habitat
3876 that won't be affected by the action based on actual habitat use and availability. The inverse of
3877 this (1-0.845) is 0.155, the product of which indicates the area of habitat that will be affected
3878 based on use and availability. Assuming ~15 panthers use some portion of the Plan Area as part
3879 of their home range (based on past telemetry records), we would expect development and earth
3880 mining (excluding eligible lands) to reduce the population of the Plan Area from 15 individuals
3881 to 12.7 (15 x 0.84 = 12.7 panthers), meaning the action will reduce the number of panthers using
3882 the Plan Area up to the equivalent of 2.3 adult panthers (15 x 0.155 = 2.3).
3883

3884 As discussed in Section 5.2.1, recent research found that panther densities in and near the Plan
3885 Area are higher than previously estimated elsewhere, and range between 3.9/100km² and

3886 4.03/100km² (Onorato et al. 2020). Based on the availability of habitat in the Action Area a
3887 density-based population size estimate ranges between 16.2 and 16.6 panthers using the Plan
3888 Area at any given time, and that proposed development will account for decrease in this
3889 population equivalent to between 2.5 and 4.4 panthers (Table 5-7). Specifically, the loss of
3890 30,616 acres of panther habitat in the Development and Mining, Base Zoning, and Eligible
3891 Lands Envelope would incur a loss in carrying capacity equivalent to 4.3 and 4.4 panthers/year at
3892 full buildout. Similarly, 18,872 acres of estimated development in an envelope only containing
3893 developable and minable lands in the HCP Covered Activities Area and Base Zoning categories
3894 reduces the estimate of carrying capacity reduction to between 2.5 and 2.6 panthers (Table 5-7).
3895 Based on the average of all estimates (3.5) we conclude habitat necessary to fully support at least
3896 3 panthers will be lost as a result of proposed development.
3897

3898 These decreases in carrying capacity from loss of habitat in the Plan Area will likely also have
3899 secondary effects on panthers beyond its boundary. For instance, it is likely intraspecific
3900 aggression beyond the Plan Area boundary will increase when such resources within the Plan
3901 Area are reduced. As it stands 14 panthers were killed between 1980 and 2018 within the Rural
3902 Lands Stewardship Area, which includes lands of the Plan Area and areas immediately adjacent
3903 to it, due to intraspecific aggression. These individuals make up 15.7 percent of all individuals
3904 known to have died from intraspecific aggression, range wide. Our expectation is that mortality
3905 attributable to intensified competition for resources, manifested as interspecific aggression, will
3906 increase beyond this baseline within and beyond the boundaries of the Plan Area as a result of
3907 habitat loss from HCP-proposed development. Habitat loss that sufficiently reduces the
3908 availability of resources to panthers in the Plan Area can also force panthers to abandon home
3909 ranges overlapping the Plan Area, or force young adults to disperse greater distances, which can
3910 increase their risk of injury and death from other sources (e.g., vehicle collisions).
3911

3912 As mentioned previously, we estimate between 23 and 12 percent of the panther population
3913 (assuming a population size of 120 or 230 adults, respectively) use habitats in the Plan Area for
3914 feeding, sheltering, denning, or dispersal each year. Given these high percentages of the total
3915 estimated population of Florida panther, it is likely habitat loss and fragmentation in the Plan
3916 Area may undermine the ability of the Plan Area to support a significant part of the overall
3917 panther population using it for a portion of their home range. It is also likely that habitat loss in
3918 the Plan Area may also reduce the resource value of the Plan Area to a substantial share of
3919 young, non-resident panthers during dispersal if adequate dispersal corridors and habitat linkages
3920 are not maintained. In both cases it is likely these will have range wide effects to the species.
3921 Two such corridors/linkages exist within the Plan Area: namely Camp Keais Strand and
3922 Okaloacoochee Slough. These secondary and tertiary effects of habitat loss in the Plan Area are
3923 discussed more fully in the appropriate following sections.
3924

3925 **5.3.2.2 Habitat Fragmentation**

3926

3927 Habitat fragmentation attributable to the effects of the action may occur directly through the
3928 conversion of habitats that connect areas used by panthers to one another due to residential use,
3929 commercial use, earth mining activities, or new transportation infrastructure built by the
3930 Applicants to connect these to existing roadways. Habitat fragmentation imposed by existing
3931 roadways may also be intensified by increases in traffic volume on existing roadways caused by

3932 residential development, commercial development, and earth mining activities undertaken by the
3933 Applicants. The effects of barrier intensification may be minimized where the Applicants take
3934 measures to maximize internal traffic capture rates of future communities, or use their resources
3935 to construct wildlife crossings, in partnership with local, state, and Federal agencies, that enable
3936 panthers to safely cross roadways.

3937
3938 The potential impacts of habitat fragmentation to the panther are described in 5.2.2.2.
3939 Information regarding the possible locations of new roads within developments or connecting
3940 developments to the highway system or an estimate of traffic volume on them, will not be
3941 available until individual developments are proposed. We accommodated this by treating the
3942 entire development area as converted to low- or no-value habitat. Considered this way, habitat
3943 fragmentation becomes primarily due to highway traffic barrier effects throughout the Action
3944 Area. We used estimates of increased risk of vehicle caused mortality provided in Sections
3945 5.3.1.3 and 5.3.1.4 to partially predict the effect these will have on panther population growth, if
3946 not population connectivity.

3947 Due to likely increases in traffic volume in the Action Area panthers that breed, feed, shelter, and
3948 disperse in the area of the 1,825 mi of existing roads (including 91 mi that will require upgrade)
3949 and 83-87.5 mi of new roadways likely to be built in the future, will find it more dangerous to
3950 cross roads or will avoid crossing roads during peak periods of traffic. The spatial extent of
3951 these roadways, which will act as barriers to travel by panthers across the landscape, encompass
3952 the full expanse of Zone A of the Functional Zone. 94 percent of these roadways are within 25
3953 mi of the HCP boundary, which encompasses a majority of panther habitat south of the River.

3954
3955 Development proposed in the HCP will also contribute to habitat fragmentation affecting
3956 connectivity between the Big Cypress Core Habitat Region and Okaloacoochee Slough Core
3957 Habitat Region, and between these and Core Habitat Areas north of the Caloosahatchee River, by
3958 intensifying existing barriers. Assuming 10,000+ vehicles per day constitutes a near-complete
3959 barrier to panthers (see Section 1.1.6.2; Charry and Jones 2009) we offer the following analysis
3960 for habitat fragmentation caused by traffic. Our analysis of the Traffic Model for Action Area
3961 roadways identifies 535 mi of existing roadways that will exceed the 10,000+ vehicles/day
3962 threshold by 2070 (Figure 5-12). The analysis also identifies 278 mi of roadways that will move
3963 from “onset” to “peak” impacts to wildlife (<3000 vehicles/day before to 3000-6000
3964 vehicles/day after) by 2070. Traffic volumes in this range are expected to increase risk to all
3965 wildlife, including panthers (Charry and Jones 2009). Existing roads at 10,000+ vehicles/day
3966 now and existing roads that will exceed the 10,000+ vehicles/day threshold because of future
3967 traffic from the Plan Area will decrease panther access to ~729.5 km² (180,263 acres, or 8
3968 percent) of Functional Zone habitat within and adjacent to the Corkscrew Regional Ecosystem
3969 Watershed (CREW). These effects can be minimized with HCP proposed measures that include
3970 but are not limited to, installation of wildlife crossing(s) and fencing, and panther corridor
3971 establishment/management. Additional measures (e.g., enforcement of speed limits) would
3972 further reduce the risk of PVM.

3973
3974 Presently, four wildlife crossings facilitate access to the southern portion of CREW, and one
3975 facilitates movement within it. Three of these exist on a singular corridor into and out of CREW
3976 from the south (through Camp Keais Strand), while a fourth appears to facilitate panther

3978 movement southward into Golden Gate Estates. Currently, there are no wildlife crossings on the
3979 ground to facilitate dispersal of panthers from CREW northward across SR-82 and CR
3980 876/Daniels Parkway, or across current (e.g., Lehigh Acres) or future barriers (e.g., HCP
3981 development). On January 28, 2020, the Applicants added a second panther corridor north of
3982 CREW and acreage to the corridor along the Collier-Hendry County line (Figure 5-13). This
3983 second corridor was designed to maintain a minimum width of 400 meters and intersects the
3984 FDOT wildlife crossing location on SR-82 at Under Canal (approximately 0.7 mi west of the
3985 intersection of SR-82 and Corkscrew Road). With the addition of this corridor, the HCP provides
3986 landscape connections through both FDOT wildlife crossings on SR-82. An additional crossing,
3987 which the county and state have designed and funded at Corkscrew Crossings, has yet to be
3988 constructed. Upon construction, though, this crossing should provide additional panther access
3989 to this area of habitat and reduce current high mortality at this location. When completed, these
3990 crossings will provide vital access to approximately 383.8 km² of habitat that facilitates dispersal
3991 of panthers from the northern boundary of the CREW habitat region to the Caloosahatchee
3992 River. The actions volunteered by the ECPO landowner in this case exemplifies the kind of
3993 coordination among Applicants and highway agencies that would be facilitated by the HCP.
3994

3995 Existing and proposed barriers, primarily roads and associated traffic volume, also reduce the
3996 ability of panthers to access the Okaloacoochee Slough State Forest from CREW to the west and
3997 the Big Cypress NP to the south. These corridors are bisected by SR 29 (from Immokalee to La
3998 Belle) and CR 846 (Immokalee to County Line Road). Currently there is only one crossing
3999 servicing this ~30-mi stretch of roadways. Projected increases in traffic generated from
4000 development proposed in the HCP will substantially reduce panther access between these
4001 locations (Figure 5-12).

4002 An additional barrier already exists along ~30 mi of roadways spanning SR-80 from Labelle to
4003 where it joins with SR-27 at Whidden Corner on to Clewiston. Most stretches of the road already
4004 exceed 10,000+ vehicles/day, and there is only one wildlife crossing. The 4 mi of this route that
4005 don't exceed this threshold are likely to become areas of substantial impact (estimated 3,000-
4006 6,000 vehicles/day), which will further intensify the impact of this barrier on panther movement
4007 across the landscape. This stretch of road is very important because it cuts across the Dispersal
4008 Zone. Local and state agencies are currently constructing an additional wildlife crossing on SR-
4009 80, which will provide additional access for panthers to move through this barrier to areas north
4010 of their present breeding range.
4011

4012 However, the most significant contribution of HCP sourced traffic volume to habitat
4013 fragmentation is its potential to contribute to the intensification of the barrier effects along
4014 north/south series of roadways that can result in bisection of the Functional Zone, potentially
4015 splitting it into two sections of roughly ~4,500 km² each. Traffic generated by development
4016 proposed in the HCP will intensify along ~89 mi of roadways beginning on SR-29 near La Belle,
4017 extending southward to its junction with the Tamiami Trail, then eastward along the Tamiami
4018 Trail to the vicinity of the Paolita Station, which is the terminus of the District 1 traffic model.
4019

4020 Specifically, our analysis of the traffic model indicates some of SR-29 from La Belle to its
4021 intersection with I-75 is already over the threshold of 10,000+ vehicles/day that serves as a
4022 nearly complete barrier to all taxa if adequate wildlife crossings are not installed. If projected
4023

4024 HCP-generated traffic is realized, nearly all of SR-29 from LaBelle to I-75 will exceed the
4025 10,000+ vehicle/day threshold. Development proposed in the Plan Area would also nearly triple
4026 AADT from the intersection of I-75 and SR-29 southwards, along SR-29 to Tamiami Trail, then
4027 eastward along it to at least Paolita Station. This increase in traffic volume will fall within the
4028 range of substantial impacts to carnivores, including *Pumas*, of 3000-and 6000 vehicles/day (as
4029 defined by Charry and Jones 2009). There are currently 6 wildlife crossings on SR-29, 4 north
4030 of I-75 and 2 south of I-75. Additional crossings will likely be needed to minimize the effects of
4031 projected increases in HCP-generated traffic (and other development activities).

4032 To address the effects of new and intensifying habitat fragmentation and vehicle mortality from
4033 increasing regional traffic the Applicants have committed the first \$12.5 million from the
4034 Marinelli Fund to facilitate the construction of wildlife crossings. Based on the opinion of
4035 species biologists that have previously worked to establish wildlife crossings for panthers in the
4036 past, which estimated a cost of \$1.5 million per crossing, we estimate the amount pledged by the
4037 applicants would enable the construction of about 8 wildlife crossings and associated fencing.
4038 As part of Plan, and consistent with the purpose of the Marinelli Fund, the applicants will work
4039 with local, state, and Federal partners to place these crossings in areas of greatest need. SR 29
4040 from Immokalee to I-75 and other locations identified by the PRIT Transportation Subcommittee
4041 have already been identified as areas in need of more crossings. Therefore, we expect crossings
4042 across these roadways will help ensure that important panther habitats will not become isolated.
4043 Cooperation among permittees is built into the HCP, which can help plan crossings across
4044 ownership, ensure that suitable habitat remains on either side of the crossing, and that fencing
4045 and gates are maintained and used properly. These crossing will help offset traffic from HCP
4046 projects and from other sources as well.

4047
4048 A currently unquantifiable benefit of the HCPs is that if a wildlife crossing is proposed on HCP
4049 covered lands, we can work with ECPO landowners to ensure that habitat for panthers is
4050 maintained in perpetuity on both sides of the road, and adequate fencing and gating is installed
4051 and maintained. These features will increase crossing effectiveness and enhance wildlife
4052 corridor functionality that will be greater than what is currently estimated in the PVA. Although
4053 this coordination would be possible without the HCP, it would become integral to HCP
4054 implementation.

4055
4056 Additionally, the Applicants' HCP establishes the intent to locate new commercial development,
4057 residential development, and earth mining activities away from these habitat corridors and
4058 linkages, and to retain at least 95 percent of current land use within them through the
4059 establishment of conservation easements. Project-specific best management practices are
4060 described in the HCP and will be required in developments to minimize their disruption of
4061 wildlife using adjacent habitat corridors.

4062
4063 Additionally, though local, state, and Federal partners are in various phases of pre-planning for
4064 an additional 4 crossings, the Service has not yet consulted on these, so we cannot assume they
4065 are reasonably certain to occur. A fifth crossing is planned and funded for Corkscrew Road, but
4066 it won't be constructed until it has been determined that traffic volumes justify widening the road
4067 at this location. However, this crossing is more than 2 mi from the nearest cluster of panther
4068 mortalities and wouldn't be included in our analysis for that reason. Nonetheless, it is
4069 reasonably certain, moving forward that we will continue to see design and construction of

wildlife crossings by agencies that control and construct roadways where PVM occurs. It is likewise reasonably certain that these agencies will continue to coordinate and receive some funding from private landowners who control adjacent land, and whose development projects influence traffic levels. The effects these crossings will have on reducing panther/vehicle collisions will be assessed at the time they are proposed in consultation with the Service.

Quantifying the demographic impact of habitat fragmentation requires a more detailed analysis than we are capable of for this HCP because we lack precise information about where the developments will be built, how landscapes around them will be managed, and where future crossings will be located. We also lack information about immigration and emigration rates across roadways bisecting areas of habitat used by panthers that would serve as a starting point for analyzing the effects of increasing habitat fragmentation. Thus, our PVA (section 5.5) does not include explicitly defined estimates of demographic impacts from habitat fragmentation. However, the PVA does incorporate estimates of impacts from highly related sources of mortality identified in Moss et al. (2016a) and discussed in more detail in sections 5.3.1.3 and 5.3.1.4. Therefore, we believe our estimates of mortality in each of those sections capture some, if not most, of the primary effects of increased habitat fragmentation within the immediate vicinity of the Plan Area and this is reflected the results of our PVA described in Section 5.5.

5.3.2.3 Habitat Degradation

Habitat degradation refers to the reduction in quality in an area of habitat for a given species. A species may still inhabit an area where habitat degradation occurs, but certain life history functions may be impacted. For example, reproductive rates and survival rates may be reduced.

Decline in Prey Abundance

Habitat loss discussed in Section 5.3.1.1 will affect the panther's prey as well as the panther. In addition to the reduction in prey using these habitats, we expect the establishment of new developments in the Plan Area will shift the wildland/urban interface (WUI) closer to the Big Cypress Core Habitat Region and Okaloacoochee Slough Core Habitat Region, the only Core Habitat Regions occupied by panthers (USFWS Draft 2020). When this occurs, we anticipate there will be a shift in the composition of the prey community and prey selection by panthers near the new WUI as has been observed elsewhere for cougars (Burdett 2010, Moss et al. 2016, Blecha et al. 2018, Alldredge et al. 2019, Coon et al. 2019, Kreling 2019). Specifically, numerous studies have found that urbanization results in the proliferation of cosmopolitan species such as rats and raccoons, the introduction of exotic species that compete with or prey on native species, the concentration of other species like white-tailed deer in exurban and urban areas, and the switching of *Puma concolor* to smaller prey items to reduce prey handling time where interruption by human activity becomes common. The reduction in preferred prey increases the likelihood panthers near the new WUI will experience nutritional stress and engage in depredation of domestic species. There may also be increases in intraspecific aggression with other panthers if prey species are concentrated into smaller areas. Thus, the impact of proposed development near otherwise suitable habitat will cause additional injury or death of panthers. The decrease in prey abundance or change in prey community composition and corresponding

4115 increase of injury or mortality of panthers near the new WUI will be indicative of degraded value
4116 of otherwise suitable habitat near HCP proposed development.

4117

4118 Human Activity

4119

4120 Impacts from construction (e.g., noise, smoke, land/vegetation clearing, earth moving and
4121 grading, dewatering, construction of buildings and infrastructure) and use of completed facilities
4122 will occur in the development footprint. Specifically, we estimate that noise, dust, and pollution
4123 from development may degrade habitat up to 300 m outside the development footprint. Some
4124 activities associated with mining (e.g., blasting) may temporarily extend farther by affecting
4125 panthers up to 1,000 m away during earth mining activities (HCP). During the construction phase
4126 some of these activities could cause panthers and/or their prey to avoid these areas until
4127 construction is completed. However, effects like noise from humans working and living in newly
4128 constructed communities and commercial facilities, pollution, and exposure to disease and
4129 harassment from interactions with pets and wildlife exposed to them, and potential management
4130 removal of individuals that become problematic for residents will persist as long as human
4131 development is present on the landscape. Studies in other regions of the country have found that
4132 other populations of *Puma concolor* have switched their prey preference to cosmopolitan meso-
4133 predators and rodents because of their elevated relative abundance and shorter handling times
4134 when the possibility of interruption by human activity becomes common. We expect the
4135 movement of the WUI via HCP proposed development closer to occupied Core Habitat Regions
4136 of the Florida panther's range (USFWS Draft 2020) will have similar effects and that these
4137 changes to the panther's environment will result in a permanent reduction in the value of
4138 adjacent areas of habitat used by panthers.

4139

4140 Environmental Contaminants

4141

4142 In the Santa Monica Mountains National Recreation Area in California (SMMNRA) 83–93
4143 percent of coyotes, bobcats, and cougars had measurable concentrations of anticoagulant
4144 rodenticides (ARs) in body tissues, with 4 cougars known to have died from anticoagulant
4145 rodenticide toxicosis (Section 5.1.6.3). These poisonings have been attributed to
4146 bioaccumulation in cougars via the consumption of rodents poisoned with these near the
4147 urban/wildlands interface (Riley et al. 2007, Moriarty et al. 2012). As mentioned previously,
4148 *Puma concolor* have been documented as shifting their prey to more abundant meso-predators
4149 and rodents where development is present, meaning those with home ranges close to the new
4150 WUI are especially vulnerable to toxicosis when ARs are used. Our own spatial analysis
4151 (Appendix D) of exposure to ARs among Florida panthers, in addition to confirmed cases of
4152 lethal AR poisonings of other wildlife species in Collier County, gives us reason to expect failure
4153 to prohibit ARs in new developments proposed in the HCP will result in exposure and effects to
4154 Florida panthers similar to those observed among cougars and other species in the SMMNRA.
4155 The presence of environmental contaminants nearer the core range of the Florida panther
4156 increases the likelihood of injury or death of panthers, thereby diminishing the value of core
4157 habitat nearer to the new WUI of HCP proposed development.

4158

4159 Estimate of Effects

4160

4161 Moss et al. (2016a) examined puma foraging ecology and survival in an expanding urban–
4162 wildland system in Colorado from 2007 to 2013. For GPS-collared individuals, they related diet
4163 to age–sex class and fine-scale space use, with regard to levels of habitat development. They also
4164 examined how habitat development impacted risk of mortality, using hazards models and records
4165 of puma–human conflict. In their study, Moss et al. (2016a) found use of developed areas
4166 substantially increased risk of puma mortality; for every 10 percent increase in housing density,
4167 risk of mortality increased by 6.5 percent, regardless of sex. However, this risk is elevated
4168 compared with the management strategy in South Florida because a total of 62 percent (16 of 26)
4169 of mortalities in adult pumas were human associated. Of the human-associated mortalities in the
4170 Colorado study, over half (n=10) were caused by lethal removal, either by a management agency
4171 or by private landowners. Other human-associated mortalities were hunting (n=3) and vehicular
4172 trauma (n=3). Natural deaths (n=5) were those caused by intraspecific conflict (n=3) or injury
4173 (n=2). The cause of death was undetermined for five individuals.
4174

4175 Since the proposed action will result in 39,973 acres of new residential and commercial
4176 development within the 159,489-acre Plan Area, we estimate housing density in the Plan Area
4177 will increase by approximately 25 percent. Dividing this by 10 percent and multiplying the
4178 answer by 6.5 percent yields an estimate of 16.3 percent of panthers using the Plan Area each
4179 year potentially being taken from all causes related to the proposed development, at full buildout.
4180 In Section 5.2.1 we estimated a population size within the Plan Area was of 27.6 ± 5.81
4181 individuals using the plan area each year, meaning a maximum of 33.4 ($27.6+5.81=33.41$)
4182 panthers likely utilize the Plan Area, annually. Thus, we estimate an unadjusted likely maximum
4183 take of the equivalent to 5.2 adult panthers could occur annually as a result of lethal/injurious
4184 stressors generated by proposed development, within the Plan Area, at full buildout. When we
4185 adjust this range to account for roadways on which mortality was already estimated by other
4186 means (SEE SECTION 5.1.1.4 Motor Vehicle Mortality and Appendix H), and eliminate
4187 mortality from causes identified in the Moss et al. (2016) that do not apply in Florida (e.g.,
4188 hunting, lower management removal), we arrive at an adjusted estimate of the equivalent of ~1
4189 adult panthers being lost annually, at full build out. These individuals will be taken from causes
4190 other than mortality on existing roadways and habitat loss due to residential and commercial
4191 development, and earth mining activities. These sources of mortality may include but are not
4192 limited to:
4193

- 4194 1 Increased mortality from intra-specific aggression among panthers displaced by proposed
4195 development and human activity;
- 4196 2 Increased mortality and decreased individual fitness caused by increased of intra- and
4197 inter- specific competition;
- 4198 3 Increased predation of panther kittens from other predators when preferred prey
4199 populations decline;
- 4200 4 Effects to individuals from habitat loss, degradation, and fragmentation because of new
4201 roads connecting new areas of development to one another and the existing road network.
- 4202 5 Increased injury and mortality from collisions with traffic on new roads;
- 4203 6 Management removal because of depredation and human/panther interactions;
- 4204 7 Increased exposure to disease;
- 4205 8 Increased exposure to toxins

4207 The PVA incorporates this estimate and is described in more detail below (Section 5.5). This
4208 estimate is above what is captured in current vital rates in the van de Kerk et al. (2019) PVA
4209 because it relates to new development.

4210

4211 **5.3.2.4 Motor Vehicle Mortality**

4212

4213 Any commercial and/or residential developments built in the Plan Area in accordance with the
4214 HCP would produce a quantifiable increase in traffic, and this increased traffic would affect the
4215 risk of wildlife mortality throughout the larger Action Area. In accordance with section 50 CFR
4216 402.17.b, we treat the increase in traffic, in both the Plan Area and larger Action Area, as a
4217 consequence of HCP implementation. In other words, it is reasonably certain that increased
4218 traffic will be generated by new developments and whether the effects of the action might result
4219 in jeopardy to the panther population. In this BO we make estimates of traffic increases to
4220 delineate the Action Area and to estimate changes in the risk of wildlife mortality from vehicle
4221 collisions. We have estimated how much the risk of PVM might increase in response to
4222 increased traffic; however, many factors influence the risk of wildlife mortality from vehicle
4223 collisions to the extent that panther mortality by vehicle strikes cannot be fully attributable to the
4224 Applicants, or any other entity. These factors include, but are not limited to adjacent habitat type,
4225 presence or absence of wildlife crossings and fencing, patterns of development, traffic levels,
4226 roadway design, vehicle speed, and driver skill and behavior. Furthermore, design and
4227 maintenance of roadway facilities by local and State government also have a large influence on
4228 wildlife roadway mortality.

4229 While the Applicants determine the number of homes/people in their developments, delineate the
4230 spatial arrangement of natural corridors, and can design developments to retain traffic within the
4231 development, they do not regulate driver behavior, nor do they control highway location and
4232 design. The Applicants can influence other factors, such as cooperating with or funding state or
4233 county agencies to install or improve wildlife crossings, but not to an extent to demonstrate
4234 direct control over such factors.

4235 Moreover, the factors beyond the Applicants' control are variable to such a degree that any
4236 estimate of PVM (which we provide in Appendix H) would be too uncertain to attribute with
4237 confidence to Applicant contributions of increased traffic volume. Increased traffic serves to
4238 increase the chances of PVM only if other factors, each with their own probability of elevating
4239 PVM, happen to align and result in a panther vehicle strike. Examples include:

- 4240 • Continuing human population growth in southwest Florida beyond the Action
4241 Area drives a demand for new residential and commercial development. The
4242 location and density of development, such as that under the HCP, directly
4243 influences the distribution and volume of traffic on existing public roads, as well
4244 as the construction of additional lanes to existing roads and entirely new
4245 transportation corridors. The improvement of existing corridors and construction
4246 of new roadways can likewise spur new development. The actions of other
4247 landowners and the affected highway agencies occur independently of ECPO's
4248 actions.
- 4249 • An absence of improved wildlife crossings would increase the chance of a panther
4250 strike, while an absence of suitable habitat in the area would reduce it.

- A driver distracted from scanning the roadway or hindered by inclement weather is less likely to avoid a panther.
- Panther population density is positively correlated with PVM. Numerous examples of such probability trends are apparent.
- Without traffic volume, highway design might hardly matter, unless panthers are extremely numerous in a given spot. In areas with high traffic volume, like Alligator Alley, PVM can be reduced to negligible levels with proper construction that precludes the need for animals to cross roadways.

Therefore, we estimate and consider the predicted increased risk of wildlife mortality, along with the environmental baseline and the predicted cumulative effects, to determine the overall effects to the species for the purposes of preparing this BO on the proposed action in accordance with 50 CFR section 402.02. However, we do not attribute take from vehicle strikes to the Applicants because they do not have sufficient direct control and the causal linkages are too remote and attenuated.

Panther deaths by vehicle collision are an important human-caused mortality type and highway exposure risk varies for individual panthers and across the landscape. This is true for panthers in the Action Area (see Sections 5.1.6.4 and 5.2.2.4). Much of the Florida landscape is characterized by high road density, and the probability of adult panther presence declines precipitously as the number of people and roads per unit area increases (Frakes et al. 2015). Benson et al. (2019) suggested that extinction probabilities could be reduced by increasing connectivity among puma populations and reducing risks of vehicle collisions.

A common method of reducing or eliminating panther/vehicle collisions along roadways where these occur regularly is via the construction of wildlife underpasses with wing fencing. According to the Florida Fish and Wildlife Conservation Commission there are currently 60 wildlife crossings or bridges that have been modified for use by panthers on Florida's roads. In an effort to reduce the risk of panther/vehicle collision, the Applicants have committed \$12.5 million of the first \$13 million from the Marinelli Fund to facilitate the construction of wildlife crossings. We estimate this amount would enable the construction of ~ 8 wildlife crossings and associated fencing (Section 5.4.2).

In order to estimate the effect of traffic generated from residential and commercial developments proposed in the HCP, we obtained estimates of future traffic from either source by using the D1RPM to predict traffic levels in the Action Area at full build-out based on socioeconomic projections (residents/jobs) for southwest Florida. We adjusted the regional socioeconomic projections to account for the addition of 174,000 residents and 91,480 dwelling units proposed in the HCP at a density and internal traffic capture (~50 percent) comparable to that in the Ave Maria development. Then we applied these assumptions on existing roads within the Plan Area where these developments are most likely to occur. This analysis is described in more detail in Appendix B.1.

4298 We found residential and commercial development proposed in the HCP will contribute to future
4299 total traffic volume. Using the D1RPM and the adjustments describe above (Adjusted D1RPM
4300 Model), we estimate the proposed development in the HCP will generate 718,498 new daily trips
4301 on regional roadways that either originate in or terminate within areas proposed for development
4302 in the HCP. The range of contribution from the HCP on individual road segments in the model
4303 is between a 0 percent and 98.5 percent increase over current AADT.

4304
4305 Our analysis found that when panther/vehicle mortality per road segment is treated as a function
4306 of traffic volume (Current PVM/Current AADT * Future AADT), additional traffic expected
4307 from residential and commercial developments at the scale proposed in the HCP could increase
4308 the risk of panther mortality from vehicle collision by approximately 11 panthers per year (above
4309 present). The early commitment of Marinelli Funds could fund about 8 improved wildlife
4310 highway crossings. If these would be located on road segments with the highest mortality rates
4311 (Appendix I, Table AI2), we estimate the risk of panther mortality by vehicle collision would be
4312 reduced by 3 panthers, and that net risk of mortality of panthers from vehicle collision will be
4313 approximately 8 per year (11 - 3 = 8) in 2070 (Appendix I, Table AI3).

4314
4315 To address potential sources of uncertainty (identified and described in Chapter 3 of this
4316 Biological Opinion) in this estimate, we incorporated this estimated future annual mortality risk
4317 into the more dynamic environment of PVA. This enabled us to address many sources of
4318 uncertainty associated with this estimate and how it interacts with other factors like demographic
4319 stochasticity, environmental stochasticity, parameter uncertainty, and the effect of panther
4320 abundance on the risk of collision. However, we did not have data to address other sources of
4321 uncertainty, such as how traffic volume itself could bias detection and reporting of
4322 panther/vehicle mortality, how improved detection can influence the estimate of the panther
4323 abundance, or how sufficiently large traffic volumes may reduce the risk of collision because of
4324 barrier effects. This analysis is discussed in more detail in Section 5.5 and the **Appendix X, X,**
4325 **and X.**

4326
4327 Therefore, as noted above, while we estimate and consider the predicted increased risk of
4328 wildlife mortality, along with the environmental baseline and the predicted cumulative effects, to
4329 determine the overall effects to the species for the purposes of preparing this BO on the proposed
4330 action in accordance with 50 CFR section 402.02, we do not attribute take from vehicle strikes to
4331 the Applicants because they do not have sufficient direct control and the causal linkages are too
4332 remote and attenuated.

4333
4334 **5.3.3 Preservation Activities and Very Low Density Development**

4335
4336 Both the Development and Preservation Areas are located in habitats that are regularly used by
4337 panthers for feeding, breeding, and sheltering (Section 5.2.1). The designated Preservation
4338 Areas are 90,576 acres in extent, and within them, we identify 69,342 acres of habitat frequently
4339 used by panthers (forested area + all other available habitat types within 300m of it, Table 5-5).
4340 This habitat makes up approximately 68 percent of all panther habitat in the Plan Area. When the
4341 effects of 1m of Sea Level Rise and projected development to 2070 are applied to the South
4342 Florida RFP model (Frakes et al. 2015) (Table 7.3 in USFWS Draft 2020) the Service estimates
4343 that up to 840 km² of panther habitat as it is defined by that model could be lost from the area

4344 south of the Caloosahatchee River currently supporting the only breeding population of panthers.
4345 Securing 69,342 acres (280.6 km²) of panther habitat in perpetuity will help offset this loss.

4346
4347 The location of the Preservation Areas is as, or more, important than simply the number of acres
4348 being preserved. The Preservation Areas are part of the Okaloacoochee Slough wetland
4349 ecosystem linkage that is adjacent to agricultural lands that lie between BCNP and
4350 Okaloacoochee Slough State Forest (OSSF). This critical linkage is a broad swath of occupied
4351 panther habitat. Without the Preservation Areas included in this HCP, and if current
4352 development trends persist, this linkage would likely be developed/degraded and could cease to
4353 function, or function less effectively, as a corridor connecting BCNP and OSSF. The loss or
4354 degradation of this corridor could inhibit the natural dispersal (population expansion) of panthers
4355 needed for the recovery of the species.

4356
4357 The Applicants' HCP proposes a continuation of existing land uses (agriculture, silviculture,
4358 etc.) in the Preservation Areas, which we listed in section 2.3. The HCP commits that the future
4359 land uses in the Preserve Areas will remain mostly the same, negligible in effect of any change,
4360 or become more beneficial to panthers. The HCP proposes the following land use activities,
4361 some of which may improve habitat for panthers and other species in the Preservation Areas:

4362
4363 a. prescribed burning;
4364 b. mechanical control of groundcover (*e.g.*, roller chopping, brush-hogging,
4365 mowing);
4366 c. ditch and canal maintenance;
4367 d. oil and gas exploration
4368 e. mechanical and/or chemical control of exotic vegetation; and
4369 f. similar activities that maintain or improve habitat quality.

4370
4371 Implementation of these activities may temporarily cause panthers to avoid areas while they take
4372 place. It is unlikely that any of these activities would result in injury or death of panthers.
4373 Because the Service has documented rare incidences of mortality from wildfire in the past, we
4374 have developed best management practices for prescribed fire. The Applicants have committed
4375 to performing surveys for listed species prior to these activities and we believe this will reduce
4376 the potential for take of listed species. The Applicants will also verify with FWC prior to
4377 burning that there are no known denning locations within the treatment area. Because
4378 documented instances of panther injury and mortality from these types of land uses are rare, we
4379 believe that if the Applicants perform pre-action surveys and adaptively plan their activities
4380 around the results of these, the risk of injury to panthers will be discountable.

4381
4382 In Chapter 4.2.3.2 of the HCP, the Applicants propose to restore, preserve, and maintain panther
4383 habitat in the Preservation Areas and Very Low Density use designations. Preservation Areas
4384 will also serve as mitigation for most or all of the covered species. While preservation via
4385 conservation easement is the primary approach to maintaining Preservation Areas habitats for
4386 panthers, the HCP proposes habitat enhancement or restoration as mitigation, at least as an
4387 option, for several of the other covered species.

4389 While the HCP does not specify performance measures (amount or extent, functional gain) for
4390 such restoration and enhancement activities, at a minimum we expect the proposed management
4391 of Preservation Areas to maintain the current numbers, reproduction, and distribution of the
4392 panthers in the Preservation Areas, because these activities would, at minimum, maintain current
4393 conditions. Restoration of 17,605 acres of non-forested lands in the Preservation Areas (Table 5-
4394 4) to forest cover could result in sustaining the equivalent of 1 to 3 panthers, annually. However,
4395 the Applicants do not commit to an express amount of habitat restoration during their
4396 implementation of the HCP.

4397
4398 The applicants also propose to replace habitat for other species, such as the caracara, that is lost
4399 during development. The HCP does not indicate where in the Preservation Areas restoration for
4400 other species will occur. Depending what type of habitat change occurs, the change could be
4401 beneficial or detrimental to panthers. For example, forested land that is converted to pasture
4402 would be detrimental while row crops converted to pasture would be beneficial.

4403
4404 The applicants also propose to do wetland restoration, but it is not possible to determine where
4405 restoration will occur or the type of restoration that will be done. As with the restoration for other
4406 species, wetland restoration could be beneficial or detrimental to panthers depending on the
4407 location, type, and magnitude of restoration.

4408
4409 The Very Low Density (VLD) use areas of the HCP contain 2,667 acres of panther habitat that
4410 could support panther breeding, feeding, sheltering, and dispersal (Table 5-4). Proposed land
4411 uses in the VLD areas are similar to the Preservation Areas, but may also include isolated
4412 residences, lodges, and hunting/fishing camps, at a density of no more than one dwelling unit per
4413 50 acres. The Applicants would continue current ranching/livestock operations and other
4414 management activities as described for the Preservation Areas (e.g., exotic species control,
4415 prescribed burning). As in the Preservation Areas, we do not expect adverse effects resulting
4416 from the continuation of the existing land management regimes to exceed present. The HCP does
4417 not specify a footprint for the isolated residences, lodges, and hunting/fishing camps, but
4418 indicates that their construction could clear up to 10 percent of the existing native vegetation (see
4419 section 2.5). New dwelling development could occur within any of the cover types present
4420 besides open water and existing development. It is possible that dwelling development in the
4421 VLD areas could entirely avoid panther habitat, but we conservatively estimate a 239-acre
4422 habitat loss (10 percent of the 2,394 acres of panther habitat). Construction within these areas
4423 may temporarily cause panthers to avoid these areas and diminish the value of surrounding lands
4424 to panthers, but we expect these effects to be insignificant.

4425
4426 **5.3.4 Tables and Figures**

4427
4428

Table 5-4. Acreage of Panther Habitat Categories that occur in the Plan Area

Panther Habitat		Very Low		Eligible for		Development		
Category	Development	Preservation	Density	Base Zoning	Inclusion	Plan Area Total	Row Percent	Envelope Total
Agriculture	33,370	17,605	0	698	10,289	61,962	38.85%	44,357
Marsh-Shrub-Swamp	1,785	23,630	223	536	2,591	28,766	18.03%	4,913
Other	1,233	2,620	1,119	4	1,891	6,857	4.31%	3,128
Prairie-Grassland	5,446	10,544	507	1,082	1,783	19,361	12.14%	8,311
Upland Forest	1,696	9,704	309	15	1,052	12,777	8.01%	2,764
Wetland Forest	722	25,988	510	94	2,453	29,768	18.66%	3,269
Total	44,252	90,092	2,667	2,431	20,059	159,501	100.00%	66,742

4429

4430
4431
4432

Table 5-5 Panther Habitat by Category of Habitat within 300m of Upland Forest and Wetland Forest Cover and the forest cover, itself.

Panther Habitat Category	Development	Preservation	Very Low Density		Base Zoning	Eligible for Inclusion	Plan Area Panther Habitat	Development Envelope
Agriculture	11,342	9,181	0	418	3,174	24,115	14,934	
Marsh-Shrub-Swamp	998	15,388	217	350	1,680	18,633	3,028	
Other	754	1,987	867	2	915	4,525	1,671	
Prairie-Grassland	3,361	7,094	491	727	862	12,534	4,950	
Upland Forest	1,696	9,704	309	16	1,052	12,777	2,764	
Wetland Forest	722	25,988	510	94	2,453	29,768	3,269	
Total	18,872	69,342	2,394	1,608	10,136	102,352	30,616	
Plan Area Total Acres	44,252	90,092	2,667	2,431	20,059	159,501	66,742	
% Plan Area that is within 300m of Forest Cover	42.6%	77.0%	89.7%	66.1%	50.5%	64.2%	45.9%	

4433
4434
4435

Table 5-6. Florida panther habitat loss likely to result from development activities in the Development Envelope (Covered Activities Area, Base Zoning, and Lands Eligible for inclusion in the HCP). Irrespective of whether development occurs in the current HCP configuration, or after Eligible Lands join the HCP, the cap for future development will remain 39,973 acres.

A. Panther Habitat Category	B. Total Plan Area Panther Habitat Acres ¹	C. Panther Habitat Acres within Development Envelope ²	E. Preference-Weighted Plan Area Habitat Acres (B*D)		F. Preference-Weighted Development Envelope Acres (C*D)	G. Post-Development Preference-Weighted Habitat Acres (E-F)	H. Panther Habitat Acres within HCP Development/Mining Designation	I. Preference-Weighted Development/Mining Habitat Acres (D*H)	J. Post-Development Preference-Weighted Habitat Acres (E-I)
			D. Panther Preference Factor ³	E. Preference-Weighted Plan Area Habitat Acres (B*D)					
Agriculture	24,115	14,934	0.962	23,210	14,374	8,836	11,342	10,916	12,294
Marsh-Shrub-Swamp	18,633	3,028	1.252	23,321	3,789	19,532	998	1,249	22,072
Other	4,525	1,671	0.955	4,322	1,596	2,726	754	720	3,602
Prairie-Grassland	12,534	4,950	1.274	15,967	6,305	9,662	3,361	4,281	11,686
Upland Forest	12,777	2,764	1.880	24,016	5,196	18,820	1,696	3,188	20,829
Wetland Forest	29,768	3,269	1.613	48,012	5,273	42,739	722	1,164	46,848
Total	102,352	30,616		138,848	36,534	102,315	18,872	21,519	117,330

1. Forest cover plus the extent of all other cover categories within 300 meters.
2. Panther habitat within the Development, Base Zoning, and Eligible HCP land-use designations.
3. The inverse of habitat selection ratios reported in Onorato et al. 2010.

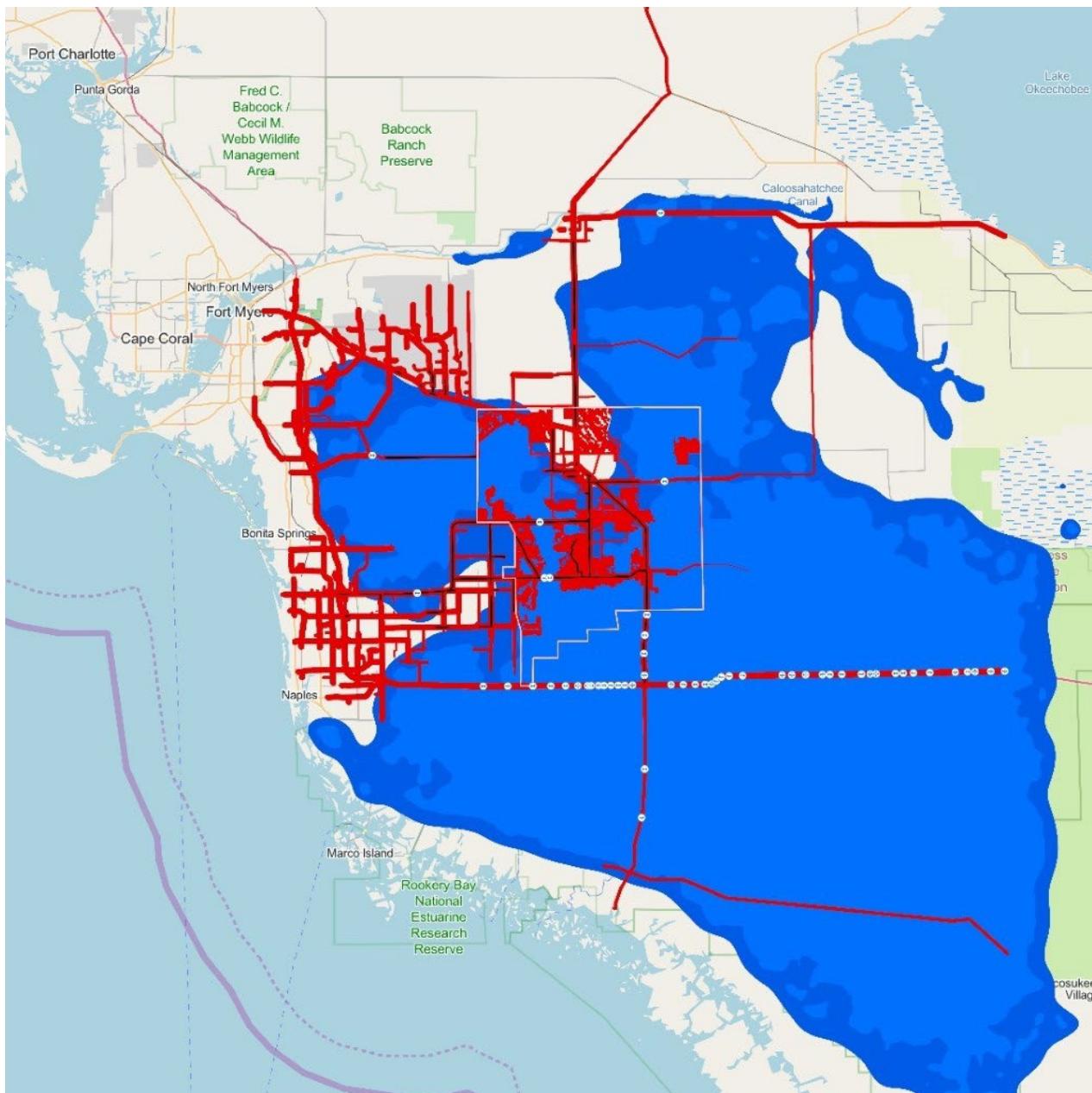
4440
4441
4442

Table 5-7 Habitat Loss interpreted as a reduction in Carrying Capacity for Florida panthers.

Interpreting habitat loss as a long-term reduction in panther carrying capacity.

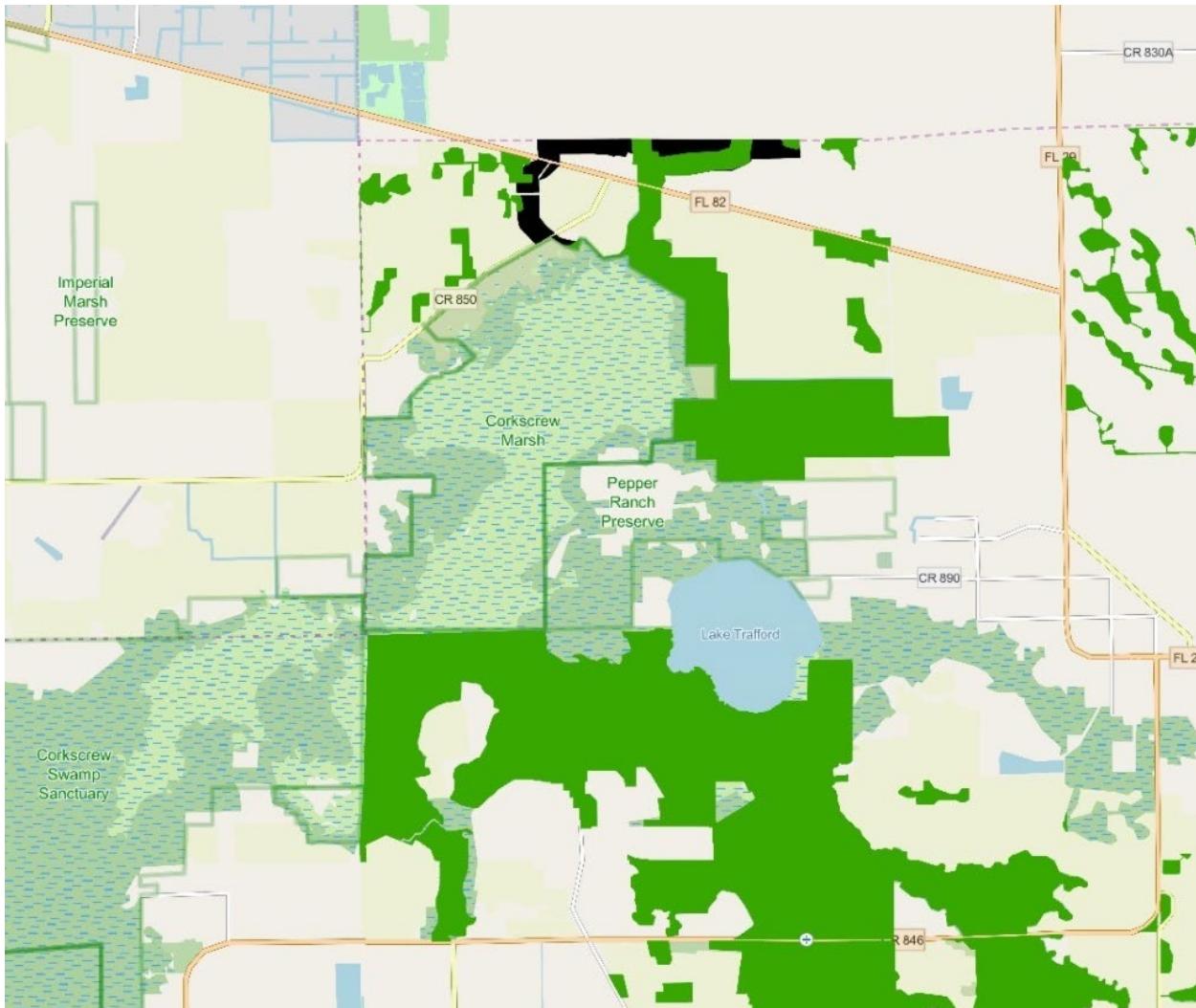
Variable	Source or Calculation	Value	Units	Measure
a	draft SSA	18,037	acres	Low panther density; 1.37/100km ² = 1 panther per 18,037 acres.
b	draft SSA	7,060	acres	High panther density; 3.5/100km ² = 1 panther per 7,060 acres.
c	Habitat Calculations B9	102,352	acres	Total Plan Area panther habitat acres (forest cover plus other types within 300m)
d	c/a	5.7	adult panthers	Plan Area low-density carrying capacity.
e	c/b	14.5	adult panthers	Plan Area high-density carrying capacity.
f	Habitat Calculations E9	138,848	weighted acres	Preference-weighted Plan Area habitat acres (total pre-development).
g	Habitat Calculations G9	102,315	weighted acres	Post-development preference-weighted habitat acres; capacity loss from the full development envelope.
h	Habitat Calculations J9	117,330	weighted acres	Post-development preference-weighted habitat acres; capacity loss from the Development/Mining HCP designation only.
i	(g/f)*d	4.2	adult panthers	Post-development Plan Area carrying capacity; low density; loss from the full development envelope.
j	(g/f)*e	10.7	adult panthers	Post-development Plan Area carrying capacity; high density; loss from the full development envelope.
k	(h/f)*d	4.8	adult panthers	Post-development Plan Area carrying capacity; low density; loss from the Development/Mining HCP designation only.
l	(h/f)*e	12.3	adult panthers	Post-development Plan Area carrying capacity; high density; loss from the Development/Mining HCP designation only.
m	d-i	1.5	adult panthers	Reduction in post-development Plan Area carrying capacity; low density; loss from the full development envelope.
n	e-j	3.8	adult panthers	Reduction in post-development Plan Area carrying capacity; high density; loss from the full development envelope.
o	d-k	0.9	adult panthers	Reduction in post-development Plan Area carrying capacity; low density; loss from the Development/Mining HCP designation only.
p	e-l	2.2	adult panthers	Reduction in post-development Plan Area carrying capacity; high density; loss from the Development/Mining HCP designation only.

4443
4444
4445



4446
 4447
 4448
 4449
 4450
 4451
 4452
 4453
 4454
 4455
 4456
 4457
 4458

Figure 5-12. Barriers caused by roads and development in the Action Area, and wildlife underpasses can reduce the effect of the barrier. Increasing traffic on roadways and development (in red) will increase fragmentation of panther habitat. Impermeability is denoted by weighted lines (the thicker the line, the stronger the barrier it will be for panthers in 2070). Our analysis of the Traffic Model for Action Area roadways identifies 535 mi of existing roadways will cross the 10,000+ vehicles/day threshold by 2070, and 278 mi of roadways that will move from “onset” to “peak” impacts (<3000 vehicles/day before to 3000-6000 vehicles/day) by 2070. Roadways outlined in black will cross this threshold because of traffic generated by proposed development in the HCP. Small white symbols identify the locations of wildlife crossings constructed as of 2019.



4459

4460

4461 **Figure 5-13.** Close-up of the second Florida panther corridor and additional acreage in the first
 4462 corridor that Applicants added north of the Corkscrew Regional Ecosystem Watershed on
 4463 January 28, 2020. The green area represents the previous Preserve configuration, and the area
 4464 shaded in black represents the addition of the new corridor configuration.

4465

4466 **5.4 Cumulative Effects on Florida Panther**

4467

4468 For purposes of consultation under ESA §7, cumulative effects are those caused by future state,
 4469 tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future
 4470 Federal actions that are unrelated to the proposed action are not considered, because they require
 4471 separate consultation under §7 of the ESA. This definition applies only to §7 analyses and should
 4472 not be confused with the broader use of this term in the National Environmental Policy Act or
 4473 other environmental laws.

4474

4475 The Action Area was extended beyond the Plan Area to include roads impacted by traffic
 4476 generated by development proposed in the HCP (Figure 5-9). Within this Action Area our
 4477 cumulative effects analysis analyzes the impact of increases in traffic volume from future, non-

4478 Federal, sources of traffic volume unrelated to development proposed in the HCP that we believe
4479 are reasonably certain to occur on the same roadways. Based on our review of past developments
4480 in the region we estimate approximately 25.3 percent of future, possible developments will be
4481 pursued without review by the Service. Thus, we assume that 25.3 percent of traffic volume
4482 identified in the D1RPM would likewise originate from developments the Service would not
4483 have opportunity to review.

4484
4485 Conservation measures, such as improved wildlife crossings with fencing, would reduce this risk
4486 of panther/vehicle mortality from any source. The Applicants have committed \$12.5 million of
4487 the first \$13 million from the Marinelli Fund towards assisting with construction of wildlife
4488 underpasses and wing fencing. Biologists that have previously worked to establish wildlife
4489 crossings for panthers estimated a cost of \$1.5 million per crossing. Based on this estimate, the
4490 amount pledged by the applicants would enable the construction of about 8 wildlife crossings
4491 and associated fencing.

4492
4493 Our analysis of cumulative effects related to increased risk of traffic mortality found that risk of
4494 vehicle collisions due to increased traffic predicted from sources other than development
4495 proposed in the HCP, and unlikely to be subject of future Federal action, could increase by
4496 approximately 5 panther/vehicle collisions per year (above present) in 2070 (Table 5-8). When
4497 we considered the effect of 8 additional wildlife crossings, we found the risk of vehicle collisions
4498 could be reduced by 3 panther/vehicle collisions and leaves a net risk of 2 panther/vehicle
4499 collisions. When the 2 panther/vehicle collisions per year from cumulative effects are added to
4500 the 8 panther/vehicle collisions per year from the effects of the action we estimate the combined
4501 increase in risk from effects of the action and cumulative effects could be a total of 10
4502 panther/vehicle collisions per year (above present) in 2070 assuming full build out of the HCP's
4503 proposed development (Table 5-8 and Appendix I, Table AI2).

4504
4505 To address potential sources of uncertainty in this estimate (identified and described in Chapter 3
4506 of this Biological Opinion), we incorporated this estimated future annual mortality into the more
4507 dynamic environment of PVA. This enabled us to link our estimate of risk of roadway mortality
4508 to panther population size, and to allow demographic stochasticity to play a role in determining
4509 how many panthers were on the landscape at a given time and could be at risk of collision with
4510 motor vehicles. We were also able to incorporate habitat availability into simulations, and to
4511 allow this, in turn, to play a role in the size of the population exposed to the risk of motor vehicle
4512 collision. However, we did not have data to address other sources of uncertainty, such as how
4513 traffic volume itself could influence the detection and reporting of panther/vehicle collisions.
4514 The PVA analysis is discussed in more detail in Section 5.5 and Appendix L.

4515
4516 **5.4.1 Tables and Figures**
4517

4518 **Table 5-8.** The risk of Florida panther mortalities estimated from traffic generated by HCP-
4519 proposed development and other sources anticipated by 2070. The risk is expressed in total
4520 panthers with female only numbers in parentheses. Female estimates were calculated as 40
4521 percent of the total because this is the percentage of female panthers recorded in panther/vehicle
4522 mortalities to date. The values were then rounded to the nearest higher whole number.

Future Risk ¹ of Mortality in the Action Area expressed as number of panthers (females)			
Source of Traffic	Before Conservation Measure ²	Future Reduction of Risk of Mortality due to Conservation Measure ²	Future Risk of Mortality in the Action Area after Conservation Measure ²
Traffic Generated by HCP- Proposed Development ³	11 (5)	-3 (-1)	8 (4)
Traffic Generated by Other Sources (Cumulative Effects)	5 (2)	-3 (-1)	2 (1)
Traffic Generated by HCP- Proposed Development and Other Sources ³	16 (7)	-6 (-2)	10 (5)

¹ Chapter 3 and section 5.6 of this BO identify and describe uncertainties associated with these estimates of risk.

² Conservation measures incorporated in this table are the 8 wildlife crossings facilitated by the \$12.5 million the Applicants have committed from the Marinelli Fund.

³ The HCP traffic was predicted based on number of dwellings anticipated in the HCP and then likely number of people and cars associated with those dwellings. While the traffic is a consequence of HCP implementation, the increased risk of panther/vehicle mortality is not attributed to the HCP as take because many factors affect panther vehicle mortality.

5.5. Population Viability Analysis

PVA is a widely utilized, species-specific method of structured risk assessment that allows wildlife and fisheries managers to compare the potential effects of different proposed courses of action, and manners of carrying out proposed actions, on the viability of populations over time. For example, state-level wildlife resource agencies often use PVAs to inform many of the management decisions they make routinely, such as comparing the impact of different proposed harvest limits for game species, the likely effects of different habitat management proposals on affected populations, or developing initiatives from a range of alternatives aimed at conserving rare or declining species.

Federal agencies such as the Service, National Park Service, and National Marine Fisheries Service also regularly use PVAs as a tool of conservation decision making. The U.S. Fish and Wildlife Service specifically uses PVAs for environmental review, management of trust resources on Refuges, listing, and recovery (e.g., 5 Year Reviews, SSAs, and Recovery Plans). Throughout the history of the Service's efforts to recover the panther the Service has relied on the results of 8 PVAs to inform recovery planning and implementation for the species. These PVAs have been run through a variety of modeling environments such as VORTEX, RAMAS GIS, and RAMAS LANDSCAPE, and those developed independently by academic researchers (Root 2004, Beier et al. 2003, USFWS 2008, USFWS Draft 2020).

The greatest advantage of PVA is it allows us to address many potential sources of uncertainty inherent to estimates of effects. For example, the PVA environment enables us to simulate annual fluctuations in habitat carrying capacity (environmental stochasticity) that may occur

4556 independent of habitat availability. It also enables us to allow for annual variation in population
4557 vital rates (demographic stochasticity). Lastly, it enables us to incorporate parametric uncertainty
4558 into our analysis via the incorporation of comparative iterations of the model using different
4559 possible initial values for such things as population size, different assumptions about carrying
4560 capacity, and different assumptions about the relationship between population size and available
4561 habitat to support it (parametric uncertainty). But even the most robust PVA doesn't eliminate all
4562 uncertainty. However, because PVAs incorporate and include more information than other
4563 methods of analysis they are more defensible than the alternative. This also makes them useful
4564 tools for analyzing how the implementation of different scenarios of management and
4565 development will affect a species.

4566

4567 **5.5.1 The Model**

4568

4569 We chose to analyze the effects of the action on Florida panther with PVA to remain consistent
4570 with methods used for recovery planning and implementation for this species. We chose the
4571 inputs for our PVA from van de Kerk et al. (2019) because these are the most recent and robust
4572 of the panther PVAs produced to date. We chose to use these inputs within a commercially
4573 available platform (RAMAS Landscape) for ease of replicability in a platform familiar to Service
4574 biologists.

4575

4576 To ensure the RAMAS Landscape would faithfully reproduce the results of van de Kerk et al
4577 (2019), we loaded their inputs into RAMAS Landscape and compared our outputs with those of
4578 van de Kerk et al. (2019). Once satisfied the two platforms produced consistent results, we
4579 assessed how the proposed HCP (Effects of the Action), future non-federal actions that are
4580 reasonably certain to occur (Cumulative Effects), and sea Level Rise of 1m would affect the
4581 abundance and extinction probability of Florida panther.

4582

4583 **5.5.2 Model Inputs and Assumptions**

4584

4585 We considered quantifiable baseline conditions in the Action Area, the effects of the action, and
4586 cumulative effects on future population growth of Florida panther in the PVA environment. We
4587 also considered the possibility that some parameters may be incorrectly estimated or have large
4588 error margins associated with them. Specifically, recent population size estimates indicate the
4589 current population size has a 95 percent probability of being between 120 and 230 adult panthers
4590 (FWC and Service 2017). Thus, we considered it equally likely the initial population size could
4591 be any of those values, or any value in between. In order to consider the full range of possible
4592 initial population sizes in the PVA environment we used the low (120 adults, 60 of whom are
4593 female), midpoint (176, 88 of whom are female), and high (230, 115 of which are female) ends
4594 of this range as possible values for initial population size (N_0) and ran PVAs at all of these
4595 possible initial population sizes.

4596

4597 There is also uncertainty around how much available habitat is currently used by the panther
4598 population. Because range wide population growth, population growth in the Action Area, and
4599 roadway mortality of panthers appears to have peaked and stabilized, in addition to the
4600 appearance of female panthers north of the Caloosahatchee River, we believe it's more likely the
4601 population is closer to carrying capacity (K) than not. However, how close is unknown. To

4602 account for uncertainty in the population's relationship with available habitat we also assumed
4603 N_0 (the current and initial population size used in the PVA) represents 100 percent, 80 percent,
4604 and 60 percent of K. Specifically, for an initial population size of 60 females, we used 60, 75, or
4605 100 as possible values of K. For an initial population size of 88 females, we used 88, 110, and
4606 147 as possible values of K. For an initial population size of 115 females, we used 115, 144 and
4607 192 as possible values of K.

4608
4609 We input these estimates (initial population size and carrying capacity) and all combinations of
4610 them into RAMAS Landscape to analyze the impact of the proposed action on the species. We
4611 replicated each possible N_0 and K combination 100 times for a duration of the ITP (50 years) and
4612 100 years beyond.

4613
4614 We treated habitat loss via sea level rise as a baseline condition in our PVA. As discussed in
4615 Section 5.1.6.7 sea level rise (SLR) of 1m by 2070 is projected under NOAA's Intermediate-
4616 High, High, and Extreme Scenarios and the CARSWG Highest scenario (Noss et al. 2014, Hall
4617 et al. 2016, Sweet et al. 2017, USGCRP 2017, USGCRP 2018). This amount of sea level rise
4618 will inundate 18 percent of habitat currently used by Florida panther.

4619
4620 We were able to identify three effects of the action that could be estimated quantifiably for the
4621 purpose of our PVA: habitat loss, panther/vehicle mortality, and "other" that includes effects
4622 such as management removal, disease, or the effects of environmental contaminants. The precise
4623 estimates and methods of their calculation are discussed in Sections 5.3.1.1, 5.3.1.3, and 5.3.1.4.
4624 Particularly, as discussed in Section 5.3.1.1 we determined the proposed actions will remove
4625 habitat that could support approximately 3 adult panthers, and that 1 of these would include
4626 habitat suitable to support a female home range. Thus, we assume the loss of this habitat will
4627 result in the loss of 1 adult female to the population. As discussed in Sections 5.2.2.4, 5.3.1.4,
4628 and 5.4 we also estimate that in addition to the approximately 22 panthers are currently killed
4629 each year in vehicle collisions the traffic generated by proposed development will increase the
4630 risk of annual panther/vehicle mortality by 8 additional adult panthers (4 females) (our estimate
4631 assumes 8 wildlife crossings are installed using Marinelli Funds). We also estimate in Section
4632 5.3.1.3 that approximately 1 panther will be removed from the population from other causes,
4633 such as vehicle collisions on new roads built as a part of proposed developments; the
4634 introduction of disease; the effects of environmental contaminants; management removal, and
4635 others. Lastly, in Section 5.4 we estimate future actions not subject to federal authorization,
4636 funding, or implementation (Cumulative Effects) will result in an additional risk of annual
4637 panther/vehicle mortality of 2 panthers (1 adult female) in 2070.

4638
4639 The risk of panther/vehicle mortality increases as the panther population increases. We addressed
4640 potential uncertainty in how many panthers would likely be at risk of collisions with vehicles by
4641 considering panther population size using the Harvest application in Ramas Landscape. We did
4642 this in the PVA environment by scaling our estimates of roadway mortality to the observed
4643 relationship between a measured population size and reported panther/vehicle collisions.
4644 Specifically, we used the regression of estimated minimum population size (as estimated from
4645 the Minimum Annual Count) and annual reported, total panther vehicle mortality to estimate
4646 how much roadway mortality could actually occur in a given year, for a specific population size

4647 of panthers. The exact regression formula we used to scale mortality in the Harvest application
4648 can be found in Appendix L.

4649
4650 As discussed above we also addressed parametric uncertainty in the population size of panthers
4651 (a large determiner of panther/vehicle collision risk) by assessing the impact of all forms of
4652 effects on the lower 95 percent confidence interval, the upper 95 percent confidence interval, and
4653 central tendency of the currently estimated population size. We used these 3 values as initial
4654 population sizes to examine how future effects of the action, habitat loss through sea level rise,
4655 and cumulative effects would impact different population sizes of Florida panther. We also
4656 allowed habitat carrying capacity to vary randomly from year to year in our PVA to simulate
4657 fluctuations in habitat productivity and prey availability and allowed population vital rates to
4658 also vary randomly within the range of variation observed in nature. Thus, we addressed many
4659 inherent uncertainties in our estimates by allowing for a great deal of demographic and
4660 environmental stochasticity in the model, and by tethering how takings impact the population in
4661 the model environment to how they've been observed to affect the species in real life.

4662
4663 However, we did not have data to address other sources of uncertainty in the PVA environment.
4664 For example, we were unable to estimate how traffic volume itself may influence the detection
4665 and reporting rate of panther/vehicle collisions on different roadways, and thus were unable to
4666 control for this in our PVA. Another source of potentially, meaningful uncertainty is annual
4667 variation in source traffic generation. Specifically, because the D1RPM is deterministic in nature
4668 it generates a single-value estimate rather than a range of possible outcomes. This output, an
4669 estimate of AADT, was assigned to a source transportation analysis zone (TAZ) for each
4670 roadway and used to estimate the number of panthers that would be affected if AADT changed
4671 over time in response to new activities within those TAZs. Yet in practice it is likely the actual
4672 number of trips generated by proposed developments in given TAZs will not grow linearly, and
4673 will vary annually by chance, just as they do in existing developments and roadways. This means
4674 it is possible the risk of panther/vehicle collision linked to these developments will similarly
4675 vary.

4676 4677 **5.5.3 Model Results**

4678
4679 Our PVA found that habitat loss and the increased risk of panther/vehicle mortality associated
4680 with traffic generated at levels proposed in this action increased the probability of extinction
4681 from 1.1 ± 0.8 percent to 6.6 ± 4.3 percent. We also found the effects of habitat loss and increase in
4682 risk of panther/vehicle mortality could reduce the panther population from 150 adults (75
4683 females) to 64 adults (32 females) within 100 years of the expiration of the ITP (Table 5-9). The
4684 increase in extinction probability and decrease in abundance that could result from these effects
4685 is statistically significant (Moods Median Test for non-normal data, $P = 0.004$ and $P = 0.0001$,
4686 respectively).

4687
4688 In addition to our PVA analyzing the Effects of the Action we also ran PVAs to identify the
4689 threshold level of take that led to a statistical difference between scenarios. Our analysis of these
4690 PVAs found that though there was still a difference in final abundances, the probability of
4691 extinction 100 years after ITP expiration does not differ significantly from Baseline + Sea Level
4692 Rise (1.38 percent P_{ext} versus the 1.1 ± 0.8 percent P_{ext} estimated for B_{SLR}) if fewer than 10 adult

4693 panthers (4 female panthers) total are lost annually, above present, from any cause (e.g., habitat
4694 loss, roadway mortality, etc.).

4695 4696 **5.5.4 Model Review**

4697
4698 At various junctures throughout the development of this BO the methods of estimating effects of
4699 the action and cumulative effects, their incorporation into PVA, and the statistical tests used to
4700 analyze the results of the PVA have been subject to peer review.

4701 In February 2020, staff at the Florida Ecological Services Field Office reached out to regional
4702 scientist Dr. Laura Brandt for a review of the modeling and statistical tests that would be used to
4703 analyze effects of the action to Florida panther. She requested Dr. Beth Ross, Assistant Unit
4704 Leader of the South Carolina Cooperative Fish and Wildlife Research Unit at Clemson
4705 University assist the Service in its review. Dr. Ross submitted the results of her review to the
4706 Service via email March 18, 2020 and March 25, 2020.

4707
4708 On November 20, 2020, the Applicants submitted an unsolicited analysis to the Service titled
4709 “Statistical review of Future Roadkill Estimation Method (FREM) used by US FWS South
4710 Florida Ecological Services Field Office staff” prepared by Dr. Megan Higgs of Critical
4711 Inference, LLC. The review addressed three general topics: assessing the quality of existing
4712 documentation and transparency, the assumptions, decisions, and sources of uncertainty
4713 associated with the FREM, and the use of the FREM approach to obtain predictions of PVM in
4714 2060 for use in the Biological Opinion.

4715
4716 On April 21, 2021, Dr. Julien Martin of the U.S. Geological Survey’s Wetland and Aquatic
4717 Center submitted a solicited review to the Service titled “Scientific Review of the “Biological
4718 and Conference Opinion of the Eastern Collier Multi-Species Habitat Conservation Plan”
4719 [Emphasis on the Florida Panther].” Specifically, the Service had requested Dr. Martin to review:

4720

- 4721 • Interpretation of past work related to Florida panther population dynamics and threats
- 4722 • Population Viability Analysis (PVA) conducted by USFWS staff
- 4723 • Future Roadkill Estimation Method (FREM) analysis
- 4724 • Decision context for model developments and interpretations
- 4725 • And additional comments, as appropriate

4726 These analyses can be found in Appendix M of this BO.

4727 4728 **5.5.5 Tables and Figures**

4729
4730 **Table 5-9.** The probability of extinction and predicted population size of the Florida panther
4731 under Baseline with Future Sea Level Rise (BSLR), BSLR plus HCP Development Effects
4732 (BSLR+HCP), and BSLR+HCP plus Cumulative Effects (BSLR+HCP+CE) scenarios given three
4733 different beginning female panther population sizes. BSLR = Baseline (Current conditions + 1m
4734 SLR by 2070) and the end time is 100 years after HCP full build-out in 2070.

N_0	B_{SLR}		$B_{SLR} + HCP$		$B_{SLR} + HCP + CE$	
	P_{ext}	N_{150}	P_{ext}	N_{150}	P_{ext}	N_{150}
60	0.027	48	0.121	18	0.15	16
	0.004	75	0.042	32	0.037	32
	0.001	100	0.0008	50	0.012	47
Average	0.01	75	0.057	33	0.066	32

4738

4739

4740

4741

5.6 Uncertainty in the Analysis

4742

4743 As noted in section 5.3.1.4., above, in our PVA we estimate and consider the predicted increased
 4744 risk of wildlife roadway mortality, along with the environmental baseline and the predicted
 4745 cumulative effects, to determine the overall effects to the species for the purposes of preparing
 4746 this BO on the proposed action in accordance with 50 CFR section 402.02. We do not attribute
 4747 take from vehicle strikes to the Applicants because they do not have sufficient direct control and
 4748 the causal linkages are too remote and attenuated.

4749

4750 We acknowledge our estimate of possible effects of the Action to panthers contains uncertainty.
 4751 Many sources of uncertainty are those inherent with the process of estimation, modeling, and
 4752 simulation. For example, it is possible there will be fewer, or more, actual roadway mortalities of
 4753 Florida panther than we have estimated explicitly elsewhere in this BO because of chance,
 4754 population size, habitat configuration, detection, reporting, and other sources. Similarly, the
 4755 impact of habitat loss could vary from what we have estimated because of annual differences in
 4756 habitat productivity and prey availability, or changes in panther population vital rates that exceed
 4757 the values of variation observed in the past.

4758

4759 For instance, Dr. Beth Ross noted in the review she submitted (described in the previous section
 4760 and Appendix M) the assumption of a closed population, a feature of the Chapman estimator
 4761 used to estimate abundance of panthers in the Plan Area, is likely violated by the movement of
 4762 panthers into and out of the Plan Area. An example of such an occasion would be while young
 4763 panthers are dispersing from their natal home ranges. Other sources of uncertainty include those
 4764 identified by Dr. Megan Higgs and Dr. Julien Martin, whose reviews can also be found in
 4765 Appendix M. Wherever possible the Service used the insights provided by these experts to
 4766 improve transparency and handling of uncertainty for values estimated and reported in this
 4767 Biological Opinion.

4768

4769 Also, many sources of uncertainty inherent to the estimates used in the model were addressed
 4770 within the modeling environment or by applications in the PVA software. Thus, we are confident
 4771 our estimates of the effects of the action, as represented by PVAs for different scenarios, do
 4772 reflect the comparative, benefits and costs of each scenario when compared to one another. This
 4773 is true even if the use of PVA to assess either scenario's effects on panther demography does not
 4774 deliver a definitive value for extinction risk or final abundance. Moreover, we are confident the

4775 results of PVAs run for each scenario indicate what is the probable result of each scenario's
4776 implementation, when available information is used within the model. While the PVA produces
4777 quantifiable results, there are other possible outcomes that may result because of things that can
4778 not be estimated or quantified with precision.

4779
4780 The greatest uncertainty is how the implementation of the HCP and the minimization and
4781 mitigation measures (costs and benefits) will work together to affect panther populations. The
4782 HCP commits to the general provision of funding and facilitation for many activities which will
4783 undoubtedly benefit panthers, but the magnitude of those benefits, their timing, and other value
4784 won't be known until specific activities occur in the future. For example, the Service is confident
4785 funds committed to date are sufficient to facilitate the construction of at least 8 additional
4786 wildlife crossings. It is likely that substantially more crossings and other protective
4787 infrastructure will be delivered during implementation of the HCP. But we don't know
4788 specifically when these will be built, how many there will be, and where they will be located on
4789 the landscape such that we can determine their effects on the panther population in a PVA.
4790

4791 It is also possible the applicants may incorporate designs in individual future developments in the
4792 Plan Area different than those described in the HCP, and that these could achieve greater benefits
4793 or have fewer impacts to panthers than we've estimated. Such design improvements may
4794 include, but are not limited to, measures that increase internal traffic capture rates, have fewer
4795 dwelling units or population per area, or fewer residents per dwelling unit. Implementation of
4796 any such measures in future developments could substantially reduce the amount of traffic we
4797 estimated would come from proposed development, broadly, and in turn this could substantially
4798 reduce the risk of panther/vehicle collision and the intensity of barrier effects imposed by traffic
4799 volume. Conversely, it is possible future developments will have a lesser internal traffic capture
4800 rate, higher dwelling unit density, and higher number of residents per dwelling unit than the
4801 Town of Ave Maria, which was a template for future development proposed in the HCP when
4802 we estimated how much traffic would likely be generated on existing roadways. If this were to
4803 occur, we would expect to see greater traffic volume and effects to panthers than we have
4804 estimated in this BO.
4805

4806 It is also possible the actions of third parties may affect how the HCP is implemented, and
4807 ultimately how that intersects with the Florida panther. For example, Collier County may impose
4808 new, or relax existing, limits on dwelling unit density allowable in future developments, require
4809 stringent internal traffic capture rates that future proposed developments must achieve, limit
4810 population size for individual developments proposed in the future, or other parameters. It is also
4811 likely that things like additional wildlife crossings will also be built or facilitated by entities not
4812 party to this BO, but at present we lack sufficient information to determine conclusively whether
4813 future wildlife crossing from such parties is reasonably certain to occur. Any or all such actions
4814 by third parties will likely further reduce the risk of panther/vehicle mortality more than we have
4815 estimated in this chapter.
4816

4817 To address these uncertainties the Service and the Applicants/permittees will periodically review
4818 plan implementation, confer on adaptive management measures whenever necessary, and review
4819 individual development proposals to ensure they are using the most up-to-date and effective

4820 avoidance, minimization, and mitigation measures available at the time in accordance with the
4821 process described in Section 2.2 of this BO.

4822

4823 **5.6.1. Qualitative Assessment of the Beneficial Effects of the HCP**

4824

4825 We also considered the potential for measures proposed in the HCP to further lessen/offset the
4826 impact of development to panthers under the RLSP. These measures include: delineation of
4827 development and Preservation Areas to minimize habitat loss and to maintain wildlife movement
4828 corridors, and project-level best management practices to minimize effects originating in the
4829 Covered Activities Area that might otherwise impact Preservation Areas. The HCP also
4830 identifies habitat restoration and enhancement needs for certain covered species. These habitat
4831 improvements, along with future wetlands mitigation, would likely occur on a local scale, either
4832 in Preservation Areas or on project sites, and in some cases would also benefit panthers. In
4833 addition to project-level actions, we considered how the use of the Marinelli Fund might also
4834 benefit panthers.

4835 Conservation measures will provide offsets to projected impacts, and the Marinelli Fund could
4836 result in substantial conservation benefits. Conservation measures for which we had data to
4837 evaluate quantitatively in the PVA are summarized in Appendix L. Conservation measures for
4838 which we lacked sufficient data to include in the PVA, including dedicated initial funding for
4839 wildlife crossings, internal traffic capture, and implementation of best management practices, are
4840 summarized qualitatively below, and discussed in Table 5-13 of the Conclusion section.

4841 Most of the HCP plan area is privately owned. The plan proposes permanent conservation of
4842 land worth up to \$1.4 billion (applicant estimate) that could otherwise be developed under other
4843 future scenarios. Some of this conservation of private land would occur under other RLSP
4844 buildout scenarios, however first benefit of the HCP is that it requires landowner participation in
4845 the RLSP as a condition of an ITP permit. This provides a level of certainty about the extent and
4846 general placement of development that did not exist when participation in the RLSP was strictly
4847 voluntary. Of the 178,868 acres of the RLSA not in public ownership, ECPO owns 151,442
4848 acres. Participation of ECPO landowners in the HCP (and by extension the RLSA) limits all
4849 development on these properties to a 45,000-acre maximum with no possibility of development
4850 at base zoning densities on the approximately 106,442 acres of remaining ECPO lands. This will
4851 largely preclude approximately 180,000 acres of RLSA land from being converted from their
4852 present use (predominantly agriculture plus 102,352 acres of native habitats used by panthers) to
4853 rural residential use. Incentives provided by Collier County also encourage the designation of
4854 the remaining 27,426 acres of non-ECPO lands as Stewardship Sending Areas by requiring this
4855 designation to entitle the full 45,000 acres of rural compact development.

4856 Yet this cap only applied to lands they own, and this offered no protection from development on
4857 lands they do not. This meant without changes to the RLSA the 45,000-acre cap proposed in the
4858 HCP would have only provided a maximum development footprint within approximately 78
4859 percent of the RLSA (the 139,442 acres owned by the Applicants). Further development could
4860 still have occurred at any density within the 39,426 acres the Applicants don't own
4861 (approximately 22 percent of lands within the RLSA). Recently, the Collier County Board of
4862 Commissioners approved Amendments to the RLSP, a step in the approval process that will
4863 make a 45,000-acre development cap apply to all properties within the RLSA and provide

4864 incentives to ensure these are the only acres developed within the RLSA. Requiring landowner
4865 participation in the RLSP ensures this 45,000-acre cap on total development in the RLSA will
4866 not be exceeded as long as the amendment makes it through the final approval process.

4867
4868 The HCP clusters and directs development of these 45,000 acres in a manner that considers
4869 wildlife occurrence, movement and impacts. Development activities will mainly occur in areas
4870 of less important habitat, primarily citrus groves and row crop fields - panther movement
4871 corridors are identified in advance. Our effects analysis revealed that Panther Vehicle Mortality
4872 (PVM) is the most significant contemporary threat faced by panthers. While development, such
4873 as the development associated with the HCP, increases traffic and therefore heightens the risk of
4874 PVM, there are also contributing factors outside the control of the Applicants. As outlined in
4875 Section 5.1.3, our analysis of all records (Radio telemetry, GPS tracking, locations of panther-
4876 vehicle collisions, locations of confirmed depredation events, confirmed den locations, and
4877 confirmed observations) found 95.7 percent of all panther records occur within a forest habitat
4878 type or within another habitat type within 984 ft (300 m) of forest cover. The identification of
4879 these forested corridors ahead of development, through the HCP, assists all stakeholders (e.g.,
4880 State and county transportation departments, NGOs others) in identifying the areas where
4881 wildlife crossings will be most effective, allowing for proactive targeting of conservation efforts.
4882

4883 The HCP provides a framework for ongoing collaboration between ITP holders, the Service, and
4884 other stakeholders involved in panther conservation. In 2019, ALICO worked cooperatively
4885 with the Service and Florida DOT to improve the functionality of FDOT's proposed wildlife
4886 crossing west of the County Road 850 intersection. Modification of their covered activities at
4887 this location assists in improving connectivity between the S.R. 82 crossing and CREW
4888 conservation lands to the south. This connectivity may not have happened without the draft
4889 HCP.
4890

4891 HCP participation and implementation by landowners also address specific recovery actions
4892 listed in the species recovery plan outline and implementation schedule. These include:

- 4893 • Initiating and encouraging landscape-level HCPs where proposed non-Federal actions or
4894 projects will impact panthers or their habitat;
- 4895 • securing Camp Keais Strand;
- 4896 • securing a corridor between Big Cypress National Preserve and Okaloachoochee Slough;
- 4897 • maintaining the spatial extent and arrangement of habitat on a landscape scale;
- 4898 • securing habitat adjacent or contiguous to areas of high risk for panther/vehicle
4899 collisions; and,
- 4900 • Providing education and outreach to residents living in, and adjacent to, panther habitat

4901
4902 Use of the Marinelli Fund may also accomplish the following recovery actions listed in the
4903 recovery action outline and implementation schedule:

- 4904 • Develop and expand funding mechanisms and other incentives for habitat restoration and,
- 4905 • Secure funding for the installation of wildlife crossings and fences in high-risk areas or
4906 to retrofit roadways with wildlife crossings and fencing to promote connectivity and
4907 dispersal.

4909 The Marinelli Fund is expected to be governed by the Marinelli Foundation Board consisting of
4910 4 NGO partners, 2 ECPO representatives, and 1 at-large member selected by the other 6 board
4911 members. The Marinelli Foundation Board will focus its spending on actions that benefit
4912 panthers (HCP chapter 9.3). Possible actions include, but are not limited to, the construction of
4913 additional wildlife crossings, habitat acquisition for preservation, habitat restoration, habitat
4914 improvement, habitat management, public outreach, education, and research. The Fund has the
4915 potential to generate in excess of \$150 million through 2050 with revenues deriving from the
4916 sale and resale of residential housing, and voluntary donations (PRT 2009). This program, if it
4917 achieves these levels of funding, is likely to facilitate substantial benefits towards the
4918 conservation and recovery of the panther. However, without know the exact number and
4919 location of improved acres, and the original and final condition of those acres, we are unable to
4920 quantify the amount of improvement and the conservation benefit for species. That said, we
4921 fully acknowledge that habitat improvements will have benefits on species and ecological
4922 functions and that these benefits are more likely to be realized under the HCP than other
4923 scenarios.

4924 Finally, the HCP also provides monitoring on a landscape level scale that would not occur under
4925 the RLSA and creates a framework for regular review of individual project proposals, impacts,
4926 and conservation measures whether or not they would otherwise be subject to consultation with
4927 the Service under §7(a)(2) of the Endangered Species Act. Developments pursued in accordance
4928 with the HCP will be checked to ensure best management practices and conservation measures
4929 proposed in the HCP are implemented at project-specific levels. Furthermore, as best
4930 management practices evolve, the regulations allow the Service to update and negotiate the
4931 inclusion of new or updated conservation practices used at project-levels with ITP holders during
4932 project-level reviews.

4933

4934 **5.7 Conclusion for Florida Panther**

4935

4936 In this section, we summarize and interpret the findings of the previous sections for the panther
4937 (status, baseline, effects, and cumulative effects) relative to the species-specific purpose of a BO
4938 under §7(a)(2) of the ESA, which is to determine whether the proposed action is likely to
4939 jeopardize the continued existence of a species. This analysis is a weight of evidence approach
4940 that includes both quantitative and qualitative estimates of both impacts, offsets, and beneficial
4941 effects of the action.

4942

4943 **Status**

4944

4945 Panthers are opportunistic predators that consume primarily white-tailed deer, feral hog, raccoon,
4946 and nine-banded armadillo. However, panthers will opportunistically select other prey when
4947 these are not available. Panthers prefer forested landscapes with sufficient edge habitat, and
4948 habitats within 300 m of forested habitat in proportion of availability. Panthers are polygynous.
4949 Female panthers establish home ranges in proximity of closely related females, while males
4950 compete for territories that overlap the ranges of several females. When suitable home ranges
4951 are strongly contested or unavailable, juvenile males and females may disperse great distances in
4952 search of alternative areas.

4953
4954 FWC documented a female panther north of the Caloosahatchee River for the first time in over
4955 40 years in 2017. Subsequent documentation of additional female(s) with kittens create
4956 optimism that the South Florida population will expand their breeding range to include areas
4957 north of the Caloosahatchee River in the future. However, as of June 2020, there is no evidence
4958 that successful recruitment, i.e., offspring born and surviving to enter the breeding population as
4959 adults, has occurred north of the Caloosahatchee River (Kelly and Onorato 2020), and until that
4960 evidence is documented, we do not conclude that the breeding range of Florida panthers has
4961 expanded beyond South Florida (USFWS 2020).

4962
4963 Panthers in the Action Area face the same threats as those listed range wide. Specifically,
4964 panthers in the Action Area face impacts from human disturbance, and human-caused habitat
4965 loss, fragmentation, and degradation from residential development, commercial development,
4966 and climate change. Sources of human-caused mortality in the Action Area, such as collision
4967 with motor vehicles, illegal shootings, and increased exposures to disease and pollution also
4968 threaten growth of the panther population. Additionally, as the human and panther population
4969 both grow incidences of human-panther conflict may also occur to the detriment of panthers.
4970 Lastly, panthers confront many ecological challenges, such as genetic risks associated with small
4971 population size or declines in prey populations caused by natural processes or human activity.
4972

4973 Conservation needs that address the most substantial threats listed above include the following:
4974

- 4975 • to conserve remaining panther habitat, restore degraded panther habitat, and enhance
4976 existing habitat to support growth of the population and the range of panthers;
- 4977 • to maintain a permeable landscape that provides connectivity between existing habitat;
- 4978 • to reduce mortality from anthropogenic sources; and
- 4979 • to ensure genetic variation remains sufficient to minimize the potential impact of
4980 inbreeding depression on survival and recovery.

4981
4982 **Baseline**

4983 Documented use of the Plan Area by panthers is extensive. Panther observations within the Plan
4984 Area make up 10 percent of all recorded panther observations in the wild. Approximately 36
4985 percent of all panthers tracked by radio telemetry have been documented as using some portion
4986 of the Plan Area. Thus, we conclude that it is likely between 10 percent and 36 percent of the
4987 panther population may use a portion of the Plan Area at some point in their lifetime, even if
4988 only transiently. The Plan Area contains 102,352 acres of habitat used by panthers for feeding,
4989 breeding, sheltering, or dispersal. Plan Area conservation needs and threats parallel the range-
4990 wide needs and threats.

4991
4992 Van de Kerk et al. (2019) found that individual-based population models predict that the
4993 probability that the population would fall below 10 panthers within 100 years (quasi-extinction)
4994 was 1.4 percent, but when the effect of genetic erosion was considered, the probability of quasi-
4995 extinction within 100 years increased to between 13 and 17 percent. They also found that when
4996 genetic introgression was implemented every 10 years via the translocation of 5 females from
4997 Texas populations of *Puma concolor* to South Florida, the probability of quasi-extinction fell
4998

4999 from 13 to 17 percent to a range between 6 and 10 percent. It is not known if efforts to
5000 translocate panthers or apply some other measure to increase genetic variability in the panther
5001 population may occur in the future.

5002

5003 Effects

5004

5005 When quantifying the effects of the action, we had to make a series of assumptions, and address
5006 uncertainties. In doing so we used information and data as presented in the HCP. We selected
5007 data (or a data range) that was consistent with other published or accepted literature. We
5008 avoided using “best case” or “worst case” scenarios in an effort to provide a thoughtful,
5009 reasonable assessment of the effects. When we were unable to quantify the effects of the action,
5010 we provided a qualitative assessment and described the range of uncertainties whenever possible.
5011

5012

5013 Proposed development and mining in the Plan Area include various activities that will
5014 permanently eliminate up to 18,337 acres of panther habitat if forest cover is developed last, but
5015 could take up to 30,616 acres of habitat if forest habitat is taken first. Because the HCP states
5016 that one of the goals of the plan is to avoid development in panther habitat, we assume the best
5017 available panther habitat will be avoided during development and that the equivalent of 3
5018 panthers/year will be lost at full buildout.

5019

5020 The designated Preservation Areas of the HCP contain 69,342 acres, or 69 percent, of forest
5021 cover and habitats within 300 m of it in the Plan Area that we consider likely panther habitat.
5022 The Applicants propose to preserve existing habitats, and to potentially restore, enhance, or
5023 create such habitats to mitigate for permanent losses associated with the Covered Activities. The
5024 HCP does not specify performance measures (amount or extent, functional gain) for such
5025 restoration and enhancement activities. Nonetheless, at minimum we do not expect the proposed
5026 management of Preservation Areas to reduce the numbers, reproduction, or distribution of the
5027 panthers in the Preservation Areas, because these activities would at least maintain current
5028 conditions. Special attention to this species in the long-term management of the Preservation
5029 Areas under conservation easements and habitat restoration could increase the number of
5030 panthers the Plan Area supports, though. For example, restoration of 17,605 acres of agricultural
5031 lands to forest cover in the Preservation Areas could boost the Plan Area population by the
5032 equivalent of 3 panthers, annually. Thus, habitat restoration on this scale could fully offset the
5033 impact of habitat loss from proposed development. However, though the HCP makes allowance
5034 for the possibility of habitat restoration, the HCP does not explicitly propose habitat restoration
5035 of this scale.

5036

5037 The HCP mentions that wetland restoration and habitat mitigation for other species will occur in
5038 the Preservation Areas. Because locations and types of restoration are not described, we are
5039 unable to determine if the changes will be beneficial for panthers.

5040

5041 The Very Low Density use areas of the HCP contain 2,394 acres of panther habitat.
5042 Development of some portions of these for residences, lodges, hunting/fishing camps could
5043 reduce such habitat by up to 239 acres, but we do not expect significant adverse consequences to
5044 panthers resulting from such displacement.

5045 We also estimate up to 1 panther may be lost annually from other effects of HCP proposed
5046 development, such as panther mortality on new roads, management removal to address
5047 human/panther conflict, new exposure to disease and toxins, and sub-lethal and lethal effects of
5048 declining prey populations (such as intra- and inter- specific aggression and malnutrition).

5049

5050 Additionally, assuming communities proposed in the HCP have a 50 percent internal traffic
5051 capture rate, and that the Applicants will facilitate the construction of 8 wildlife crossings that
5052 are at least 80 percent effective in reducing roadway mortality, we estimate traffic volume
5053 generated from the HCP will increase the risk of panther/vehicle mortality by 8 panthers/year.

5054

5055 In summary, we expect the implementation of the HCP to result in the loss of 12 additional
5056 panthers per year over the term of the permit. Eight from roadway mortality, 3 from habitat loss
5057 and 1 from other causes.

5058

5059 Cumulative Effects

5060

5061 Traffic on public roads, which is the sole source of cumulative effects we have identified for this
5062 Action, is likely to increase the risk of panther/vehicle mortality by approximately 2
5063 panthers/year above present in 2070. When these are added the effects of the HCP (12
5064 panthers/year) we expect a reduction of approximately 14 panthers/year from the population at
5065 full buildout.

5066

5067 Population Viability Analysis (PVA)

5068

5069 The results of our baseline PVA are consistent with the results of the van de Kerk et al. (2019)
5070 PVA. Simulation results with the combined effects of Sea Level Rise, the effects of the HCP,
5071 and cumulative effects, added to the baseline predict the development proposed in the HCP will
5072 result in a smaller population size. The results of the PVA suggests a decrease in the panther
5073 population from an average of ~150 adults persisting 100 years after expiration of the ITP to an
5074 average of ~64-66 adults. The results of our simulations also found a lower probability of
5075 persistence when the effects of the action and cumulative effects are added to the baseline. The
5076 change suggested is from a baseline average of 1 ± 0.8 percent probability of extinction (BSLR) to
5077 5.7 ± 3.5 percent (BSLR + HCP) and 6.6 ± 4.3 percent (BSLR + HCP + CE) 100 years after full
5078 implementation of the actions proposed in the HCP and cumulative effects, respectively. The
5079 number of panthers that could be lost annually and not result in a statistically significant difference
5080 in probability of extinction relative to the baseline estimates is 10. Our analysis of conditions
5081 under which change in abundance and viability would not statistically differ from baseline found
5082 that if the Applicants are able to further reduce the effects of their action (e.g., “through adaptive
5083 management”) or through use of the Marinelli Fund and reduce the loss to no more than 10 adult
5084 panthers (4 female adult panthers)/year above present (from all causes) the probability of
5085 extinction falls from 5.7 percent to 1.4 percent. This latter result is not statistically different from
5086 scenarios in which no further development occurs in the RLSA.

5087

5088 Because we do not have evidence that kittens produced by female panthers north of the
5089 Caloosahatchee River have survived to an age where they can contribute to population growth,
5090 the PVA was based on a closed population south of the River. It is likely over the 50-year course

5091 of the HCP and the additional 100 years modeled by the PVA that a breeding population will be
5092 established north of the River. If expansion occurs and all else remains as input into the PVA,
5093 then the effect of range expansion would reduce the negative influence of the HCP on the
5094 panther population by increasing the overall abundance of panthers and reducing the probability
5095 of their extinction.

5096
5097 We were only able to partially quantify the conservation measures in demographic terms that
5098 could be incorporated into our traffic or PVA models. This is a result of both the adaptive nature
5099 of many of the conservation measures (*i.e.*, not knowing where or when the measure(s) will be
5100 implemented) and assumptions built into the PVA. As a result, we cannot demonstrate a full
5101 offset of the predicted effects of development and increased risk from traffic expected from the
5102 activities described in the HCP. For example, a predicted total mortality of panthers from
5103 development proposed in the HCP and the subsequent increase in traffic (12 individuals above
5104 present) remains after the risk of panther/vehicle mortality has been reduced by 6 panthers/year
5105 because of the construction of 8 additional wildlife crossings (built using Marinelli Funds) with
5106 80 percent efficacy, and maintenance of an internal traffic capture rate of at least 50 percent in
5107 newly built communities. It is possible the construction of additional wildlife crossings, fencing,
5108 acquisitions, as well as habitat restoration and management facilitated by the Marinelli Fund
5109 could offset much, if not most or all, of these predicted effects. Other proposed Marinelli Funded
5110 conservation measures are not quantifiable at this time. For example, habitat is proposed to be
5111 managed in a way that increases the value for panthers. At this time, we do not know how many
5112 acres may be improved, to what extent the habitat value may be increased, or where on the
5113 landscape those improvements might be made. Undoubtedly such actions will reduce the overall
5114 predicted effect of the Action, but the magnitude of the reduction is unknown and cannot be
5115 included in the PVA at this time.

5116
5117 **Effects on Recovery**

5118
5119 Implementation of the HCP could substantially contribute towards the first Recovery Objective
5120 listed in the Florida Panther Recovery Plan (2008), which is to “To maintain, restore, and expand
5121 the panther population and its habitat in south Florida and expand the breeding portion of the
5122 population in south Florida to areas north of the Caloosahatchee River.” Specifically, the
5123 required participation of ITP holders in the RLSP ensures the protection of 69,342 acres of
5124 habitat frequently used by approximately 27.6 ± 5.81 panthers. These panthers use this habitat for
5125 home ranges or linkages between areas of habitat suitable for use as home ranges. In the absence
5126 of the HCP, the maintenance of this habitat would be less certain.

5127
5128 The HCP contributes to other recovery actions including:

- 5129 • initiating and encouraging landscape-level HCPs where proposed non-Federal actions or
5130 projects will impact panthers or their habitat;
- 5131 • securing Camp Keais Strand;
- 5132 • securing a corridor between Big Cypress National Preserve and Okaloachoochee Slough;
5133 maintaining the spatial extent and arrangement of habitat on a landscape scale;
- 5134 • and securing wildlife crossings with habitat adjacent or contiguous to crossings in areas
5135 of high risk for panther/vehicle collisions.

5137 These qualitative benefits from the HCP are not immediately quantifiable but may be able to be
5138 quantified in the future. Regardless, they likely also provide administrative, analytical, or other
5139 efficiencies in both the short and long term. While these benefits or offsets may not be species
5140 specific, most provide some direct or indirect conservation for panthers. These are summarized
5141 in Table 5-10. Qualitative benefits are considered in addition to those we were able to quantify
5142 when conducting our jeopardy analysis.

5143
5144

Table 5-10. Comparison of project-by-project consultation vs the programmatic HCP approach.

Project-by-Project (Without HCP)	With HCP
Project-by-project review and authorization via §7 exemption or §10 ITP	Programmatic authorization, via §10 ITPs, of projects within limits prescribed by HCP
Repeated negotiation/consultation, permit actions for each project	Project consistency check. Partial permit transfer to project-specific developer
Mitigation based in RLSP, negotiated, planned project-by-project, traffic effects negotiated, planned, and funded project-by-project	Mitigation, as based in RLSP, defined across the HCP area, project-specific BMPs, traffic effects addressed via Marinelli Fund and via cooperative framework of check-ins. Effects addressed via Marinelli Fund, cooperative framework of check-ins, and the option of course corrections.
Layout of RLSP sending areas would result in habitat corridors.	Proposed HCP habitat corridors expand on the RLSP sending areas adding assurance of functional corridors in perpetuity. Estimate an additional 26,000 acres of habitat conserved under HCP compared with RLSA only.
Range-wide initiatives are needed and are an appropriate way for landowners to participate with other panther stakeholders to address jointly responsible impacts to panthers.	Range-wide initiatives like the Marinelli Fund would be more certain under the HCP. Periodic check-ins provide a new venue for ECPO and other stakeholders to cooperate on conservation issues.
Habitat corridors and crossing sites could be planned on a regional basis (e.g., Wild Blue corridor), but would be built one-by-one [independently, individually, piecemeal].	Habitat corridors and crossing sites identified up front, funded and installed commensurate with development area. Coordinated plan, certainty of region-wide conservation planning, framework for cooperation with other stakeholders, provides a framework to build cooperation among panther stakeholders.

<p>In the current individual project approach, effects analysis, including jeopardy, would be repeated.</p> <p>A threshold of jeopardy may be reached beyond which no new actions could be contemplated or permitted.</p>	<p>Programmatic approach consolidates impacts analysis and permitting to one action versus numerous individual actions accumulating through time.</p> <p>Under the proposed programmatic approach, an expedited individual project review, consistency check, would occur and serve the same function to alert of an impending threshold of jeopardy.</p>
<p>Potential future conservation opportunities could be lost if lands are converted to some other land use that provides little conservation value and does not require mitigation or consultation under ESA review, such as land conversion to agriculture.</p> <p>Project-specific conservation lands are often committed up front and protected with a conservation easement, management plan, and management funding in perpetuity, but are smaller in size because they are only for the one project. Lands of less value to panthers are rarely included in conservation lands offered by applicants.</p> <p>Cost of management for preservation lands born by property owners rather than by public agencies or easement holders.</p> <p>Land that is conserved is at no cost to public of conservation lands, public conservation money can go to other objectives.</p>	<p>Landscape level Preservation Areas obligated by permit condition, not at risk of competing land uses. Conservation easements are placed on preserves as part of individual project approval. It is unclear if a management plan will be created. Lands of low quality habitat at this point in time are included in the preserve areas, but habitat quality may improve due to management.</p> <p>Potential future conservation lands (opportunities) would be identified and obligated as mitigation by permit conditions.</p> <p>Cost of management for preservation lands born by property owners rather than by public agencies or easement holders.</p> <p>No cost to public of conservation lands, public conservation money can go to other objectives.</p>
<p>Covered species determined project-by-project. All listed species on or in the vicinity of a project are considered. Species identified as at-risk by the Service are considered, but there are not many in the HCP area. Because projects are smaller in size than the HCP, there are generally fewer considered per consultation. State-listed species are not considered.</p>	<p>Many covered species addressed, long term planning for species that are not normally addressed in project review regulatory planning.</p>

County RLSP delineates high-density development areas, cumulative impacts (including Ave Maria) of 45,000 acres throughout 71,000 acres of open lands.	High-density development area consistent with, and more limited than, RLSP (reduced development envelope of 49,000 acres). Cumulative impacts (including Ave Maria) of 45,000 acres.
	Designates the Summerland Swamp landscape linkage as a Preservation Areas (currently RLSA Open Lands), providing additional panther habitat protection and improved landscape functionality.
Planning crossings complicated if different ownerships involved.	Cooperation among permittees built-in, can plan crossings across ownerships. Secures landscape linkages that will preserve functionality of FDOT-planned wildlife crossings on SR82 and connect existing conservation lands in the Plan Area (e.g., CREW) to designated conservation and agricultural lands in Sector Plans proposed in Hendry County.

5145

5146

5147 Because of the 50-year term of the requested permits, there may be unexpected events or habitat
5148 trends in the future that might cause the Service to consider revocation of the permit pursuant to
5149 regulations under 50 CFR Parts 17.22(b)(8) or 17.32(b)(8). We intend, however, to seek early
5150 remedies to avoid permit revocation in accordance with Parts 17.22(b)(8) or 17.32(b)(8). The
5151 factors or events that might initiate concern at this level may or may not be related to ECPO
5152 actions, would adversely affect panther conservation or status rangewide, and would cause the
5153 Service to consider re-initiation of all active section 7 consultations rangewide and to alter
5154 practices in future consultations.

5155 Examples of potential factors or events include but are not limited to:

- 5156 • An adverse population trend and/or projections of population persistence identified in
5157 species five-year status reviews, and/or species status assessments, or similar;
- 5158 • Emergence of disease (e.g., FLM) or other new threat; or,
- 5159 • Persistent failure of properly implemented HCP management to achieve primary
5160 biological goals. These might include:
 - 5161 ○ Adverse changes in the quality and/or function of Preserve lands, including
5162 designated landscape linkages/corridors. Indicators of reduced function could
5163 include, but are not limited to, reduced occupancy and/or recruitment of covered
5164 species on Preserve lands.
 - 5165 ○ Repeated agency management response to human-wildlife conflicts in Covered
5166 Activities areas. These management actions could include, but are not limited to,
5167 aversive conditioning and/or removal of wildlife species from developments.

5168
5169 Coordination to identify such adverse situations and to identify remedial measures will be
5170 conducted as described in the section 10 findings and in permit conditions XX.

5171
5172 **Opinion**
5173
5174 As described in section 5.3.1.4., above, we estimate and consider the predicted increased risk of
5175 wildlife mortality, along with the environmental baseline and the predicted cumulative effects, to
5176 determine the overall effects to the species for the purposes of preparing this BO on the proposed
5177 action in accordance with 50 CFR section 402.02. We do not attribute take from vehicle strikes
5178 to the Applicants because they do not have sufficient direct control and the causal linkages are
5179 too remote and attenuated.
5180
5181 Measures included in the HCP have the potential to aid in accomplishing several recovery
5182 actions listed in the Florida Panther Recovery Plan (3rd edition 2008). These could aid in
5183 maintaining the overall quality, quantity, and functionality of habitat within areas of the Plan
5184 Area, ensure that equivalent habitat protection and restoration are provided, and compensate for
5185 both the quantity and functional value of the lost habitat. Additionally, measures proposed in the
5186 HCP contribute to recovery goals for the panther as described in Section 5.7 of this BO, above.
5187
5188 Best management practices proposed in the HCP encourage habitat management on private lands
5189 to benefit panthers and their prey; provide incentives and assistance to willing landowners to
5190 manage their lands for panthers and prey using tools such as prescribed fire and invasive plant
5191 control; and provide incentives that encourage them not to convert a portion of their lands to less
5192 suitable habitat. Best management practices proposed within developed areas would serve to
5193 isolate Preserve habitat corridors from development disturbances and attractants (garbage, etc.)
5194 and therefore enhance the corridors' habitat value and minimize adverse human-wildlife
5195 conflicts. Measures proposed in the HCP also minimize and prevent injuries and mortalities by
5196 modifying conditions on existing roads and implementing appropriate actions to protect panthers
5197 during the planning, permitting, and construction of new roads and highway expansion projects,
5198 and facilitating the securing of funding for the installation of wildlife crossings and fencing in
5199 high risk areas.
5200
5201 However, the benefits of HCP proposed measures must be balanced against the demographic
5202 effects of the action on the panther population. Specifically, the loss of approximately 18,337
5203 acres of panther habitat will reduce range-wide carrying capacity by the equivalent of ~3
5204 panthers, annually at full buildout. Converting the majority of cropland in the Preservation Area
5205 to forests could offset most if not all of this impact, but such enhancement is not explicitly
5206 proposed or guaranteed within the HCP. Additionally, the loss of 1 additional panther/year at
5207 full buildout is predicted from other causes (such as mortality on new roads, reduction in prey
5208 habitat, increased exposure to disease and toxins, increased likelihood of management
5209 intervention to address depredation and human/panther conflict etc.).
5210
5211 For the purpose of our analysis, we assumed communities built in accordance with the HCP will
5212 maintain a 50 percent rate of internal traffic capture; the applicants will facilitate the construction
5213 of at least 8 wildlife crossings that are at least 80 percent effective at reducing mortality. We
5214 also assumed the panther population would remain at, or greater than, its current size until
5215 impacted by development projected by the HCP. We assume that the proposed BMPs will
5216 maintain the Preserves as functional habitat corridors allowing panther movements with minimal

5217 interference by human activities in developed areas. Based on these assumptions and
5218 considering the conservation measures proposed by the Applicants, we estimate traffic associated
5219 with HCP development will increase the risk of panther \vehicle mortality by up to 8
5220 panthers/year (at full build-out) above the present rate.

5221
5222 We additionally recognize that increasing traffic on roadways from development proposed in the
5223 HCP will extend across much of the panther's present range and these increases will increase the
5224 effect of roadways as barriers to movement to panthers and may intensify the effects of habitat
5225 fragmentation. We acknowledge measures proposed in the HCP to maintain existing corridors
5226 and construct additional wildlife crossings will reduce the impact of roadway mortality and
5227 habitat fragmentation. Through identifying the Preservation Areas and corridors upfront in the
5228 HCP, it allows for better planning and placement of wildlife crossings in conjunction with the
5229 Marinelli Fund, transportation agencies, and others.

5230
5231 The HCP's requirement of landowner participation in the RLSP for an ITP to cover their
5232 proposed development creates certainty around the future of development in the RLSA and
5233 guarantees protection of habitat necessary for the recovery of the panther. The establishment of
5234 the Marinelli Fund through implementation of the HCP creates additional benefit to panther
5235 recovery that exceeds the substantial benefit conveyed through landowner participation in the
5236 RLSP. However, our effects analysis is predicated on the assumption that community (internal)
5237 traffic capture averages 50 percent at full build-out. Because we were required to make
5238 assumptions on the number, location, and effectiveness of wildlife crossings, we may have
5239 under- or over-estimated the amount of offset for panthers.

5240
5241 Additionally, our PVA predicts the implementation of the HCP, in the absence of further actions
5242 to reduce the impact of the action to the panthers, could reduce the abundance of panthers across
5243 their range such that the probability of extinction is predicted to increase from 1 percent (95
5244 percent C.I. 0.2 to 1.8 percent) to 5.7 percent (95 Percent C.I. 2.2 to 9.2 percent). When
5245 cumulative effects are added to the effects of the HCP the probability of extinction further
5246 increases to 6.6 percent (95 percent C.I. 2.3 to 10.9 percent). The probability of extinction after
5247 implementation of the HCP is statistically significantly different than baseline conditions. If the
5248 Applicants are able to achieve a greater than 50 percent community (internal) traffic capture rate,
5249 further reduce the effects of their action, or mitigate them through use of the Marinelli Fund for
5250 habitat restoration to the extent that the net effect is a loss of no more than 10 adult panthers (4
5251 female adult panthers)/year above present (from all causes) our analysis finds the probability of
5252 extinction falls from 5.7 percent to 1.4 percent. This probability of extinction is within the 95
5253 percent C.I. of scenarios where no additional panthers are taken above present (*i.e.*, not
5254 significantly different from baseline).

5255
5256 The assumptions we make here, taken altogether, assume that the HCP will work as intended.
5257 The Service will ensure this through §10 permit conditions that will include adaptive
5258 management measures to monitor plan implementation and outcomes and allow issues to be
5259 identified and addressed at the earliest possible time. See the §10 findings for our evaluation of
5260 the adaptive measures.

5262 After reviewing the current status of the species, the environmental baseline for the Action Area,
5263 the effects of the Action and the cumulative effects, it is the Service's biological opinion that the
5264 Action **is/is not** likely to jeopardize the continued existence of the Florida panther.

5265

5266 **6. Big Cypress Fox Squirrel**

5267

5268 This section provides the Service's conference opinion of the Action for the Big Cypress fox
5269 squirrel.

5270

5271 **6.1 Status of Big Cypress Fox Squirrel**

5272

5273 This section summarizes best available data about the biology and current condition of the Big
5274 Cypress fox squirrel (*Sciurus niger avicennia*; BCFS) throughout its range that are relevant to
5275 formulating an opinion about the Action. At this time, the BCFS is not protected under the ESA.
5276 The Service has not reviewed the species' status relative to the ESA definitions of "endangered"
5277 and "threatened." The State of Florida protects the BCFS as a threatened species under its
5278 Endangered and Threatened Species Rule. For purposes of this Conference Opinion, we
5279 summarize the *Species Action Plan for the Big Cypress Fox Squirrel* (FWC 2013), the *Species*
5280 *Conservation Measures and Permitting Guidelines for the Big Cypress Fox Squirrel* (FWC
5281 2018), and other available data to describe the species' status.

5282

5283 **6.1.1 Species Description**

5284

5285 The BCFS is a large tree squirrel that is highly variable in color and patterning. The most
5286 common pattern includes a black head and dorsal fur, buff sides and belly, buff and black tail,
5287 and white nose and ears. Darker and lighter color patterns have been documented as well. The
5288 BCFS is the smallest of the four eastern fox squirrel subspecies that occur in Florida.

5289

5290 **6.1.2 Life History**

5291

5292 Although considered a tree squirrel, the BCFS spends a lot of time on the ground. The BCFS diet
5293 consists of a variety of seeds, nuts, fruits, berries, flowers, insects, and fungi that vary in seasonal
5294 availability. Cypress trees support most documented nests, with some in pines and cabbage
5295 palms. Nest materials are variable, but most consist of bark stripped from cypress placed on
5296 sticks or bromeliads.

5297

5298 Fox squirrels can mate at any time of the year, but BCFS have two breeding seasons: winter/dry
5299 season, from December to April, and summer/wet season, from July to October. Females
5300 generally mate with more than one male and the average litter size is typically 2 or 3 offspring.
5301 Gestation is about 6 weeks and weaning around 12 weeks after birth. Pups may remain with their
5302 mother through their first winter before dispersing. FWC (2011) reported that BCFS captured in
5303 Naples and released in Big Cypress National Preserve exhibited inconsistent site fidelity and
5304 movements of up to 32 km (about 20 mi) from the release locations.

5305

5306 BCFS use a variety of habitats including tropical hardwood forest, live oak forest, mangrove
5307 forest, cypress swamp, pine flatwoods, pastures, parks, and golf courses. In urban environments,

5308 BCFS use parks and golf courses where large trees and food sources are retained and the
5309 groundcover is open and low. Food availability significantly influences the size of the area used
5310 by BCFS, especially by females. In natural areas, mean home range size is 187 acres for males
5311 and 26 acres for females. Individual home ranges typically overlap substantially without
5312 observed territoriality; however, adults, especially females, often defend a core area of
5313 approximately 3 acres. The difficulties of surveying cypress swamps and gaining access to
5314 private ranchlands have constrained the collection of BCFS distribution and abundance data.
5315 Available density estimates are 0.09 and 1.92 squirrels/km² (3.6 and 78 squirrels/10,000 acres) in
5316 cypress swamps and wooded ranchlands, respectively (FWC 2011).

5317

5318 **6.1.3 Numbers, Reproduction, and Distribution**

5319

5320 The BCFS occurs in the southwestern tip of peninsular Florida, where FWC (2011) reports an
5321 area of occupancy of 1,677–3,840 km² (414,396–948,885 acres), and an estimated abundance of
5322 “well below” 10,000 squirrels. Applying the density estimates cited in the previous section to
5323 this range of occupancy estimates yields a population range of 151–7,373 squirrels, but FWC
5324 considered the population size greater than 1,000 mature individuals in its 2011 Biological Status
5325 Review Report. The status of BCFS in the core of the species’ range, Big Cypress National
5326 Preserve and the Everglades, is largely unknown, but is considered declining due to extirpation
5327 from several historically occupied locations. FWC (2011) estimated a zero probability of BCFS
5328 extinction in the next 100 years, but a 50% probability of a 95% population decline in the next
5329 100 years.

5330

5331 **6.1.4 Conservation Needs and Threats**

5332

5333 The BCFS requires areas with open ground cover and mature trees for food availability and
5334 nests. Habitat loss, degradation, and fragmentation are the main threats. Rapid urbanization in
5335 western Lee and Collier counties has isolated local BCFS populations within fragmented habitat
5336 patches. An insufficient use of prescribed fire has contributed to a degradation of BCFS habitat
5337 conditions on some conservation lands and private rural lands. In urban areas, mortality due to
5338 vehicles, pets, and other causes (e.g., feeding squirrels with inappropriate human foods, exposure
5339 to rodenticides and other toxic chemicals) is a growing concern. Munim (2008) documented 10
5340 BCFS road-kills in suburban areas in 2006–2007. Loss of native bromeliads (used as nest sites)
5341 caused by a non-native weevil, and various diseases, pose threats of an unknown magnitude to
5342 BCFS. The species’ primary conservation need is the protection and management of open
5343 understory woodlands. FWC (2018) provides recommendations to address this need and others
5344 in its *Species Conservation Measures and Permitting Guidelines for the Big Cypress Fox*
5345 *Squirrel*.

5346

5347 **6.2 Environmental Baseline for Big Cypress Fox Squirrel**

5348

5349 This section describes the current condition of the BCFS in the Action Area without the
5350 consequences to the listed species caused by the proposed Action.

5351

5352 **6.2.1 Action Area Numbers, Reproduction, and Distribution**

5353

5354 The Plan Area contains 63,849 acres of land cover classes that may provide BCFS habitat,
5355 including forested wetlands, forested uplands, rural open lands, and improved pasture (Table 2-
5356 1). The Applicants did not conduct BCFS surveys of the Plan Area during the development of
5357 the HCP. The Biological Assessment for the 4,000-acre Rural Lands West Project, which is
5358 within the Plan Area, documented one BCFS on site in 2008 (Passarella & Associates, Inc.
5359 2017). A University of Florida and FWC web-based survey of the public and natural resource
5360 professionals (August 2011–April 2012) received reports of 3 BCFS sightings within the Plan
5361 Area and of about 100 sightings on lands within 25 mi of the Plan Area (FWC 2013).

5362 Based on these reports, the species' ability for relatively long-distance movements, and a
5363 substantial acreage of habitat types associated with the species, we are reasonably certain that
5364 BCFS occupy the Plan Area. We have no data that indicates the Plan Area supports a
5365 disproportionate share of the range-wide population, which does not occur at high densities
5366 anywhere. The lack of historic records in the Plan Area suggests a relatively lower density and
5367 patchy distribution. Lacking abundance data specific to the Action Area, we conservatively use
5368 the average of the densities reported for BCFS in cypress swamps and wooded ranchlands (40.8
5369 squirrels/10,000 acres) to estimate that the Plan Area supports about 260 BCFS.

5371 **6.2.2 Action Area Conservation Needs and Threats**

5372 The range-wide conservation needs and threats we described in section 6.1.4 are relevant in the
5373 Action Area. With respect to the threat of exposure to toxic chemicals, at least three eastern grey
5374 squirrels have died of suspected rodenticide poisoning in Collier and Lee counties since 2011 (J.
5375 Fitzgerald, von Arx Wildlife Hospital, personal communication).

5376 **6.3 Effects of the Action on Big Cypress Fox Squirrel**

5377 This section describes all reasonably certain consequences to the BCFS that we predict the
5378 proposed Action would cause, including the consequences of other activities not included in the
5379 proposed Action that would not occur but for the proposed Action. Such effects may occur later
5380 in time and may occur outside the immediate area involved in the Action.

5381 **6.3.1 Development and Mining, Base Zoning, and Lands Eligible for Inclusion**

5382 The BCFS uses many land cover classes and most commonly uses forested wetlands for nesting.
5383 These characteristics are consistent with our criteria for applying the Proportional method
5384 described in section 2.1.4 to estimate the spatial extent of development impacts. By this method,
5385 we estimate that development and mining activities within the development envelope of the Plan
5386 Area would result in the loss of 9,284 acres of suitable habitat for the BCFS (the sum of acreages
5387 in Table 2-3 column "G" for those cover classes associated with the BCFS).

5388 FWC (2018) permitting guidelines for the BCFS do not require pre-construction surveys,
5389 because it is difficult to locate BCFS nests, and the Applicants do not propose such surveys.
5390 Where BCFS nest or shelter within a construction footprint, the use of heavy equipment to
5391 remove vegetation and grade land surfaces during the construction (horizontal) phase of

5399 development activity (see Table 2-5) is likely to kill or injure most pups in nests and an
5400 undeterminable percentage of adult BCFS.

5401
5402 BCFS occupy areas year-round. Female BCFS forage within a 575-foot radius (24 acres) of their
5403 nests. Habitat modification resulting in a loss of more than 25% of plants providing food
5404 resources, more than 10% of trees providing other potential nest sites, or that alters the timing,
5405 quantity, or quality of water availability, would impair essential foraging and nesting behaviors
5406 (FWC 2018). Such modifications are likely to displace entirely or shift the home range of
5407 individuals that avoid death or injury caused by construction activity. Displacement would
5408 expose individuals to an increased risk of predation, roadkill, and other lethal/injurious hazards
5409 during dispersal. Human habitation of the developed areas following construction would
5410 introduce various stressors that increase the risk of death and injury caused by pets, pesticides,
5411 and vehicles on roads. Due to the relative abundance of BCFS habitat in the Plan Area and low
5412 densities, a percentage of animals displaced by construction activity would survive and persist in
5413 adjacent areas, but we are unable to estimate this percentage.

5414
5415 By the direct and indirect effect pathways described in the previous two paragraphs, and using
5416 the average of reported BCFS densities (40.8 squirrels per 10,000 acres, see section 6.2.1), we
5417 expect an estimated 9,284 acres of development of BCFS habitat to harm up to 38 BCFS.

5418 5419 **6.3.2 Preservation Activities**

5420
5421 The designated Preservation Areas of the HCP contain 47,811 acres of land cover that we
5422 consider as BCFS habitat (Table 2-1), including 11,550 acres of cypress forest and 7,599 acres of
5423 improved pasture (the two most extensive cover classes). Using the average of reported BCFS
5424 densities (40.8 squirrels per 10,000 acres, see section 6.2.1), we expect the Preservation Areas to
5425 support about 195 BCFS. Activities in these areas would include prescribed burning, mechanical
5426 control of groundcover, mechanical and chemical control of exotic vegetation, and other
5427 activities that maintain or improve land quality and existing agricultural uses.

5428
5429 Although many of these activities maintain habitat for BCFS, some can also kill, injure, or
5430 disrupt the normal behaviors of BCFS that are present at the time. For example, prescribed
5431 burning maintains open ground cover that BCFS require for foraging. Burning may also cause
5432 squirrels to leave the burn zone or take refuge in their nests, which temporarily disrupts feeding
5433 behavior, and may kill or injure some squirrels through heat or smoke inhalation. Nests and nest
5434 trees may be destroyed during prescribed burns or by heavy equipment during exotic vegetation
5435 control; however, we consider these events rare and discountable.

5436
5437 The activities described above are a continuation of current land management practices, which
5438 we do not expect to alter the numbers, reproduction, or distribution of the BCFS in the
5439 Preservation Areas. BCFS would experience occasional disturbances from land management
5440 practices conducted near nest trees.

5441
5442 Preservation Areas will serve as mitigation for most or all of the covered species. While
5443 preservation via conservation easement is the primary approach to maintaining Preservation
5444 Areas habitats, the HCP proposes habitat enhancement or restoration as mitigation, at least as an

5445 option, for certain of the covered species, including those using forested habitats. The fox
5446 squirrel, however, does not have a habitat mitigation requirement. In addition, Preservation
5447 Areas are probable sites for mitigation of wetland fill.

5448
5449 We expect BCFS to persist in the Preservation Areas, because the preservation and management
5450 activities under the HCP will, at minimum, maintain current conditions. Special attention to this
5451 species in the long-term management of the Preservation Areas under conservation easements
5452 could increase BCFS densities and the Plan Area population. However, lacking more detailed
5453 information about BCFS in the Plan Area, and about how habitat management under easements
5454 may specifically benefit this species, we are unable to reasonably estimate the extent of potential
5455 BCFS benefits.

5456 **6.3.3 Very Low Density Development**

5457 The Very Low Density (VLD) use areas of the HCP contain 1,561 acres of land cover that we
5458 consider as BCFS habitat (Table 2-1), including 357 acres of freshwater forested wetlands and
5459 502 acres of improved pasture (the two most extensive cover classes). Using the average of
5460 reported BCFS densities (40.8 squirrels per 10,000 acres, see section 6.2.1), we expect the VLD
5461 areas to support about 6 BCFS.

5462 Land uses in the VLD areas are similar to the Preservation Areas, but may also include isolated
5463 residences, lodges, and hunting/fishing camps, at a density of no more than one dwelling unit per
5464 50 acres. Croplands and orchards are not present in the VLD, but the Applicants would continue
5465 current ranching/livestock operations and other management activities as described for the
5466 Preservation Areas (e.g., exotic species control, prescribed burning). As in the Preservation
5467 Areas, we expect any adverse effects resulting from the continuation of the existing land
5468 management regimes as rare and discountable.

5469 The HCP does not specify a footprint for the isolated residences, lodges, and hunting/fishing
5470 camps, but indicates that their construction could clear up to 10% of the existing native
5471 vegetation (see section 2.5). New dwelling development could occur within any of the cover
5472 types present besides open water and existing development. Clearing up to 10% of the cover
5473 types that we consider as BCFS habitat would reduce such habitat by 156 acres. It is possible that
5474 dwelling development in the VLD areas could entirely avoid BCFS-occupied areas, but we
5475 conservatively estimate an impact that is proportional to the maximum extent of the habitat
5476 modification, which is 10% of 6 BCFS, or the loss of 1 individual. The pathways for this effect
5477 are the same as we described for construction activity in the Development areas in section 6.3.1.

5478 **6.4 Cumulative Effects on Big Cypress Fox Squirrel**

5479 For purposes of consultation under ESA §7, cumulative effects are those caused by future state,
5480 tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future
5481 Federal actions that are unrelated to the proposed action are not considered, because they require
5482 separate consultation under §7 of the ESA.

5490 We identified in section 3 of this BO/CO a projected increase in traffic on public roads as the
5491 sole source of effects that are consistent with the definition of cumulative effects for this Action.
5492 Roadkill is a documented cause of BCFS mortality in suburban areas (Munim 2008). We expect
5493 an increase in traffic on Action Area roads to increase roadkill rates for BCFS where roads cross
5494 or adjoin occupied areas; however, we have no data upon which to develop a reasonable
5495 relationship between traffic volume and BCFS mortality.

5496

5497 **6.5 Conclusion for Big Cypress Fox Squirrel**

5498

5499 In this section, we summarize and interpret the findings of the previous sections for the BCFS
5500 (status, baseline, effects, and cumulative effects) relative to the species-specific purpose of a BO
5501 under §7(a)(2) of the ESA, which is to determine whether the proposed action is likely to
5502 jeopardize the continued existence of a species.

5503

5504 **Status**

5505

5506 The BCFS occurs in the southwestern tip of peninsular Florida, where FWC (2011) reports an
5507 area of occupancy of 414,396–948,885 acres, and an estimated abundance of 1,000–7,373
5508 squirrels. The status of BCFS in the core of the species' range, Big Cypress National Preserve
5509 and the Everglades, is largely unknown, but is considered declining due to extirpation from
5510 several historically occupied locations.

5511

5512 Threats to the BCFS include habitat loss, degradation, and fragmentation; mortality from roads,
5513 pets, disease, and toxic substances; and reduction of nesting sites (bromeliads and large trees).
5514 The species' primary conservation need is the protection and management of open understory
5515 woodlands.

5516

5517 **Baseline**

5518

5519 The Plan Area contains 63,849 acres of land cover classes that may provide BCFS habitat,
5520 including forested wetlands, forested uplands, rural open lands, and improved pasture. Based on
5521 reports of the BCFS within the Plan Area and adjacent areas, the species' ability for relatively
5522 long-distance movements, and a substantial acreage of habitat types associated with the species,
5523 we are reasonably certain that BCFS occupy the Plan Area. Lacking abundance data specific to
5524 the Action Area, we use the average of the densities reported for BCFS in cypress swamps and
5525 wooded ranchlands (40.8 squirrels/10,000 acres) to estimate that the Plan Area supports about
5526 260 BCFS.

5527

5528 The range-wide conservation needs of and threats to the BCFS are relevant in the Action Area.

5529

5530 **Effects**

5531

5532 We expect an estimated 9,284 acres of development of BCFS habitat to harm up to 38 BCFS.
5533 Due to the relative abundance of BCFS habitat in the Plan Area and low densities, a percentage
5534 of animals displaced by construction activity would survive and persist in adjacent areas, but we
5535 are unable to estimate this percentage.

5536
5537 The designated Preservation Areas of the HCP contain the majority (47,811 acres, or 74.9%) of
5538 land cover that we consider as BCFS habitat within the Plan Area. We expect BCFS to persist in
5539 the Preservation Areas, because the HCP preservation and management activities will, at
5540 minimum, maintain current conditions. Special attention to this species in the long-term
5541 management of the Preservation Areas under conservation easements could increase BCFS
5542 densities and the Plan Area population.

5543
5544 Clearing up to 10% of the cover types that we consider as BCFS habitat within the Very Low
5545 Density use areas would reduce such habitat by 156 acres. We conservatively estimate an impact
5546 that is proportional to the maximum extent of the habitat modification, which is 10% of 6 BCFS,
5547 or the loss of 1 individual.

5548
5549 **Cumulative Effects**
5550
5551 We expect an increase in traffic on Action Area roads to increase roadkill rates for BCFS where
5552 roads cross or adjoin occupied areas; however, we have no data upon which to develop a
5553 reasonable relationship between traffic volume and BCFS mortality.

5554
5555 **Opinion**
5556
5557 BCFS are likely to occur in the Plan Area at a low density and with a patchy distribution.
5558 Conservatively applying the average of reported densities (40.8/10,000 acres) to habitats of the
5559 Plan Area associated with the BCFS indicates that the development activities would harm up to
5560 39 squirrels, with an undeterminable percentage of displaced individuals reestablishing territories
5561 in undeveloped areas. Precluding further development in the Preservation Areas, and limiting
5562 development in the Very Low Density (VLD) areas, would maintain habitat for the remaining
5563 260 – 39 = 221 BCFS that the Plan Area may support.

5564
5565 The loss of up to 39 BCFS would represent a 0.5–3.9% reduction to the range-wide population
5566 size of 1,000–7,373. We consider this range a worst-case scenario due to our conservative
5567 attribution of an average BCFS density to a portion of the range that is not likely to support a
5568 disproportionate share of the range-wide population. Population increases in the Preservation
5569 Areas, and possibly the VLD use areas, could wholly or partially offset this loss. Such increases
5570 would depend on the success of habitat improvements in these areas, which we anticipate are
5571 likely, but not guaranteed. An increasing rate of BCFS mortality on Action Area roads is a
5572 logical outcome of increasing traffic volume, due to both regional population growth and the
5573 new developments of the proposed Action, but present mortality rates are unknown and future
5574 rates are unpredictable.

5575
5576 Habitat types that may support BCFS in the Plan Area are relatively abundant and could support
5577 a much higher BCFS density with management. The species has demonstrated an ability to
5578 colonize non-traditional habitats, including pastures and open rural land, which occur throughout
5579 the Plan Area. Both agricultural lands and native habitats will receive protection from further
5580 development in the Preservation Areas and undeveloped portions of the VLD use areas as other
5581 portions of the Plan Area are developed. We believe the following factors support a view that the

5582 likely net impact of the Action on the species is substantially less than the worst-case scenario of
5583 a 0.5–3.9% population reduction:

- 5584 • our application of an average BCFS density to Plan Area habitats likely overestimates
5585 BCFS numbers;
- 5586 • increases in habitat quality in the Preservation Areas through management under
5587 conservation easements are likely; and
- 5588 • the survival of animals displaced from construction areas is undeterminable, but possibly
5589 substantial, due to the abundance of potential habitat and low densities.

5590 Therefore, we believe the net impact of the Action on the BCFS is within the species' ability to
5591 sustain.

5592 After reviewing the current status of the species, the environmental baseline for the Action Area,
5593 the effects of the Action and the cumulative effects, it is the Service's conference opinion that
5594 the Action is not likely to jeopardize the continued existence of the BCFS.

5597 **7. Florida Sandhill Crane**

5598 This section provides the Service's conference opinion of the Action for the Florida sandhill
5599 crane.

5602 **7.1 Status of Florida Sandhill Crane**

5604 This section summarizes best available data about the biology and current condition of the
5605 Florida sandhill crane (*Antigone canadensis pratensis*) throughout its range that are relevant to
5606 formulating an opinion about the Action. At this time, the Florida sandhill crane is not protected
5607 under the ESA. The Service has not reviewed the species' status relative to the ESA definitions
5608 of "endangered" and "threatened." The State of Florida protects the Florida sandhill crane as a
5609 threatened species under Florida's Endangered and Threatened Species Rule. For purposes of
5610 this Conference Opinion, we summarize the *Species Action Plan for the Florida Sandhill Crane*
5611 (FWC 2013), the *Species Conservation Measures and Permitting Guidelines for the Florida*
5612 *Sandhill Crane* (FWC 2016), and other available data to describe the species' status.

5614 **7.1.1 Species Description**

5616 Sandhill cranes are long-legged, long-necked, heavy-bodied, gray birds with a patch of bald, red
5617 skin on top of their heads. Adults average 4 ft in height with a wingspan of 6.5 ft. They fly with
5618 their necks outstretched and their distinctive, rattling calls can be heard from far away. Males
5619 and females appear identical except the male is slightly larger. Two subspecies of sandhill crane
5620 are found in Florida. The Florida sandhill crane (*Antigone canadensis pratensis*) is non-
5621 migratory and the greater sandhill crane (*A. c. tabida*) winters in Florida, arriving in October and
5622 leaving for breeding grounds in the Great Lakes region in March. Although the two subspecies
5623 are indistinguishable, those observed in the peninsula from April to September are most likely
5624 the resident Florida subspecies. The two subspecies are not known to interbreed.

5626 **7.1.2 Life History**

5628 Florida sandhill cranes mate for life and are long-lived, averaging 20 years. Although some start
5629 breeding at 3 years old, they are rarely successful until age 5. Florida sandhill cranes nest
5630 primarily from February through April, but may begin as early as December and extend through
5631 August. Nests are built of plant stems in shallow marshes where water depths average 5 to 13
5632 inches. Although they lay eggs in only one nest, pairs may build accessory nests or platforms.
5633 Nesting success is a function of water levels during the nesting season and predation. Pairs can
5634 re-nest after a nest failure.

5635
5636 Clutch size can range from one to three eggs, but is usually two. The average incubation period
5637 is 30 days and the average brood size is 1.32 chicks. Both members of the pair incubate the eggs
5638 and raise the young. The chicks can fly within 65 to 70 days. Flightless young may forage up to
5639 1,500 ft away from the nest site within weeks of hatching. Young sandhill cranes stay with their
5640 parents about 10 months before becoming independent and gaining the featherless red crowns.
5641 Male and female Florida sandhill cranes disperse a mean distance of 2.4–7.2 mi from their natal
5642 territory, respectively. The maximum observed female dispersal distance was 29.8 mi.

5643
5644 Sandhill cranes are omnivorous, feeding on seeds, grain, berries, insects, earthworms, mice,
5645 small birds, snakes, lizards, frogs, and crayfish. Florida sandhill cranes forage in a variety of
5646 open habitats, including shallow herbaceous wetlands, improved pastures, prairies, open pine
5647 forests, croplands, golf courses, airports, sod farms, and road rights-of-way. A pair's average
5648 home range is about 1,100 acres, which includes some amount of shallow-water non-forested
5649 wetlands for nesting and roosting. Home ranges may overlap, but core nesting areas are defended
5650 from other cranes, which varies from 300–635 acres.

5651
5652 **7.1.3 Numbers, Reproduction, and Distribution**

5653
5654 Florida sandhill cranes occur from the Okefenokee Swamp, in southern Georgia, to the
5655 Everglades. However, most of the population is in peninsular Florida from Alachua County to
5656 the northern edge of the Everglades (FWC 2013, Figure 2). The Florida sandhill crane population
5657 was estimated at 4,000–6,000 individuals in 1992, and just under 4,600 individuals in 2003
5658 (FWC 2011). Based on inferences from habitat analyses, the population declined by 35.7% from
5659 1974 to 2003 (an average of 1.23% per year). If that trend has continued at the same rate, the
5660 population has declined another 20% to around 3,680 in 2019.

5661
5662 **7.1.4 Conservation Needs and Threats**

5663
5664 Sandhill cranes rely on shallow marshes for roosting and nesting and use open upland and
5665 wetland habitats for foraging. Major threats to Florida sandhill cranes are habitat loss and
5666 degradation. Most of the remaining habitat is on private lands (e.g., urban areas, improved
5667 pastures), which are not a priority for conservation. Cranes abandon areas that lack a
5668 management regime or natural conditions that maintain low-stature vegetation (e.g., prescribed
5669 fire, cattle grazing). Dense vegetation may harbor predators, such as bobcats (*Lynx rufus*).
5670 Cranes displaced from habitats that become unsuitable are exposed to an increased risk of
5671 mortality from predators and collisions with vehicles, utility lines, and fences. Human presence
5672 can increase abundance of predators such as raccoons (*Procyon lotor*) and domestic dogs (*Canis*
5673 *lupus familiaris*). Non-native predators such as coyotes (*Canis latrans*), red fox (*Vulpes vulpes*),

5674 feral hogs (*Sus scrofa*), and fire ants (*Solenopsis invicta*) are also a threat. Exposure of cranes
5675 and their prey to pesticides and other toxic substances that are commonly used in urban, rural,
5676 and agricultural areas is a growing concern (FWC 2013).

5677
5678 Changes in water quantity or timing due to drought, storms, ground water withdrawal, ditching,
5679 draining, or flooding can cause nest failures. Low water levels can make nests and young more
5680 vulnerable to predators and rapid rises in water levels can flood nests. The effects of climate
5681 change on rainfall amounts and timing may exacerbate water-related nest failures. FWC (2016)
5682 reports that human activity within 250 ft of nests can cause adults to flush and leave eggs
5683 exposed to extreme temperatures, predation, and may cause nest abandonment. More severe and
5684 sustained disturbance within 400 ft of nests, such as construction activity, can interrupt nesting
5685 behavior and cause nest abandonment. Land conversion within 1,500 ft of nests may
5686 significantly impair the ability of flightless young to forage.

5687
5688 The primary conservation need for the Florida sandhill crane is to maintain or increase the area
5689 of suitable habitat in order to stabilize or increase the population (FWC 2013). Florida sandhill
5690 cranes use a variety of land cover types that have an open aspect, as long as a suitable wetland
5691 exists nearby for roosting and nesting. Practices that maintain the open aspect include prescribed
5692 fire and cattle grazing.

5693
5694 **7.2 Environmental Baseline for Florida Sandhill Crane**

5695
5696 This section describes the current condition of the Florida sandhill crane in the Action Area
5697 without the consequences to the listed species caused by the proposed Action.

5698
5699 **7.2.1 Action Area Numbers, Reproduction, and Distribution**

5700
5701 The Plan Area contains 77,760 acres of land cover classes that may provide Florida sandhill
5702 crane habitat, including 28,773 acres of non-forested wetland types (marshes, prairies and bogs,
5703 isolated freshwater march, and freshwater non-forested wetlands), improved pasture, rural open
5704 land, and cropland/pasture (Table 2-1). The Applicants did not conduct Florida sandhill crane
5705 surveys of the Plan Area during the development of the HCP. The Biological Assessment for the
5706 Rural Lands West Project, which is within the HCP Development area, documented several
5707 Florida sandhill cranes on site during May and June of 2007 (Passarella & Associates, Inc.
5708 2017). eBird (2019) reports substantial numbers of adult and juvenile sandhill cranes during the
5709 months of April through September within and near the Plan Area, which is when migratory
5710 sandhill cranes have left to breed in the Great Lakes region. Therefore, we are reasonably certain
5711 that a breeding population of Florida sandhill cranes occupies the Plan Area.

5712
5713 To estimate the size of the breeding population (not including juveniles), we use the mid-point in
5714 the range of core nesting area size that breeding pairs defend (300–635 acres, or 467.5 acres).
5715 Dividing the extent of non-forested wetland types in the Plan Area (28,773 acres) by 467.5 acres
5716 yields habitat for about 62 breeding pairs, or 124 adults with a 1:1 sex ratio. Using the average
5717 clutch size of 2 eggs and the average brood size of 1.32 chicks, a stable population of this size
5718 would have 124 eggs and 81 chicks during the breeding season each year. At any time, the

5719 population would also include birds that are not yet reproductively active (less than 3 to 5 years
5720 old).

5721 5722 **7.2.2 Action Area Conservation Needs and Threats**

5723 Threats to the Florida sandhill crane in the Action Area are the same as the range-wide threats,
5724 which include:

- 5726 • loss of non-forested wetland habitats;
- 5727 • water level extremes during the nesting season;
- 5728 • predation by native and exotic species;
- 5729 • disturbance of nesting activities by construction activities and humans;
- 5730 • collisions with vehicles, utility lines, and fences; and
- 5731 • exposure to pesticides and other toxic substances.

5732 The primary conservation need for the Florida sandhill crane in the Action Area is to maintain or
5733 increase the area of suitable habitat in order to stabilize or increase the population.

5734 **7.3 Effects of the Action on Florida Sandhill Crane**

5735 This section describes all reasonably certain consequences to the Florida sandhill crane that we
5736 predict the proposed Action would cause, including the consequences of other activities not
5737 included in the proposed Action that would not occur but for the proposed Action. Such effects
5738 may occur later in time and may occur outside the immediate area involved in the Action.

5739 **7.3.1 Development and Mining, Base Zoning, and Lands Eligible for Inclusion**

5740 The Florida sandhill crane uses several land cover classes represented in the Plan Area and relies
5741 on non-forested wetlands for nesting and roosting. These characteristics are consistent with our
5742 criteria for applying the Proportional method described in section 2.1.4 to estimate the spatial
5743 extent of development impacts. By this method, we estimate that development and mining
5744 activities within the development envelope of the Plan Area would result in the loss of 20,594
5745 acres of suitable sandhill crane habitat (the sum of acreages in Table 2-3 column “G” for those
5746 cover classes associated with the sandhill crane). The conversion to development and mining
5747 uses would involve mostly agricultural and rural open lands that provide foraging habitat (17,669
5748 acres, or 85.8%), but also 2,925 acres of non-forested wetlands that provide roosting habitat year
5749 round and nesting habitat in the breeding season.

5750 As a programmatic proposal, the HCP does not specify the timing of project-level construction
5751 activities. Florida sandhill cranes are not migratory and are present in the Plan Area year-round.
5752 Human activity and noise during the nesting season (February through April) within 400 ft of
5753 nests may harm eggs and chicks by causing adults to leave the nest for the duration of the
5754 disturbance (FWC 2016). Habitat modifications within 1,500 ft of nest sites (equivalent to a 162-
5755 acre circle) may impair feeding essential feeding behavior of flightless chicks (FWC 2016). We
5756 expect that construction activities (drainage, clearing, and grading operations) during the nesting
5757 season (February–April) within 1,500 ft of nest sites would harm eggs and flightless chicks and
5758 displace adults from their core nesting areas. Construction outside the nesting season would

5765 avoid harming eggs and chicks, but eliminate nesting habitat in subsequent years. Based on a
5766 core nesting area size of 467.5 acres (see section 7.2.1), and complete utilization of the available
5767 non-forested wetlands as nesting habitat, development on 2,925 acres of non-forested wetlands
5768 would directly or indirectly affect up to about 6 nesting pairs of Florida sandhill cranes.
5769 Regardless of the timing of construction, development in shallow-water non-forest wetlands
5770 would eliminate roosting habitat.

5771
5772 Development activity in uplands is unlikely to kill or injure sandhill cranes, because they
5773 generally avoid human activity, but a substantial loss of foraging habitat within a bird's home
5774 range (average 1,100 acres) would cause the individual to forage elsewhere. Adult home ranges
5775 overlap, and multiple individuals may forage in the same areas. Following the development,
5776 cropland, pasture, and rural open land would remain relatively abundant in the potential
5777 development areas (9,633 acres; the total of these three classes from column "H" of Table 2-3)
5778 and in the other land use designations of the HCP. Native wetlands habitats for nesting, roosting,
5779 and foraging are much more likely to limit local sandhill crane numbers and reproduction, and of
5780 these, the nesting habitat requirements are the most specific, because pairs defend a core nesting
5781 area. We estimate that the development areas support nesting for up to 6 breeding pairs.
5782 Therefore, we believe that habitat loss associated with the development would reduce crane
5783 numbers by up to 6 breeding pairs.

5784
5785 Following construction, human occupancy of the developed areas that are located near wetlands
5786 that support roosting/nesting cranes could cause an increase in predation by predators attracted to
5787 garbage and an increase in exposure to pesticides and other chemicals used in the developed
5788 areas. Additional power lines and fences could increase electrocution and entanglement of
5789 Florida sandhill cranes. An increase in traffic would likely increase the incidence of vehicles
5790 striking cranes. Although these various hazards would increase the risks to individuals that
5791 occupy areas near the developed areas, we lack data with which to estimate the amount or extent
5792 of probable harm to sandhill cranes. We do not believe that these risks would substantially
5793 increase the amount or extent of harm caused by habitat loss.

5794 5795 **7.3.2 Preservation Activities**

5796
5797 The designated Preservation Areas of the HCP contain 44,606 acres of land cover that we
5798 consider as Florida sandhill crane habitat (Table 2-1), including 23,693 acres of non-forested
5799 wetlands. Based on a core nesting area size of 467.5 acres (see section 7.2.1), and complete
5800 utilization of the available non-forested wetlands as nesting habitat, we estimate that these
5801 wetlands, and nearby pastures, croplands, and rural open lands, would support up to 51 breeding
5802 pairs. Activities in these areas would include prescribed burning, mechanical control of
5803 groundcover, mechanical and chemical control of exotic vegetation, and other activities that
5804 maintain or improve land quality and existing agricultural uses.

5805
5806 Many of these activities maintain habitat conditions for Florida sandhill cranes. In particular,
5807 prescribed burning can control woody encroachment into both uplands and wetlands. Grazing
5808 and mowing can maintain open areas for crane foraging. Because nesting occurs in wetlands
5809 with shallow water (5 to 13 inches deep), direct impacts to eggs and chicks caused by fire or the
5810 use of heavy equipment to manage vegetation are unlikely. Outside the breeding season or more

5811 than 400 ft from an active nest, FWC (2016) reports that the following activities are unlikely to
5812 harm or disturb cranes:

- 5813 • managing vegetation along utility and highway rights-of-way;
- 5814 • the routine use of roads, homes, and other infrastructure; and
- 5815 • routine agricultural operations.

5817 The Applicants propose the following general measures in the Preservation and Very Low
5818 Density use areas for sandhill cranes (HCP chapter 7.5.1.1):

- 5819 • Preserve and maintain sandhill crane habitat in accordance with the terms of the FWC
5820 state permit for the HCP Area.
- 5821 • Mitigate permanent losses of Florida sandhill crane habitat associated with the Covered
5822 Activities through preservation, and possibly restoration, enhancement and/or creation of
5823 an equal acreage of in-kind Florida sandhill crane habitat.
- 5824 • Where practicable, in-kind mitigation for wetland impacts will enhance and/or restore
5825 suitable short-hydroperiod nesting habitats (shallow open marshes, wet prairies) for the
5826 Florida sandhill crane that function across a range of hydrologic conditions.

5827 We do not expect the management of HCP Preservation Areas to reduce the numbers,
5828 reproduction, or distribution of the Florida sandhill crane to in the Preservation Areas, because
5829 these activities would, at minimum, maintain current conditions. Special attention to this species
5830 in the long-term management of the Preservation Areas under conservation easements could
5831 increase crane densities and the Plan Area population. However, lacking more detailed
5832 information about the Florida sandhill crane in the Plan Area, and about how habitat
5833 management under conservation easements may benefit this species, we are unable to reasonably
5834 estimate the extent of potential benefits.

5835 **7.3.3 Very Low Density Development**

5836 The Very Low Density (VLD) use areas of the HCP contain 966 acres of land cover that we
5837 consider as Florida sandhill crane habitat (Table 2-1), including 223 acres of freshwater non-
5838 forested wetlands. With a core nesting area size of 300–635 acres (see section 7.2.1), the extent
5839 of wetlands within the VLD use areas is unlikely to support a breeding pair of sandhill cranes,
5840 but may support roosting and foraging for non-breeding cranes and for mature cranes outside the
5841 breeding season. Pastures, cropland/pasture, and rural open lands of the VLD areas (743 acres)
5842 may also support crane foraging.

5843 Land uses in the VLD areas are similar to the Preservation Areas, but may also include isolated
5844 residences, lodges, and hunting/fishing camps, at a density of no more than one dwelling unit per
5845 50 acres. The Applicants would continue current ranching/livestock operations and other
5846 management activities as described for the Preservation Areas (e.g., exotic species control,
5847 prescribed burning). As in the Preservation Areas, we do not expect adverse effects resulting
5848 from the continuation of the existing land management regimes.

5849 The HCP does not specify a footprint for the isolated residences, lodges, and hunting/fishing
5850 camps, but indicates that their construction could clear up to 10% of the existing native
5851 vegetation (see section 2.5). New dwelling development could occur within any of the cover
5852 types present besides open water and existing development. Clearing up to 10% of the native

5857 cover types that we consider as crane habitat would reduce such habitat by 22 acres (Table 2-7).
5858 It is possible that dwelling development in the VLD areas could entirely avoid wetlands, but we
5859 conservatively estimate a 22-acre habitat loss. Because we do not expect the VLD area wetlands
5860 to support nests, this extent of habitat modification is unlikely to kill or injure cranes.

5861
5862 The general measures listed in the HCP for enhancing crane habitat in the Preservation Areas
5863 apply to the VLD areas as well (see previous section 7.3.2). However, the potential to increase
5864 crane numbers or reproduction is limited due to the small extent of non-forested wetlands in the
5865 VLD areas.

5866 5867 **7.4 Cumulative Effects on Florida Sandhill Crane**

5868
5869 For purposes of consultation under ESA §7, cumulative effects are those caused by future state,
5870 tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future
5871 Federal actions that are unrelated to the proposed action are not considered, because they require
5872 separate consultation under §7 of the ESA.

5873
5874 We identified in section 3 of this BO/CO a projected increase in traffic on public roads as the
5875 sole source of effects that are consistent with the definition of cumulative effects for this Action.
5876 Roadkill is a known cause of Florida sandhill crane mortality. We expect an increase in traffic on
5877 Action Area roads to increase roadkill rates for cranes where roads cross or adjoin occupied
5878 areas; however, we have no data upon which to develop a reasonable relationship between traffic
5879 volume and sandhill crane mortality.

5880 5881 **7.5 Conclusion for Florida Sandhill Crane**

5882
5883 In this section, we summarize and interpret the findings of the previous sections for the Florida
5884 sandhill crane (status, baseline, effects, and cumulative effects) relative to the species-specific
5885 purpose of a BO under §7(a)(2) of the ESA, which is to determine whether the proposed action is
5886 likely to jeopardize the continued existence of a species.

5887 5888 **Status**

5889
5890 The Florida sandhill crane population is declining. The most recent population estimate (2003),
5891 inferred from habitat availability, was just under 4,600 individuals. Most of the population
5892 occurs in peninsular Florida, from Alachua County to the northern edge of the Everglades.

5893
5894 The primary conservation need for the Florida sandhill crane is to maintain or increase the area
5895 of suitable habitat in order to stabilize or increase the population. Florida sandhill cranes use a
5896 variety of land cover types that have an open aspect, as long as a suitable wetland exists nearby
5897 for roosting and nesting. Practices that maintain the open aspect include prescribed fire and cattle
5898 grazing.

5899 5900 **Baseline**

5902 Based on various incidental records, we are reasonably certain that a breeding population of
5903 Florida sandhill cranes occupies the Plan Area. The Plan Area contains 77,760 acres of land
5904 cover classes that may provide Florida sandhill crane habitat, including 28,773 acres of non-
5905 forested wetland types that could support nesting, plus improved pasture, rural open land, and
5906 cropland/pasture that could support foraging. Using the average size of the core nesting area that
5907 cranes defend and the extent of non-forested wetlands, we estimate that the Plan Area may
5908 support up to 62 breeding pairs.

5909
5910 The primary conservation need in the Plan Area is the same as the range-wide need: maintain or
5911 increase the area of suitable habitat in order to stabilize or increase the population.

5912
Effects

5913 We estimate that development and mining activities within the development envelope of the Plan
5914 Area would result in the loss of 20,594 acres of suitable sandhill crane habitat. The conversion to
5915 development and mining uses would involve mostly agricultural and rural open lands that
5916 provide foraging habitat (17,669 acres, or 85.8%), but also 2,925 acres of non-forested wetlands
5917 that provide roosting habitat year round and nesting habitat in the breeding season. We estimate
5918 that these wetlands support nesting for up to 6 breeding pairs. Therefore, we believe that habitat
5919 loss associated with the HCP development would reduce crane numbers by up to 6 breeding
5920 pairs.

5921
5922 The designated Preservation Areas may support up to 51 breeding pairs of cranes. We do not
5923 expect the management of Preservation Areas to reduce the numbers, reproduction, or
5924 distribution of the Florida sandhill crane to in the Preservation Areas, because these activities
5925 will, at minimum, maintain current conditions. Special attention to this species in the long-term
5926 management of the Preservation Areas under conservation easements could increase crane
5927 densities and the Plan Area population.

5928
5929 Clearing up to 10% of the native cover types that we consider as crane habitat in the Very Low
5930 Density (VLD) use areas would reduce crane habitat by 22 acres. Because we do not expect the
5931 VLD area wetlands to support nests, this extent of habitat modification is unlikely to kill or
5932 injure cranes.

5933
Cumulative Effects

5934 We expect an increase in traffic on Action Area roads to increase roadkill rates for sandhill
5935 cranes where roads cross or adjoin occupied areas; however, we have no data upon which to
5936 develop a reasonable relationship between traffic volume and crane mortality.

5937
Opinion

5938 The loss of about 3,000 acres of non-forested wetlands to development in the Plan Area would
5939 add an increment of habitat loss in the range of the Florida sandhill crane, whose numbers have
5940 been declining due primarily to habitat loss since the 1970's. Following full build-out under the
5941 HCP, we estimate habitat losses in the Plan Area would cause a population reduction of up to 6

5948 breeding pairs. Extrapolating the rate of decline from 1974–2003, the estimated 2003 population
5949 of just under 4,600 mature cranes has possibly declined to about 3,680 in 2019. The loss of 6
5950 breeding pairs over the course of development in the Plan Area relative to either estimate would
5951 represent a 0.3% reduction to the range-wide population.

5952
5953 Precluding new development and mining activity in the dedicated Preservation Areas would
5954 protect a substantial amount of sandhill crane habitat, which we estimate supports the majority
5955 (51 breeding pairs, or 82%) of the Plan Area population. As these areas are brought under
5956 conservation easements, habitat enhancements that may increase crane numbers are likely, but
5957 the amount or extent is not predictable at this time. Where practicable, the Applicants propose to
5958 implement project-level mitigation for wetlands impacts that is required for Clean Water Act
5959 permits in a manner that enhances or restores marshes and wet prairies for crane nesting. Again,
5960 such enhancements appear likely, but the amount or extent is not predictable at this time, and
5961 such permits are future federal actions that we do not evaluate in this BO/CO. Given the
5962 relatively small impact of the Development activities to crane populations (0.3%) and the
5963 likelihood of benefits in the Preservation Areas, we believe the net impact of the Action on the
5964 Florida sandhill crane is within the species' ability to sustain.

5965
5966 After reviewing the current status of the species, the environmental baseline for the Action Area,
5967 the effects of the Action and the cumulative effects, it is the Service's conference opinion that
5968 the Action is not likely to jeopardize the continued existence of the Florida sandhill crane.

5969
5970

5971 **8. Florida scrub-jay**

5972

5973 This section provides the Service's biological opinion of the Action for the Florida scrub-jay.

5974

5975 **8.1 Status of Florida Scrub-jay**

5976

5977 This section summarizes best available data about the biology and current condition of the
5978 Florida scrub-jay (*Aphelocoma coerulescens*) (scrub-jay) throughout its range that are relevant to
5979 formulating an opinion about the Action. The Service published its decision to list the scrub-jay
5980 as threatened on June 3, 1987 (52 FR 20715-20719).

5981

5982 **8.1.1 Species Description**

5983

5984 The scrub-jay is about 10 to 12 in (25 to 30 cm) long and weighs about 3 ounces (85 grams).
5985 They are similar in size and shape to blue jays (*Cyanocitta cristata*), but differ significantly in
5986 coloration (Woolfenden and Fitzpatrick 1996a). Unlike the blue jay, the scrub-jay lacks a crest. It
5987 also lacks the conspicuous white-tipped wing and tail feathers, black barring, and bridle of the
5988 blue jay. The scrub-jay's head, nape, wings, and tail are blue, and its body is pale gray on its
5989 back and belly. Its throat and upper breast are lightly striped and bordered by a pale blue-gray
5990 "bib" (Woolfenden and Fitzpatrick 1996a). Scrub-jay sexes are not distinguishable by plumage
5991 (Woolfenden and Fitzpatrick 1984), and males, on the average, are only slightly larger than
5992 females (Woolfenden 1978). The sexes may be identified by a distinct "hiccup" call made only
5993 by females (Woolfenden and Fitzpatrick 1984; Woolfenden and Fitzpatrick 1986). Scrub-jays

5994 less than about 5 months of age are easily distinguishable from adults; their plumage is smoky
5995 gray on the head and back, and they lack the blue crown and nape of adults. During late summer
5996 and early fall, when the first basic molt is nearly done, fledgling scrub-jays are indistinguishable
5997 from adults in the field (Woolfenden and Fitzpatrick 1984).

5998

5999 **8.1.2 Life History**

6000

6001 The scrub-jay is endemic to peninsular Florida's ancient dune ecosystems or scrubs, which occur
6002 on well-drained to excessively well-drained sandy soils (Laessle 1958; Laessle 1968; Myers
6003 1990). This relict oak-dominated scrub, or xeric oak scrub, is essential habitat to the scrub-jay,
6004 and is adapted to nutrient-poor soils, periodic drought, and frequent fires (Abrahamson 1984). In
6005 some cases, scrub-jay habitat occurs as patches of oak scrub within a matrix of little-used habitat
6006 of saw palmetto and herbaceous swale marshes (Breininger et al. 1991, Breininger et al. 1995).
6007 This matrix of native habitats supply prey for scrub-jays.

6008

6009 Scrub-jays are non-migratory and permanently territorial, occupying multipurpose territories
6010 year-round (Woolfenden and Fitzpatrick 1978; Woolfenden and Fitzpatrick 1984; Fitzpatrick et
6011 al. 1991). Once scrub-jays pair and become breeders, generally within two territories of their
6012 natal area, they stay on their breeding territory until death. In suitable habitat, fewer than 5% of
6013 scrub-jays disperse more than 5 mi (8 km) (Fitzpatrick et al. 1991). Stith et al. (1996) believe that
6014 a dispersal distance of 5 mi (8 km) is close to the biological maximum for scrub-jays. Scrub-jays
6015 live in families ranging from two birds (a single-mated pair) to extended families of eight adults
6016 (Woolfenden and Fitzpatrick 1984) and one to four juveniles.

6017

6018 Fledgling scrub-jays stay with the breeding pair in their natal (birth) territory as "helpers,"
6019 forming a closely-knit, cooperative family group. Juveniles may stay in their natal territory for
6020 up to 6 years before dispersing to become breeders (Woolfenden and Fitzpatrick 1984;
6021 Woolfenden and Fitzpatrick 1986). Territory size average 22–25 acres (9–10 ha) (Woolfenden
6022 and Fitzpatrick 1990; Fitzpatrick et al. 1991), with a minimum size of about 12 acres (5 ha)
6023 (Woolfenden and Fitzpatrick 1984; Fitzpatrick et al. 1991). Nesting normally occurs from March
6024 1 through June 30 (Woolfenden and Fitzpatrick 1984), and clutch size ranges from one to five
6025 eggs, but is typically three or four eggs (Woolfenden and Fitzpatrick 1990). Eggs are incubated
6026 for 17–19 days (Woolfenden 1974), and fledging occurs 15–21 days after hatching (Woolfenden
6027 1978). Only the breeding female incubates and broods eggs and nestlings (Woolfenden and
6028 Fitzpatrick 1984), and the presence of helpers improves fledging success (Woolfenden and
6029 Fitzpatrick 1990; Mumme 1992).

6030

6031 The longest observed lifespan of a scrub-jay is 15.5 years at Archbold Biological Station in
6032 Highlands County (Woolfenden and Fitzpatrick 1996b). Survival of scrub-jay fledglings to
6033 yearling age class averages about 35% in optimal scrub; while annual survival of both adult
6034 males and females averages around 80% (Woolfenden and Fitzpatrick 1996b). However, data
6035 from Archbold Biological Station indicate that survival and reproductive success of scrub-jays in
6036 suboptimal habitat is lower (Woolfenden and Fitzpatrick 1991), which probably explains the
6037 extirpation of scrub-jays from unburned, late successional habitats. Similarly, Toland (1991)
6038 reported significant differences in mean annual productivity (# young fledged per adult pair) in
6039 Indian River County between:

6040 1. contiguous optimal scrub (2.2 young);
6041 2. fragmented moderately-developed scrub (1.8 young); and
6042 3. very fragmented suboptimal scrub (1.2 young).

6043
6044 Scrub-jays forage mostly on or near the ground, often along the edges of natural or man-made
6045 openings. They visually search for food by hopping or running along the ground beneath the
6046 scrub or by jumping from shrub to shrub. Insects form most of the animal portion of the scrub-
6047 jays' diet (Woolfenden and Fitzpatrick 1984), but small vertebrates are also eaten when
6048 encountered. In suburban areas, scrub-jays will accept supplemental foods once the scrub-jays
6049 have learned about them (Woolfenden and Fitzpatrick 1984). Acorns are the scrub-jays'
6050 principal plant food (Woolfenden and Fitzpatrick 1984; Fitzpatrick et al. 1991). From August to
6051 November each year, scrub-jays may harvest and cache 6,500 to 8,000 oak (*Quercus* sp.) acorns
6052 throughout their territory. Acorns are typically buried beneath the surface of bare sand patches in
6053 the scrub during fall, and retrieved and consumed year round, though most are consumed in fall
6054 and winter (DeGange et al. 1989). Other small nuts, fruits, and seeds also are eaten (Woolfenden
6055 and Fitzpatrick 1984).

6056
6057 **8.1.3 Numbers, Reproduction, and Distribution**

6058
6059 Historically, oak scrub occurred as numerous isolated patches in peninsular Florida, concentrated
6060 along both the Atlantic and Gulf coasts and on the central ridges of the peninsula (Davis 1967).
6061 Probably until as recently as the 1950s, scrub-jay populations occurred in the oak scrub and
6062 scrubby pine flatwoods habitats of 39 of the 40 counties south of, and including Levy, Gilchrist,
6063 Alachua, Clay, and Duval Counties. Historically, most of these counties would have contained
6064 hundreds or even thousands of breeding pairs (Fitzpatrick et al. 1994). Only the southernmost
6065 county, Monroe, lacked scrub-jays (Woolfenden and Fitzpatrick 1996a). Although scrub-jay
6066 numbers probably began to decline when European settlement began in Florida (Cox 1987), the
6067 decline was first noted in the literature by Byrd (1928).

6068
6069 An extensive statewide survey of scrub-jays in 1992–1993 estimated 3,961 scrub-jay family
6070 groups with 10,972 individuals (Fitzpatrick et al. 1994). The survey most likely overestimated
6071 the abundance of scrub-jays at Merritt Island National Wildlife Refuge and Cape Canaveral Air
6072 Force Station (Boughton and Bowman 2011), but underestimated the abundance of scrub-jays in
6073 Ocala National Forest, some areas in southwest Florida, and some areas in southern Brevard and
6074 northern Indian River counties (Miller and Stith 2002, Breininger et al. 2003).

6075
6076 The statewide survey indicated that scrub-jays were extirpated from Alachua and Clay counties,
6077 although at least one scrub-jay group was later discovered in Clay County (Bowman and
6078 Boughton 2011). Ten or fewer scrub-jay groups remained in an additional seven counties
6079 (Flagler, Hardee, Hendry, Hernando, Levy, Orange, and Putnam) (Fitzpatrick et al. 1994).
6080 Population numbers in 27 of the original 39 counties had 30 or fewer breeding pairs (Fitzpatrick
6081 et al. 1994). Fitzpatrick et al. (1994) estimated that scrub-jays had declined between 25–50% in
6082 the northern third of the species' range since the surveys by Cox (1987). Woolfenden and
6083 Fitzpatrick (1996b) estimated that scrub-jay populations had declined by 90% or more since
6084 European settlement. On protected lands, scrub-jays have continued to decline due to inadequate
6085 habitat management (Stith 1999; Boughton and Bowman 2011).

6086
6087 Over the last several years, managers of conservation lands have taken steps to reverse the
6088 observed decline in scrub-jays on these lands, primarily by more aggressively using fire to
6089 improve habitat quality (Hastie and Eckl 1999; Stith 1999; The Nature Conservancy 2001;
6090 Turner et al. 2006). If the decline can be reversed, managed lands have the potential to support
6091 about twice the number of scrub-jays groups as in 2009 and 2010 (Boughton and Bowman
6092 2011).

6093
6094 **8.1.4 Conservation Needs and Threats**

6095
6096 Threats to scrub-jays include habitat loss and fragmentation, fire suppression, predation, disease,
6097 urban development, and non-native and invasive species. Scrub-jays require a habitat type that
6098 occurs only in particular regions within Florida (Woolfenden and Fitzpatrick 1984), which have
6099 experienced a substantial alteration for agricultural and residential uses. Habitat loss and
6100 fragmentation are the major threats to the species' survival and recovery. Cox (1987) noted local
6101 extirpations and major decreases in numbers of scrub-jays and attributed them to the clearing of
6102 scrub for housing and citrus groves. Statewide, estimates of scrub habitat loss range from 70 to
6103 90% (Woolfenden and Fitzpatrick 1996a). Fernald (1989), Fitzpatrick *et al.* (1991), and
6104 Woolfenden and Fitzpatrick (1996a) noted habitat losses due to agriculture, silviculture, and
6105 commercial and residential development were continuing to play a role in the decline in numbers
6106 of scrub-jays throughout the state.

6107
6108 Habitat fragmentation increases the probability of inbreeding and genetic isolation, which is
6109 likely to increase extinction probability (Fitzpatrick *et al.* 1991; Woolfenden and Fitzpatrick
6110 1991; Stith *et al.* 1996; Thaxton and Hingtgen 1996). Dispersal distances of scrub-jays in
6111 fragmented habitat are further than in optimal unfragmented habitats, and demographic success
6112 (survival and reproduction rates) is poor (Thaxton and Hingtgen 1996; Breininger 1999).
6113 Persistent breeding populations of scrub-jays exist only where there are scrub oaks in sufficient
6114 quantity and form to provide an ample winter acorn supply, cover from predators, and nest sites
6115 during the spring (Woolfenden and Fitzpatrick 1996b). Scrub-jay dispersal behavior is affected
6116 by the intervening land uses. Protected scrub habitats will most effectively sustain scrub-jay
6117 populations if they are located within surrounding habitat types that can be used and traversed by
6118 scrub-jays. Brushy pastures, scrubby corridors along railway and road rights-of-way, and open
6119 burned flatwoods offer links for colonization among scrub-jay populations.

6120
6121 A primary cause for scrub-jay decline is poor demographic success associated with reductions in
6122 fire frequency (Woolfenden and Fitzpatrick 1984; Woolfenden and Fitzpatrick 1991; Schaub *et*
6123 *al.* 1992; Stith *et al.* 1996; Breininger *et al.* 1999). Fire suppression may exceed habitat loss as
6124 the single most important limiting factor (Woolfenden and Fitzpatrick 1991; Woolfenden and
6125 Fitzpatrick 1996a; Fitzpatrick *et al.* 1994). Fitzpatrick *et al.* (1991) reported that overgrown
6126 scrub habitats are often occupied by the blue jay; a native predator of scrub-jay nestlings and a
6127 competitor for resources. Woolfenden and Fitzpatrick (1996b) and Toland (1999) suggest that
6128 hunting efficiency for scrub-jay predators is greater in overgrown scrub habitats.

6129
6130 Predation probably causes most scrub-jay mortality (Woolfenden and Fitzpatrick 1996b). The
6131 second most frequent cause may be disease, or predation on disease-weakened scrub-jays

(Woolfenden and Fitzpatrick 1996b). Known predators of scrub-jays include several species of snakes, mammals, and birds that eat eggs, nestlings, fledglings, and adults (Woolfenden and Fitzpatrick 1990; Fitzpatrick *et al.* 1991; Schaub *et al.* 1992; Woolfenden and Fitzpatrick 1996a, 1996b; Breininger 1999; Franzreb and Puschock 2004; Miller 2004). Bowman and Averill (1993) noted scrub-jays occupying fragments of scrub found in or near housing developments were more prone to predation by free-roaming cats and to competition from blue jays and mockingbirds. Young scrub-jays are especially vulnerable to ground predators (e.g., snakes and mammals) before they are fully capable of sustained flight.

Scrub-jays host various naturally-occurring parasites that are unlikely to cause population-level impacts. However, the sticktight flea (*Echidnophaga gallinacea*; Woolfenden and Fitzpatrick 1996b), which occurs on some individuals, is believed to lower fitness and potentially cause death (Boughton *et al.* 2006). The host vector for this flea was a domestic dog (*Canis familiaris*), suggesting that introduction of human pets into scrub-jay areas may increase parasite loads and reduce fitness.

Housing and commercial developments within scrub habitats are accompanied by the development of roads. Since scrub-jays often forage along roadsides and other openings in the scrub, they are often killed by passing cars. Research by Mumme *et al.* (2000) along a two-lane paved road indicated that clusters of scrub-jay territories found next to the roadside represented population sinks (breeder mortality exceeds production of breeding-age recruits), which persisted only by immigration from other territories. Since this species may be attracted to roadsides because of their open habitat characteristics, vehicular mortality presents a significant and growing management problem throughout the remaining range of the scrub-jay (Dreschel *et al.* 1990; Mumme *et al.* 2000). The design of scrub preserves should consider proximity to high-speed paved roads (Woolfenden and Fitzpatrick 1996a).

Another potential problem in suburban areas supporting scrub-jays is supplemental feeding by humans (Bowman and Averill 1993; Woolfenden and Fitzpatrick 1996a; Bowman 1998). The presence of additional food may allow scrub-jays to persist in fragmented habitats, but recruitment in these populations is lower than in native habitats. Although human feeding may postpone local extirpations, it cannot substitute for protecting native oak scrub habitat that is necessary for nesting and long-term persistence. Scrub-jays in suburban settings often build nests high in tall shrubbery, which are susceptible to destruction by March winds (Woolfenden and Fitzpatrick 1996b; Bowman 1998).

The invasion of disturbed areas by exotic species, including Brazilian pepper (*Schinus terebinthifolius*), white cypress-pine (*Callitris glaucophylla*), and Australian pine (*Casuarina equisetifolia*), degrades scrub habitat for scrub-jays (Fernald 1989). Other biological stressors associated with human habitation in or near scrub-jay habitats include: domestic dogs and cats, black rats, greenhouse frogs (*Eleutherodactylus planirostris*), giant toads (*Bufo marinus*), Cuban tree frogs (*Osteopilus septentrionalis*), brown anoles (*Anolis sagrei*), and other exotic animal species (Fernald 1989). These exotic species may be predators of scrub-jays, or compete with scrub-jays for space and food. As with roads, the design of scrub preserves should consider proximity to housing developments (Woolfenden and Fitzpatrick 1996a, 1996b).

6178 **8.2 Environmental Baseline for Florida Scrub-jay**

6179
6180 This section describes the current condition of the Florida scrub-jay in the Action Area without
6181 the consequences to the listed species caused by the proposed Action.

6182
6183 **8.2.1 Action Area Numbers, Reproduction, and Distribution**

6184
6185 The Plan Area contains only 38 acres classified as scrub and scrubby flatwoods, which alone is
6186 insufficient to maintain more than a single scrub-jay territory. However, the 1992–1993
6187 statewide scrub-jay survey located 34 families in Lee and Collier counties at the locations shown
6188 in Figure 8-1. The largest cluster of families (17 families) occurred in and around Immokalee,
6189 which the Plan Area surrounds. A survey of the Immokalee area in March and May of 2007
6190 identified a total of 15 families at the locations shown in Figure 8-2 (Service GIS data). The 2007
6191 scrub-jay detections were in the same general areas as in the 1992–1993 survey, but the 2007
6192 survey results indicate a net loss of 2 families.

6193
6194 Field inspections of areas associated with a FDOT (2014) study of the SR29 corridor in the
6195 Immokalee area recorded observations of two scrub-jays at two locations in October 2010, and
6196 two scrub-jays at three locations in April 2011. These sightings were in a patch of woodland
6197 habitat at the northern edge of developed areas within Immokalee, which the 2007 survey also
6198 identified as occupied. Otherwise, the 2007 survey represents the most recent data on the
6199 numbers and distribution of the Immokalee cluster. For purposes of this BO, we consider that the
6200 Immokalee area continues to support 15 scrub-jay family groups where they were detected in the
6201 2007 survey, of which 4 are located within the Plan Area.

6202
6203 The unincorporated town of Immokalee is not included in the Plan Area; however, we include
6204 the roads through Immokalee identified in section 3.1.1 as part of the Action Area.. It is likely
6205 that one or more individuals from all 15 families of the Immokalee scrub-jay cluster cross these
6206 roads during either routine movements within their territories (average size 22–25 acres) or when
6207 dispersing to become breeders in another territory (up to about 5 mi). Such crossings would
6208 expose these individuals to an increase in vehicular traffic associated with the developments of
6209 the HCP and with other sources.

6210
6211 The scrub-jay locations shown in Figure 8-2 are each less than 5 mi from the nearest neighboring
6212 location such that dispersal (adult helpers becoming breeders) among the territories of the
6213 Immokalee cluster is feasible. The Immokalee cluster is about 7 mi southeast of the nearest
6214 isolated scrub-jay family, and 14 mi southeast of the nearest cluster of families, identified in the
6215 1992–1993 survey. With a probable maximum dispersal range of about 5 mi, the scrub-jays of
6216 the Immokalee cluster are most likely isolated from all other scrub-jays of the Lee
6217 metapopulation defined by Stith (1999).

6218
6219 A family group consists of at least a breeding pair. In optimal habitat, family groups may include
6220 up to six additional adult helpers and one to four juveniles (a maximum of 12 birds). The 15
6221 family groups of the Immokalee area could consist of up to $15 \times 12 = 180$ birds; however, habitat
6222 conditions in this area are not optimal. Habitat with scrub characteristics is scarce, fragmented,
6223 and degraded. Survival and recruitment rates are lower in suboptimal habitat (see section see

6224 section 8.1.2). It is more likely that the Immokalee cluster is comprised of as few as 30 birds (15
6225 breeding pairs), and up to as many as 75 birds (the 15 breeding pairs plus one adult helper and
6226 two juveniles per family group).

6227 Surveyors recorded scrub-jays at the 23 locations shown in Figure 8-2, five of which
6228 are within the Plan Area. Scrub-jay locations from the March survey that are less than 0.5 mi
6229 from scrub-jay locations from the May survey were most likely birds of the same family group
6230 territory. If so, the six northern-most locations in Figure 8-2 (five within the Plan Area and one
6231 nearby just outside the Plan Area) represent points within four scrub-jay territories, which are
6232 wholly or partially within the Plan Area. The remaining 17 locations are wholly outside the Plan
6233 Area, but the territories associated with these locations may straddle or abut road segments that
6234 we include in the Action Area.

6235 Average scrub-jay territory size is 22–25 acres, with smaller territories in optimal habitat.
6236 Territories of the Immokalee cluster are likely larger than average. Using 25-acre circles centered
6237 on the five scrub-jay point locations that are within the Plan Area, the northern-most circle lies
6238 fully within a designated Development area of the HCP, and contains land cover classified as
6239 pasture/cropland and improved pasture. Circles centered on two points that are probably birds
6240 from the same family group straddle a junction of designated Development, designated Preserve,
6241 and non-Plan Area. These circles contain land cover classified as improved pasture and marshes.
6242 The other two circles around points in the Plan Area are wholly within designated Preserve areas.
6243

6244 **8.2.2 Action Area Conservation Needs and Threats**

6245 The scrub-jays in the Action Area are subject to the same suite of threats described in section
6246 8.1.4 of this document. In particular, the isolated Immokalee cluster is vulnerable to inbreeding
6247 effects on reproductive success, and is exposed to the variety of stressors associated with nearby
6248 human habitation and degraded habitat conditions. The size of the Immokalee cluster based on
6249 the 2007 survey results exceeds a quasi-extinction threshold of 10 breeding pairs (Stith 1999) by
6250 only 5 pairs.

6251 Stith (1999) developed a spatially-explicit individual-based model specifically to assess scrub-
6252 jay population viability. The model divided the species' range into 21 metapopulations based on
6253 apparent physical barriers to scrub-jay dispersal. A metapopulation is defined as "a set of local
6254 populations which interact via individuals moving among populations" (Hanski and Gilpin
6255 1991). Results of the model for the Lee metapopulation, comprised of three widely separated
6256 clusters of scrub-jay families in parts of Lee and Collier Counties, including the Immokalee
6257 cluster, predicted a high risk of extinction or quasi-extinction (falling below 10 breeding pairs)
6258 with existing habitat availability. Simulating the addition of the maximum possible amount of
6259 scrub habitat (through acquisition and restoration), the model predicted a moderate risk of
6260 extinction and a high risk of quasi-extinction. Without additional habitat, the model predicted
6261 that the Lee metapopulation would collapse.

6262 Coulon et al. (2008) assigned the scrub-jays near the Caloosahatchee River in Lee County (in the
6263 northern part of the Lee and Northern Collier metapopulation) to genetic group K, and did not
6264 assign birds of the Immokalee cluster in Collier County to a group. Historic records of scrub-jay

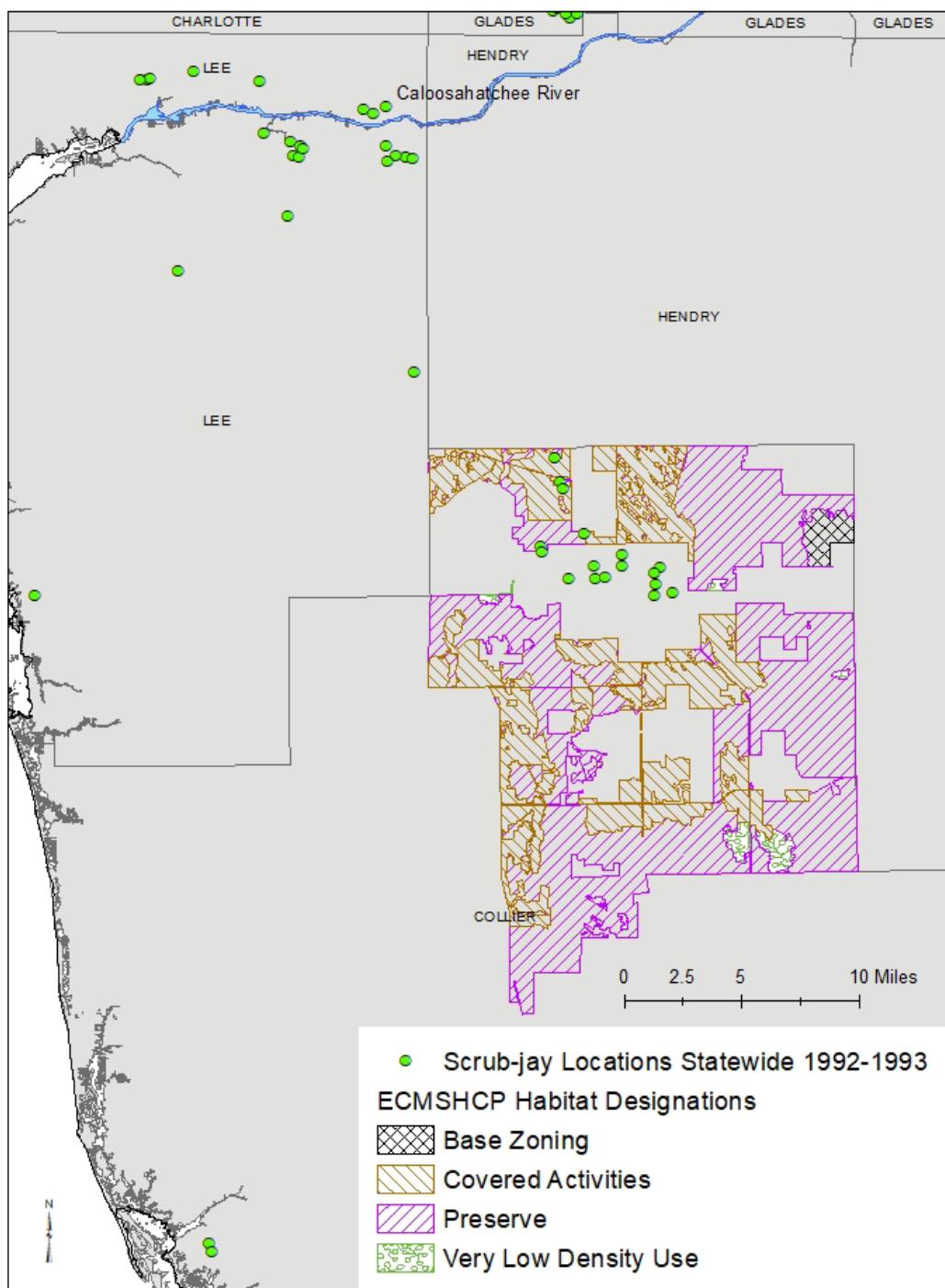
6270 observations located between the Caloosahatchee River and the Immokalee clusters suggest that
6271 these two groups would likely share the group K genetic profile. Neither the Lee and North
6272 Collier metapopulation (genetic group K) or the Immokalee cluster in Collier County are in or
6273 near areas that are the focus of current recovery efforts (USFWS 2019). The substantial
6274 restoration of scrub habitat that would be necessary to increase numbers of the Immokalee
6275 cluster and prevent its eventual extirpation appears unlikely.
6276

DRAFT

6277 **8.2.3 Tables and Figures**

6278

6279

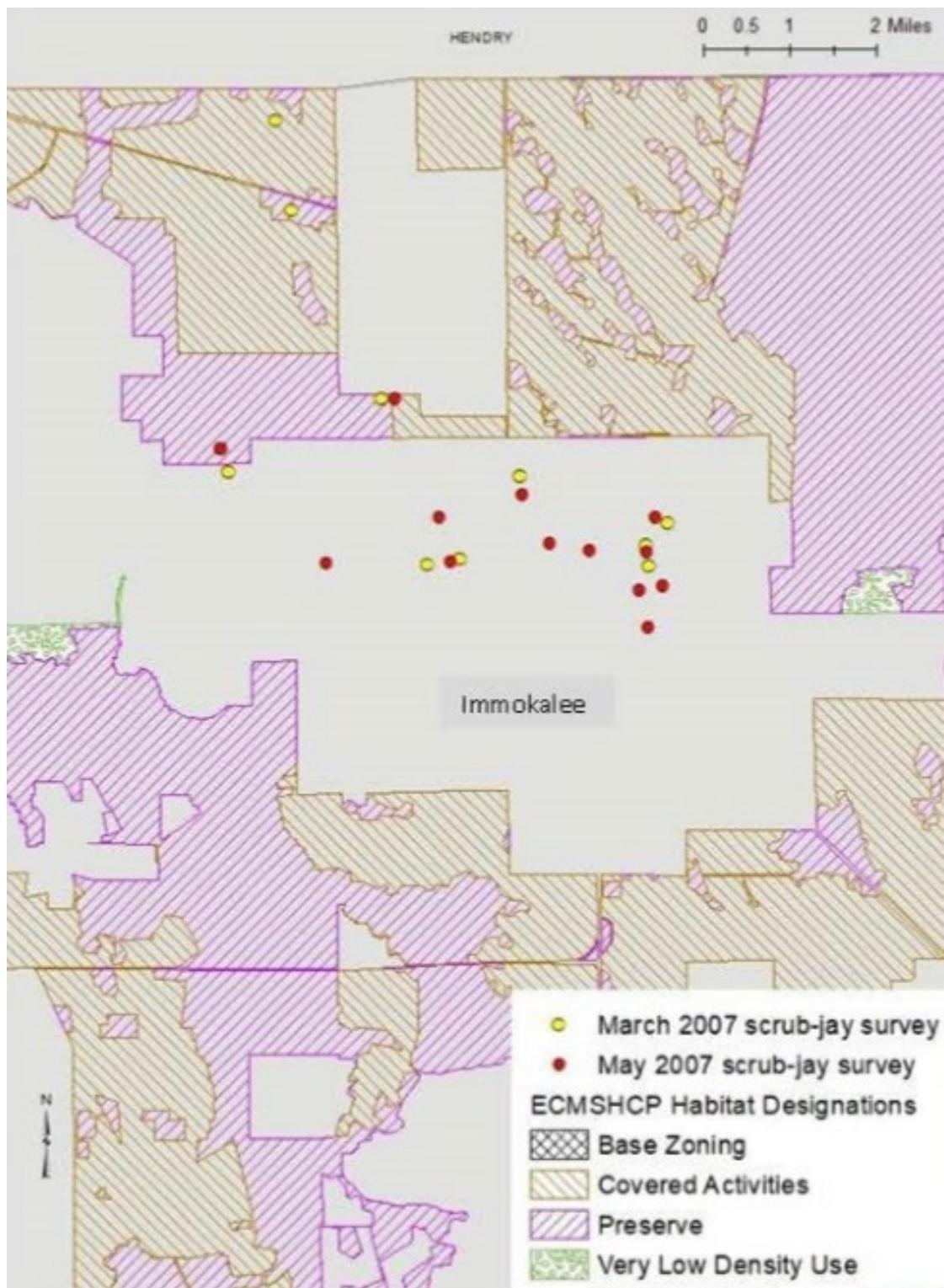


6280

6281

6282 **Figure 8-1.** Scrub jay locations within and near the Plan Area from the 1992–1993 statewide
6283 survey (data source: Fitzpatrick et al. 1994).

6284



6285

6286

6287 **Figure 8-2.** Scrub jay locations from a survey of the Immokalee area in March and May of 2007
 6288 (data source: Service GIS data).

6289

6290 **8.3 Effects of the Action on Florida Scrub-jay**

6291
6292 This section describes all reasonably certain consequences to the Florida scrub-jay that we
6293 predict the proposed Action would cause, including the consequences of other activities not
6294 included in the proposed Action that would not occur but for the proposed Action. Such effects
6295 may occur later in time and may occur outside the immediate area involved in the Action.

6296
6297 **8.3.1 Development and Mining, Base Zoning, and Eligible Lands**

6298
6299 The scarcity of scrub and scrubby flatwoods in the Plan Area (38 acres) suggests that scrub-jays
6300 are highly unlikely to occur in areas besides the locations identified in section 8.2.1, where we
6301 expect that 30–75 birds of the Immokalee cluster persist in fragmented patches of sub-optimal
6302 habitat. Therefore, our effects analyses are limited to these previously documented locations.
6303 Based on data from 2007 (see section 8.2.1), we believe the designated Development areas
6304 wholly contain one scrub-jay territory, and a portion of a second territory. We have no data that
6305 indicates scrub-jays occur within the Base Zoning and Eligible Lands designations.

6306
6307 In section 7.2.1.4 of the HCP, the Applicants propose to:

- 6308 • conduct scrub-jay surveys as particular development projects prepare for permitting in
6309 areas where prior occurrence data and/or the presence of potential habitats (scrub oaks,
6310 scrubby flatwoods, *etc.*) are observed;
- 6311 • observe a 50-meter (164-foot) buffer around any occupied “habitat/nest” until any young
6312 have fledged;
- 6313 • translocate “any isolated individual Florida scrub-jays or family groups” birds to a viable
6314 population, to the extent possible and in coordination with the Service, located within
6315 development project areas; and
- 6316 • mitigate unavoidable impacts to occupied scrub-jay habitats by:
 - 6317 ○ enhancing and/or restoring an equal acreage of in-kind Florida scrub-jay habitat
6318 within the Immokalee Urban Area; OR
 - 6319 ○ contributing funds commensurate with the impacts to the Florida Scrub-Jay
6320 Conservation Fund.

6321
6322 Measures (a)–(c) make it unlikely that construction activities would kill or injure scrub-jays.
6323 The translocation of birds could supplement the numbers of another population for recovery
6324 purposes, but is not a recovery action the Service would permit under ESA section 10(a)(1)(A).
6325 Translocation involves capturing and handling a listed species, which is prohibited without
6326 special authorization. To authorize an action that is intended to avoid incidental take that would
6327 otherwise occur, a section 10(a)(1)(B) ITP issued for this HCP would need to provide terms and
6328 conditions applicable to the translocation, such as personnel qualifications, capture and handling
6329 protocols, and coordination with the Service regarding sites that would receive the birds. If the
6330 occupied territories of translocated scrub-jays are developed for residential/commercial or
6331 mining uses, these areas would no longer support scrub-jays.

6332
6333 Enhancing and/or restoring an equal acreage of in-kind Florida scrub-jay habitat within the
6334 Immokalee area would partially offset the habitat loss, due to the time lag between the loss and
6335 achieving a functional habitat gain elsewhere. Service (2009) guidance for using the Florida

6336 Scrub-Jay Conservation Fund or other Service-approved conservation bank specifies the
6337 acquisition of 2 acres of scrub-jay habitat for each acre of occupied scrub-jay habitat affected to
6338 achieve a full offset of habitat impacts.

6339
6340 We expect that development will displace through translocation one family group from the Plan
6341 Area, and affect a second family group with a territory that may straddle the intersection of
6342 designated Development, Preservation, and non-HCP lands. The impacts of development on this
6343 second family group would depend on site-specific factors (e.g., which property supports
6344 nesting, the distribution and abundance of food resources between the properties, *etc.*). However,
6345 given the general scarcity of scrub-jay habitat resources in the area, we expect that resources
6346 remaining following the loss of those within the developed portion of the territory would no
6347 longer support a family group. Therefore, we expect the loss from the Plan Area of up to 4–10
6348 scrub jays (two breeding pairs and possibly one adult helper and two juveniles per family group).
6349 Development would permanently preclude scrub-jay use of the developed areas.

6350
6351 The two scrub-jay territories located in Development areas are close enough to some of the other
6352 13 territories of the Immokalee cluster for individuals to interact, but whether they do is
6353 unknown. Some degree of interaction between groups within the cluster probably contributed to
6354 maintaining until 2007, through dispersal and territory turnover, 15 of the 17 family groups
6355 identified in the 1992–1993 statewide scrub-jay survey. The loss of two more family groups and
6356 their habitat would:

- 6357 • accelerate the loss of genetic diversity within the isolated Immokalee cluster;
- 6358 • reduce the potential for dispersal to provide breeders for vacant territories; and
- 6359 • increase the cluster's vulnerability to extirpation by catastrophic events/conditions
(e.g., hurricane, extended drought, disease).

6362 **8.3.2 Preservation Activities**

6363
6364 Two of the four scrub-jay family territories that we believe occur within the Plan Area (see
6365 section 8.2.1 and Figure 8-2) are wholly within designated Preservation Areas. We explained in
6366 the previous section (8.3.1) that we expect the loss of scrub-jays from a third territory that is
6367 partially within a Preservation Areas, but likely straddles designated Development lands and
6368 non-HCP lands as well. We do not include this latter family group and its territory in our
6369 analyses of the effects of Preservation Activities.

6370
6371 Conservation easements on Preservation lands would preclude future development and mining
6372 activities, but would allow existing agricultural land uses to continue. Covered Activities in the
6373 Preservation Areas include prescribed burning, mechanical control of groundcover, ditch and
6374 canal maintenance, mechanical and chemical control of exotic vegetation, soil tillage, and other
6375 activities that maintain or improve land quality and agricultural uses.

6376
6377 Exposure to environmental changes caused by Covered Activities for the Preservation Areas may
6378 cause a mix of beneficial and adverse scrub-jay responses. Prescribed burning can disrupt normal
6379 breeding, feeding, and sheltering behaviors while scrub-jays avoid smoke and heat, and impair
6380 such behaviors if an entire territory is burned at one time. However, burning also maintains the
6381 open woodland conditions that scrub-jays require. Similarly, use of mechanical equipment for

6382 groundcover control or exotic vegetation treatments can disrupt normal breeding, feeding, and
6383 sheltering behaviors while scrub-jays avoid the noise and human activity, but also maintain open
6384 conditions when fire does not. Soil tillage where scrub-jays have cached acorns, typically along
6385 the edges of wooded cover, reduces food availability. Ditch and canal maintenance that involves
6386 removing scrub oaks from the tops of canal banks would also remove a scrub-jay habitat
6387 resource, but we do not know whether such canals are present in occupied territories of the
6388 Preservation Areas. Scrub-jays could become sick or die if exposed to chemicals used for
6389 agricultural or exotic vegetation control purposes in occupied portions of the Preservation Areas,
6390 but we cannot determine whether such exposure and adverse responses are reasonably certain to
6391 occur.

6392
6393 Preservation Areas will serve as mitigation for most or all of the covered species. While
6394 preservation via conservation easement is the primary approach to maintaining Preservation
6395 Areas habitats, the HCP proposes habitat enhancement or restoration as mitigation, at least as an
6396 option, for the Florida scrub-jay. This habitat management may occur in Preservation Areas.
6397

6398 We do not expect the management of Preservation Areas to reduce the numbers, reproduction, or
6399 distribution of the scrub-jay in the Preservation Areas, because these activities would, at
6400 minimum, maintain current conditions. Special attention to this species in the long-term
6401 management of Preserves in the Immokalee area could increase scrub-jay numbers and possibly
6402 contribute to maintaining the Immokalee cluster. However, lacking more detailed information
6403 about how habitat management under conservation easements may benefit this species, we are
6404 unable to reasonably estimate the extent of potential benefits.
6405

6406 **8.3.3 Very Low Density Development**

6407
6408 We have no evidence that suggests scrub-jays may occur in the Very Low Density (VLD) use
6409 areas. The VLD areas are not near or located between any known scrub-jay territories; therefore,
6410 any changes in these areas would not hinder scrub-jay dispersal between territories. We expect
6411 no effects to scrub-jays from Covered Activities in the VLD areas.
6412

6413 **8.4 Cumulative Effects on Florida Scrub-jay**

6414
6415 For purposes of consultation under ESA §7, cumulative effects are those caused by future state,
6416 tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future
6417 Federal actions that are unrelated to the proposed action are not considered, because they require
6418 separate consultation under §7 of the ESA.
6419

6420 We identified in section 3 of this BO/CO a projected increase in traffic on public roads as the
6421 sole source of effects that are consistent with the definition of cumulative effects for this Action.
6422 Mortality from collisions with vehicles is a known cause of Florida scrub-jay mortality. An
6423 increase in traffic on Action Area roads could increase the risk of this type of mortality for scrub-
6424 jays where roads cross or adjoin occupied territories of the Immokalee cluster, both within and
6425 outside the Plan Area. However, we have no data upon which to develop a reasonable
6426 relationship between traffic volume and scrub-jay mortality in order to quantify this risk.
6427

6428 **8.5 Conclusion for Florida Scrub-jay**

6429
6430 In this section, we summarize and interpret the findings of the previous sections for the scrub-jay
6431 (status, baseline, effects, and cumulative effects) relative to the species-specific purpose of a BO
6432 under §7(a)(2) of the ESA, which is to determine whether the proposed action is likely to
6433 jeopardize the continued existence of a species.

6434
6435 **Status**

6436 Since the time of European settlement, scrub-jay numbers have declined up to 90%, depending
6437 on the location. A 1992–1993 statewide scrub-jay survey estimated 3,961 extant scrub-jay family
6438 groups comprised of 10,972 individuals. Since the survey, scrub-jays continued to decline on
6439 protected lands due to inadequate habitat management, which is likely the case on unprotected
6440 private lands as well. However, steps to reverse the decline on protected lands are ongoing.

6441
6442 The greatest threats to scrub-jays are habitat loss, fragmentation, and degradation caused by
6443 residential and commercial development, conversion of scrub lands to citrus and other
6444 agricultural uses, sand mining, displacement of scrub oaks by invasive exotic species such as
6445 Brazilian pepper, and fire suppression. Habitat fragmentation that widely separates local
6446 populations from others increases the probability of inbreeding and genetic isolation, which
6447 increases the probability of local population extirpation. Inter-specific competition for habitat
6448 resources, non-native predators, and collisions with vehicles are additional threats to scrub-jays
6449 throughout their range.

6450
6451 **Baseline**

6452 The Plan Area contains only 38 acres classified as scrub and scrubby flatwoods, which alone is
6453 insufficient to maintain more than a single scrub-jay territory. The 1992–1993 statewide scrub-
6454 jay survey located a cluster of 17 scrub-jay families in and around Immokalee, which the Plan
6455 Area surrounds. A survey of the Immokalee area in March and May of 2007 identified a total of
6456 15 families in the same general areas.

6457
6458 For purposes of this BO, we consider that the Immokalee area continues to support 15 scrub-jay
6459 family groups where they were detected in the 2007 survey, of which 4 likely territories are
6460 located within the Plan Area. Scrub-jays of the Immokalee cluster are probably isolated from all
6461 other scrub-jays of the Lee/Collier metapopulation defined by Stith (1999). We estimate that the
6462 Immokalee cluster is comprised of as few as 30 birds (15 breeding pairs), and up to as many as
6463 75 birds (the 15 breeding pairs plus one adult helper and two juveniles per family group). Land
6464 cover within 25-acre circles centered on the 2007 survey detections located in the Plan Area
6465 consists of pasture/cropland, improved pasture, and marshes.

6466
6467 The isolated Immokalee cluster is vulnerable to inbreeding effects on reproductive success, and
6468 is exposed to the variety of stressors associated with nearby human habitation and degraded
6469 habitat conditions. The size of the Immokalee cluster based on the 2007 survey results exceeds a
6470 quasi-extinction threshold of 10 breeding pairs (Stith 1999) by only 5 pairs. Without additional
6471 habitat, a 1999 population viability model predicted that the Lee and Northern Collier

6474 metapopulation would collapse. The Lee and Northern Collier metapopulation is not in or near
6475 areas that are the focus of current scrub-jay recovery efforts (USFWS 2019).

6476

6477 **Effects**

6478

6479 The Applicants propose to conduct project-level scrub-jay surveys where prior occurrence data
6480 and/or the presence of potential habitats are observed, observe a 50-meter buffer around active
6481 nests, translocate birds in coordination with the Service, and compensate for unavoidable impacts
6482 to habitats by enhancing/restoring habitats in the Immokalee area or contributing to the Florida
6483 Scrub-Jay Conservation Fund. We believe the designated Development areas wholly contain one
6484 scrub-jay territory, and a portion of a second territory. We expect the loss from the Plan Area of
6485 up to 4–10 scrub jays (two breeding pairs and possibly one adult helper and two juveniles per
6486 family group). Reducing the Immokalee cluster by up to 2 family groups would:

- 6487 • accelerate the loss of genetic diversity within the isolated Immokalee cluster;
- 6488 • reduce the potential for dispersal to provide breeders for vacant territories; and
- 6489 • the cluster's vulnerability to extirpation by catastrophic events/conditions (e.g.,
6490 hurricane, extended drought, disease).

6491

6492 We believe the designated Preservation Areas wholly contain two scrub-jay territories. We do
6493 not expect the management of Preservation Areas to reduce the numbers, reproduction, or
6494 distribution of these family groups. Preservation activities would, at minimum, maintain current
6495 conditions. Special attention to this species in the long-term management of Preserves in the
6496 Immokalee area could increase scrub-jay numbers and possibly contribute to maintaining the
6497 Immokalee cluster.

6498

6499 **Cumulative Effects**

6500

6501 An increase in traffic on Action Area roads could increase the risk of collisions with vehicles for
6502 scrub-jays of the Immokalee cluster where roads cross or adjoin occupied areas; however, we
6503 have no data upon which to develop a reasonable relationship between traffic volume and scrub-
6504 jay mortality in order to quantify this risk.

6505

6506 **Opinion**

6507

6508 The loss of sub-optimal habitat that may still support two scrub-jay family groups (4–10
6509 individuals) in the Plan Area would add an increment of habitat loss in the range of species,
6510 whose numbers have been declining due largely to habitat loss for many decades. Translocating
6511 these individuals could augment the numbers of more viable populations elsewhere, but the
6512 success of such an effort is not guaranteed. Relative to the 1992–1993 range-wide population
6513 estimate of about 4,000 breeding pairs, the possible loss of 2 breeding pairs represents a 0.05%
6514 reduction. If current numbers are instead about 2,000 breeding pairs, the loss would represent a
6515 0.1% reduction.

6516

6517 Precluding new development and mining activity in the dedicated Preservation Areas would
6518 protect the habitat that may still support another two scrub-jay family groups. As these areas are
6519 brought under conservation easements, habitat enhancements that may increase scrub-jay

6520 numbers are possible, but not reasonably certain using data available at this time. Maintaining
6521 current conditions in the Preservation Areas could maintain the resident scrub-jay groups for
6522 some time. However, the long-term persistence of the Immokalee cluster, which may include
6523 another 11 family groups outside the Plan Area, appears unlikely without substantial increases in
6524 suitable habitat. Such increases are not reasonably foreseeable. Regardless, given the relatively
6525 small effect of the Development activities in the range-wide context, and the Applicants'
6526 commitment to translocate affected birds and to compensate for unavoidable habitat losses, we
6527 believe the net impact of the Action on the Florida scrub-jay is within the species' ability to
6528 sustain.

6529

6530 After reviewing the current status of the species, the environmental baseline for the Action Area,
6531 the effects of the Action and the cumulative effects, it is the Service's biological opinion that the
6532 Action is not likely to jeopardize the continued existence of the scrub-jay.

6533

6534

6535 **9. Florida Burrowing Owl**

6536

6537 This section provides the Service's conference opinion of the Action for the Florida burrowing
6538 owl.

6539

6540 **9.1 Status of Florida Burrowing Owl**

6541

6542 This section summarizes best available data about the biology and current condition of the
6543 Florida burrowing owl (*Athene cunicularia floridana*) throughout its range that are relevant to
6544 formulating an opinion about the Action. At this time, the burrowing owl is not protected under
6545 the ESA. The Service has not reviewed the species' status relative to the ESA definitions of
6546 "endangered" and "threatened." The State of Florida protects the burrowing owl as a threatened
6547 species under Florida's Endangered and Threatened Species Rule. For purposes of this
6548 Conference Opinion, we summarize the *Species Action Plan for the Florida Burrowing Owl*
6549 (*FWC 2013*), the *Species Conservation Measures and Permitting Guidelines for the Florida*
6550 *Burrowing Owl* (*FWC 2018*), and other available data to describe the species' status.

6551

6552 **9.1.1 Species Description**

6553

6554 The Florida burrowing owl is a small, long-legged owl with sandy brown plumage. Adults
6555 average 9 inches in height with a mean wingspan of 21 inches. The face is accented by bright
6556 yellow, sometimes with black mottling, and a white chin. The ear tufts of the typical woodland
6557 owls are lacking on the burrowing owls. Unlike most owls, burrowing owls are active during
6558 both day and night. During the day, owls stand at the mouth of their burrow or on a nearby post.
6559 When disturbed, owls bob in agitation and utter a chattering or clucking call. In flight,
6560 burrowing owls typically undulate as if they are flying an invisible obstacle course. Foraging
6561 owls can hover midair before pouncing on prey. Burrowing owls mainly eat insects, especially
6562 grasshoppers and beetles, but also small lizards, frogs, snakes, birds, and rodents.

6563

6564 **9.1.2 Life History**

6565

6566 Florida burrowing owls live as single breeding pairs or in loose colonies consisting of two or
6567 more families. They typically dig their own burrows, but will use gopher tortoise (*Gopherus*
6568 *polyphemus*) or armadillo (*Dasypus novemcinctus*) burrows and other structures, such as
6569 manholes, sewer drains, and concrete pipes. Owl family units will often use a breeding burrow
6570 and one or more satellite burrows. Burrows are typically 6 to 9 ft in length, up to 3 ft deep, and
6571 lined with grass clippings, feathers, paper, and manure. In urban areas, burrowing owls use
6572 burrows for roosting during the winter and for breeding during the nesting season. However, in
6573 rural areas, burrowing owls may have limited use of burrows outside of the nesting season.
6574

6575 The typical nesting season is from February to July. Most egg laying is in March, but may occur
6576 as early as October and as late as May. The female lays 6 to 8 eggs over a 1-week period.
6577 Incubation lasts about 4 weeks, and young start to emerge from the burrow around 2 weeks after
6578 hatching. The juveniles start learning to fly at 4 weeks, but cannot fly well until they are 6 weeks
6579 old. Juveniles continue to use their parents' burrows for 30 to 60 days after they are able to fly.
6580 After breeding, burrowing owls may remain in their breeding area or disperse (maximum
6581 documented dispersal of 46 mi) (Mrykalo 2005).
6582

6583 **9.1.3 Numbers, Reproduction, and Distribution**

6584
6585 The Florida burrowing owl occurs primarily in peninsular Florida, although isolated pairs and
6586 small colonies have been found as far west as Eglin Air Force Base and as far south as the Dry
6587 Tortugas. Burrowing owls typically inhabit open grassy habitats, with localized and patchy
6588 distribution. The dry prairies of central Florida provided habitat historically, but due to
6589 increasing development, the species' range has expanded north, south, and to the coasts.
6590 Burrowing owls now most commonly occur in pastures, golf courses, airports, school yards, and
6591 vacant lots. The highest concentrations of burrowing owls in Florida are in Cape Coral, Marco
6592 Island, and along the southeast coast.
6593

6594 The current range-wide abundance of the Florida burrowing owl is unknown. It appears that the
6595 use of native habitats has decreased and the use of urban areas has increased. The urban birds are
6596 adapted to human activity and occupy some areas at high densities. A 1996 estimate placed
6597 statewide owl abundance at 3,000–10,000, and a 2001 review of occurrence data identified 1,757
6598 unique records (FWC 2011). The latter number likely under-represents burrowing owls in rural
6599 areas due to low densities and limited access to private property. Recent population data from
6600 Marco Island and Cape Coral show that the number of burrowing owls in urban areas is
6601 increasing. As of November 2016, Marco Island had over 400 owls (Audubon of the Western
6602 Everglades 2016), and a May 2017 census of Cape Coral counted approximately 3,700 owls
6603 (Cape Coral Burrowing Owls 2019). These two areas account for at least 4,100 burrowing owls
6604 in Florida, which does not include the southeast coast and rural populations.
6605

6606 **9.1.4 Conservation Needs and Threats**

6607
6608 Burrowing owls require sufficient foraging habitat around their burrows, and loss of foraging
6609 habitat can impair essential behaviors. In rural areas, potential foraging habitat includes dry
6610 prairie, mowed grass, vegetative berms, rural open areas (with few trees), row crops and field
6611 crops (with low vegetation), improved pasture, sod farms, wet prairie, and depression marsh. In

6612 urban areas, burrowing owls forage in vacant lots, yards, cemeteries, golf courses,
6613 athletic fields, and other open areas. Based upon an average foraging radius of 1,970 ft from the
6614 nest burrow for western burrowing owls in rural areas, FWC considers that Florida burrowing
6615 owls need a foraging area of 280 acres (FWC 2018).

6616
6617 The major threats to the Florida burrowing owl are loss of native habitat and the resulting
6618 reliance on human-altered habitat. In urban areas, preferred nesting habitat and burrows are
6619 destroyed by construction activities, domestic animals (e.g., dogs), and humans. FWC (2018)
6620 found that burrowing owl nests within 33 ft of construction activity had significantly lower
6621 productivity. Collisions with automobiles are a frequent cause of owl mortality in urban areas,
6622 and human disturbance can cause burrow abandonment. Domestic animals (e.g., cats, dogs) and
6623 exotic wildlife (e.g., large lizards) likely also contribute to owl mortality. Iguanas, for example,
6624 have been observed occupying burrowing owl burrows. The proximity of the largest populations
6625 of this species to coastal areas carries the increasing threat of impacts from hurricanes, tropical
6626 storms, and sea level rise due to global climate change.

6627
6628 For burrowing owls in rural areas, lack of protected habitat is a concern. Urban and agricultural
6629 areas (e.g., athletic fields, improved pastures) are not a priority for conservation, but many
6630 support burrowing owls. Management strategies for owls in such settings are lacking. No data is
6631 available about the effects on burrowing owls of contaminants, pesticides, and herbicides
6632 commonly used in urban and rural open spaces. Murray (2011) documented instances of owls
6633 and other raptors sickened or killed after eating prey that have consumed anticoagulant
6634 rodenticides, which are frequently used in both urban and agricultural areas. Conservation needs
6635 include increased habitat protection/management, as described in the *Species Conservation*
6636 *Measures and Permitting Guidelines for the Florida Burrowing Owl* (FWC 2018).

6637 **9.2 Environmental Baseline for Florida Burrowing Owl**

6638

6640 This section describes the current condition of the Florida burrowing owl in the Action Area
6641 without the consequences to the listed species caused by the proposed Action.

6642 **9.2.1 Action Area Numbers, Reproduction, and Distribution**

6643 The Plan Area contains up to 48,988 acres of land cover that is suitable habitat for burrowing
6644 owls, which includes improved pasture, rural open land, and cropland/pasture (see Table 2-1).
6645 Unimproved pasture is included in the cropland/pasture cover type. Cultivated cropland
6646 (routinely tilled) is unlikely to support owl burrows, but may support foraging. Native dry prairie
6647 upland habitats associated with burrowing owls (e.g.,) are not present in the Plan Area.

6648
6649 The Applicants did not conduct burrowing owl surveys of the Plan Area during the development
6650 of the HCP. Available data includes five confirmed and one possible location within or very near
6651 the Plan Area (FWC 2003). Studies supporting State and Federal permitting in 2004-2005 for the
6652 Town of Ave Maria determined that 11 burrowing owls occupied the 4,466 acres of suitable
6653 habitat within the town footprint (USFWS 2005). The Plan Area surrounds, but does not include,
6654 Ave Maria.

6658 Cape Coral and Marco Island contain large, well-monitored populations of burrowing owls
6659 located east of the Plan Area. Given known locations within and near the Plan Area, large
6660 dispersal distances, and the presence of suitable habitat, we are reasonably certain that burrowing
6661 owls occupy the Plan Area. Using the density of Florida burrowing owls documented in the Ave
6662 Maria studies ($11 \text{ owls} \div 4,466 \text{ acres} = 0.00246 \text{ owls/acre}$), we estimate that 48,988 acres of owl
6663 habitat in the Plan Area supports up to 121 burrowing owls, which includes the full extent of the
6664 cropland/pasture cover type as suitable habitat.

6665

6666 **9.2.2 Action Area Conservation Needs and Threats**

6667 Threats to the Florida burrowing owl in the Action Area include predation by native and exotic
6668 species, destruction of burrows by construction activities, disturbance by domestic animals and
6669 humans, collisions with vehicles, and exposure to contaminants, rodenticides, pesticides, and
6670 herbicides. Records show at least 3 great-horned owls, 1 barred owl, and over 30 red-shouldered
6671 hawks have died of suspected rodenticide poisoning in Collier and Lee counties since 2011 (J.
6672 Fitzgerald, von Arx Wildlife Hospital, personal communication). Conservation needs include
6673 increased habitat protection/management, as described in the *Species Conservation Measures*
6674 and *Permitting Guidelines for the Florida Burrowing Owl* (FWC 2018).

6675

6676 **9.3 Effects of the Action on Florida Burrowing Owl**

6677 This section describes all reasonably certain consequences to the Florida burrowing owl that we
6678 predict the proposed Action would cause, including the consequences of other activities not
6679 included in the proposed Action that would not occur but for the proposed Action. Such effects
6680 may occur later in time and may occur outside the immediate area involved in the Action.

6681

6682 **9.3.1 Development and Mining, Base Zoning, and Eligible Lands**

6683

6684 Because burrowing owls likely use the open agricultural cover types of the Plan Area, and it is
6685 plausible that development would occur disproportionately in these non-wetland cover types, we
6686 used the RMI method described in section 2.1.4 to estimate the extent of development in
6687 burrowing owl habitats. The extent of burrowing owl cover types (improved pasture, rural open
6688 land, and cropland/pasture) within the designated Development areas, Base Zoning, and Eligible
6689 lands is 20,356, 1,781, and 5,195 acres, respectively, or a total of 27,332 acres, which is less than
6690 the development cap of 39,973 acres. Therefore, high-density development confined entirely to
6691 the Development areas, or implemented with the maximum possible substitution of Base Zoning
6692 and/or Eligible lands in the accounting for the cap, could replace all burrowing owl habitat in one
6693 or more of these HCP land use designations.

6694

6695 The proposed action would involve clearing, grading, vegetation removal, excavation and piling,
6696 transport of aggregate by trucks, and construction of buildings and associated infrastructure.
6697 Such substantial alterations of land that supports essential owl feeding, breeding, and sheltering
6698 behaviors would disturb, displace, injure, or kill burrowing owls that are present at the time of
6699 those actions, depending on timing and other site- and project-specific circumstances.

6700

6701

6702

6703 The Applicants propose to time construction activity to avoid and minimize impacts to Florida
6704 burrowing owl nesting. Before construction at a site begins, the Applicants propose to conduct
6705 burrowing owl surveys according to FWC survey protocols (FWC 2018). Based on survey
6706 results, construction activity would maintain a buffer of at least 33 ft around burrows during the
6707 breeding season and 10 ft during the non-breeding season, as recommended by FWC (2018).
6708

6709 Burrowing owls may use their burrows year-round, and construction activities near burrows can
6710 disrupt breeding and sheltering activities. Collapsing or blocking burrows during clearing,
6711 grading, excavation, or piling can kill or injure adults, juveniles, or eggs within the burrows.
6712 Burrowing owls require approximately 280 acres of foraging habitat around their burrows, and
6713 habitat modification resulting in a loss of more than 50 percent of foraging habitat impairs
6714 essential feeding behavior (FWC 2018). Development and mining activity that overlaps the
6715 home range of an owl would eliminate foraging habitat outside the 33-foot buffers around
6716 burrows, which is a 99 percent loss from a foraging area of 280 acres.
6717

6718 A substantial loss of foraging habitat around burrows would cause burrowing owls to travel
6719 farther to find food. The use of anticoagulant rodenticides around developed areas could reduce
6720 the prey available for burrowing owls and sicken or kill any owls that consume poisoned rodents.
6721 Increased vehicle traffic during and after construction would likely increase the risk of mortality
6722 and injury caused by collisions with vehicles. The presence of humans post-construction could
6723 increase predation by both native predators attracted to garbage and introduced exotic species,
6724 and increase the destruction or disturbance of burrows by domestic animals.
6725

6726 Because 27,332 acres of the suitable burrowing owl habitat in the Plan Area are located in the
6727 Development, Mining, Base Zoning, and Eligible Lands areas, we expect that up to 67 owls
6728 ($27,332 \text{ acres} \times 0.00246 \text{ owls/acre}$) would experience the adverse effects described above. Such
6729 effects would coincide with development activity at unspecified times during the 50-year permit
6730 period. The pre-development surveys and buffers around burrows should avoid the immediate
6731 death and injury caused by burrow destruction. However, we expect that full HCP development
6732 would cause all 67 owls to experience a loss of foraging habitat and/or disturbance that would
6733 displace them to other areas of suitable habitat available within the species' dispersal
6734 capabilities. The low density of owls and the abundance of pastures and rural open lands in the
6735 Plan area suggest that a substantial percentage of owls could survive a gradual displacement
6736 caused by development activity, but some would not survive the hazards (e.g., vehicle strikes,
6737 predators, etc.) associated with relocating feeding, breeding, and sheltering activity to an
6738 unfamiliar area. Those surviving dispersal would likely experience the injury of reduced
6739 reproductive success until established in a new area.
6740

6741 Therefore, we expect take in the form of harm (habitat modification that actually causes
6742 subsequent death or injury) of up to 67 owls in the Development, Mining, Base Zoning, and
6743 Eligible Lands areas, depending on the distribution of 39,973 acres of high-density development.
6744 We have no data or reasonable basis to estimate the percentage of lethal versus injurious
6745 responses (e.g., impaired reproduction) to action-caused changes in these areas. Although
6746 burrowing owls could use open areas that remain following construction or mining until full
6747 build-out occurs, we believe owls are more likely to persist long-term in the open rural areas of

6748 the Preservation and Very Low Density Development areas (see the following sections 9.3.2 and
6749 9.3.3).

6750 6751 **9.3.2 Preservation Activities**

6752
6753 Approximately 20,913 acres of burrowing owl habitat occur within the Preservation Areas (4,155
6754 acres rural open lands, 7,599 acres improved pastures, and 9,159 acres cropland/pasture), which
6755 the Applicants would place under conservation easements as development occurs elsewhere.
6756 These easements would preclude future commercial and residential development and earth
6757 mining, but would allow a continuation of the existing agricultural land uses. Activities in the
6758 Preservation Areas would include prescribed burning, mechanical control of groundcover, ditch
6759 and canal maintenance, mechanical and chemical control of exotic vegetation, soil tillage, cattle
6760 grazing, pesticide and herbicide applications, and other activities that maintain or improve land
6761 quality and agricultural uses.

6762
6763 Although many of these activities maintain habitat for burrowing owls, some can also disrupt
6764 normal behaviors, injure, or kill owls that are present at the time. Prescribed burning maintains
6765 open habitat conditions that burrowing owls require. Burning may also cause owls to take refuge
6766 in their burrows, which temporarily disrupts feeding behavior, and may kill or injure some owls
6767 through heat or smoke inhalation. Heavy equipment used for groundcover control, exotic
6768 vegetation treatments, or soil tillage may crush owls in their burrows. Grazing cattle at high
6769 stocking rates may degrade foraging habitat and collapse burrows. Exposure to chemicals
6770 (pesticides, rodenticides, insecticides, fungicides and/or herbicides) associated with agricultural
6771 uses could kill or sicken owls. To minimize impacts to burrowing owls, the Applicants propose
6772 to follow FWC's recommended conservation measures in rural areas (FWC 2018), which we
6773 summarize here:

- 6774 • Avoid the use of pesticides, rodenticides, insecticides, fungicides and/or herbicides
6775 immediately around the burrow entrance. Reduce or avoid the use of these products in
6776 burrowing owl foraging habitat to the extent practicable, especially during nesting
6777 season. Use these products according to label instructions.
- 6778 • Maintain low vegetation heights beneficial for burrowing owl foraging through mowing,
6779 prescribed grazing, and/or prescribed burning.
- 6780 • Manage invasive, non-native plant species if they reduce habitat quality for burrowing
6781 owls. If invasive, non-native shrubs or trees are encroaching on a burrow, wait until after
6782 the breeding season to treat the vegetation, and remove the vegetation only if removal
6783 will not result in collapse of the burrow.
- 6784 • Reduce the amount of foraging habitat converted to more intensive agricultural land uses
6785 (e.g., row crops, silviculture).
- 6786 • Consider protecting burrows with a framing device that will allow full access for cattle to
6787 graze without collapsing the burrow. Select a low and open design that does not impede
6788 visibility for burrowing owls.
- 6789 • Follow the Agricultural Wildlife Best Management Practices (Florida Department of
6790 Agriculture and Consumer Services 2015) which recommend avoiding contact with
6791 known or visibly apparent burrowing owls year-round, locating concentrated heavy
6792 equipment operations away from known or visibly apparent active burrows, and marking

6793 and avoiding damage to burrow openings when heavy equipment operations must be
6794 located near burrows.

6795
6796 Preservation Areas will serve as mitigation for most or all of the covered species. While
6797 preservation via conservation easement is the primary approach to maintaining Preservation
6798 Areas habitats, the HCP proposes habitat enhancement or restoration as mitigation, at least as an
6799 option, for the Florida burrowing owl.

6800
6801 Burrowing owls that occupy the Preservation Areas are accustomed to current agricultural
6802 practices. Implementing the FWC conservation measures should avoid, or limit to a discountable
6803 probability, the death or injury of burrowing owls caused by these practices. We expect the
6804 20,913 acres of the suitable burrowing owl habitat located in the Preservation Areas to support
6805 about 52 owls (20,913 acres \times 0.00246 owls/acre). All 52 owls would experience occasional
6806 disturbance from land management practices conducted near burrows.

6807
6808 We expect burrowing owls to persist in the Preservation Areas, because the preservation and
6809 management activities will, at minimum, maintain the conditions that have allowed owls to
6810 colonize these areas from their historic dry prairie habitats of central Florida. Special attention to
6811 this species in the long-term management of the Preservation Areas could likely increase owl
6812 densities and the total population, which we expect are currently low. However, lacking detailed
6813 information about burrowing owls in the Plan Area, and about how the habitat management may
6814 specifically benefit this species, we are unable to estimate the extent of potential benefits.

6815
6816 **9.3.3 Very Low Density Development**

6817
6818 The Very Low Density (VLD) use areas (total area 2,667 acres) contain about 743 acres of
6819 burrowing owl habitat (improved pasture and rural open lands). Land uses include isolated
6820 residences, lodges, and hunting/fishing camps, limited to no more than one dwelling unit per 50
6821 acres. Otherwise, the land uses for the VLD areas are the same as for the Preservation Areas.
6822 Within pastures and rural open areas, where burrowing owls may occur, the Applicants would
6823 continue current ranching/livestock operations and other management activities as described for
6824 the Preservation Areas (e.g., exotic species control, prescribed burning). The Applicants propose
6825 to implement the FWC (2018) conservation measures for burrowing owls, which should avoid,
6826 or limit to a discountable probability, the immediate death or injury of burrowing owls in their
6827 burrows caused by agricultural or low-density development activities.

6828
6829 We expect habitats of the VLD areas to support at most a single pair of owls (743 acres \times
6830 0.00246 owls/acre = 1.83 owls) that would likely share one or more burrows within a common a
6831 foraging area of about 280 acres, based on the foraging distances documented for western
6832 burrowing owls (see section 9.1.4). The HCP does not specify a footprint for isolated residences,
6833 lodges, and hunting/fishing camps, but indicates that their construction could involve clearing up
6834 to 10% of the 1,180 acres (118 acres) of existing native vegetation (see section 2.5). Native
6835 upland habitats that the burrowing uses (e.g., dry prairie) are not present in the VLD areas or
6836 anywhere else in the Plan Area. New dwelling construction in non-native cover types is not
6837 specifically proposed, but not precluded.

6839 The 118-acre cap for native vegetation clearing is the only indication the HCP provides for the
6840 maximum extent of potential land alteration associated with new dwelling development in the
6841 VLD areas. This maximum footprint represents $118 \text{ acres} \div 2,667 \text{ acres} = 4.4\%$ of the VLD
6842 areas. The foraging area for a single pair of owls represents $280 \text{ acres} \div 2,667 \text{ acres} = 10.5\%$ of
6843 the VLD areas. The probability that dwelling development would overlap the owl foraging area
6844 is the product of these percentages (0.5%), which we consider discountable for purposes of this
6845 assessment. In the unlikely event that dwelling development overlaps the range of an owl pair,
6846 we do not expect any resulting shift in their home range to actually kill or injure either
6847 individual. The local availability of pastures and open rural lands in the VLD areas (743 acres) is
6848 substantially greater than the needs of a single pair, such that shifting foraging activity away
6849 from a new dwelling is unlikely to impair feeding behaviors.
6850

6851 **9.4 Cumulative Effects on Florida Burrowing Owl**

6852 For purposes of consultation under ESA §7, cumulative effects are those caused by future state,
6853 tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future
6854 Federal actions that are unrelated to the proposed action are not considered, because they require
6855 separate consultation under §7 of the ESA.
6856

6857 We identified in section 3 of this BO/CO a projected increase in traffic on public roads as the
6858 sole source of effects that are consistent with the definition of cumulative effects for this Action.
6859 Collisions with vehicles is a known cause of Florida burrowing owl mortality, especially in
6860 urban areas. An increase in traffic on Action Area roads could increase the risk of this type of
6861 mortality for owls where roads cross or adjoin occupied areas; however, we have no data upon
6862 which to develop a reasonable relationship between traffic volume and owl mortality in order to
6863 quantify the increased risk.
6864

6865 **9.5 Conclusion for Florida Burrowing Owl**

6866 In this section, we summarize and interpret the findings of the previous sections for the Florida
6867 burrowing owl (status, baseline, effects, and cumulative effects) relative to the species-specific
6868 purpose of a BO under §7(a)(2) of the ESA, which is to determine whether the proposed action is
6869 likely to jeopardize the continued existence of a species.
6870

6871 **Status**

6872 The dry prairies of central Florida provided the species' historic habitats, but development in
6873 these areas has caused a range expansion to the north and south, and to the coasts. Non-native
6874 habitats now include pastures, agricultural fields, golf courses, airports, school yards, and vacant
6875 lots in residential areas. The current range-wide abundance of the Florida burrowing owl is
6876 unknown. In 1996, estimated abundance was 3,000–10,000 burrowing owls. More recent data
6877 from Marco Island and Cape Coral document at least 4,100 burrowing owls in these two
6878 populations.
6879

6880 A continuing loss of native habitat and the resulting reliance on non-native habitat is a threat to
6881 the species, due to the many unique hazards of the urban environment. Urban settings expose
6882

6885 owls to foraging habitat and burrow destruction caused by construction activity, frequent
6886 disturbance by domestic animals and people, rodenticides and other contaminants, collisions
6887 with vehicles, and predation by native and exotic wildlife. The frequency and severity of these
6888 stressors are likely reduced in rural settings, but cattle grazing at high stocking densities is an
6889 additional stressor. The primary conservation need for the species is increased habitat protection
6890 and management, as described in the *Species Conservation Measures and Permitting Guidelines*
6891 for the Florida Burrowing Owl (FWC 2018).

6892

Baseline

6893 The Plan Area contains up to 48,988 acres of land cover that is suitable habitat for burrowing
6894 owls, which includes improved pasture, rural open land, and cropland/pasture. Native upland
6895 habitats that the burrowing owl uses (e.g., dry prairie) are not present in the Plan Area. Given
6896 known locations within and near the Plan Area, large dispersal distances, and the presence of
6897 suitable non-native habitat, we are reasonably certain that burrowing owls occupy the Plan Area.
6898 Using the density of Florida burrowing owls documented in studies for the Ave Maria
6899 development ($11 \text{ owls} \div 4,466 \text{ acres} = 0.00246 \text{ owls/acre}$), we estimate that the Plan Area
6900 supports up to 121 burrowing owls.

6901 Threats to the Florida burrowing owl in the Action Area are the same as the range-wide threats,
6902 and the primary conservation need is habitat protection and better land management.

6903

Effects

6904 The extent of burrowing owl cover types (improved pasture, rural open land, and
6905 cropland/pasture) within the designated Development areas, Base Zoning, and Eligible lands is
6906 27,332 acres, which is less than the development cap of 39,973 acres. High-density development
6907 confined entirely to the Development areas, or implemented with the maximum possible
6908 substitution of Base Zoning and/or Eligible lands in the accounting for the cap, could replace all
6909 burrowing owl habitat in one or more of these HCP land use designations.

6910 We estimate that up to 67 owls ($27,332 \text{ acres} \times 0.00246 \text{ owls/acre}$) occupy the lands within the
6911 potential development envelope of the HCP. Pre-construction owl surveys and buffers around
6912 burrows should avoid the immediate death and injury caused by burrow destruction. However,
6913 we expect that full HCP development would cause all 67 owls to experience a loss of foraging
6914 habitat and/or disturbance that would eventually displace them to other areas of suitable habitat.
6915 A substantial, but undeterminable percentage of those that survive the hazards associated with
6916 displacement would likely experience the injury of reduced reproductive success until
6917 established elsewhere. Therefore, we expect take in the form of harm (habitat modification that
6918 actually causes subsequent death or injury) of up to 67 owls in the Development, Mining, Base
6919 Zoning, and Eligible Lands areas, depending on the distribution of 39,973 acres of high-density
6920 development.

6921 The Preservation Areas contain 20,913 acres of suitable burrowing owl habitat, which we expect
6922 to support 52 owls ($20,913 \text{ acres} \times 0.00246 \text{ owls/acre}$). We expect burrowing owls to persist in
6923 the Preservation Areas, because the preservation and management activities will, at minimum,

6931 maintain the conditions that have allowed owls to colonize these non-native habitats. Special
6932 attention to this species in the long-term management of the Preservation Areas would likely
6933 increase owl densities and the total population; however, we are unable to estimate the extent of
6934 potential benefits. We do not expect Covered Activities in the Very Low Density use areas,
6935 which may support a single pair of owls, to harm them.

6936

6937 Cumulative Effects

6938

6939 An increase in traffic on Action Area roads could increase the risk of collisions with vehicles for
6940 owls where roads cross or adjoin occupied areas; however, we have no data upon which to
6941 develop a reasonable relationship between traffic volume and owl mortality in order to quantify
6942 this risk.

6943

6944 Opinion

6945

6946 The possible death of up to 67 owls would represent a 0.7–1.6 percent reduction in the Florida-
6947 wide population of burrowing owls, relative to a maximum estimate of about 10,000 owls and a
6948 minimum of 4,100 in the Marco Island and Cape Coral populations, respectively. However, we
6949 believe that a substantial percentage of owls displaced by development activity would survive
6950 and then experience a temporary reduction in reproductive success, because suitable non-native
6951 habitat in the overall Plan Area is relatively abundant. Population increases in the Preservation
6952 Areas could wholly or partially offset the loss of individuals and productivity caused by
6953 development activity, but would depend on the success of management in these areas, which we
6954 believe is likely, but not guaranteed. The Preservation Areas could probably support a much
6955 higher owl density with management. Cumulative effects caused by an increase in Action Area
6956 traffic are possible, but not determinable.

6957

6958 The species has demonstrated an ability to colonize non-native habitats, including urban and
6959 suburban developments, pastures, and open rural lands, which occur throughout the Plan Area.
6960 Agricultural lands (and native habitats) in the Preservation Areas would remain undeveloped
6961 under permanent easements while about 25% of the Plan Area is developed (39,973 of 159,489
6962 acres). The likely survival of displaced birds and possible increases in habitat quality in the
6963 Preservation Areas would reduce the overall impact of the Action to the Florida-wide population
6964 to a level substantially below the worst-case scenario of a 1.6 percent loss. We believe the net
6965 impact of the Action and cumulative effects on the Florida burrowing owl is within the species'
6966 ability to sustain.

6967

6968 After reviewing the current status of the species, the environmental baseline for the Action Area,
6969 the effects of the Action and the cumulative effects, it is the Service's conference opinion that
6970 the Action is not likely to jeopardize the continued existence of the Florida burrowing owl.

6971

6972 10. Red Knot

6973

6974 This section provides the Service's biological opinion of the Action for the red knot.

6977 **10.1 Status of Red Knot**
6978
6979 This section summarizes best available data about the biology and current condition of the red
6980 knot (*Calidris canutus rufa*) throughout its range that are relevant to formulating an opinion
6981 about the Action. The Service published its decision to list the red knot as threatened on
6982 December 11, 2014 (79 FR 73705–73748). The Service has not proposed or designated critical
6983 habitat for the red knot at this time.
6984

6985 **10.1.1 Species Description**
6986
6987 The red knot (or “rufa red knot”) is a medium-sized shorebird about 9–11 inches in length that is
6988 named for the distinctive rufous (red) breeding plumage of its face, breast, and upper belly.
6989 Winter plumage is a pale ashy gray from crown to rump, with white underparts, a lightly
6990 streaked and speckled breast, and narrowly barred gray flanks. The red knot has a small head in
6991 proportion to its size, small eyes, and a short neck. Its straight black bill tapers from a stout base
6992 to a relatively fine tip and is slightly longer than its head. Legs are short and typically dark gray
6993 to black, but sometimes greenish in juveniles or older birds in nonbreeding plumage.
6994

6995 **10.1.2 Life History**
6996
6997 The red knot migrates annually between its tundra breeding grounds in the Canadian Arctic and
6998 coastal wintering regions along the Gulf of Mexico, south Atlantic U.S. states, north coast of
6999 Brazil, and Tierra del Fuego at the southern tip of South America (Argentina and Chile). The
7000 19,000-mi journey between the Arctic and Tierra del Fuego is one of the longest known animal
7001 migrations. During both the northbound (spring) and southbound (fall) migrations, red knots use
7002 key staging and stopover areas to rest and feed, primarily in coastal areas.
7003

7004 Small numbers of red knots sometimes use manmade freshwater habitats (e.g., impoundments)
7005 along inland migration routes. In Florida, red knots that are either wintering in the state or
7006 passing through on migration are most commonly found along sandy, gravel, or cobble beaches,
7007 tidal mudflats, mangroves, salt marshes, shallow coastal impoundments, and brackish lagoons
7008 (Harrington 2001; Truitt *et al.* 2001; Niles *et al.* 2008; Cohen *et al.* 2009, 2010).
7009

7010 In shoreline settings, red knot eats hard-shelled mollusks, sometimes supplemented with easily
7011 accessed softer invertebrate prey, such as shrimp- and crab-like organisms, marine worms, and
7012 horseshoe crab eggs (Piersma and van Gils 2011; Harrington 2001). On its Arctic breeding
7013 grounds (dry, slightly elevated tundra located near coasts), the red knot’s diet consists mostly of
7014 terrestrial invertebrates such as insects and other arthropods. However, early in the breeding
7015 season, before insects and other macroinvertebrates are active and accessible, the red knot will
7016 eat grass shoots, seeds, and other vegetable matter (Harrington 2001). Diets during stopovers at
7017 inland wetlands are unknown.
7018

7019 **10.1.3 Numbers, Reproduction, and Distribution**
7020
7021 A current, reliable, range-wide population estimate for the red knot is not available. Red knots
7022 breed across a huge and remote area of the Arctic. Regional counts of red knots in wintering

7023 areas and migration stopovers provided the primary evidence of a significant declining trend in
7024 numbers that prompted the Service's review of the species' status (USFWS 2014). Major coastal
7025 wintering areas include the southern tip and northern coast of South America, the Gulf of
7026 Mexico, and south Atlantic U.S. states. Delaware Bay is recognized as the primary Atlantic
7027 stopover in spring migration. The estimated passage population through Delaware Bay declined
7028 from 152,900 birds in 1989 to 48,955 birds in 2013 (USFWS 2014).

7029
7030 Information about red knot numbers and distribution along the Gulf coast of peninsular Florida is
7031 most relevant to this BO. The highest concentration of red knots wintering in Florida occurs in
7032 the greater Tampa Bay region. Annual winter aerial surveys along Florida's Gulf coast from
7033 2006 to 2010 counted an average of 1,451 red knots between Anclote Key (north of Clearwater)
7034 and Cape Romano (south of Naples) (Niles 2009; Dey *et al.* 2011). Corresponding ground counts
7035 in 2006, 2008, and 2009 were roughly comparable (within 6–11%) to the aerial counts.

7036 **10.1.4 Conservation Needs and Threats**

7037
7038 The Service (2014) summarized threats to the red knot in our review of data for the final listing
7039 rule. Threats from habitat destruction and modification are occurring throughout its range,
7040 including climate change (especially sea level rise), shoreline stabilization, and coastal
7041 development, exacerbated regionally or locally by lesser habitat-related threats such as beach
7042 cleaning, invasive vegetation, agriculture, and aquaculture. Reduced food availability at the
7043 Delaware Bay stopover site due to commercial harvest of the horseshoe crab likely contributed to
7044 the decline of red knot populations in the 2000s.

7045 **10.2 Environmental Baseline for Red Knot**

7046
7047 This section describes the current condition of the red knot in the Action Area without the
7048 consequences to the listed species caused by the proposed Action.

7049 **10.2.1 Action Area Numbers, Reproduction, and Distribution**

7050 Our only data for red knot use of the Plan Area are three sightings in the winter of 2016, and one
7051 in the winter of 2017, documented in eBird (2019). The 2016 sightings were in large fields (total
7052 extent about 75 acres) that were intentionally flooded to suppress weed growth. During the
7053 growing season, these fields produce tomatoes. The 2017 sighting was in an unspecified upland
7054 cover class. We believe small numbers of red knots, not large flocks, may use portions of the
7055 Plan Area occasionally when displaced inland by severe weather, disturbance, or other
7056 alterations of nearby coastal habitats, possibly following other species of shorebirds that more
7057 commonly use inland fields. Red knots red knots are well documented along the Gulf shoreline
7058 of Estero Island, Lovers Key, Long Key, Marco Island, and to a lesser extent Naples Beach.

7059
7060 The Plan Area contains pond/lake shorelines and non-forested wetlands that may occasionally
7061 provide foraging and resting stopovers for red knots. The 2017 red knot sighting in an upland
7062 habitat was atypical, and we do not consider uplands of the Plan Area as potential red knot
7063 habitat. Lacking evidence that red knots regularly use any portion of the Plan Area, we consider

7068 the 75 acres of periodically flooded agricultural fields as the sole area that supports occasional
7069 red knot use.

7070 7071 **10.2.2 Action Area Conservation Needs and Threats**

7072
7073 The Action Area does not contain coastal habitats that red knots most commonly use for
7074 wintering in and migrating through Florida; therefore, the suite of threats to such habitats in the
7075 range-wide context are not relevant in the Action Area. Conserving inland non-forested wetlands
7076 would benefit red knots that occasionally use them as short-term alternatives to coastal habitats.

7077 7078 **10.3 Effects of the Action on Red Knot**

7079
7080 This section describes all reasonably certain consequences to the red knot that we predict the
7081 proposed Action would cause, including the consequences of other activities not included in the
7082 proposed Action that would not occur but for the proposed Action. Such effects may occur later
7083 in time and may occur outside the immediate area involved in the Action.

7084 7085 **10.3.1 Development and Mining, Base Zoning, and Eligible Lands**

7086
7087 The 75 acres of winter-flooded tomato fields in which red knots were sighted in 2016 are within
7088 a designated Development area of the HCP. As an agricultural cover type that could plausibly
7089 receive a disproportionate share of development under the 39,973-acre development cap, the
7090 “reasonable maximum impact” method described in section 2.1.4 is appropriate. The size of the
7091 only known red knot habitat within the Plan Area is substantially less than 39,973 acres;
7092 therefore, we consider that commercial/residential development would affect all 75 acres.

7093
7094 Development of these fields would eliminate seasonal flooding practices, which makes the fields
7095 attractive to shore birds venturing inland, and convert the cropland to urban cover. Development
7096 would occur necessarily when the fields are not flooded and when red knots are not present. The
7097 area would no longer support use by red knots; however, we do not expect this habitat loss to kill
7098 or injure any red knots. We believe the use of the flooded fields is opportunistic, and that
7099 sufficient lake, pond, and wetland shorelines are available in the general area to serve occasional
7100 and opportunistic use when red knots may wander inland from traditional coastal habitats.

7101 7102 **10.3.2 Preservation Activities**

7103
7104 The 2017 sighting of a single red knot in the Plan Area was at an upland site within a designated
7105 Preservation Areas. As a shorebird that winters in and migrates through Florida primarily along
7106 its coastlines, the use of inland areas appears occasional and unpredictable. We do not consider
7107 uplands or wetlands of the Plan Area to provide substantial habitat value for the red knot.
7108 However, by continuing current agricultural uses and precluding future commercial/residential
7109 development and earth mining, the Preservation Areas would remain available for occasional red
7110 knot use. Otherwise, we expect the Covered Activities in the Preservation Areas to have no
7111 effect on the species.

7113 **10.3.3 Very Low Density Development**

7114

7115 We have no data that the red knot has used or is reasonably certain to use the areas designated
7116 for Very Low Density development. For the same reasons we provided in the previous section,
7117 we expect the Covered Activities in these areas to have no effect on the red knot.

7118

7119 **10.3.4 Cumulative Effects on Red Knot**

7120

7121 For purposes of consultation under ESA §7, cumulative effects are those caused by future state,
7122 tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future
7123 Federal actions that are unrelated to the proposed action are not considered, because they require
7124 separate consultation under §7 of the ESA.

7125

7126 We identified in section 3 of this BO/CO a projected increase in traffic on public roads as the
7127 sole source of effects that are consistent with the definition of cumulative effects for this Action.
7128 We have no information that suggests traffic on public roads is a predictable cause of red knot
7129 injury, mortality, or significant behavioral modification.

7130

7131 **10.4 Conclusion for Red Knot**

7132

7133 In this section, we summarize and interpret the findings of the previous sections for the red knot
7134 (status, baseline, effects, and cumulative effects) relative to the species-specific purpose of a BO
7135 under §7(a)(2) of the ESA, which is to determine whether the proposed action is likely to
7136 jeopardize the continued existence of a species.

7137

7138 **Status**

7139

7140 A current, reliable, range-wide population estimate for the red knot is not available. The
7141 estimated passage population through Delaware Bay, the primary Atlantic stopover during spring
7142 migration, declined from 152,900 birds in 1989 to 48,955 birds in 2013. Numbers on the Gulf
7143 coast of peninsular Florida averaged 1,451 red knots in annual winter aerial surveys from 2006 to
7144 2010.

7145

7146 Threats to the coastal habitats of the red knot include climate change (especially sea level rise),
7147 shoreline stabilization, and coastal development, exacerbated regionally or locally by lesser
7148 habitat-related threats such as beach cleaning, invasive vegetation, agriculture, and aquaculture.

7149

7150 **Baseline**

7151

7152 Our only data for red knot use of the Plan Area are three sightings in the winter of 2016, and one
7153 in the winter of 2017. The 2016 sightings were in large tomato fields (total extent about 75 acres)
7154 that were intentionally flooded to suppress weed growth. The 2017 sighting was in an
7155 unspecified upland cover class. We believe small numbers of red knots, not large flocks, may use
7156 portions of the Plan Area occasionally when displaced inland by severe weather, disturbance, or
7157 other alterations of nearby coastal habitats, possibly following other species of shorebirds that
7158 more commonly use inland fields.

7159

7160 **Effects**

7161

7162 Development of the 75 acres of flooded tomato fields that have supported previous red knot use
7163 would eliminate seasonal flooding practices, which makes the fields attractive to shore birds
7164 venturing inland, and convert the cropland to urban cover. Development would occur necessarily
7165 when the fields are not flooded and when red knots are not present. The fields would no longer
7166 support use by red knots; however, we do not expect this habitat loss to kill or injure any red
7167 knots. We expect the Covered Activities in the Preservation and Very Low Density Development
7168 areas to have no effect on the species.

7169

7170 **Cumulative Effects**

7171

7172 We do not anticipate coextensive non-federal actions within the Action Area unrelated to the
7173 HCP that would affect the red knot.

7174

7175 **Opinion**

7176

7177 Red knots infrequently occur in the Plan Area, likely at a very low density and a patchy
7178 distribution. The development activity could convert approximately 75 acres of tomato fields,
7179 which are periodically flooded for weed control, to residential and commercial development. Red
7180 knots have used these fields for foraging and roosting. Although this habitat conversion would
7181 permanently preclude such use in the future, we do not expect the habitat loss to kill or injure
7182 any red knots or otherwise reduce the likelihood of the species' survival and recovery.

7183

7184 After reviewing the current status of the species, the environmental baseline for the Action Area,
7185 the effects of the Action and the cumulative effects, it is our biological opinion that the Action is
7186 not likely to jeopardize the continued existence of the red knot.

7187

7188

7189 **11. Little Blue Heron**

7190

7191 This section provides the Service's conference opinion of the Action for the little blue heron.

7192

7193 **11.1 Status of Little Blue Heron**

7194

7195 This section summarizes best available data about the biology and current condition of the little
7196 blue heron (*Egretta caerulea*) (LBH) throughout its range that are relevant to formulating an
7197 opinion about the Action. At this time, the LBH is not protected under the ESA. The Service
7198 has not reviewed the species' status relative to the ESA definitions of "endangered" and
7199 "threatened." The State of Florida protects the LBH as a threatened species under Florida's
7200 Endangered and Threatened Species Rule. For purposes of this Conference Opinion, we rely
7201 upon the Biological Status Review prepared by the Florida Fish and Wildlife Conservation
7202 Commission (FWC 2011) and other available data to describe the species' status.

7203

7204 **11.1.1 Species Description**

7205
7206 The LBH is a small wading bird species that can reach a length of up to 29 inches, a wingspan of
7207 41 inches, and a weight of 14 ounces. Little blue herons have a grayish-blue body and a dark red
7208 head during breeding, and a purplish head and neck during non-breeding periods.

7209
7210 **11.1.2 Life History**

7211
7212 Rodgers and Smith (2012) synthesized available data about the biology of the LBH, which is the
7213 source of information we provide here. The LBH is a colonial-nesting wading bird that forages
7214 and breeds in a variety of freshwater and marine-estuarine habitats. Northern breeding
7215 populations are migratory, and others are year-round residents.

7216
7217 Nesting usually occurs in colonies, sometimes with thousands of other wading birds, on islands,
7218 thickets near water, or emergent vegetation over water. LBHs produce one brood per season,
7219 laying clutches of three to five eggs that hatch in 20–24 days. Young fledge at 28 days. Suitable
7220 breeding sites have woody vegetation that can support nests, absence of ground-predators, and
7221 proximity to foraging habitat.

7222
7223 Typical prey items include fish, insects, crustaceans, and amphibians. Foraging habitats include
7224 tidal ponds and sloughs, mudflats, mangrove-dominated pools, freshwater sloughs and marshes,
7225 the edges of rivers, streams, and lakes, and canals and impoundments. Flight distance to foraging
7226 sites from nesting colonies is variable, probably as a function of food availability. The average
7227 distance traveled from an interior (not coastal) freshwater colony to foraging sites in Florida was
7228 6.7 km (4.2 mi).

7229
7230 **11.1.3 Numbers, Reproduction, and Distribution**

7231
7232 The LBH is widely distributed in the Americas and Caribbean (Rodgers and Smith 2012). Its
7233 contiguous U.S. breeding range extends along the Atlantic coast from southern Maine to Florida,
7234 along the Gulf Coast from Florida to Texas, and inland as far north as southern Illinois and
7235 central Kentucky. Breeding also occurs on the west side of North America in California and
7236 Mexico. LBH that breed in northern portions of the range migrate south in the fall to various
7237 wintering areas, including Florida. Rodgers and Smith (2012) report that the LBH appears most
7238 abundant in Delaware, North Carolina, South Carolina, Florida, Texas, and especially Louisiana,
7239 but a range-wide population estimate is not available.

7240
7241 FWC (2011) cited an unpublished report that identified wading bird nesting colonies in south
7242 Florida that supported more than 2,000 LBH pairs in 2009. FWC believes the statewide
7243 population is between 5,000–15,000 individuals, and reports indications that LBH numbers have
7244 exhibited a slow but steady decline since the latter 1990s. The LBH occurs throughout Florida in
7245 wetland habitats of all nearly all types, but more commonly in freshwater types.

7246
7247 **11.1.4 Conservation Needs and Threats**

7249 Current threats to the species are degradation or loss of habitat, hydrologic alterations to
7250 wetlands, and reductions to important prey sources. FWC (2013) suggested that prey availability
7251 is the most important factor limiting the populations of several wading birds, including the LBH.
7252 Human disturbance at nesting colonies, increased pressure from predators, oil spills, and
7253 exposure to other contaminants are additional recognized threats (FWC 2011). Rodgers and
7254 Smith (2012) cite studies that suggest that competition for nesting habitat with cattle egrets has
7255 contributed to reduced LBH productivity.

7256
7257 Conservation needs include hydrological restoration, management of suitable habitat, and
7258 removal of non-native species.

7260 **11.2 Environmental Baseline for Little Blue Heron**

7261 This section describes the current condition of the LBH in the Action Area without the
7262 consequences to the listed species caused by the proposed Action.

7263 **11.2.1 Action Area Numbers, Reproduction, and Distribution**

7264 The Applicants did not conduct species-specific surveys for the LBH within the Plan Area, but
7265 note in section 5.5.1.4 of the HCP that the species is routinely observed in the Plan Area. The
7266 Plan Area contains 58,543 acres of native freshwater wetlands that are potential LBH habitat
7267 (Table 2-2). In 1996, freshwater wetlands covered about 10.2 million acres of Florida, and the
7268 rate of wetlands loss in the previous decade was about 5,000 acres annually (Dahl 2005).
7269 Extrapolating this rate of loss to 2019 yields about 10 million acres statewide. The statewide
7270 LBH population of about 5,000–15,000 individuals (FWC 2011) in about 10 million acres of
7271 wetlands in Florida is a density of one bird per 667–2,000 acres of habitat. We apply this density
7272 to the wetland acreage of the Plan Area to estimate that 29–88 LBH occur within the Plan Area.

7273 The Florida Fish and Wildlife Research Institute has identified two active wading bird colonies
7274 within the Plan Area that support LBH nesting (FWRI 2018) of less than 10 nesting pairs per
7275 colony. The two known colonies are located within areas designated for Preservation near the
7276 northeast corner of the Plan Area. Whether other active nesting sites for LBH occur in the Plan
7277 Area is unknown. Up to 10 pairs in only two colonies would amount to 40 adults, which is within
7278 the density-based range of 29–88 adults that we expect the Plan Area wetlands to support.

7279 **11.2.2 Action Area Conservation Needs and Threats**

7280 Large areas of native wetlands habitat within the Plan Area have been altered via land clearing
7281 and drainage for agricultural uses. This loss of habitat has reduced prey availability and likely
7282 increased competition with other wading birds. Like other cattle grazing areas in Florida, the
7283 Plan Area supports a population of cattle egrets, which may compete with LBH for nesting sites.
7284 Threats to the LBH within the Plan Area include further habitat loss and degradation, and
7285 disturbance at breeding and foraging sites. Conservation needs within the Plan Area include the
7286 protection and management of existing suitable habitat, especially colonial nesting sites, and the
7287 hydrologic restoration of degraded wetlands.

7295 **11.3 Effects of the Action on Little Blue Heron**

7296
7297 This section describes all reasonably certain consequences to the LBH that we predict the
7298 proposed Action would cause, including the consequences of other activities not included in the
7299 proposed Action that would not occur but for the proposed Action. Such effects may occur later
7300 in time and may occur outside the immediate area involved in the Action.

7301
7302 **11.3.1 Development and Mining, Base Zoning, and Eligible Lands**

7303
7304 To estimate the spatial extent of development across cover classes the LBH may occupy, we use
7305 the “Proportional” method described in section 2.1.4, which distributes 39,973 acres of
7306 development among all areas (Development and Mining, Base Zoning, and Eligible Lands) that
7307 could receive high-density development under the HCP. By this method, we estimate that the
7308 proposed Action could convert up to 4,885 acres of wetland habitats to residential, commercial,
7309 or mining uses (Table 2-3, sum of column “G” for native wetlands). The designated
7310 Development and Mining areas contain 2,442 acres of native wetlands (Table 2-2), which is the
7311 maximum loss of wetlands that could occur if development is confined entirely to these areas
7312 (*i.e.*, no substitution of Base Zoning or Eligible lands in the development cap). Using densities of
7313 one bird per 667–2,000 acres of habitat (see section 11.2.1), 2,442–4,884 acres of wetlands
7314 would support about 2–8 LBH.

7315
7316 Development and mining in wetlands would involve various activities (drainage, filling,
7317 excavation, paving, building construction, *etc.*) that would permanently eliminate the affected
7318 areas as LBH habitat. The two known LBH nesting colonies within the Plan Area are within
7319 designated Preservation Areas; therefore, we do not expect development activities to directly kill
7320 or injure LBH eggs or flightless young. However, development of wetlands used as foraging
7321 areas would cause 2–8 LBH to forage elsewhere.

7322
7323 We would expect habitat alteration that causes displacement from foraging areas to harm
7324 (actually kill or injure) LBH individuals indirectly through reduced reproductive success if it
7325 substantially reduces prey availability within the typical foraging distance from colonial nesting
7326 sites (average of about 4.2 mi; see section 11.1.2). Due to the uncertain distribution of 39,973
7327 acres of development within a 66,245-acre envelope (total extent of the Development and
7328 Mining, Base Zoning, and Eligible Lands), we are unable to determine the extent of development
7329 that would occur within 4.2 mi of the two known active LBH nesting colonies. These nesting
7330 sites are located in designated Preservation Areas near the northeast corner of the Plan Area
7331 about 4 mi from the nearest designated Development area. This quadrant of the Plan Area
7332 contains the Base Zoning parcel and two parcels of the Eligible Lands, and these areas may
7333 substitute for designated Development areas in the development cap. However, Preservation is
7334 the designated use for most of the area surrounding the nesting sites, and the Preservation Areas
7335 contain 84.9% of the native wetlands in the Plan Area (see Table 2-2). We believe it is unlikely
7336 that a potential loss of foraging habitat in the Base Zoning and Eligible Lands in this quadrant of
7337 the Plan Area would impair LBH reproductive success, but we acknowledge that prey
7338 availability is considered an important factor limiting LBH and other wading bird populations
7339 (FWC 2013).

7341 The Applicants propose to mitigate for permanent losses of habitat for Covered wading bird
7342 species through “preservation, and potential restoration, enhancement and/or creation of an equal
7343 acreage of in-kind little blue heron and tricolored heron habitat” (HCP chapter 7.5.1.4). In its
7344 “Species Conservation Measures and Permitting Guidelines,” FWC (2019) considers wetland
7345 mitigation through the State’s Environmental Resource Permit (ERP) process sufficient to satisfy
7346 its permitting requirements for potential take of LBH caused by significant modification of
7347 foraging habitat. We expect that the developments of the HCP would engage the State’s ERP
7348 process.

7349

7350 **11.3.2 Preservation Activities**

7351

7352 The designated Preservation Areas of the HCP contain 49,695 acres of native wetlands (Table 2-
7353 1) that we consider LBH foraging and nesting/roosting habitat. Using densities of one bird per
7354 667–2,000 acres of habitat (see section 11.2.1), these wetlands would support about 25–75 LBH.
7355 The two sites known to support recent LBH nesting activity within the Plan Area are located
7356 within Preservation Areas.

7357

7358 The Applicants propose a continuation of existing land uses (agriculture, silviculture, *etc.*) in the
7359 Preservation Areas, which we listed in section 2.3. All of these uses may occur to some extent in
7360 native wetlands of the Preservation Areas except crop cultivation. Land management activities in
7361 the Preservation Areas for which the Applicants seek take authorization and that may occur in
7362 wetlands include:

7363 prescribed burning;
7364 mechanical control of groundcover (*e.g.*, roller chopping, brush-hogging, mowing);
7365 ditch and canal maintenance;
7366 mechanical and/or chemical control of exotic vegetation; and
7367 similar activities that maintain or improve land quality.

7368

7369 In wetlands, prescribed burning is usually applied to control woody encroachment in non-
7370 forested wetlands (*e.g.*, wet prairies and bogs), which do not ordinarily support LBH nesting.
7371 Therefore, we do not expect prescribed fire to harm LBH. The other activities listed above may
7372 temporarily disrupt LBH foraging activity, but are unlikely to harm birds unless conducted near
7373 nesting sites. We believe that trees surrounded by standing water, the typical setting of a colonial
7374 wading bird rookery, are unlikely locations for these land management actions.

7375

7376 Preservation Areas will serve as mitigation for most or all of the covered species. While
7377 preservation via conservation easement is the primary approach to maintaining Preservation
7378 Areas habitats, the HCP proposes habitat enhancement or restoration as mitigation, at least as an
7379 option, for the little blue heron. In addition, Preservation Areas are probable sites for habitat
7380 management as well as mitigation of wetland fill.

7381

7382 We do not expect the management of Preservation Areas to reduce the numbers, reproduction, or
7383 distribution of the LBH in the Preservation Areas, because these activities would, at minimum,
7384 maintain current conditions. Special attention to this species in the long-term management of the
7385 Preservation Areas under conservation easements could increase LBH densities and the Plan
7386 Area population. However, lacking detailed information about the LBH in the Plan Area, and

7387 about how habitat management under conservation easements may benefit this species, we are
7388 unable to estimate the extent of potential benefits.

7390 **11.3.3 Very Low Density Development**

7392 The Very Low Density (VLD) use areas of the HCP contain 733 acres of native wetlands that we
7393 consider as LBH habitat (Table 2-2). Using densities of one bird per 667–2,000 acres of habitat
7394 (see section 11.2.1), these wetlands would support less than two LBH. No sites known to support
7395 recent LBH nesting activity within the Plan Area are located within the VLD areas.

7397 Land uses in the VLD areas are similar to the Preservation Areas, but may also include isolated
7398 residences, lodges, and hunting/fishing camps, at a density of no more than one dwelling unit per
7399 50 acres. The Applicants would continue current ranching/livestock operations and other
7400 management activities as described for the Preservation Areas (e.g., exotic species control,
7401 prescribed burning). As in the Preservation Areas, we do not expect adverse effects resulting
7402 from the continuation of the existing land management regimes.

7404 The HCP does not specify a footprint for the isolated residences, lodges, and hunting/fishing
7405 camps, but indicates that their construction could clear up to 10% of the existing native
7406 vegetation (see section 2.5). New dwelling development could occur within any of the cover
7407 types present besides open water and existing development. Clearing up to 10% of the native
7408 cover types that we consider as LBH habitat would reduce such habitat by 73 acres (Table 2-7).
7409 It is possible that dwelling development in the VLD areas could entirely avoid wetlands, but we
7410 conservatively estimate a 73-acre habitat loss. Because the VLD area wetlands do not support
7411 known nesting colonies, we do not expect this extent of habitat modification to kill or injure
7412 LBH.

7413 The general measures for enhancing LBH habitat in the Preservation Areas apply to the VLD
7414 areas as well (see previous section 11.3.2). However, the potential to increase LBH numbers or
7415 reproduction is limited due to the small extent of wetlands in the VLD areas.

7418 **11.4 Cumulative Effects on Little Blue Heron**

7420 For purposes of consultation under ESA §7, cumulative effects are those caused by future state,
7421 tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future
7422 Federal actions that are unrelated to the proposed action are not considered, because they require
7423 separate consultation under §7 of the ESA.

7425 We identified in section 3 of this BO/CO a projected increase in traffic on public roads as the
7426 sole source of effects that are consistent with the definition of cumulative effects for this Action.
7427 We have no information that suggests traffic on public roads is a predictable cause of LBH
7428 injury, mortality, or significant behavioral modification.

7430 **11.5 Conclusion for Little Blue Heron**

7432 In this section, we summarize and interpret the findings of the previous sections for the LBH
7433 (status, baseline, effects, and cumulative effects) relative to the species-specific purpose of a BO
7434 under §7(a)(2) of the ESA, which is to determine whether the proposed action is likely to
7435 jeopardize the continued existence of a species.

7436

7437 Status

7438

7439 The LBH is widely distributed in the Americas and Caribbean. A range-wide estimate of
7440 abundance is not available. The Florida population is between 5,000–15,000 individuals, and has
7441 slowly but steadily declined since the 1990s. The LBH occurs throughout Florida in wetland
7442 habitats of all nearly all types, but more commonly in freshwater types. Current threats to the
7443 species are degradation or loss of habitat, hydrologic alterations to wetlands, and reductions to
7444 important prey sources. Prey availability is an important factor limiting the populations of
7445 several wading birds, including the LBH. LBH conservation needs include hydrological
7446 restoration, management of suitable habitat, and removal of non-native species.

7447

7448 Baseline

7449

7450 The Plan Area contains 58,543 acres of native freshwater wetlands that are potential LBH
7451 habitat. The statewide LBH population of about 5,000–15,000 individuals in about 10 million
7452 acres of wetlands in Florida is a density of one bird per 667–2,000 acres of habitat. We apply this
7453 density to the wetland acreage of the Plan Area to estimate that 29–88 LBH occur within the
7454 Plan Area. Two active wading bird colonies within the Plan Area support LBH nesting of less 10
7455 nesting pairs per colony. Whether other active nesting sites for LBH occur in the Plan Area is
7456 unknown. LBH conservation needs within the Plan Area include the protection and management
7457 of existing suitable habitat, especially colonial nesting sites, and the hydrologic restoration of
7458 degraded wetlands.

7459

7460 Effects

7461

7462 Depending on the distribution of the development cap among the Development and Mining, Base
7463 Zoning, and Eligible Lands designations of the HCP, we estimate the development would
7464 eliminate 2,442–4,884 acres of wetlands that would support foraging for about 2–8 LBH. The
7465 two known LBH nesting colonies within the Plan Area are within designated Preservation Areas;
7466 therefore, we do not expect development activities to directly kill or injure LBH eggs or
7467 flightless young. Based on the distance of these colonies from potential development activity, we
7468 believe it is unlikely that the loss of foraging habitat within the development envelope would
7469 impair LBH reproductive success at these colonies.

7470

7471 The designated Preservation Areas may support 25–75 LBH. We do not expect the management
7472 of Preservation Areas to reduce the numbers, reproduction, or distribution of the LBH in the
7473 Preservation Areas, because these activities will, at minimum, maintain current conditions.
7474 Special attention to this species in the long-term management of the Preservation Areas under
7475 conservation easements could increase LBH densities and the Plan Area population.

7476

7477 Native wetlands in the Very Low Density (VLD) use areas may support less than two LBH.
7478 Clearing up to 10% of the native wetlands in the VLD use areas would reduce LBH habitat by 73
7479 acres. Because the VLD area wetlands do not support known nesting colonies, we do not expect
7480 this extent of habitat modification to kill or injure LBH.

7481

7482 Opinion

7483

7484 The loss of about 2,442–4,884 acres of wetlands that may support LBH foraging would add an
7485 increment of habitat loss to the species' range in Florida, where numbers have been declining
7486 due primarily to habitat loss since the 1990's. Foraging habitat reductions near nesting colonies
7487 may impair reproductive success, but the only two known active LBH colonies in the Plan Area
7488 are not within or near designated Development areas that are most likely to receive development.
7489 However, prey availability is recognized as a primary factor limiting LBH populations. Using the
7490 statewide FBH density as a measure of the impact of wetlands loss on LBH populations, the
7491 development could reduce LBH numbers by 2–8 individuals. Relative to statewide numbers of
7492 5,000–15,000, this represents a 0.01–0.16% reduction. Range-wide abundance throughout the
7493 Americas and Caribbean is unknown, but likely several orders of magnitude greater than the
7494 Florida population.

7495

7496 Precluding new development and mining activity in the dedicated Preservation Areas would
7497 protect 49,695 acres of LBH habitat, which contains 85% of the Plan Area wetlands. As these
7498 areas are brought under conservation easements, habitat enhancements that may increase LBH
7499 numbers are likely, but the amount or extent is not predictable at this time. Given the relatively
7500 small proportional impact of the Development activities to Florida LBH populations, and a much
7501 smaller proportional impact range-wide, we believe the net impact of the Action on the LBH is
7502 within the species' ability to sustain.

7503

7504 After reviewing the current status of the species, the environmental baseline for the Action Area,
7505 the effects of the Action and the cumulative effects, it is the Service's conference opinion that
7506 the Action is not likely to jeopardize the continued existence of the LBH.

7507

7508

7509 **12. Tricolored Heron**

7510

7511 This section provides the Service's conference opinion of the Action for the tricolored heron.

7512

7513 **12.1 Status of Tricolored Heron**

7514

7515 This section summarizes best available data about the biology and current condition of the
7516 tricolored heron (*Egretta tricolor*) (TCH) throughout its range that are relevant to formulating an
7517 opinion about the Action. At this time, the TCH is not protected under the ESA. The Service has
7518 not reviewed the species' status relative to the ESA definitions of "endangered" and
7519 "threatened." The State of Florida protects the TCH as a threatened species under Florida's
7520 Endangered and Threatened Species Rule. For purposes of this Conference Opinion, we rely
7521 upon the Biological Status Review prepared by the Florida Fish and Wildlife Conservation
7522 Commission (FWC 2011) and other available data to describe the species' status.

7523
7524 **12.1.1 Species Description**
7525
7526 The TCH has a dark slate-blue colored head and upper body, a purple chest, and white
7527 underparts. This wading bird has a long and slender neck and bill, and reaches a length between
7528 24–26 inches with a wingspan of approximately 36 inches (FWC 2011).
7529
7530 **12.1.2 Life History**
7531
7532 Frederick (2013) synthesized available data about the biology of the TCH, which is the source of
7533 information we provide here. The TCH is a colonial-nesting wading bird that breeds and forages
7534 mostly in coastal wetlands, but also in freshwater wetlands. Northern breeding populations are
7535 migratory, and others are year-round residents.
7536
7537 Nesting generally occurs on islands or areas of higher ground that support small trees or shrubs
7538 surrounded by open water or inundated wetland vegetation. Nesting is typically in mixed-species
7539 colonies, and sometimes in small (2–100 pairs) monospecific colonies. TCH feed mostly on
7540 small fishes (e.g., topminnows and killifishes). The size of foraging areas fluctuate throughout
7541 the year, shrinking during the breeding season to an average radial distance of about 8 mi from a
7542 nest location.
7543
7544 **12.1.3 Numbers, Reproduction, and Distribution**
7545
7546 The breeding range of the TCH parallels the coasts of the U.S. Atlantic states, Gulf of Mexico,
7547 southern California and Baja California, Central America, both Atlantic and Pacific coasts of
7548 northern South America, and the Caribbean (Frederick 2013). Frederick (2013) speculates that
7549 the TCH was likely the most numerous North American heron before the arrival of the cattle
7550 egret (*Bubulcus ibis*) in the 1950s. The TCH was considered one of the most common herons in
7551 Florida before the 1970s, where the species still occurs throughout most of the state in both
7552 freshwater and estuarine habitats (FWC 2011).
7553
7554 A range-wide population estimate is not available. Comprehensive surveys of the U.S. breeding
7555 range in 1976 suggested a minimum breeding population of about 193,600 adults, distributed as
7556 follows: Louisiana (72%), Texas (12%), Florida (6.3%), and Atlantic coastal states north of
7557 Florida (9.7%) (Frederick 2013). Most data collected since that time suggest that the species is
7558 declining, perhaps rapidly. FWC (2011) estimated the statewide population at about 10,000
7559 individuals. Citing various reports, FWC (2011) indicated that numbers of TCH nesting in south
7560 Florida Water Conservation Areas and Everglades National Park (not statewide) declined from
7561 about 10,000–15,000 pairs in the 1930's, to 1,723 pairs in 1999, and to 1,144 pairs in 2009.
7562
7563 **12.1.4 Conservation Needs and Threats**
7564
7565 Citing various sources, FWC (2013) lists loss of wetland habitat, habitat degradation due to
7566 changes in hydrology and water quality, disturbance at breeding sites, and elevated populations
7567 of native and non-native nest predators as the primary threats to the TCH. Frederick (2013)
7568 suggested that reduced productivity caused by reduced flow of fresh water to the estuaries

7569 associated with the Everglades is the most important conservation problem for the TCH. This is
7570 consistent with the view that prey availability is the most important factor limiting the
7571 populations of several wading birds in Florida, including the TCH (FWC 2013). Sea level rise
7572 may reduce the availability of nesting islands and coastal foraging habitat (Frederick 2013).
7573

7574 The primary conservation needs of the TCH mirror those of other species of wading birds:
7575 maintain and restore wetlands for nesting and foraging, and protect nesting sites from
7576 disturbance.
7577

7578 **12.2 Environmental Baseline for Tricolored Heron**

7580 This section describes the current condition of the TCH in the Action Area without the
7581 consequences to the listed species caused by the proposed Action.
7582

7583 **12.2.1 Action Area Numbers, Reproduction, and Distribution**

7585 The Applicants did not conduct species-specific surveys for the TCH within the Plan Area, but
7586 note in section 5.5.1.4 of the HCP that the species is routinely observed in the Plan Area. The
7587 FWC Water Bird Locator, a statewide database of known colonial nesting sites since the 1970s
7588 for wading birds and other species, does not contain records of TCH nesting colonies within the
7589 Plan Area or within 30 mi of Plan Area (FWRI 2019). Without any records of nesting activity in
7590 the Plan Area, and given the species' more typical use of coastal wetland nesting sites, we
7591 believe that the Plan Area supports TCH foraging and roosting, but is not reasonably certain to
7592 support nesting.
7593

7594 The Plan Area contains 58,543 acres of native freshwater wetlands that are potential TCH habitat
7595 (Table 2-2). In 1996, freshwater wetlands covered about 10.2 million acres of Florida, and the
7596 rate of wetlands loss in the previous decade was about 5,000 acres annually (Dahl 2005).
7597 Extrapolating this rate of loss to 2019 yields about 10 million acres statewide. The statewide
7598 TCH population of about 10,000 individuals (FWC 2011) in about 10 million acres of wetlands
7599 in Florida is a density of one bird per 1,000 acres of habitat. We apply this density to the wetland
7600 acreage of the Plan Area to estimate that about 59 TCH occur within the Plan Area.
7601

7602 **12.2.2 Action Area Conservation Needs and Threats**

7604 Large areas of native wetlands habitat within the Plan Area have been altered via land clearing
7605 and drainage for agricultural uses. This loss of habitat has likely reduced prey availability and
7606 increased competition with other wading birds. Threats to the TCH within the Plan Area include
7607 further habitat loss and degradation. Conservation needs within the Plan Area include the
7608 protection and management of existing suitable habitat, and the hydrologic restoration of
7609 degraded wetlands.
7610

7611 **12.3 Effects of the Action on Tricolored Heron**

7613 This section describes all reasonably certain consequences to the TCH that we predict the
7614 proposed Action would cause, including the consequences of other activities not included in the
7615

7615 proposed Action that would not occur but for the proposed Action. Such effects may occur later
7616 in time and may occur outside the immediate area involved in the Action.

7617

7618 **12.3.1 Development and Mining, Base Zoning, and Eligible Lands**

7619

7620 To estimate the spatial extent of development across cover classes the TCH may occupy, we use
7621 the “Proportional” method described in section 2.1.4, which distributes 39,973 acres of
7622 development among all areas (Development and Mining, Base Zoning, and Eligible Lands) that
7623 could receive high-density development under the HCP. By this method, we estimate that the
7624 proposed Action could convert up to 4,885 acres of wetland habitats to residential, commercial,
7625 or mining uses (Table 2-3, sum of column “G” for native wetlands). The designated
7626 Development and Mining areas contain 2,442 acres of native wetlands (Table 2-2), which is the
7627 maximum loss of wetlands that could occur if development is confined entirely to these areas
7628 (*i.e.*, no substitution of Base Zoning or Eligible lands in the development cap). Using a density of
7629 one bird per 1,000 acres of habitat (see section 12.2.1), 2,442–4,884 acres of wetlands would
7630 support about 3–5 TCH.

7631

7632 Development and mining in wetlands would involve various activities (drainage, filling,
7633 excavation, paving, building construction, *etc.*) that would permanently eliminate the affected
7634 areas as TCH habitat. No known TCH nesting colonies occur within the Plan Area; therefore,
7635 we do not expect development activities to directly kill or injure TCH eggs or flightless young.
7636 However, development of wetlands used as foraging areas would cause 3–5 TCH to forage
7637 elsewhere.

7638

7639 We would expect habitat alteration that causes displacement from foraging areas to harm
7640 (actually kill or injure) TCH individuals indirectly through reduced reproductive success if it
7641 substantially reduces prey availability within the typical foraging distance from colonial nesting
7642 sites (average of about 8 mi; see section 12.1.2). The nearest documented TCH nesting colony is
7643 over 30 mi from the Plan Area (FWRI 2019). The Applicants report that TCH are routinely
7644 observed in the Plan Area, which suggests that undetected nesting activity occurs somewhere
7645 within or near the Plan Area. Lacking evidence that indicates where TCH nesting may occur, we
7646 are not reasonably certain that loss of wetlands foraging habitat resulting from the development
7647 would impair TCH reproductive success. However, we recognize that prey availability is
7648 considered an important factor limiting TCH and other wading bird populations (FWC 2013).

7649

7650 The Applicants propose to mitigate for permanent losses of habitat for Covered wading bird
7651 species through “preservation, and potential restoration, enhancement and/or creation of an equal
7652 acreage of in-kind little blue heron and tricolored heron habitat” (HCP chapter 7.5.1.4). In its
7653 “Species Conservation Measures and Permitting Guidelines,” FWC (2019) considers wetland
7654 mitigation through the State’s Environmental Resource Permit (ERP) process sufficient to satisfy
7655 its permitting requirements for potential take of TCH caused by significant modification of
7656 foraging habitat. We expect that the developments of the HCP would engage the State’s ERP
7657 process.

7658

7659 **12.3.2 Preservation Activities**

7660

7661 The designated Preservation Areas of the HCP contain 49,695 acres of native wetlands (Table 2-
7662 2) that we consider TCH foraging and roosting habitat. Using a density of one bird per 1,000
7663 acres of habitat (see section 12.2.1), these wetlands would support about 50 TCH. We have no
7664 records of TCH nesting in the Preservation Areas, but undetected nesting may occur in wetlands
7665 of the Plan Area.

7666

7667 The Applicants propose a continuation of existing land uses (agriculture, silviculture, *etc.*) in the
7668 Preservation Areas, which we listed in section 2.3. All of these uses may occur to some extent in
7669 native wetlands of the Preservation Areas except crop cultivation. Land management activities in
7670 the Preservation Areas for which the Applicants seek take authorization and that may occur in
7671 wetlands include:

7672 prescribed burning;

7673 mechanical control of groundcover (*e.g.*, roller chopping, brush-hogging, mowing);

7674 ditch and canal maintenance;

7675 mechanical and/or chemical control of exotic vegetation; and

7676 similar activities that maintain or improve land quality.

7677

7678 In wetlands, prescribed burning is usually applied to control woody encroachment in non-
7679 forested wetlands (*e.g.*, wet prairies and bogs), which do not ordinarily support TCH nesting.
7680 Therefore, we do not expect prescribed fire to harm TCH. The other activities listed above may
7681 temporarily disrupt TCH foraging activity, but are unlikely to harm birds unless conducted near
7682 nesting sites. We believe that trees surrounded by standing water, the typical setting of a colonial
7683 wading bird rookery, are unlikely locations for these land management actions.

7684

7685 Preservation Areas will serve as mitigation for most or all of the covered species. While
7686 preservation via conservation easement is the primary approach to maintaining Preservation
7687 Areas habitats, the HCP proposes habitat enhancement or restoration as mitigation, at least as an
7688 option, for the tricolored heron. In addition, Preservation Areas are probable sites for such
7689 habitat management as well as mitigation of wetland fill.

7690

7691 We do not expect the management of Preservation Areas to reduce the numbers, reproduction, or
7692 distribution of the TCH in the Preservation Areas, because these activities would, at minimum,
7693 maintain current conditions. Special attention to this species in the long-term management of the
7694 Preservation Areas under conservation easements could increase TCH densities and the Plan
7695 Area population. However, lacking detailed information about the TCH in the Plan Area, and
7696 about how habitat management under conservation easements may benefit this species, we are
7697 unable to estimate the extent of potential benefits.

7698

7699 **12.3.3 Very Low Density Development**

7700

7701 The Very Low Density (VLD) use areas of the HCP contain 733 acres of native wetlands that we
7702 consider as TCH habitat (Table 2-2). Using a density of one bird per 1,000 acres of habitat (see
7703 section 12.2.1), these wetlands would support one TCH. No sites known to support TCH nesting
7704 activity within the Plan Area are located within the VLD areas.

7705

7706 Land uses in the VLD areas are similar to the Preservation Areas, but may also include isolated
7707 residences, lodges, and hunting/fishing camps, at a density of no more than one dwelling unit per
7708 50 acres. The Applicants would continue current ranching/livestock operations and other
7709 management activities as described for the Preservation Areas (e.g., exotic species control,
7710 prescribed burning). As in the Preservation Areas, we do not expect adverse effects resulting
7711 from the continuation of the existing land management regimes.

7712
7713 The HCP does not specify a footprint for the isolated residences, lodges, and hunting/fishing
7714 camps, but indicates that their construction could clear up to 10% of the existing native
7715 vegetation (see section 2.5). New dwelling development could occur within any of the cover
7716 types present besides open water and existing development. Clearing up to 10% of the native
7717 cover types that we consider as TCH habitat would reduce such habitat by 73 acres (Table 2-7).
7718 It is possible that dwelling development in the VLD areas could entirely avoid wetlands, but we
7719 conservatively estimate a 73-acre habitat loss. Because the VLD area wetlands do not support
7720 known nesting colonies, we do not expect this extent of habitat modification to kill or injure
7721 TCH.

7722
7723 The general measures for enhancing TCH habitat in the Preservation Areas apply to the VLD
7724 areas as well (see previous section 11.3.2). However, the potential to increase TCH numbers or
7725 reproduction is limited due to the small extent of wetlands in the VLD areas.

7726 7727 **12.4 Cumulative Effects on Tricolored Heron**

7728
7729 For purposes of consultation under ESA §7, cumulative effects are those caused by future state,
7730 tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future
7731 Federal actions that are unrelated to the proposed action are not considered, because they require
7732 separate consultation under §7 of the ESA.

7733
7734 We identified in section 3 of this BO/CO a projected increase in traffic on public roads as the
7735 sole source of effects that are consistent with the definition of cumulative effects for this Action.
7736 We have no information that suggests traffic on public roads is a predictable cause of TCH
7737 injury, mortality, or significant behavioral modification.

7738 7739 **12.5 Conclusion for Tricolored Heron**

7740
7741 In this section, we summarize and interpret the findings of the previous sections for the TCH
7742 (status, baseline, effects, and cumulative effects) relative to the species-specific purpose of a BO
7743 under §7(a)(2) of the ESA, which is to determine whether the proposed action is likely to
7744 jeopardize the continued existence of a species.

7745 7746 **Status**

7747
7748 The TCH is widely distributed in the Americas and Caribbean. A range-wide estimate of
7749 abundance is not available, but most data suggest that the species is declining, perhaps rapidly.
7750 The Florida population is about 10,000 individuals. The TCH occurs throughout Florida in
7751 wetland habitats of all nearly all types, but more commonly in coastal areas. Primary threats to

7752 the species include loss of wetland habitat, habitat degradation due to changes in hydrology and
7753 water quality, disturbance at breeding sites, and elevated populations of native and non-native
7754 nest predators. Prey availability is an important factor limiting the populations of several wading
7755 birds, including the TCH. Sea level rise may reduce the availability of nesting islands and coastal
7756 foraging habitat (Frederick 2013). The primary conservation needs of the TCH mirror those of
7757 other species of wading birds: maintain and restore wetlands for nesting and foraging, and
7758 protect nesting sites from disturbance.

7759

Baseline

7760

7761 The Plan Area contains 58,543 acres of native freshwater wetlands that are potential TCH
7762 habitat. The statewide TCH population of about 10,000 individuals in about 10 million acres of
7763 wetlands in Florida is a density of one bird per 1,000 acres of habitat. We apply this density to
7764 the wetland acreage of the Plan Area to estimate that about 59 TCH occur within the Plan Area.
7765 TCH nesting within the Plan Area is not documented. Given the species' more typical use of
7766 coastal wetland nesting sites, we believe that the Plan Area supports TCH foraging, but is not
7767 reasonably certain to support nesting. Threats to the TCH within the Plan Area include habitat
7768 loss and degradation. Conservation needs within the Plan Area include the protection and
7769 management of existing suitable habitat, and the hydrologic restoration of degraded wetlands.
7770

7771

Effects

7772

7773 Depending on the distribution of the development cap among the Development and Mining, Base
7774 Zoning, and Eligible Lands designations of the HCP, we estimate the development would
7775 eliminate 2,442–4,884 acres of wetlands that would support foraging for about 3–5 TCH.
7776 Lacking evidence that indicates TCH nesting occurs within or near the Plant Area, we are not
7777 reasonably certain that loss of wetlands foraging habitat resulting from the development would
7778 impair TCH reproductive success.
7779

7780

7781 The designated Preservation Areas may support about 50 TCH. We do not expect the
7782 management of Preservation Areas to reduce the numbers, reproduction, or distribution of the
7783 TCH in the Preservation Areas, because these activities will, at minimum, maintain current
7784 conditions. Special attention to this species in the long-term management of the Preservation
7785 Areas under conservation easements could increase TCH densities and the Plan Area population.
7786

7787

7788 Native wetlands in the Very Low Density (VLD) use areas may support one TCH. Clearing up to
7789 10% of the native wetlands in the VLD use areas would reduce TCH habitat by 73 acres.
7790 Because the VLD area wetlands do not support known nesting colonies, we do not expect this
7791 extent of habitat modification to kill or injure TCH.

7792

Cumulative Effects

7793

7794 We have no information that suggests traffic on public roads, which is the sole source of
7795 cumulative effects we've identified for this Action, is a predictable cause of TCH injury,
7796 mortality, or significant behavioral modification.
7797

7798 **Opinion**

7799

7800 The loss of about 2,442–4,884 acres of wetlands that may support TCH foraging would add an
7801 increment of habitat loss to the species' range in Florida, where numbers have been declining,
7802 most likely due to wetlands loss and degradation. Foraging habitat reductions near nesting
7803 colonies may impair reproductive success, but no known TCH nesting colonies occur within or
7804 near the Plan Area. However, prey availability is recognized as a primary factor limiting TCH
7805 populations. Using the statewide TCH density as a measure of the impact of wetlands loss on
7806 TCH populations, the development could reduce TCH numbers by 3–5 individuals. Relative to
7807 statewide numbers of about 10,000, this represents a 0.03–0.05% reduction. Range-wide
7808 abundance throughout the Americas and Caribbean is unknown, but likely several orders of
7809 magnitude greater than the Florida population.

7810

7811 Precluding new development and mining activity in the dedicated Preservation Areas would
7812 protect 49,695 acres of TCH habitat, which contains 85% of the Plan Area wetlands. As these
7813 areas are brought under conservation easements, habitat enhancements that may increase TCH
7814 numbers are likely, but the amount or extent is not predictable at this time. Given the relatively
7815 small proportional impact of the Development activities to Florida TCH populations, and a much
7816 smaller proportional impact range-wide, we believe the net impact of the Action on the TCH is
7817 within the species' ability to sustain.

7818

7819 After reviewing the current status of the species, the environmental baseline for the Action Area,
7820 the effects of the Action and the cumulative effects, it is the Service's conference opinion that
7821 the Action is not likely to jeopardize the continued existence of the TCH.

7822

7823

7824 **13. Wood Stork**

7825

7826 This section provides the Service's biological opinion of the Action for the wood stork.

7827

7828 **13.1 Status of Wood Stork**

7829

7830 This section summarizes best available data about the biology and current condition of the wood
7831 stork (*Mycteria americana*) throughout its range that are relevant to formulating an opinion
7832 about the Action. The Service published its decision to list the U.S. breeding population of the
7833 wood stork as endangered on February 28, 1984 (49 FR 7332–7335). The Service reclassified the
7834 species as threatened and established the U.S. breeding population as a distinct population
7835 segment on June 30, 2014 (79 FR 37077–37103). The Service has not designated critical habitat
7836 for the wood stork.

7837

7838 **13.1.1 Species Description**

7839

7840 Wood storks are large, long-legged, colonial-nesting wading birds, about 50 inches tall, with a
7841 wingspan of 60–65 inches. Adult plumage is white except for black primary and secondary wing
7842 feathers and a short black tail. The dark gray head and neck are unfeathered. The bill is black,
7843 thick at the base, and slightly decurved. Immature birds are gray and have a yellowish bill.

7844

7845 13.1.2 Life History

7846

7847 The wood storks diet consists mostly of fish (Depkin et al. 1992) that are 1–10 inches long (Kahl
7848 1964; Ogden et al. 1976; Coulter 1987), supplemented occasionally with crustaceans,
7849 amphibians, reptiles, mammals, birds, and arthropods (Depkin et al. 1992). Wood storks select
7850 foraging sites that provide a high prey density in shallow water, which results in a narrower
7851 range of foraging opportunities than for many of the other wading bird species (Gawlik 2002).

7852

7853 Storks begin breeding at 3–4 years old. Wood storks are relatively long-lived (up to about 12
7854 years) and seasonally monogamous, probably forming a new pair bond each breeding season.
7855 Female wood storks lay a staggered clutch of 2–5 (average 3) per breeding season, but may lay a
7856 second clutch if nest failure occurs early in the breeding season (Coulter et al. 1999). Incubation
7857 lasts about 30 days and begins with the first egg laid. Eggs hatch at different times and nestlings
7858 vary in size (Coulter et al. 1999). Young fledge in about 8 weeks, but adults feed them at the nest
7859 for an additional 3–4 weeks.

7860

7861 Adults feed the young by regurgitating whole fish into the bottom of the nest about 3–10 times
7862 per day. Feedings are more frequent when the birds are young (Coulter et al. 1999) and less
7863 frequent when wood storks must fly great distances to locate food (Bryan et al. 1995). The entire
7864 nesting period for a single pair, from courtship and nest-building through offspring
7865 independence, lasts about 100 to 120 days (Coulter et al. 1999). Asynchronous nest initiation
7866 within a colony may extend breeding activity for the colony as a whole substantially beyond the
7867 120 days required for a single pair. Adults and independent young may continue to forage around
7868 the colony site for a relatively short period following the completion of breeding.

7869

7870 Wood storks are dependent on consistent foraging opportunities in wetlands near nesting
7871 colonies for reproductive success. Kahl (1964) estimated that each pair of storks consumes about
7872 443 pounds of fish, crustaceans, and other prey during the nesting season. In south Florida, the
7873 Service defines an 18.6-mi radius around a wood stork nesting colony as its core foraging area
7874 (CFA).

7875

7876 The seasonal timing of nest initiation is March–May in areas outside of south Florida.
7877 Historically, nest initiation in south Florida occurred from November–January, and sometimes as
7878 early as October, generally coinciding with the onset of the dry season. The disproportionate loss
7879 of short hydro-period wetlands caused by drainage and development activity is most likely
7880 responsible for shifting stork nest initiation in the Everglades and Big Cypress areas to February–
7881 March in most years since the 1970s. This delay risks an overlap of the nesting season with the
7882 onset of the wet season in May– June, when water levels rise and disperse the forage fish that
7883 support nesting success.

7884

7885 Following the nesting season, both adult and fledgling wood storks generally disperse away from
7886 the nesting colony. Fledglings have relatively high mortality rates within the first 6 months, most
7887 likely due to their lack of experience in foraging (Hylton et al. 2006). Post-fledgling survival also
7888 appears variable among years, probably reflecting the environmental variability that affects prey
7889 abundance and availability (Hylton et al. 2006). In south Florida, both adult and juvenile storks

7890 consistently disperse northward from nest sites (Kahl 1964). Storks breeding in central Florida
7891 also appear to disperse northward, but generally do not move as far (Coulter et al. 1999). Many
7892 juvenile storks from south Florida move into Georgia, Alabama, Mississippi, and South Carolina
7893 (Coulter et al. 1999; Borkhataria et al. 2004; Borkhataria et al. 2006). Some flocks of juvenile
7894 storks move well beyond the breeding range of storks (Kahl 1964).

7895
7896 Adult and juvenile storks return southward in the late fall and early winter months. In a study
7897 employing satellite telemetry, Borkhataria et al. (2006) reported that nearly all storks tagged in
7898 the southeast U.S. outside of Florida moved into Florida near the beginning of the dry season,
7899 including all sub-adult storks that fledged from both Florida and Georgia breeding colonies.
7900 Adult storks that bred in Georgia remained in Florida until March, and then moved back to
7901 northern breeding colonies. About 75% of all locations of tagged wood storks occurred within
7902 Florida.
7903

7904 Preliminary analyses of the range-wide occurrence of wood storks in December, recorded during
7905 annual Christmas bird surveys, suggest that the majority of the southeast U.S. wood stork
7906 population is in central and south Florida at this time. Relative abundance of storks in this region
7907 was 10–100 times higher than in north Florida and Georgia (Service 2007). This concentration
7908 of the range-wide population coincides with the early portion of the stork breeding season in
7909 Florida, during which prey abundance and availability are critical to breeding success. The same
7910 wetlands that support foraging for both breeding and non-breeding wood storks must also
7911 support a variety of other wading bird species (Gawlik 2002).

7912 **Foraging Habitat**

7913 Wood storks forage in a wide variety of wetland types. Wetland habitat types used include
7914 freshwater marshes, ponds, hardwood and cypress swamps, narrow tidal creeks, shallow tidal pools,
7915 and artificial wetlands such as stock ponds, seasonally flooded roadside or agricultural ditches, and
7916 managed impoundments (Coulter and Bryan 1993; Coulter et al. 1999). Optimal foraging habitats are
7917 shallow-water (depth 2–16 inches), sparsely vegetated wetlands (Ogden et al. 1978; Browder 1984;
7918 Coulter 1987; Coulter and Bryan 1993).

7919 In south Florida, water levels in wetlands rise and peak during the wet season (June to
7920 November), and gradually recede during the dry season (December to May), which roughly
7921 corresponds with the stork nesting season. A particular location may provide suitable stork
7922 foraging depths only during part of the year. Wood storks generally use wetlands with a short
7923 hydro-period (duration of inundation) early in the nesting season, a mid-range hydro-period during
7924 the middle of the nesting season, and a long hydro-period during the latter part of the nesting
7925 season (Kahl 1964; Gawlik 2002). Browder (1984) reported that storks forage in wet prairie
7926 ponds early in the dry season, and as they dried, shifted to slough ponds later in the season.
7927

7928 In addition to water depth, suitable stork foraging habitats provide a sufficient density and
7929 biomass of forage fish or other prey species. Wetlands with a longer hydro-period generally
7930 support more fish and larger fish than those with a shorter hydro-period, but are too deep for
7931 stork foraging until later in the dry season (Loftus and Ecklund 1994; Jordan et al. 1997 and
7932 1998; Turner et al. 1999). Nutrient enrichment (primarily phosphorus) has increased the density
7933 and biomass of fish in the naturally oligotrophic Everglades wetlands (Rehage and Trexler
7934

7937 2006). The foraging habitats associated with most wood stork colonies in south Florida
7938 encompass a wide range of hydro-period classes, nutrient conditions, and spatial configuration.
7939
7940 Dense submerged and emergent vegetation reduces foraging suitability by impeding stork
7941 movement through the habitat and prey detection (Coulter and Bryan 1993). Wood storks tend to
7942 select foraging areas that have an open canopy, but occasionally use sites with 50–100% canopy
7943 closure (Coulter and Bryan 1993; O'Hare and Dalrymple 1997; Coulter et al. 1999). Densely
7944 forested wetlands are seldom used for foraging (Coulter and Bryan 1993). The presence of minor
7945 to moderate amounts of submerged and emergent vegetation maintains fish populations and does
7946 not appear to preclude stork foraging.
7947

7948 **Nesting Habitat**

7949
7950 Wood storks build nests on live and dead shrubs or trees, as short as 3-foot mangroves and as tall
7951 as 100-foot cypress, surrounded by relatively broad expanses of open water (Palmer 1962; Rodgers
7952 et al. 1987; Ogden 1991; Coulter et al. 1999). In mixed-species nesting colonies, wood storks
7953 generally occupy the larger-diameter trees (Rodgers et al. 1996). Storks may use for many years
7954 undisturbed nesting sites that have sufficient feeding habitat in the surrounding area, but
7955 individuals do not necessarily return the same site every year (Kushlan and Frohring 1986). Storks
7956 abandon nesting sites that dry up during the nesting season (Rodgers et al. 1996). Ogden (1991)
7957 suggests that a substantial increase in stork nesting within managed or impounded wetlands in
7958 central and north Florida is a response to regional hydrologic changes that have dried natural
7959 wetland nesting sites during the spring months. Wood storks that abandon a colony early in the
7960 nesting season due to unsuitable water levels may re-nest in other nearby areas (Borkhataria et al.
7961 2004; Crozier and Cook 2004).

7962
7963 Between breeding seasons or while foraging, wood storks roost in trees over dry ground, on
7964 levees, or large patches of open ground. Wood storks may also roost within wetlands while
7965 foraging far from nest sites and outside of the breeding season (Gawlik 2002). While the
7966 majority of stork nesting occurs within traditional rookeries, a handful of new stork nesting
7967 colonies are discovered each year (Meyer and Frederick 2004; Brooks and Dean 2008). New
7968 locations may represent a temporary shift of one or more historic colonies in response to changes
7969 in local conditions, or an expansion of breeding activity into new areas where habitat conditions
7970 have improved.

7971 7972 **13.1.3 Numbers, Reproduction, and Distribution**

7973
7974 The wood stork occurs from northern Argentina, eastern Peru and western Ecuador, north to
7975 Central America, Mexico, Cuba, Hispaniola, and the southeastern U.S. (American Ornithologists
7976 Union 1983). The Service classifies as threatened only the distinct population segment that
7977 breeds in the southeastern U.S., which is the geographic scope of this and the following section.
7978

7979 Wood storks formerly nested in all U.S. coastal states from Texas to South Carolina (Wayne
7980 1910; Bent 1926; Oberholser 1938; Dusi and Dusi 1968; Oberholser and Kincaid 1974). The
7981 current breeding range includes Florida, Georgia, and South Carolina, and since 2005, North
7982 Carolina. The breeding range is expanding within these states (Service 2007). Florida and south

7983 Georgia are occupied year-round, and host storks from the remainder of the breeding range
7984 during the winter.

7985

7986 Our 2014 final rule that reclassified the wood stork as a threatened distinct population segment
7987 (79 FR 37077–37103) summarized available population estimates through 2013. The U.S. wood
7988 stork breeding population in the 1930s was probably between 15,000–20,000 pairs. It declined to
7989 about 10,000 pairs by 1960, and further declined to low of 2,700–5,700 pairs between 1977 and
7990 1980 (Ogden et al. 1987). From 1984 (when the Service classified the species as endangered) to
7991 2013, the Service and cooperators conducted 20 synoptic surveys of wood stork nesting colonies
7992 in the U.S. breeding range, of which 14 counted over 6,000 pairs, and 3 counted over 10,000
7993 pairs (2006, 2009, and 2013). The highest count of 12,720 pairs in 2009, along with a
7994 conservative estimate of 4,000 pre-breeding age birds, suggested that U.S. wood stork population
7995 at that time was about 30,000 individuals. The average number of nesting pairs in 2013–2015
7996 was about 10,800 (USFWS 2015,
7997 https://www.fws.gov/northflorida/WoodStorks/WOST_Data/Wood%20Stork%20Southast%20United%20States%20Nesting%20Data.html).
7998

7999

8000 Annual numbers of colonies and nesting pairs are variable, but the clear trend is a gradually
8001 increasing U.S. wood stork population in a gradually expanding breeding range. The number of
8002 pairs nesting annually has roughly doubled in the past 3 decades. The number of active colonies
8003 has roughly tripled, from an average of 29 colonies before 1995 (1975–1995; range 17–54) to an
8004 average of 77 since then (1996–2013; range 44–100). Therefore, a range-wide population
8005 increase is occurring through a larger number of smaller colonies. Before 1995, average colony
8006 size was about 200 nesting pairs, and since then, has averaged about 100 pairs.
8007

8008 The number of chicks fledged per nesting attempt is the annual productivity measure the Service
8009 adopted for recovery monitoring purposes in the most recent revision of the wood stork recovery
8010 plan (USFWS 1997). Data collected intermittently from 1975–2013 (not in 1980 and 1986–
8011 1992) at 70 unique nesting colonies throughout the species range (average of 8.5 colonies
8012 surveyed per year; range 0–33 colonies) indicate that this measure is highly variable among sites
8013 and between years (USFWS 2013). Dividing the total number of fledglings by the total number
8014 of nests for all sites surveyed during a single year is an estimate of range-wide productivity. This
8015 annual calculation for sites surveyed 1975–2013 yields an average of 1.45 fledglings per nest
8016 (range 0.65–2.49), and a median of 1.50. A clear increasing or decreasing trend is not apparent.
8017

8018 These productivity data were collected irregularly, usually at a small percentage of the total
8019 number of colonies active each year (average 17%; range 0–45%). In half the years for which
8020 data are available, productivity exceeded the recovery goal of 1.5 chicks per nest attempt, and in
8021 half the years, it did not. Although variable, the observed productivity has supported population
8022 growth and range expansion. In 2014, our final rule reclassifying the wood stork as threatened
8023 (79 FR 37077–37103) stated that population trends at that time suggested the overall population
8024 could approach the delisting benchmark of 10,000 nesting pairs during the next 15–20 years.
8025

8026 **13.1.4 Conservation Needs and Threats**
8027

8028 The primary conservation needs of the wood stork mirror those of other species of wading birds:
8029 maintain and restore wetlands for nesting and foraging, and protect nesting sites from
8030 disturbance and predation. The principal threat to the species is habitat loss and alteration.
8031 Invasive predators and chemical contamination are potential threats. We discuss all three of these
8032 threats in the following sections.

8033

8034 **Habitat loss and alteration**

8035

8036 Hefner et al. (1994) estimated 55% of the 2.3 million acres of the wetlands lost in the
8037 southeastern United States between the mid-1970s and mid-1980s were located in the Gulf-
8038 Atlantic Coastal Plain, which was the historic breeding range of the wood stork. Flemming et al.
8039 (1994) attributed substantial declines in the U.S. wood stork population in the decades before the
8040 1990s to reduced prey availability caused by wetlands loss and hydrologic alteration in south
8041 Florida, which then supported a majority of the U.S. wood stork breeding population.

8042 Coinciding with habitat loss throughout the breeding range, the numbers of wood storks nesting
8043 within artificial impoundments and on islands created by dredging activities increased (Ogden
8044 1991). Nesting in artificial wetlands in central and north Florida increased from about 10% of all
8045 nesting pairs in 1959–1960 to 60–82% between 1976–1986 (Ogden 1991). Ogden (1996)
8046 suggested that the increasing use of artificial wetlands indicates that wood storks are not finding
8047 suitable nesting conditions within natural wetlands or are finding better conditions within
8048 artificial wetlands. Whether reliance on artificial wetlands for nesting can sustain wood stork
8049 productivity in the long term is still unclear. Trees eventually die, and most species that tolerate
8050 extended periods of root inundation and support nesting require periods of substrate exposure to
8051 establish new seedlings.

8052 Prey abundance and availability near nesting sites in both natural and artificial wetlands is a
8053 primary factor contributing to stork productivity. Ogden and Nesbitt (1979) attributed a decline
8054 in stork numbers to a reduced food base during a time when the number of nest sites was
8055 relatively stable. At any time, only a small fraction of all wetlands in a particular area have the
8056 water depth, prey density, and relatively open vegetative structure that support stork foraging.
8057 Browder (1978) estimated a 35% reduction in the total acreage of wetland types that support
8058 wood stork foraging south of Lake Okeechobee, Florida, for the period 1900–1973. Wetlands
8059 loss in south Florida, facilitated by local and regional networks of ditches and canals, has
8060 disproportionately affected wetlands with a short hydro-period. Typically, short hydro-period
8061 wetlands are inundated at depths that may support stork foraging only towards the end of the wet
8062 season and during the beginning of the dry season (October–January), which formerly coincided
8063 with stork nest initiation. Since the 1970s, stork nest initiation in south Florida more typically
8064 occurs in February–March, most likely in response to insufficient prey resources in shallow
8065 waters earlier in the dry season.

8066 Kushlan and Frohring (1986) attributed a decrease in wood storks nesting on Cape Sable to the
8067 construction of drainage canals during the 1920s. Canals and associated water management
8068 infrastructure throughout south Florida have altered the seasonal depth and distribution of water
8069 in wetlands. Continuously high water levels at stork nesting sites precludes nest tree
8070 regeneration, as most species require periods of substrate exposure for seedling survival. The
8071

breeding requirements of many fishes that serve as wood stork prey are linked to seasonal and inter-annual hydrologic patterns, which water management may disrupt, causing changes in the density and spatial distribution of prey.

Non-native invasive species

The Burmese python represents a potential threat to the wood stork in south Florida. The species is well established and expanding its range in the greater Everglades ecosystem. Despite removing more than 1,400 Burmese pythons from Everglades National Park (ENP) since 2000, the estimated population is in the thousands. Burmese pythons consume a wide variety of mammal and bird species, as well as other reptiles, amphibians, and fish (Dove et al. 2011; Snow et al. 2007). In addition to a juvenile wood stork, bird species found in the digestive tracts of Burmese pythons include pied-billed grebe (*Podilymbus podiceps*), limpkin (*Aramus guarauna*), white ibis (*Eudocimus albus*), American coot (*Fulica americana*), house wren (*Troglodytes aedon*), and domestic goose (*Anser* spp.) (Dove et al. 2011). Juveniles of these giant constrictors are known to climb trees and bushes and prey upon birds. However, the amount or extent of python predation on wood storks is unknown at this time.

Chemical contamination

The risk of chemical contamination to wood stork survival and recovery is unclear. Fleming et al. (1984) reported pesticide levels high enough to cause eggshell thinning, but no effect to wood stork productivity is linked to chemical contamination. Burger et al. (1993) examined levels of heavy metals in wood storks from Florida and Costa Rica. Generally, adult birds exhibited higher levels than young birds, which is consistent with bioaccumulation from prey and various foraging locations over time. However, young birds from Florida exhibited higher levels of mercury than young or adult birds from Costa Rica. Young birds from Florida also exhibited higher levels of cadmium and lead than young birds from Costa Rica. Burger et al. (1993) recommended monitoring lead levels in Florida, but made no conclusions about the potential health effects of contaminants to wood storks.

Environmental Baseline for Wood Stork

This section describes the current condition of the wood stork in the Action Area without the consequences to the listed species caused by the proposed Action.

Action Area Numbers, Reproduction, and Distribution

Figure 13-1 shows the locations of three wood stork colonies active in 2018 that are within (two colonies) or near (one colony) the Plan Area (USFWS 2019). The latter colony is within the National Audubon Society's Corkscrew Swamp Sanctuary, which is about 2 mi west of the Plan Area. In 2018, surveys reported to the USFWS counted a total of 438 pairs of wood storks at these colonies, as follows:

- 27 at the eastern-most colony near the Collier/Hendry line (the Collier-Hendry colony);
- 141 at the colony located near the southeastern corner of the Plan Area (the Barron Collier colony); and

8120 • 270 pairs at the Corkscrew Swamp colony.

8121 At this time, we have no productivity data for these colonies.

8122
8123 The HCP (section 5.2.1.2.3) cites an earlier (2017) USFWS update and map of active stork
8124 colonies that shows a fourth colony located within the Plan Area that has not been active in
8125 recent years. This former colony and the two other Plan Area colonies are within the
8126 Okaloacoochee Slough regional flowway. The Baron Collier colony is located on a
8127 shrub/brushland island within an impoundment, and the Collier-Hendry colony is located within
8128 an isolated freshwater swamp (Figure 13-2). We do not know the extent to which the Plan Area
8129 may support wood storks in the winter months that breed elsewhere.

8130
8131 The Corkscrew colony, monitored annually since 1958, has recorded more wood stork fledging
8132 than any other in the U.S., but total productivity has declined from a 1958–1967 average of 5,450
8133 chicks/year to a 2009–2016 average of 287 chicks/year (National Audubon Society,
8134 <https://corkscrew.audubon.org/conservation/wood-storks>, accessed 8-15-2019). During the latter
8135 period, nesting occurred only in 2009 and 2014. The colony was active again in 2018. The most
8136 probable cause of the decline is a substantial loss of shallow-water wetland foraging habitats in
8137 the surrounding areas, which include the City of Naples and most of the Plan Area.

8138
8139 Collectively, the 18.6-mi-radius core foraging area (CFA) of the three colonies active in 2018
8140 fully encompass the Plan Area (Figure 13-1). We lack specific data about the foraging patterns of
8141 birds that nest in the three colonies. For our analyses in this BO, we expect that the amount of
8142 wood stork foraging in the Plan Area during the breeding season is directly proportional to the
8143 fraction of foraging habitat within the Plan Area that is within each colony's CFA. That is, if
8144 10% of the native wetlands within a CFA are within the Plan Area, we expect the Plan Area to
8145 support 10% of that colony's foraging activity. Wood storks disperse from nesting sites
8146 following the breeding season, and in south Florida colonies, this dispersal is generally to the
8147 north. Although an unknown fraction may remain in the Plan Area year-round, the primary
8148 conservation value of the Plan Area to wood storks is its contribution to productivity.

8149
8150 Table 13-1 tabulates the acreage of all native wetlands types inside and outside of the Plan Area
8151 for each of the three wood stork CFAs. Although non-forested wetlands more commonly support
8152 wood stork foraging, we also include forested wetlands in Table 13-1. Forested wetlands support
8153 some foraging activity, but may also provide future nesting sites as well as non-breeding season
8154 roosting sites for storks that remain for longer periods in the Plan Area. For the Corkscrew CFA,
8155 wood stork foraging habitats include estuarine types that do not occur in the Plan Area. The total
8156 wetlands acreage within the CFAs ranges from 218,530 acres (Corkscrew) to 392,133 acres
8157 (Barron Collier). The 18.6-mi radius around the Corkscrew CFA encompasses some open waters
8158 of the Gulf, which we do not include as wood stork habitat, as well as developed areas within the
8159 City of Naples, which partly accounts for its lower total wetlands acreage. The Corkscrew colony
8160 is located outside the Plan Area, but contains the highest percentage of wetlands within the Plan
8161 Area (19.6%). The Baron Collier colony contains the lowest percentage within the Plan Area
8162 (14.9%).

8163
8164 We lack hydro-period and other data that would allow us to estimate the relative importance of
8165 wetlands within each CFA. The prey base within the CFA of a larger colony must support the

8166 foraging needs of more storks than the CFA of a smaller colony, and the three CFAs that overlap
8167 the Plan Area substantially overlap each other. Therefore, we estimate the percentage of wood
8168 stork foraging activity for each colony that wetlands within the Plan Area are likely to support by
8169 multiplying the CFA-specific percentage of wetlands in the Plan Area by the number of storks in
8170 each colony. Table 13-1 provides this calculation under "Wood stork numbers equivalent to the
8171 'Percentage of CFA TOTAL WETLANDS.'" By this method, we estimate that Plan Area
8172 wetlands support the total foraging needs equivalent to about 79 of the 438 wood storks (18.0%)
8173 counted at the three colonies in 2018. Although all 438 storks may at some time forage in the
8174 Plan Area, 79 storks is our estimation of the fraction that Plan Area wetlands support among the
8175 total wetlands acreage of all three CFAs.

8176

8177 **Action Area Conservation Needs and Threats**

8178

8179 Large areas of native wetlands habitat within the Plan Area have been altered via land clearing
8180 and drainage for agricultural and other land uses. This loss of habitat has likely reduced prey
8181 availability and increased competition with other wading birds. Threats to the wood stork within
8182 the Plan Area include further habitat loss and degradation. Conservation needs within the Plan
8183 Area include the protection and management of existing suitable habitat, and the hydrologic
8184 restoration of degraded wetlands.

8185

8186

8187 **Tables and Figures**

8188

Table 13-1. Native wetlands cover (acres) within three wood stork core foraging areas (CFAs,
8189 18.6-mi radius from nest colony site) that overlap the Plan Area, and estimated number of
8190 wood storks for which wetlands inside and outside the Plan Area would support foraging
8191 and roosting, based upon 2018 nesting colony stork counts (Percentage of CFA TOTAL
8192 WETLANDS \times # storks per colony).

8194
8195

WOOD STORK COLONY	CFA WETLANDS INSIDE PLAN	CFA WETLANDS OUTSIDE PLAN	CFA TOTAL WETLANDS
	AREA	AREA	
Barron Collier	58,404	333,728	392,133
Collier - Hendry	57,291	251,648	308,939
Corkscrew	42,760	175,770	218,530
Percentage of CFA TOTAL WETLANDS			
Barron Collier	14.9%	85.1%	
Collier - Hendry	18.5%	81.5%	
Corkscrew	19.6%	80.4%	
Wood stork numbers equivalent to the "percentage of CFA TOTAL WETLANDS"			
Barron Collier (282 storks)	42	240	282
Collier - Hendry (54 storks)	10	44	54
Corkscrew (540 storks)	106	434	540
Total	158	718	876

8196
8197



8198
8199

8200 **Figure 13-1.** Location of three active wood stork colonies buffered with Core Foraging Areas
8201 within and adjacent to the East Collier HCP Action Area.
8202



8203
8204
8205 **Figure 13-2.** Aerial view of the immediate area around two wood stork colonies within the Plan
8206 Area that were active in 2018.

8207
8208
8209 **Effects of the Action on Wood Stork**

8210
8211 This section describes all reasonably certain consequences to the wood stork that we predict the
8212 proposed Action would cause, including the consequences of other activities not included in the
8213 proposed Action that would not occur but for the proposed Action. Such effects may occur later
8214 in time and may occur outside the immediate area involved in the Action.

8215
8216 **Development and Mining, Base Zoning, and Eligible Lands**

8217 Development and mining in wetlands would involve various activities (drainage, filling,
8218 excavation, paving, building construction, *etc.*) that would permanently eliminate the affected
8219 areas as wood stork habitat. The two wood stork nesting colonies active in 2018 that occur
8220 within the Plan Area (the “Barron Collier” and “Collier-Hendry” colonies; see section 13.2.1) are
8221 not within the Development and Mining, Base Zoning, and Eligible Lands designations (the
8222 potential development “envelope” of the HCP). Therefore, we do not expect development
8223 activities to directly kill or injure wood stork eggs or flightless young. However, a previously
8224 active colony that was not active in 2018 was located within a parcel of the Eligible Lands (see
8225 HCP section 5.2.1.2.3). We have no data from which to infer the cause for its recent
8226 abandonment. For this analysis, we consider the colonies active in 2018 as representative of
8227 current and expected wood stork nesting.

8228
8229 The core foraging areas (CFAs) of three colonies active in 2018 (the two within the Plan Area
8230 plus the Corkscrew Swamp colony) overlap areas designated as Development and Mining, Base
8231 Zoning, and Eligible Lands (Figure 13-1). Development of wetlands used as foraging areas
8232 would cause wood storks that use these areas to forage elsewhere.

8235 Table 13-2 refines the Plan-Area-wide wetlands acreage tabulation of Table 13-1 (section 13.2.3)
8236 with a breakdown by HCP land use designation of wetlands acreage for each of the three core
8237 foraging area (CFAs) that overlap the Plan Area. For example, 2,361 acres of native wetlands
8238 within the Barron Collier colony CFA (0.6% of the CFA total wetlands acreage, 392,133 acres)
8239 are within the designated Development areas of the HCP. Further, we estimate that this
8240 percentage of the CFA wetlands, divided equally among the 282 storks nesting in this colony
8241 during 2018, would support the foraging needs equivalent to 2 of these storks (section 13.2.1
8242 provides our rationale for this methodology). Similarly, wetlands within the Development, Base
8243 Zoning, and Eligible lands designations collectively would support the foraging needs equivalent
8244 to 6 of the Barron Collier colony storks. Table 13-2 replicates this methodology for each of the
8245 three CFAs and each of the Plan Area land use designations.

8246
8247 To compute the total wood stork numbers equivalent to the CFA wetland acreage within each
8248 designated land use, we sum the stork numbers associated with each CFA that overlaps the land
8249 use (the bottom row of Table 13-2). This summation recognizes that the number of storks likely
8250 to use an area is a function of the numbers of storks in all colonies with CFAs that overlap the
8251 area. By this methodology, we estimate that wetlands in the full development envelope of the
8252 HCP support the foraging needs of about 22 wood storks from the three colonies, most (16) from
8253 the Corkscrew colony. The designated Development areas support the foraging needs of about 8
8254 wood storks.

8255
8256 To estimate the spatial extent of development across cover classes the wood stork may use for
8257 foraging, we use the “Proportional” method described in section 2.1.4, which distributes 39,973
8258 acres of development among all areas (Development and Mining, Base Zoning, and Eligible
8259 Lands) that could receive high-density development under the HCP. By this method, we estimate
8260 that the proposed Action could convert up to 4,885 acres of wetland habitats to residential,
8261 commercial, or mining uses (Table 2-3, sum of column “G” for native wetlands). This 4,885
8262 acres of development represents 60% of the wetlands that occur in the full development
8263 envelope. Therefore, we expect development distributed among the use designations of the full
8264 envelope would affect the foraging needs equivalent to 60% of 22 wood storks, or about 14
8265 wood storks. Development confined entirely to the Development and Mining designation (*i.e.*, no
8266 substitution of Base Zoning or Eligible lands in the development cap), which includes 2,442
8267 acres of wetlands (see Table 2-2), would affect the foraging needs equivalent to 8 wood storks.

8268
8269 We would expect habitat alteration that causes displacement from foraging areas to harm
8270 (actually kill or injure) wood stork individuals indirectly through reduced reproductive success if
8271 it substantially reduces prey availability within a colony’s CFA. In section 13.1.4 under “Habitat
8272 Loss and Alteration,” we discussed evidence that attributes local stork population declines to a
8273 reduced food base. In section 13.2.1, we discussed the substantial decline in numbers of nesting
8274 pairs at the Corkscrew colony over the past 50 years, most likely due to a reduced food base.
8275 Based on the preceding analysis in this section, we believe that the conversion of wetland
8276 foraging habitats to residential/commercial or mining uses would cause, through reduced
8277 reproductive success, a long-term reduction of about 8–14 wood storks, collectively, from the
8278 three active colonies with CFAs that overlap the Plan Area.

8280 To mitigate for permanent wood stork habitat losses associated with the Covered Activities, the
8281 Applicants propose to “preserve, restore, enhance, and/or create suitable wood stork habitat”
8282 within the designated Preservation and Very Low Density Use areas (HCP chapter 7.2.1.2). We
8283 consider these proposals in the following section.

8284

8285 **Preservation Activities**

8286

8287 The designated Preservation Areas of the HCP contain 49,695 acres of native wetlands (Table 2-
8288 2) that we consider as potential wood stork habitat. In Table 13-2, we estimate that these
8289 wetlands would support foraging for about 134 wood storks from the three active colonies with
8290 CFAs that overlap the Plan Area. The nesting site for one of these colonies, the Collier-Hendry
8291 colony, is within an isolated freshwater swamp (see Figure 13-2) on designated Preservation
8292 lands.

8293

8294 The Applicants propose a continuation of existing land uses (agriculture, silviculture, *etc.*) in the
8295 Preservation Areas, which we listed in section 2.3. All of these uses may occur to some extent in
8296 native wetlands of the Preservation Areas except crop cultivation. Land management activities in
8297 the Preservation Areas for which the Applicants seek take authorization and that may occur in
8298 wetlands include:

8299

prescribed burning;

8300

mechanical control of groundcover (*e.g.*, roller chopping, brush-hogging, mowing);

8301

ditch and canal maintenance;

8302

mechanical and/or chemical control of exotic vegetation; and

8303

similar activities that maintain or improve land quality.

8304

In wetlands, prescribed burning is usually applied to control woody encroachment in non-
forested wetlands (*e.g.*, wet prairies and bogs), which do not ordinarily support wood stork
nesting. Therefore, we do not expect prescribed fire to harm wood stork eggs or flightless chicks.
The other activities listed above may temporarily disrupt wood stork foraging activity, but are
unlikely to harm birds unless conducted near nesting sites. We believe that trees surrounded by
standing water, the typical setting of a colonial wading bird rookery, are unlikely locations for
these land management actions.

8312

In Chapter 7.2.1.2 of the HCP, the Applicants propose to preserve and maintain wood stork
habitats in the Preservation and Very Low Density use designations (Objective 1), and to restore,
enhance, or create such habitat to mitigate for permanent losses associated with the Covered
Activities (Objective 2). The HCP notes that the latter activities would typically occur in
conjunction with Clean Water Act section 404 permitting processes. Where feasible, the
Applicants would focus on “enhancement and/or restoration of suitable short-hydroperiod
foraging habitats (shallow open marshes, wet prairies)” to provide wood stork foraging during
the pre-nesting and fledging periods. The HCP does not specify performance measures (amount
or extent, functional gain) for such restoration and enhancement activities.

8322

We do not expect the management of Preservation Areas to reduce the numbers, reproduction, or
distribution of the wood stork in the Preservation Areas, because these activities would, at
minimum, maintain current conditions. Special attention to this species in the long-term

8326 management of the Preservation Areas under conservation easements could increase wood stork
8327 densities and the Plan Area population. However, lacking detailed information about how habitat
8328 management under conservation easements may benefit this species, we are unable to estimate
8329 the extent of potential benefits.

8330

8331 **Very Low Density Development**

8332

8333 The Very Low Density (VLD) use areas of the HCP contain 733 acres of native wetlands that we
8334 consider as wood stork habitat (Table 2-2). In Table 13-2, we estimate that these wetlands would
8335 support the foraging needs equivalent to only 2 wood storks from the three active colonies with
8336 CFAs that overlap the Plan Area. The nesting site for one of these colonies, the Barron Collier
8337 colony, is on an island within an impoundment on one of the VLD use areas (see Figure 13-2).

8338 Land uses in the VLD areas are similar to the Preservation Areas, but may also include isolated
8339 residences, lodges, and hunting/fishing camps, at a density of no more than one dwelling unit per
8340 50 acres. The Applicants would continue current ranching/livestock operations and other
8341 management activities as described for the Preservation Areas (e.g., exotic species control,
8342 prescribed burning). As in the Preservation Areas, we do not expect adverse effects resulting
8343 from the continuation of the existing land management regimes.

8344

8345 The HCP does not specify a footprint for the isolated residences, lodges, and hunting/fishing
8346 camps, but indicates that their construction could clear up to 10% of the existing native
8347 vegetation (see section 2.5). New dwelling development could occur within any of the cover
8348 types present besides open water and existing development. We believe it is unlikely that such
8349 development would occur on the narrow island that supports the Barron Collier colony.
8350 Elsewhere, clearing up to 10% of the native wetland cover types that we consider as wood stork
8351 habitat would reduce such habitat by 73 acres (Table 2-7). It is possible that dwelling
8352 development in the VLD areas could entirely avoid wetlands, but we conservatively estimate a
8353 73-acre habitat loss, which would support the foraging needs equivalent to less than one of the
8354 wood storks associated with the three active colonies.

8355

8356 The general measures for enhancing wood stork habitat in the Preservation Areas apply to the
8357 VLD areas as well (see previous section 11.3.2). However, the potential to increase wood stork
8358 numbers or reproduction is limited due to the small extent of wetlands in the VLD areas.

8359

8360 **Tables and Figures**

8361

8362

8363 **Table 13-2.** Native wetlands cover (acres) within three wood stork core foraging areas (CFAs,
8364 18.6-mi radius from nest colony site) that overlap the land use designations of the HCP,
8365 and estimated number of wood storks for which wetlands inside and outside the Plan
8366 Area would support foraging and roosting, based upon 2018 nesting colony stork counts
8367 (Percentage of CFA TOTAL WETLANDS × # storks per colony).

COLONY	DEVELOPMENT	BASE ZONING	ELIGIBLE FOR INCLUSION	Subtotal for All Potential Development Areas			PLAN AREA TOTAL	CFA WETLANDS		CFA TOTAL WETLANDS
				PRESER-	VERY LOW DENSITY	OUTSIDE PLAN AREA				
Barron Collier	2,361	630	4,853	7,843	49,829	733	58,404	333,728	392,133	
Collier - Hendry	2,492	630	4,460	7,581	48,977	733	57,291	251,648	308,939	
Corkscrew	2,450	0	3,972	6,422	35,920	418	42,760	175,770	218,530	
Percentage of CFA WETLANDS										
Barron Collier	0.6%	0.2%	1.2%	2.0%	12.7%	0.2%	14.9%	85.1%		
Collier - Hendry	0.8%	0.2%	1.4%	2.5%	15.9%	0.2%	18.5%	81.5%		
Corkscrew	1.1%	0.0%	1.8%	2.9%	16.4%	0.2%	19.6%	80.4%		
Wood stork numbers equivalent to the "Percentage of CFA TOTAL WETLANDS"										
Barron Collier (282 storks)	2	0	4	6	36	0	42	240	282	
Collier - Hendry (54 storks)	1	0	1	2	8	0	10	44	54	
Corkscrew (540 storks)	6	0	10	16	88	2	106	434	540	
Total	9	0	15	24	132	2	158	718	876	

8368

8369

8370

8371 Cumulative Effects on Wood Stork

8372

8373 For purposes of consultation under ESA §7, cumulative effects are those caused by future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future Federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under §7 of the ESA.

8377

8378 We identified in section 3 of this BO/CO a projected increase in traffic on public roads as the sole source of effects that are consistent with the definition of cumulative effects for this Action. We have no information that suggests traffic on public roads is a predictable cause of wood stork injury, mortality, or significant behavioral modification.

8382

8383 Conclusion for Wood Stork

8384

8385 In this section, we summarize and interpret the findings of the previous sections for the wood stork (status, baseline, effects, and cumulative effects) relative to the species-specific purpose of a BO under §7(a)(2) of the ESA, which is to determine whether the proposed action is likely to jeopardize the continued existence of a species.

8389

8390 Status

8391

8392 Following a substantial population decline in the decades before the species' classification as endangered in the U.S. in 1984, the wood stork's breeding range and numbers have gradually increased. In 2014, the Service reclassified the species as threatened and established the U.S. breeding population as a distinct population segment. The current breeding range includes Florida, Georgia, and South Carolina, and since 2005, North Carolina. The average number of nesting pairs in 2013–2015 was about 10,800. A doubling of the U.S. wood stork population in the past 3 decades has occurred through an increasing number of smaller nesting colonies (average about 100 nesting pairs). New colonies are increasingly located in artificial impoundments. Colony productivity (number of chicks fledged per nesting attempt) is highly variable among sites and between years, and a clear increasing or decreasing trend is not apparent.

8403
8404 Primary threats to the species include the degradation or loss of habitat due to development,
8405 hydrologic alteration of wetlands, and reductions in prey abundance. Prey availability is an
8406 important factor limiting the populations of several wading birds, including the wood stork. The
8407 primary conservation needs of the wood stork mirror those of other species of wading birds:
8408 maintain and restore wetlands for nesting and foraging, and protect nesting sites from
8409 disturbance.

8410
8411 **Baseline**
8412

8413 The core foraging area (CFA; 18.6-mi radius around the nesting site) of three wood stork nesting
8414 colonies active in 2018 overlap the Plan Area. The nesting site for two of these colonies are
8415 within the Plan Area, and the third colony (the Corkscrew Swamp colony) is located about 2 mi
8416 west of the Plan Area. In 2018, these colonies supported nesting for a total of 876 adult wood
8417 storks. We expect that the amount of wood stork foraging in the Plan Area during the breeding
8418 season is directly proportional to the fraction of wetlands habitat within the Plan Area that is
8419 within each colony's CFA. Plan Area wetlands constitute between 14.9% and 19.6% of the total
8420 wetlands acreage within each of the three CFAs. We estimate that Plan Area wetlands supply the
8421 total foraging needs equivalent to about 158 of the 876 wood storks (18.0%) nesting at the three
8422 colonies in 2018. Threats to the wood stork within the Plan Area include habitat loss and
8423 degradation. Conservation needs within the Plan Area include the protection and management of
8424 existing suitable habitat, and the hydrologic restoration of degraded wetlands.

8425
8426 **Effects**
8427

8428 The two wood stork nesting colonies active in 2018 that occur within the Plan Area are not
8429 within the Development and Mining, Base Zoning, and Eligible Lands designations (the potential
8430 development “envelope” of the HCP), but the CFAs of these colonies and the Corkscrew Swamp
8431 colony overlap these designations. We estimate that wetlands in the full development envelope
8432 of the HCP support the foraging needs of about 22 wood storks from the three colonies, most
8433 (16) from the Corkscrew colony. The designated Development areas support the foraging needs
8434 of about 8 wood storks. Depending on the distribution of the development cap (39,973 acres)
8435 among the Development and Mining, Base Zoning, and Eligible Lands designations, we estimate
8436 the development would eliminate 2,442–4,884 acres of wetlands that support the foraging needs
8437 equivalent to 8–14 wood storks from the three colonies. We expect that this wetlands loss would
8438 cause, through reduced reproductive success in the three colonies, a corresponding long-term
8439 reduction in the Plan Area wood stork population.

8440
8441 We estimate that wetlands within the designated Preservation Areas support the foraging needs
8442 equivalent to about 134 wood storks from the three active colonies with CFAs that overlap the
8443 Plan Area. The nesting site for one of these colonies is within an isolated freshwater swamp on
8444 designated Preservation lands. We do not expect the management of Preservation Areas to
8445 reduce the numbers, reproduction, or distribution of the wood stork in the Preservation Areas,
8446 because these activities will, at minimum, maintain current conditions. Special attention to this
8447 species in the long-term management of the Preservation Areas under conservation easements
8448 could increase wood stork densities and the Plan Area population.

8449
8450 We estimate that wetlands within the designated Very Low Density use areas support the
8451 foraging needs equivalent to about 2 wood storks from the three active colonies with CFAs that
8452 overlap the Plan Area. The nesting site for one of these colonies is on an island within an
8453 impoundment on one of the VLD use areas. We believe it is unlikely that limited development (1
8454 dwelling per 50 acres) would occur on the narrow island that supports this colony. Clearing up to
8455 10% of the native wetlands in the VLD use areas would reduce potential wood stork habitat by
8456 73 acres, which would support the foraging needs equivalent to less than one of the wood storks
8457 of the three active colonies.

8458
8459 **Cumulative Effects**
8460

8461 We have no information that suggests traffic on public roads, which is the sole source of
8462 cumulative effects we have identified for this Action, is a predictable cause of wood stork injury,
8463 mortality, or significant behavioral modification.

8464
8465 **Opinion**
8466

8467 The loss of about 2,442–4,884 acres of wetlands that support wood stork foraging activity and
8468 potential nesting activity in the future would add an increment of habitat loss to the species'
8469 range. Foraging habitat reductions near nesting colonies may impair reproductive success, and
8470 we estimate a reduction that would reduce the Plan Area population by about 8–14 wood storks
8471 from current levels of 876 breeding individuals. Range-wide abundance is about 10,800 nesting
8472 pairs (21,600 individuals).

8473
8474 Precluding new development and mining activity in the dedicated Preservation Areas would
8475 protect 49,695 acres of wood stork habitat, which contains 85% of the Plan Area wetlands. As
8476 these areas are brought under conservation easements, habitat enhancements that may increase
8477 wood stork numbers are likely, but the amount or extent is not predictable at this time. Given the
8478 small proportional impact of the Development activities to the Plan Area wood stork population,
8479 and a much smaller proportional impact range-wide, we believe the net impact of the Action on
8480 the wood stork is within the species' ability to sustain.

8481
8482 After reviewing the current status of the species, the environmental baseline for the Action Area,
8483 the effects of the Action and the cumulative effects, it is the Service's biological opinion that the
8484 Action is not likely to jeopardize the continued existence of the wood stork.

8485
8486
8487 **14. Red-cockaded Woodpecker**
8488

8489 This section provides the Service's biological opinion of the Action for the red-cockaded
8490 woodpecker.

8491
8492 **14.1 Status of Red-cockaded Woodpecker**
8493

8494 This section summarizes best available data about the biology and current condition of the red-
8495 cockaded woodpecker (*Picoides borealis*) (RCW) throughout its range that are relevant to
8496 formulating an opinion about the Action. The Service published its decision to list the RCW as
8497 endangered on October 13, 1970 (35 FR 16047–16048). The most recently completed 5-year
8498 review of the species' status recommended no change to its endangered classification (USFWS
8499 2006). The Service has not designated critical habitat for the RCW.

8500
8501 For a more detailed discussion of the status of the species in south Florida and throughout its
8502 range, please refer to the Service's South Florida Multi-species Recovery Plan (USFWS 1999)
8503 and the Revised Recovery Plan (USFWS 2003), respectively.

8504 **14.1.1 Species Description**

8505 The RCW measures approximately 7–8 inches in length with a wingspan of 14–15 inches. The
8506 RCW is distinguished from other woodpeckers by its conspicuous white cheek patches, black
8507 cap and neck, and black-and-white barred back and wings.

8508 **14.1.2 Life History**

8509 The RCW is a territorial, non-migratory, cooperative breeding species (Lennartz et al. 1987). It is
8510 the only North American woodpecker that excavates its roost and nest cavities exclusively in
8511 living pines. RCWs live in family social units called groups. A group is comprised of a breeding
8512 pair, the current year's offspring, and zero to four helpers (adults, normally male offspring of the
8513 breeding pair from previous years) (Walters 1991).

8514 Each group member has its own cavity, although a single tree may support multiple cavities.
8515 The area containing a group's cavity trees plus a 200-foot forested buffer is called a cluster
8516 (Walters 1991). Cavities within a cluster are either complete or under construction, and either
8517 active, inactive, or abandoned. We refer to multiple clusters in relatively close proximity to each
8518 other as a colony.

8519 Cooperative breeding behavior, in which a pool of adult helpers is available to replace breeders,
8520 makes RCW populations unusually resistant to environmental and demographic variation, but
8521 highly sensitive to the spatial arrangement of habitat (USFWS 2003). Helpers readily occupy
8522 breeding vacancies as they arise, but do not disperse very far, and typically occupy vacancies on
8523 their natal territory or a neighboring one. This limited dispersal ability makes geographically
8524 isolated groups much less likely to persist through time. Colonization of unoccupied habitat is
8525 exceedingly slow under natural conditions, because cavity excavation in living pines is a lengthy
8526 process, and RCWs will not occupy habitat without cavities. Rates of natural cavity excavation
8527 and colonization increase as forests age and old pines become more abundant.

8528 RCWs forage almost exclusively on live pine trees, and occasionally on recently killed pines
8529 (Franzreb 2004). Their prey consists of wood cockroaches, caterpillars, spiders, woodborer
8530 larvae, centipedes, and ants (Hanula and Horn 2004). Although they will use smaller pine trees
8531 as foraging substrate, RCWs prefer pines greater than 10 inches in diameter at breast height
8532 (dbh) (Hooper and Harlow 1986; Engstrom and Sanders 1997).

8540
8541 The spatial extent of foraging habitat needed to sustain a RCW cluster depends primarily on
8542 habitat quality. Home ranges in optimal habitat in the Carolinas average 173–222 acres. Habitat
8543 quality in most of Florida and other portions of the species' range is generally lower. Home
8544 ranges for RCWs in north Florida average 297–346 acres (Porter and Labisky 1986), and 346–
8545 395 acres in central and south Florida (Patterson and Robertson 1981; Nesbitt et al. 1983;
8546 DeLotelle and Epting 1992). In Big Cypress National Preserve, where the pinelands are not
8547 contiguous, RCWs used areas as large as 741–988 acres (D. Jansen, Big Cypress National
8548 Preserve, personal communication 1996). At Avon Park Air Force Range (AFR), home range
8549 size varied from 173–890 acres, with an average of 395 acres (P. Ebersbach, Avon Park AFR,
8550 personal communication 1996).

8551
8552 **14.1.3 Numbers, Reproduction, and Distribution**
8553

8554 The RCW persists in remaining fragmented parcels of suitable pine forest in 11 southeastern
8555 States. The species is extirpated from New Jersey, Maryland, Missouri, Tennessee, and
8556 Kentucky (Costa 2004). The Service's most recent (2003) range-wide population estimate was
8557 14,500 RCWs in 5,800 known active clusters (average of 2.5 individuals per cluster). This is less
8558 than 3% of the estimated abundance at the time of European settlement.

8559
8560 The RCW probably once occurred in all 67 Florida counties, with exception of the Florida Keys
8561 in Monroe County (Hovis and Labisky 1996). The southern-most historic record is from the
8562 Florida City area in Miami-Dade County (Howell 1921). The species is still widely distributed in
8563 the state, but substantial populations now occur only in the Panhandle. Elsewhere, populations
8564 are relatively small and disjunct. The estimated breeding population of the RCW in Florida is
8565 1,500 pairs, of which 75% are in the Panhandle (Cox et al. 1995). The population centered in the
8566 Apalachicola National Forest (680 active clusters as of 1996) is the largest in Florida (R. Costa,
8567 FWS, personal communication 2011).

8568
8569 **14.1.4 Conservation Needs and Threats**
8570

8571 The primary threat to RCW survival and recovery is an ongoing loss, fragmentation, and
8572 degradation of pine habitats. RCW habitat quality depends largely on a fire regime that maintains
8573 a plant community structure with a relatively open understory. In Florida, invasive exotic
8574 vegetation exacerbates the problem of insufficient fire frequency. In south Florida generally, and
8575 especially in southwest Florida, the conversion of pine flatwoods habitat on private lands to
8576 urban development is a substantial cause of habitat loss and fragmentation.

8577
8578 The loss of habitat on private lands has demographically isolated RCWs remaining on public
8579 lands, which could affect the genetic viability of these populations. As recently as 30 years ago,
8580 genetic interchange among RCWs in south Florida was likely. Increasing isolation resulting from
8581 habitat loss could lead to inbreeding and genetic depression.

8582
8583 Changes in hydrology in south Florida also have caused the loss and degradation of pineland habitat.
8584 Alteration of the hydroperiod caused by residential housing construction killed a large area of pines
8585 on the Cecil M. Webb Wildlife Management Area. Without a frequent fire regime, draining hydric

8586 slash pine flatwoods, which support most RCW colonies in southwest Florida, allows a dense
8587 understory to develop (Beever and Dryden 1992).

8588
8589 The availability of suitable cavity trees is a factor limiting RCW populations. The use of artificial
8590 cavities can quickly establish RCW groups in unoccupied habitat that is otherwise suitable
8591 (Copeyon 1990; Allen 1991). Significant population expansions following artificial cavity
8592 provisioning are well documented (Gaines et al. 1995; Franzreb 1999; Carlile et al. 2004;
8593 Doresky et al. 2004; Hagan et al. 2004; Hedman et al. 2004; Marston and Morrow 2004; Stober and
8594 Jack 2003).

8595 **14.2 Environmental Baseline for Red-cockaded Woodpecker**

8596 This section describes the current condition of the RCW in the Action Area without the
8597 consequences to the listed species caused by the proposed Action.

8600 **14.2.1 Action Area Numbers, Reproduction, and Distribution**

8601 The Applicants did not conduct surveys of the Plan Area designed to detect RCWs, and we have
8602 no records of active RCW clusters within the Plan Area. RCWs are known to occur near the Plan
8603 Area, and the Plan Area contains 9,932 acres of pine flatwoods habitats (wet, mesic, and scrubby
8604 flatwoods, see Table 2-1). We have no data about the condition of these flatwoods relative to
8605 RCW habitat requirements (e.g., understory density, availability of large trees for cavities). The
8606 Applicants' include the RCW as a Covered Species of the HCP in the event that the species
8607 colonizes the Plan Area from adjacent conservation lands during the 50-year ITP period. Figure
8608 14-1 shows the location of RCW clusters documented near the Plan Area.

8609 Southwest Florida currently supports at least 85 active RCW clusters, of which 51% are on
8610 Federal lands, 35% are on State lands, and 14% are on private lands. The Cecil M. Webb WMA,
8611 located in Charlotte County about 40 mi north of the Plan Area, supports 27 active RCW clusters
8612 that appear stable. The National Park Service actively manages 43 clusters in Big Cypress National
8613 Preserve (BCNP), which abuts the southeastern edge of the Plan Area, and this population appears
8614 to be increasing. The Picayune Strand State Forest (PSSF) and Florida Panther National Wildlife
8615 Refuge (FPNWR) support the active RCW clusters that are closest to the Plan Area. We have
8616 additional RCW records from private lands near Naples (Figure 14-1). It is likely that RCW
8617 numbers have declined on private lands in southwest Florida in recent decades due to habitat loss
8618 and degradation (Beever and Dryden 1992).

8619 The RCW colony that is closest to the Plan Area is located approximately 5 mi to the south in the
8620 FPNWR. This colony consist of two active RCW clusters that occupy eight artificial nest
8621 cavities. The next closest colony is located in the Belle Meade and South Golden Gates Estates
8622 tracts of the PSSF. This colony consists of 3 active and 11 inactive clusters. RCWs in this colony
8623 may interact with RCWs on private lands near Naples. The PSSF population has been in decline
8624 for several decades, due to lack of habitat management prior to acquisition by the State of
8625 Florida. Prescribed fire and other actions now underway on the PSSF are likely to reverse this
8626 decline.

8632 Colonization of unoccupied habitat is exceedingly slow under natural conditions, and we have no
8633 direct evidence that RCWs occupy the Plan Area. The suitability of Plan Area flatwoods as RCW
8634 habitat is unknown, but likely poor, consistent with other private lands known to support RCWs
8635 in Collier County (Beever and Dryden 1992). The extent of RCW dispersal is typically limited to
8636 adjacent territories with unoccupied cavities. RCW territories average about 300–400 acres in
8637 south Florida, but some encompass as much as 1,000 acres in areas of non-contiguous pinelands
8638 (see section 14.1.2). The diameter of a 400-acre circle is 0.89 mi, and that of a 1,000-acre circle
8639 is 1.41 mi. We believe it is unlikely that RCWs from known clusters that are 5 mi or more from
8640 the Plan Area have colonized the Plan Area. Although undocumented clusters within the Plan
8641 Area are possible, we lack sufficient evidence to conclude that RCWs are reasonably certain to
8642 occur in the Plan Area.

8643

8644 **14.2.2 Action Area Conservation Needs and Threats**

8645

8646 Beever and Dryden (1992) summarized data about the substantial conversion of slash pine
8647 flatwoods in south Florida to agricultural and urban land uses, and examined the role of hydric
8648 (wet) flatwoods as RCW nesting and foraging habitat. By 1970, forest clearing reduced the
8649 historic extent of slash pine flatwoods by about 50 percent. By 1989, the acreage of urban areas in
8650 southwest Florida exceeded that of slash pine flatwoods. Unlike more northern parts of the
8651 species' range, where mesic and xeric (upland) longleaf pine communities most commonly support
8652 RCW colonies, hydric (wetland) slash pine flatwoods support the majority of active colonies in
8653 southwest Florida. A combination of saturated soils during the wet season and periodic fire
8654 during the dry season produce the open understory characteristics that RCWs prefer. Without
8655 frequent fire, dryer flatwoods in the climate and soils of southwest Florida develop a dense
8656 understory. The drying of hydric flatwoods caused by large drainage canals associated with the
8657 Golden Gate development and the Cocohatchee River degraded habitat conditions for RCW
8658 colonies located on private lands in Collier County west of FPNWR.

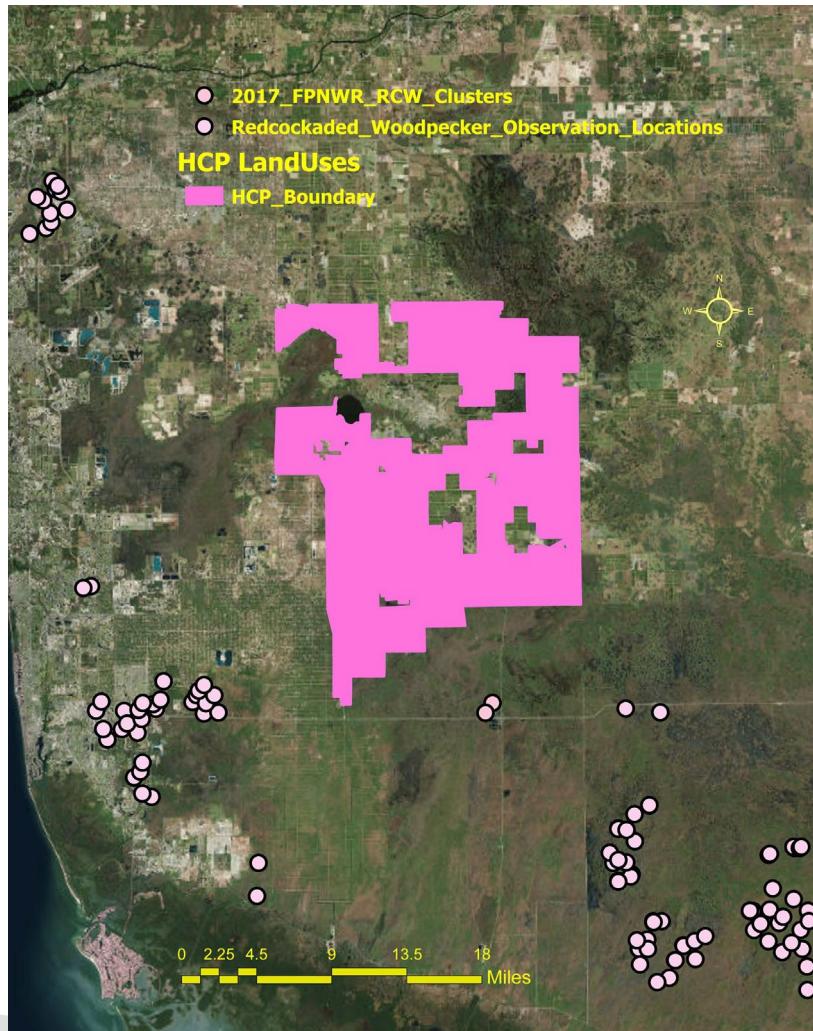
8659

8660 Maintaining the hydrology of wet flatwoods and applying prescribed fire to such areas are the
8661 primary conservation needs of the RCW in southwest Florida, including the Plan Area.
8662 Conservation lands near the Plan Area that support RCWs (e.g., FPNWR, BCNP) are
8663 implementing fire management plans that seek to maintain or restore habitat conditions for RCWs
8664 and other listed species that depend on pine forests with a relatively open understory. Installing
8665 artificial cavities to expand existing colonies or establish new colonies may also contribute to
8666 stabilizing or increasing RCW numbers in areas with otherwise suitable habitat conditions.

8667

8668 **14.2.3 Tables and Figures**

8669



8670

8671

8672 **Figure 14-1.** Red-cockaded woodpecker locations near the Plan Area.

8673

14.3 Effects of the Action on Red-cockaded Woodpecker

8674

8675 This section describes all reasonably certain consequences to the RCW that we predict the
 8676 proposed Action would cause, including the consequences of other activities not included in the
 8677 proposed Action that would not occur but for the proposed Action. Such effects may occur later
 8678 in time and may occur outside the immediate area involved in the Action.

8679

14.3.1 Development and Mining, Base Zoning, and Eligible Lands

8680

8681 As we explained in section 14.2.1, we do not believe the Plan Area is reasonably certain to
 8682 support RCWs. Therefore, we do not expect the development of up to 39,973 acres within the
 8683 designated Development and Mining, Base Zoning, and Eligible Lands of the HCP to affect the
 8684 RCW.

8685

8686

8687

8688 The three land-use designations of the HCP development envelope contain 1,461 acres of
8689 flatwoods habitat (wet, mesic, and scrubby; see Table 2-1) that could possibly support previously
8690 undocumented RCW clusters. The Applicants propose to conduct USFWS protocol (USFWS
8691 2003, Appendix 4) RCW surveys in pine flatwoods that are included in development project
8692 areas (HCP chapter 7.2.1.3). The survey protocol directs surveyors to report the discovery of
8693 cavity trees or other evidence of RCW activity to the USFWS.

8694

8695 **14.3.2 Preservation Activities**

8696

8697 As we explained in section 14.2.1, we do not believe the Plan Area is reasonably certain to
8698 support RCWs. Therefore, we do not expect the preservation of 8,356 acres of pine flatwoods
8699 (wet, mesic, and scrubby flatwoods; see Table 2-1) within the designated Preservation Areas to
8700 affect the RCW.

8701 The Applicants propose to manage pine flatwoods within the Preservation Areas to benefit
8702 multiple Covered Species, including the RCW, if RCWs colonize such areas (HCP chapter
8703 7.2.1.3). The Preservation Areas contain 84% of the Plan Area flatwoods cover. Specifically, the
8704 Applicants propose to maintain an open understory where RCWs are present. If pinelands within
8705 the Preservation Areas are maintained or restored as suitable RCW habitat, and if RCWs
8706 colonize these areas, 8,356 acres of pine flatwoods could support up to 21 RCW clusters with a
8707 territory size of about 400 acres.

8708

8709 **14.3.3 Very Low Density Development**

8710

8711 As we explained in section 14.2.1, we do not believe the Plan Area is reasonably certain to
8712 support RCWs. Therefore, we do not expect the Covered Activities within 115 acres of pine
8713 flatwoods (112 acres mesic, and 3 acres wet flatwoods; see Table 2-1) within the designated
8714 Very Low Density (VLD) areas to affect the RCW.

8715 The Applicants propose to manage pine flatwoods within the VLD areas to benefit multiple
8716 Covered Species, including the RCW, if RCWs colonize such areas (HCP chapter 7.2.1.3).
8717 Specifically, the Applicants propose to maintain an open understory where RCWs are present.
8718 Pinelands within the VLD use areas are insufficient to support the habitat requirements of a
8719 single RCW cluster, but some adjoin larger tracts of flatwoods in the Preservation Areas. If
8720 maintained or restored as suitable RCW habitat, and if RCWs colonize these areas, the VLD
8721 areas could contribute a fraction of the foraging or roosting/nesting habitat associated with one or
8722 more clusters.

8723

8724 **14.4 Cumulative Effects on Red-cockaded Woodpecker**

8725

8726 For purposes of consultation under ESA §7, cumulative effects are those caused by future state,
8727 tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future
8728 Federal actions that are unrelated to the proposed action are not considered, because they require
8729 separate consultation under §7 of the ESA.

8733 We identified in section 3 of this BO/CO a projected increase in traffic on public roads as the
8734 sole source of effects that are consistent with the definition of cumulative effects for this Action.
8735 We have no information that suggests traffic on public roads is a predictable cause of RCW
8736 injury, mortality, or significant behavioral modification.

8737

8738 **14.5 Conclusion for Red-cockaded Woodpecker**

8739

8740 In this section, we summarize and interpret the findings of the previous sections for the red-
8741 cockaded woodpecker (status, baseline, effects, and cumulative effects) relative to the species-
8742 specific purpose of a BO under §7(a)(2) of the ESA, which is to determine whether the proposed
8743 action is likely to jeopardize the continued existence of a species.

8744

8745 **Status**

8746

8747 The RCW persists in remaining fragmented parcels of suitable pine forest in 11 southeastern
8748 States. Our most recent range-wide population estimate was 14,500 RCWs in 5,800 known
8749 active clusters. The species is widely distributed in Florida, but substantial populations now
8750 occur only in the Panhandle.

8751 The primary threat to RCW survival and recovery is an ongoing loss, fragmentation, and
8752 degradation of pine habitats. RCW habitat quality depends largely on a fire regime that maintains
8753 a plant community structure with a relatively open understory. The availability of suitable cavity
8754 trees is a factor limiting RCW populations. The use of artificial cavities can quickly establish
8755 RCW groups in unoccupied habitat that is otherwise suitable

8756

8757 **Baseline**

8758

8759 The Applicants did not conduct surveys of the Plan Area designed to detect RCWs, and we have
8760 no records of active RCW clusters within the Plan Area. RCWs are known to occur near (≥ 5
8761 mi) the Plan Area, and the Plan Area contains 9,932 acres of pine flatwoods habitats. We have no
8762 data about the condition of these flatwoods relative to RCW habitat requirements (e.g.,
8763 understory density, availability of large trees for cavities), but they are likely of poor quality,
8764 consistent with other private lands that are known to support RCWs in Collier County. The
8765 Applicants' include the RCW as a Covered Species of the HCP in the event that the species
8766 colonizes the Plan Area from adjacent conservation lands during the 50-year ITP period.

8767 The RCW colony that is closest to the Plan Area is located in a conservation area approximately
8768 5 mi to the south. We believe it is unlikely that RCWs from known clusters that are 5 mi or more
8769 from the Plan Area have colonized the Plan Area. Although undocumented clusters within the
8770 Plan Area are possible, we lack sufficient evidence to conclude that RCWs are reasonably certain
8771 to occur in the Plan Area.

8772

8773 **Effects**

8774

8775 Because we do not believe the Plan Area is reasonably certain to support RCWs, we do not
8776 expect the proposed Action to affect the RCW. The Applicants propose to conduct RCW surveys

8779 in pine flatwoods that are included in development project areas. The survey protocol directs
8780 surveyors to report the discovery of cavity trees or other evidence of RCW activity to the
8781 USFWS. The Applicants propose to manage pine flatwoods within the Preservation Areas
8782 (which contain 84% of the Plan Area flatwoods) to benefit the RCW, if RCWs colonize such
8783 areas. Specifically, the Applicants propose to maintain an open understory where RCWs are
8784 present. If all pinelands within the Preservation Areas (8,306 acres) are maintained or restored as
8785 suitable RCW habitat, and if RCWs colonize these areas, the Preservation Areas could support
8786 up to 21 RCW clusters, each with a territory size of about 400 acres.

8787

Cumulative Effects

8788 We have no information that suggests traffic on public roads, which is the sole source of
8789 cumulative effects we have identified for this Action, is a predictable cause of RCW injury,
8790 mortality, or significant behavioral modification.

8791

Opinion

8792 Our assessment of the best available data about RCWs and their habitat in southwest Florida is
8793 that RCWs are not reasonably certain to occur in the Action Area. Therefore, we expect the
8794 Action to have no effect on the RCW. Any findings of adverse or beneficial effects caused by
8795 Covered Activities in the HCP would be speculative and contrary to the legal standards that
8796 apply to the ESA section 7 compliance process. However, we acknowledge the Applicants': (a)
8797 pre-development surveys of development project sites; (b) subsequent coordination with the
8798 USFWS upon detecting RCWs; and (c) commitment to maintaining an open understory in
8799 pinelands of the Preservation and Very Low Density use areas that RCWs may colonize during
8800 the course of the ITPs. The Preservation Areas contain 84% of the Plan Area pine flatwoods;
8801 therefore, any future colonization of the Plan Area is more likely to occur the Preservation Areas
8802 than elsewhere.

8803 After reviewing the current status of the species, the environmental baseline for the Action Area,
8804 the effects of the Action and the cumulative effects, it is the Service's biological opinion that the
8805 Action is not likely to jeopardize the continued existence of the RCW.

8806

15. Roseate Spoonbill

8807 This section provides the Service's conference opinion of the Action for the roseate spoonbill.

8808

15.1 Status of Roseate Spoonbill

8809 This section summarizes best available data about the biology and current condition of the
8810 roseate spoonbill (*Platalea ajaja*) (spoonbill) throughout its range that are relevant to
8811 formulating an opinion about the Action. At this time, the roseate spoonbill is not protected
8812 under the ESA. The Service has not reviewed the species' status relative to the ESA definitions
8813 of "endangered" and "threatened." The State of Florida protects the roseate spoonbill as a
8814 threatened species under Florida's Endangered and Threatened Species Rule. For purposes of

8825 this Conference Opinion, we rely upon the Biological Status Review prepared by the Florida
8826 Fish and Wildlife Conservation Commission (FWC 2011) and other available data to describe
8827 the species' status.

8828

8829 **15.1.1 Species Description**

8830

8831 The roseate spoonbill is a large wading bird, reaching a length of 30–40 inches with a wingspan
8832 of 50–53 inches. It has a long, spoon-shaped bill, pink wings and underparts, a white neck and
8833 back, and pinkish legs and ft.

8834

8835 **15.1.2 Life History**

8836

8837 Dumas (2000) synthesized available data about the biology of the spoonbill, which is the source
8838 of information we provide here. The spoonbill is a colonial-nesting wading bird that breeds and
8839 forages mostly in coastal wetlands, but also in freshwater wetlands. Nesting is primarily on
8840 coastal islands over standing water in trees and shrubs, but may also occur further inland. Birds
8841 typically disperse after breeding, sometimes to inland areas, depending on variable hydrologic
8842 conditions and prey availability. The spoonbill forages in shallow water, targeting small fish and
8843 crustaceans. Foraging occurs in a variety of coastal and inland settings, including bays, estuaries,
8844 lagoons, sea grass meadows, marsh, wet prairies, swamps, canals, tidal mudflats, tidal pools,
8845 sloughs, lakes, ponds, river drainages, mosquito control impoundments, catfish and crayfish
8846 ponds, cattle ponds, roadside ditches, and puddles. The average flight distance from a Florida
8847 Bay nest site to foraging areas was about 7.5 mi.

8848

8849 **15.1.3 Numbers, Reproduction, and Distribution**

8850

8851 The breeding range of the roseate spoonbill includes portions of South America, the Pacific and
8852 Gulf coasts of Mexico and Central America, the Caribbean, and the U.S. states of Texas,
8853 Louisiana, and Florida (Dumas 2000). FWC (2011) cites various sources that estimate the range-
8854 wide population at about 150,000–200,000 individuals, with about 5,500 breeding pairs in the
8855 U.S.

8856 The largest breeding colonies in Florida are in Florida Bay, with additional colonies in Tampa
8857 Bay and in Brevard County on the Atlantic coast. The Florida population was about 736
8858 individuals statewide in 1965, but has since slowly increased in numbers and range to a total of
8859 $\geq 1,800$ individuals in 2011 (FWC 2011). FWC (2011) estimates the extent of wetlands that
8860 spoonbills use for foraging in Florida at about 12,500 mi² (8 million acres).

8861

8862 **15.1.4 Conservation Needs and Threats**

8863

8864 In its Biological Status Review Report, FWC (2011) summarized available data about threats to
8865 the spoonbill in Florida, which is the source of information we provide here. The plume trade of
8866 the late 1800s reduced the Florida spoonbill population to only 15 breeding pairs by the early
8867 1900's, but numbers increased and range expanded following legal protections. Current threats
8868 include the degradation or loss of habitat due to coastal development, hydrologic alteration of
8869 wetlands, and reductions in prey abundance. Like other wading birds in wetland habitats,

8871 spoonbills are exposed to persistent contaminants such as heavy metals and pesticides. Breeding
8872 sites and some foraging sites are vulnerable to oil spills and disturbance from recreational
8873 activity. Raccoons and other predators that gain access to a rookery can seriously impair
8874 reproduction and cause the colony to abandon the rookery.

8875
8876 Conservation needs mirror those of other colonial wading birds: management and protection of
8877 breeding and foraging habitats (*e.g.*, posting and enforcing no-disturbance buffers around a
8878 nesting site), and hydrologic restoration to restore and maintain prey productivity.

8879 8880 **15.1.5 Environmental Baseline for Roseate Spoonbill**

8881
8882 This section describes the current condition of the roseate spoonbill in the Action Area without
8883 the consequences to the listed species caused by the proposed Action.

8884 8885 **15.1.6 Action Area Numbers, Reproduction, and Distribution**

8886
8887 The Applicants did not conduct species-specific surveys for the spoonbill within the Plan Area,
8888 but note in section 5.5.1.4 of the HCP that the species is routinely observed in the Plan Area. The
8889 eBird database contains numerous records of sightings at locations within the Plan Area of up to
8890 12 spoonbills, but typically 1–5 birds (eBird 2019). The FWC Water Bird Locator, a statewide
8891 database of known colonial nesting sites since the 1970s for wading birds and other species, does
8892 not contain records of spoonbill nesting colonies within the Plan Area or within 30 mi of Plan
8893 Area (FWRI 2019). Without any records of nesting activity in the Plan Area, and given the
8894 species' more typical use of coastal wetland nesting sites, we believe that the Plan Area supports
8895 spoonbill foraging and roosting, but is not reasonably certain to support nesting.

8896
8897 The Plan Area contains 58,543 acres of native freshwater wetlands that are potential spoonbill
8898 habitat (Table 2-2). The estimated Florida spoonbill population of about 1,800 individuals that
8899 forage in about 8 million acres of wetlands (FWC 2011) represents an overall density of about 1
8900 bird per 4,444 acres. We apply this density to the wetland acreage of the Plan Area to estimate
8901 that about 13 roseate spoonbills may forage and roost within the Plan Area.

8902 8903 **15.1.7 Action Area Conservation Needs and Threats**

8904
8905 Large areas of native wetlands habitat within the Plan Area have been altered via land clearing
8906 and drainage for agricultural uses. This loss of habitat has likely reduced prey availability and
8907 increased competition with other wading birds. Threats to the spoonbill within the Plan Area
8908 include further habitat loss and degradation. Conservation needs within the Plan Area include the
8909 protection and management of existing suitable habitat, and the hydrologic restoration of
8910 degraded wetlands.

8911 8912 **15.2 Effects of the Action on Roseate Spoonbill**

8913
8914 This section describes all reasonably certain consequences to the roseate spoonbill that we
8915 predict the proposed Action would cause, including the consequences of other activities not

8916 included in the proposed Action that would not occur but for the proposed Action. Such effects
8917 may occur later in time and may occur outside the immediate area involved in the Action.
8918

8919 **15.2.1 Development and Mining, Base Zoning, and Eligible Lands**
8920

8921 To estimate the spatial extent of development across cover classes the spoonbill may occupy, we
8922 use the “Proportional” method described in section 2.1.4, which distributes 39,973 acres of
8923 development among all areas (Development and Mining, Base Zoning, and Eligible Lands) that
8924 could receive high-density development under the HCP. By this method, we estimate that the
8925 proposed Action could convert up to 4,884 acres of wetland habitats to residential, commercial,
8926 or mining uses (Table 2-3, sum of column “G” for native wetlands). The designated
8927 Development and Mining areas contain 2,442 acres of native wetlands (Table 2-2), which is the
8928 maximum loss of wetlands that could occur if development is confined entirely to these areas
8929 (*i.e.*, no substitution of Base Zoning or Eligible lands in the development cap). Using a density of
8930 one bird per 4,444 acres of habitat (see section 15.2.1), 2,442–4,884 acres of wetlands would
8931 support only about one spoonbill.
8932

8933 Development and mining in wetlands would involve various activities (drainage, filling,
8934 excavation, paving, building construction, *etc.*) that would permanently eliminate the affected
8935 areas as spoonbill habitat. No known spoonbill nesting colonies occur within the Plan Area;
8936 therefore, we do not expect development activities to directly kill or injure spoonbill eggs or
8937 flightless young. However, development of wetlands used as foraging areas would cause
8938 spoonbills that may use these areas to forage elsewhere.
8939

8940 We would expect habitat alteration that causes displacement from foraging areas to harm
8941 (actually kill or injure) spoonbill individuals indirectly through reduced reproductive success if it
8942 substantially reduces prey availability within the typical foraging distance from colonial nesting
8943 sites (about 7.5 mi for birds at a Florida Bay colony; see section 15.1.2). The nearest documented
8944 spoonbill nesting colony is over 30 mi from the Plan Area (FWRI 2019). Undetected nesting
8945 activity may occur in the Plan Area, but lacking any evidence that indicates where such nesting
8946 occurs, we are not reasonably certain that loss of wetlands foraging habitat resulting from the
8947 development would impair spoonbill reproductive success. However, we recognize that prey
8948 availability is considered an important factor limiting spoonbill and other wading bird
8949 populations (FWC 2013).
8950

8951 The Applicants propose to mitigate for permanent losses of habitat for Covered wading bird
8952 species through “preservation, and potential restoration, enhancement and/or creation of an equal
8953 acreage” of in-kind habitat (HCP chapter 7.5.1.4). In its “Species Conservation Measures and
8954 Permitting Guidelines,” FWC (2019) considers wetland mitigation through the State’s
8955 Environmental Resource Permit (ERP) process sufficient to satisfy its permitting requirements
8956 for potential take of spoonbill caused by significant modification of foraging habitat. We expect
8957 that the developments of the HCP would engage the State’s ERP process.
8958

8959 **15.2.2 Preservation Activities**
8960

8961 The designated Preservation Areas of the HCP contain 49,695 acres of native wetlands (Table 2-
8962 2) that we consider spoonbill foraging and roosting habitat. Using a density of one bird per 4,444
8963 acres of habitat (see section 15.2.1), these wetlands would support about 11 spoonbills. We have
8964 no records of spoonbill nesting in the Preservation Areas, but undetected nesting may occur in
8965 wetlands of the Plan Area.

8966
8967 The Applicants propose a continuation of existing land uses (agriculture, silviculture, *etc.*) in the
8968 Preservation Areas, which we listed in section 2.3. All of these uses may occur to some extent in
8969 native wetlands of the Preservation Areas except crop cultivation. Land management activities in
8970 the Preservation Areas for which the Applicants seek take authorization and that may occur in
8971 wetlands include:

8972 prescribed burning;
8973 mechanical control of groundcover (*e.g.*, roller chopping, brush-hogging, mowing);
8974 ditch and canal maintenance;
8975 mechanical and/or chemical control of exotic vegetation; and
8976 similar activities that maintain or improve land quality.

8977
8978 In wetlands, prescribed burning is usually applied to control woody encroachment in non-
8979 forested wetlands (*e.g.*, wet prairies and bogs), which do not ordinarily support spoonbill nesting.
8980 Therefore, we do not expect prescribed fire to harm spoonbills. The other activities listed above
8981 may temporarily disrupt spoonbill foraging activity, but are unlikely to harm birds unless
8982 conducted near nesting sites. We believe that trees surrounded by standing water, the typical
8983 setting of a colonial wading bird rookery, are unlikely locations for these land management
8984 actions.

8985
8986 Preservation Areas will serve as mitigation for most or all of the covered species. While
8987 preservation via conservation easement is the primary approach to maintaining Preservation
8988 Areas habitats, the HCP proposes habitat enhancement or restoration as mitigation, at least as an
8989 option, for the roseate spoonbill. Preservation Areas are probable sites for such habitat
8990 management as well as mitigation of wetland fill.

8991
8992 We do not expect the management of Preservation Areas to reduce the numbers, reproduction, or
8993 distribution of the spoonbill in the Preservation Areas, because these activities would, at
8994 minimum, maintain current conditions. Special attention to this species in the long-term
8995 management of the Preservation Areas under conservation easements could increase spoonbill
8996 densities and the Plan Area population. However, lacking detailed information about the
8997 spoonbill in the Plan Area, and about how habitat management under conservation easements
8998 may benefit this species, we are unable to estimate the extent of potential benefits.

8999
9000 **15.2.3 Very Low Density Development**

9001
9002 The Very Low Density (VLD) use areas of the HCP contain 733 acres of native wetlands that we
9003 consider as spoonbill habitat (Table 2-2). Using a density of one bird per 4,444 acres of habitat
9004 (see section 12.2.1), these wetlands are unlikely to support substantial use by spoonbills. No sites
9005 known to support spoonbill nesting activity within the Plan Area are located within the VLD
9006 areas.

9007
9008 Land uses in the VLD areas are similar to the Preservation Areas, but may also include isolated
9009 residences, lodges, and hunting/fishing camps, at a density of no more than one dwelling unit per
9010 50 acres. The Applicants would continue current ranching/livestock operations and other
9011 management activities as described for the Preservation Areas (e.g., exotic species control,
9012 prescribed burning). As in the Preservation Areas, we do not expect adverse effects resulting
9013 from the continuation of the existing land management regimes.

9014
9015 The HCP does not specify a footprint for the isolated residences, lodges, and hunting/fishing
9016 camps, but indicates that their construction could clear up to 10% of the existing native
9017 vegetation (see section 2.5). New dwelling development could occur within any of the cover
9018 types present besides open water and existing development. Clearing up to 10% of the native
9019 cover types that we consider as spoonbill habitat would reduce such habitat by 73 acres (Table 2-
9020 7). It is possible that dwelling development in the VLD areas could entirely avoid wetlands, but
9021 we conservatively estimate a 73-acre habitat loss. Because the VLD area wetlands do not support
9022 known nesting colonies, we do not expect this extent of habitat modification to kill or injure
9023 spoonbills.

9024
9025 The general measures for enhancing spoonbill habitat in the Preservation Areas apply to the
9026 VLD areas as well (see previous section 11.3.2). However, the potential to increase spoonbill
9027 numbers or reproduction is limited due to the small extent of wetlands in the VLD areas.

9028
9029 **15.3 Cumulative Effects on Roseate Spoonbill**

9030
9031 For purposes of consultation under ESA §7, cumulative effects are those caused by future state,
9032 tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future
9033 Federal actions that are unrelated to the proposed action are not considered, because they require
9034 separate consultation under §7 of the ESA.

9035
9036 We identified in section 3 of this BO/CO a projected increase in traffic on public roads as the
9037 sole source of effects that are consistent with the definition of cumulative effects for this Action.
9038 We have no information that suggests traffic on public roads is a predictable cause of roseate
9039 spoonbill injury, mortality, or significant behavioral modification.

9040
9041 **15.4 Conclusion for Roseate Spoonbill**

9042
9043 In this section, we summarize and interpret the findings of the previous sections for the roseate
9044 spoonbill (status, baseline, effects, and cumulative effects) relative to the species-specific
9045 purpose of a BO under §7(a)(2) of the ESA, which is to determine whether the proposed action is
9046 likely to jeopardize the continued existence of a species.

9047
9048 **Status**

9049
9050 The spoonbill is widely distributed in the Americas and Caribbean. Range-wide abundance is
9051 about 150,000–200,000 individuals, with about 5,500 breeding pairs in the U.S. The Florida
9052 population was estimated at >= 1,800 individuals in 2011, with an area of occupancy of about

9053 12,500 mi² (8 million acres). Nesting is primarily on coastal islands over standing water in trees
9054 and shrubs, but may also occur further inland. Birds typically disperse after breeding, sometimes
9055 to inland areas, depending on variable hydrologic conditions and prey availability. Primary
9056 threats to the species include the degradation or loss of habitat due to coastal development,
9057 hydrologic alteration of wetlands, and reductions in prey abundance. Prey availability is an
9058 important factor limiting the populations of several wading birds, including the spoonbill. The
9059 primary conservation needs of the spoonbill mirror those of other species of wading birds:
9060 maintain and restore wetlands for nesting and foraging, and protect nesting sites from
9061 disturbance.

9062 **Baseline**

9063 Spoonbills are known to use the Plan Area, but not for nesting. The Plan Area contains 58,543
9064 acres of native freshwater wetlands that are potential spoonbill habitat. The estimated Florida
9065 spoonbill population of about 1,800 individuals that forage in about 8 million acres of wetlands
9066 (FWC 2011) represents an overall density of about 1 bird per 4,444 acres. We apply this density
9067 to the wetland acreage of the Plan Area to estimate that about 13 roseate spoonbills may forage
9068 and roost within the Plan Area. Threats to the spoonbill within the Plan Area include habitat loss
9069 and degradation. Conservation needs within the Plan Area include the protection and
9070 management of existing suitable habitat, and the hydrologic restoration of degraded wetlands.
9071

9072 **Effects**

9073 Depending on the distribution of the development cap among the Development and Mining, Base
9074 Zoning, and Eligible Lands designations of the HCP, we estimate the development would
9075 eliminate 2,442–4,884 acres of wetlands that would support only about one spoonbill. Lacking
9076 evidence that indicates spoonbill nesting occurs within or near the Plan Area, we are not
9077 reasonably certain that loss of wetlands foraging habitat resulting from the development would
9078 impair spoonbill reproductive success.
9079

9080 The designated Preservation Areas may support about 11 spoonbills. We do not expect the
9081 management of Preservation Areas to reduce the numbers, reproduction, or distribution of the
9082 spoonbill in the Preservation Areas, because these activities will, at minimum, maintain current
9083 conditions. Special attention to this species in the long-term management of the Preservation
9084 Areas under conservation easements could increase spoonbill densities and the Plan Area
9085 population.
9086

9087 Native wetlands in the Very Low Density (VLD) use areas are unlikely to support frequent or
9088 substantial use by spoonbills. Clearing up to 10% of the native wetlands in the VLD use areas
9089 would reduce potential spoonbill habitat by 73 acres. Because the VLD area wetlands do not
9090 support known spoonbill nesting colonies, we do not expect this extent of habitat modification to
9091 kill or injure spoonbills.
9092

9093 **Cumulative Effects**

9098 We have no information that suggests traffic on public roads, which is the sole source of
9099 cumulative effects we've identified for this Action, is a predictable cause of spoonbill injury,
9100 mortality, or significant behavioral modification.

9101

9102 **Opinion**

9103

9104 The loss of about 2,442–4,884 acres of wetlands that may support spoonbill foraging activity
9105 would add an increment of habitat loss to the species' range in Florida, where numbers have
9106 slowly increased to current levels of about 1,800 individuals over the past several decades.
9107 Foraging habitat reductions near nesting colonies may impair reproductive success, but no
9108 known spoonbill nesting colonies occur within or near the Plan Area. However, prey availability
9109 is recognized as a primary factor limiting spoonbill populations. Using the statewide spoonbill
9110 density (1 per 4,444 acres of wetland foraging habitats) as a measure of the impact of wetlands
9111 loss on spoonbill populations, the development could reduce spoonbill numbers by only one
9112 individual. Range-wide abundance is about 150,000–200,000 individuals.

9113

9114 Precluding new development and mining activity in the dedicated Preservation Areas would
9115 protect 49,695 acres of spoonbill habitat, which contains 85% of the Plan Area wetlands. As
9116 these areas are brought under conservation easements, habitat enhancements that may increase
9117 spoonbill numbers are likely, but the amount or extent is not predictable at this time. Given the
9118 small proportional impact of the Development activities to Florida spoonbill populations, and a
9119 much smaller proportional impact range-wide, we believe the net impact of the Action on the
9120 spoonbill is within the species' ability to sustain.

9121

9122 After reviewing the current status of the species, the environmental baseline for the Action Area,
9123 the effects of the Action and the cumulative effects, it is the Service's conference opinion that
9124 the Action is not likely to jeopardize the continued existence of the roseate spoonbill.

9125

9126

9127 **16. Audubon's Crested Caracara**

9128

9129 This section provides the Service's biological opinion of the Action for the crested caracara.

9130

9131 **16.1 Status of Audubon's Crested Caracara**

9132

9133 This section summarizes best available data about the biology and current condition of the
9134 Audubon's crested caracara (*Polyborus plancus audubonii*; now northern crested caracara,
9135 *Caracara cheriway*) (caracara) throughout its range that are relevant to formulating an opinion
9136 about the Action. The Service published its decision to list the Florida population of the caracara
9137 as threatened on July 6, 1987 (52 FR 25229). A more detailed description of the status of the
9138 species is available at:

9139 https://www.fws.gov/verobeach/StatusoftheSpecies/20170405_SOS_AudubonCrestedCaracara.pdf.

9140 The Service has not designated critical habitat for the caracara.

9141

9142 **16.1.1 Species Description**

9143

9144 The caracara is a large falcon with a head crest, naked face, heavy bill, elongated neck, long legs,
9145 and a bright yellow-orange face and legs (Service 1999; Morrison and Dwyer, 2012). Adult
9146 caracaras are dark brownish-black dorsally and have a white and black barred breast (Service
9147 1999). A caracara's feet are also a noteworthy identification trait. The feet have talons that are
9148 flatter than those of other raptor species. This adaptation aids in foraging because it allows the
9149 caracara to walk or run on the ground more easily (Service 1999).

9150

9151 **16.1.2 Life History**

9152

9153 Caracaras are diurnal and non-migratory. Breeding adults establish territories, which average
9154 approximately 3,000 acres, where they are typically found year round (Morrison and Humphrey
9155 2001). Territory size ranges from about 1,000 acres to about 5,000 acres, likely dependent upon
9156 the quality of the habitat. Breeding pairs are monogamous, territorial, and exhibit fidelity to both
9157 their mate and the site (Morrison 1999). Caracaras vigorously defend their nesting territory
9158 during the breeding season (Morrison 2001).

9159

9160 Although breeding activity can occur from September through June, the primary breeding season
9161 is considered November through April. Nest initiation and egg-laying peak from December
9162 through February. Caracaras construct new nests each nesting season, often in the same tree as
9163 the previous year. Nests are well concealed and most often found in the tops of cabbage palms
9164 (Morrison and Humphrey 2001), although nests have been found in several other tree species.

9165

9166 The clutch size is usually two eggs, although sometimes three. Both parents take turns incubating
9167 the eggs for about 31 to 33 days (Morrison 1999). Breeding pairs ordinarily raise one brood per
9168 season, but about 10% of pairs may raise a second brood. Young fledge at about 7–8 weeks of
9169 age, and post-fledgling dependency on parental birds lasts approximately 8 weeks.

9170

9171 Foraging

9172

9173 Foraging typically occurs throughout the territory during both nesting and non-nesting seasons
9174 (Morrison 2001). Caracaras are highly opportunistic in their feeding habits. They will capture
9175 live prey and eat carrion. The diverse diet consists of insects and other invertebrates, fish, snakes,
9176 turtles, birds, and mammals (Layne 1996; Morrison 2001). Recent information from Morrison
9177 (2005) indicates wetland-dependent prey species and mammals (primarily in the form of carrion)
9178 comprise about 64% and 31% of the total diet, respectively.

9179

9180 Foraging behavior includes regularly patrolling sections of roads for animals killed by collisions
9181 with motor vehicles (Palmer 1988). Caracaras will occasionally chase the larger black vulture
9182 (*Coragyps atratus*) and turkey vulture (*Cathartes aura*) away from a carcass (Howell 1932).
9183 Scavenging at landfills occurs (Morrison 2001). Tractors plowing fields or mowing pastures and
9184 road right-of-ways are often closely followed by individuals who feed opportunistically on the
9185 prey that may be flushed or exposed. Agricultural drainage ditches, cattle ponds, roadside
9186 ditches, the margins of wetlands and other shallow water features, and recently burned lands may
9187 also provide good foraging areas for the caracara (Morrison 2001).

9188

9189 Movements

9190
9191 Caracaras are strong fliers and highly mobile birds that are capable of moving long distances,
9192 including juveniles. Morrison (2005) noted that sub-adult caracaras are nomadic. As a result of a
9193 three-year study which included 58 tagged birds, Dwyer et al (2013) reported that non-breeding
9194 caracaras “ranged five times more widely during breeding seasons than during non-breeding
9195 seasons, and ranged >250 times more widely than breeding caracaras which defended territories
9196 year-round.” An individual may traverse a large portion of the species’ range in Florida from the
9197 time it leaves its parents’ natal territory to the time it establishes a territory. Adults will also
9198 occasionally leave their territory and travel great distances, usually outside of the breeding
9199 season.

9200
9201 Substantial vagility and sub-adult nomadic behavior result in occasional caracara observations
9202 recorded far outside the species’ breeding range. Caracaras have been observed in the Florida
9203 Keys, the panhandle of Florida (Bay County), other states, and as far north as Nova Scotia,
9204 although some of these individuals may have escaped from captivity (Layne 1996). Currently,
9205 there is no evidence to suggest that breeding and genetic exchange occurs between the ESA-
9206 protected Florida population and other populations of the Northern caracara.

9207
9208 Gathering Areas
9209

9210 Observations and radio-telemetry monitoring have documented aggregations of caracaras within
9211 several “gathering areas” and communal roosts in south-central Florida. Gathering areas are
9212 typically pasture and citrus areas that simultaneously support large groups (*i.e.*, 50+ individuals)
9213 of foraging, non-breeding caracaras during the daytime. Gathering areas have been observed:

- 9214 • along the Kissimmee River north of State Route (SR) 98;
- 9215 • south of Old Eagle Island Road in northern Okeechobee County;
- 9216 • south of SR 70 and west of Fort Pierce in St. Lucie County;
- 9217 • south of SR 70 on the Buck Island Ranch in Highlands County; and
- 9218 • near the intersection of SR 82 and SR 29 in Collier County.

9219
9220 Morrison (2001) suggests that gathering areas are important to caracaras before first breeding
9221 during the first 3 years after leaving their natal territory. Dwyer (2008) indicated that gathering
9222 areas “do not appear to be defended by territorial adults and may provide important refuge from
9223 territorial adults during the day.” Gathering areas vary in size and therefore, likely support
9224 different numbers of non-breeders. These areas are regularly, but not continually used, and occur
9225 near communal roosts. At dusk, the birds move into communal roosts, which are usually palm-
9226 dominated forests, although scattered palms or cypress hammocks are also used. Figure 16-1
9227 shows a large group of caracaras near Fisheating Creek in a pasture and roosting in a dead oak
9228 tree.

9229
9230 Dwyer (2010) identified 13 non-breeding communal roosts that are regularly spaced through the
9231 species’ range in Florida (Figure 16-2). The ratio of geometric mean distance between nearest
9232 neighbors to arithmetic mean distance is a measure of regular spacing, with values approaching
9233 1.0 indicating greater regularity. For all 13 communal roosts, Dwyer calculated a spacing ratio of
9234 0.85. Combining roosts #10 and #13 (*i.e.*, two of the three roosts east of the Immokalee roost)
9235 gives a ratio of 0.90. Individual nonbreeding caracaras moved regularly among these sites, and

9236 10 of the 13 known communal roosts are within habitat identified as having high or very high
9237 probabilities of nesting caracaras (Smith et al. 2013).

9238

9239 Dwyer et al (2013) interpreted the ecological significance of communal roosts to caracaras as
9240 “central places from which non-breeders forage not for food, but for territories in a prospecting
9241 context.” Non-breeding adult birds maintain the numbers and distribution of a breeding
9242 population by replacing breeding individuals that die. The loss of a communal roost and/or its
9243 associated gathering area could reduce non-breeder survival and delay the re-occupation of
9244 vacant breeder territories by non-breeders from more distant communal roosts. Without non-
9245 breeding adults (“floaters”) regularly prospecting for newly unoccupied suitable habitat within
9246 the current breeding range, overall population productivity would decline.

9247

9248 The size of a gathering area that is necessary to maintain its ability to replenish the breeding
9249 population of the surrounding landscape is not known. Dwyer (2008) noted that approximately
9250 50% of his telemetry locations occurred within 5 km of roosts, but noted that he did not locate all
9251 tagged birds on all survey dates. The longest distance traveled by mid-day from the roost of the
9252 previous night was 6 km. He also reported that 95% of all telemetry locations occurred within 22
9253 km of roosts, and that 25 km is the average distance between roosts. Because birds appeared to
9254 avoid crossing large areas of non-habitat, he suggested that conservation actions should maintain
9255 habitat connectivity between communal roosts to maximize survival and recruitment.

9256

9257 Habitat

9258

9259 The caracara prefers habitats with short-stature vegetation and a low density of trees for nesting.
9260 Historically, caracaras inhabited native dry or wet prairies containing scattered cabbage palms,
9261 their preferred nesting tree. Over the last century, cattle ranching in central and south Florida has
9262 largely replaced native prairie vegetation with improved and unimproved pasture dominated by
9263 non-native, sod-forming grasses. Caracaras occur within these pastures, presumably because the
9264 vegetation structure of this habitat type is similar to that of native prairies. The scattered cabbage
9265 palms that are often present within improved pastures provide nesting sites for caracaras.
9266 Morrison and Humphrey (2001) suggested that a preference for habitats with short-stature
9267 vegetation derives from the species’ tendency to walk on the ground while foraging. Walking is
9268 easier in shorter vegetation, and provides less cover for predators. Caracaras likely benefit from
9269 regular mowing, burning, and high-density grazing in agricultural lands, and from prescribed
9270 burning in native habitat types, which maintain vegetation in a low-stature and structurally
9271 simple condition (Morrison and Humphrey 2001).

9272

9273 Morrison et al. (2006) determined that a mix of habitats comprised of six land cover types
9274 interspersed with small (less than 2.47 ac [0.99 ha]) freshwater wetlands (lentic and lotic) were
9275 the best predictors of caracara distribution in Florida. Landscapes that appear most suitable for
9276 caracara contain a contiguous mix of such small wetlands plus:

9277

- cabbage palm-live oak hammock;
- grassland;
- improved pasture;
- unimproved pasture;
- hardwood hammocks and forest; and

9278

9279

9280

9281

9282 • cypress/pine/cabbage palm.

9283 More than 70% of known caracara nests occur within small clumps of trees, usually cabbage
9284 palms, in areas classified in land cover data as improved pasture (Barnes 2007).

9286 For non-breeding caracaras, Dwyer et al. (2013) reported, “pasture occupied by cattle was the
9287 most used habitat relative to availability and was used more than pasture without cattle.” This is
9288 likely due to increased insect prey production associated with cattle (carcasses and dung). Citrus
9289 groves were also used during the day, and because pasture and citrus were often adjacent, they
9290 suggested that citrus groves function as refugia from socially-dominant breeding caracaras. Row
9291 crops, forests, shrubs, scrub, open water, wetlands, and urban areas were the least-used habitats
9292 by non-breeders.

9294 **16.1.3 Numbers, Reproduction, and Distribution**

9296 Distribution

9298 The caracara is a resident, non-migratory species that occurs in Florida as well as the
9299 southwestern United States and Central America. Florida’s population of caracaras occupies the
9300 south-central region of the State, from Polk and southern Volusia Counties southward to Collier
9301 and northern Dade Counties. The caracara is most abundant in a five-county area that includes
9302 Glades, DeSoto, Highlands, Okeechobee, and Osceola Counties (Service 1999).

9304 Morrison and Humphrey (2001) characterized caracara distribution, reproductive activity, and
9305 land use patterns within a 5,180,000-acre (2,096,000-ha) area in south-central Florida.
9306 Comparisons of caracara territories to randomly selected areas of available habitat within the
9307 study area indicated that caracara territories contained higher proportions of improved pasture
9308 and lower proportions of forest, woodland, oak scrub, and marsh. Territory size was inversely
9309 related to the amount of improved pasture within the territory. In addition, breeding-area
9310 occupancy rate, breeding rate, and nesting success were consistently higher on private ranch
9311 lands during the study.

9313 Population Dynamics

9315 Monitoring the caracara population, determining territory occupancy, and measuring nesting
9316 effort/success, is difficult because most caracara breeding territories occur on private lands in
9317 Florida that are not accessible to researchers (Humphrey and Morrison 1997). Consequently,
9318 roadside counts have provided the primary means of estimating caracara population size
9319 (Heinzman 1970; Layne 1995). Breeding individuals occupy territories that do not overlap
9320 substantially, but non-breeding individuals are nomadic and concentrate in gathering areas. Non-
9321 territorial juvenile and nomadic sub-adult birds may represent a disproportionate share of
9322 roadside counts.

9324 Morrison et al. (2007) report that breeding territories monitored since the 1990s tend to remain
9325 occupied by birds that attempt breeding every year. Although access to suitable habitat on
9326 private lands is limited, they interpret the consistent occupation of known territories as evidence
9327 that the caracara population is at or near the carrying capacity of the available habitat. Dwyer et

9328 al. (2012) tracked individual non-breeding caracaras in adult plumage that failed to establish
9329 breeding territories for over three years, which is consistent with the notion that all available
9330 breeding habitat is occupied. Dwyer (2010) reported that nonbreeding adults (floaters) made up
9331 approximately 40% of the adult population, which suggests that territories are unavailable for
9332 these birds that are likely otherwise capable of breeding.

9333
9334 Morrison and Humphrey (2001) noted that the published literature on the caracara characterized
9335 the species as experiencing a long-term decline in numbers, despite limited data on historic
9336 patterns of abundance or habitat availability. Layne (1996) estimated the adult portion of the
9337 population was stable with a minimum of about 300 birds in 150 territories, about 100–200
9338 immature birds, and a total statewide population of about 400–500 birds. However, this estimate
9339 was informed mostly by roadside counts. A more recently published population estimate is not
9340 available.

9341
9342 The Service's South Florida Field Office has a geospatial database of various listed species
9343 occurrences in which we have recorded the location of 265 discrete caracara territories from
9344 1994 to 2016. Recent land development may have displaced some of these. At most, these
9345 territories represent 530 breeding adults, which is almost double Layne's (1996) estimate of
9346 about 300 breeding adults. Using an average of 3,000 acres per territory, 265 breeding pairs
9347 would occupy 795,000 acres of breeding habitat, which is substantially less than the 1,835,777
9348 acres of pasture and dry prairie habitats within the general range of the caracara based on land
9349 cover data. Because the previously cited research (Morrison et al. 2007; Dwyer et al. 2012;
9350 Dwyer 2010) suggests that caracaras occupy nearly all suitable breeding habitat, the additional
9351 1,040,777 acres pasture and dry prairie habitats could support up to 347 additional territories, or
9352 $265 + 347 = 612$ territories. This total represents the upper end of the range of the potential size
9353 of the breeding population, because not all pasture and prairie habitats are in contiguous blocks.
9354 This equates to a population estimate of 1,224 breeding adults. Layne's (1996) estimate of about
9355 300 breeding adults, based primarily upon roadside counts, represents the lower end of the range.

9356 9357 **16.1.4 Conservation Needs and Threats**

9358 9359 Habitat Loss or Degradation

9360
9361 The caracara's perceived decline, as described in the literature, is attributed primarily to habitat
9362 loss (Layne 1996). Large areas of native prairie and pasture in south-central Florida were
9363 converted to citrus groves, tree farms, or other forms of agricultural, commercial, or residential
9364 development. As a result, habitat loss has accelerated in the past few decades (Morrison and
9365 Humphrey 2001). The perceived population decline and the geographic isolation of the Florida
9366 population prompted the listing of the caracara as threatened in 1987. However, while native
9367 prairies and pastures were appropriated for other uses, some forested habitats were converted to
9368 pastures. The net effect on caracara habitat availability is not documented, so a full accounting of
9369 historic habitat changes is lacking. Regardless, the threat of habitat loss persists as changes in
9370 land use continue, particularly as pastures are converted to residential and commercial
9371 development.

9373 A change in habitat management may result in the degradation or loss of caracara habitat. For
9374 example, the reduction in cattle on Allapattah Ranch (Martin County; after acquisition by the
9375 State of Florida for a Wetland Reserve Program project) allowed woody shrubs and dog fennel to
9376 grow in the pastures, which reduced caracara habitat suitability. However, some years later, fire
9377 management re-opened the pastures for caracaras to return. In addition, some large-acreage
9378 landowners sell cabbage palms from their properties for landscaping. Cabbage palms are also
9379 occasionally harvested for local consumption (swamp cabbage or heart of palm). This may
9380 reduce the availability of potential nesting sites.

9381
9382 Cattle ranching appears compatible with caracara persistence on the Florida landscape. Reducing
9383 tree density on overgrown pastures and/or restoring agricultural lands to native prairies would
9384 increase habitat availability and probably increase caracara numbers. The continuing conversion
9385 of pasture to citrus, sugarcane, and residential/commercial development is cause for concern
9386 (Morrison 2001). Recognizing the habitat value of cattle ranches and enlisting landowner
9387 cooperation in the conservation and management of these lands are essential elements in the
9388 recovery of the caracara.

9389
9390 Disturbance

9391
9392 The caracara's tolerance of human activities is variable and likely affected by previous
9393 experience (Morrison 2001). The greatest risk of nest failure from disturbance occurs during the
9394 late incubation and early nestling stages (Morrison 2001). Flushing distance was estimated at
9395 approximately 300 meters (1,000 ft) from the nest, but can increase with repeated disturbance
9396 (unpublished data, as cited in Morrison 2001). Repeated flushing can increase the likelihood of
9397 nest abandonment or make nestlings more susceptible to predation.

9398
9399 The Service recommends a 300-meter primary zone around any active caracara nest to preclude
9400 human disturbance. The Service does not have disturbance-distance data for non-breeding
9401 caracaras (including at communal roosts). However, if repeated disturbance results in lost roost
9402 functionality (see section 1.1.2), then avoiding repeated disturbance of roosts is a conservation
9403 need. Birds on a nest are more invested (in eggs or nestlings) compared to birds merely roosting,
9404 and therefore, are more likely to exhibit a greater tolerance of disturbance (closer disturbance).
9405 However, in the absence of better information, the Service recommends the 300-meter primary
9406 zone for the conservation of communal roosts also.

9407
9408 Other Threats

9409
9410 Collision with vehicles along roadways may also be a significant form of mortality and
9411 contribute to further population level declines. Florida's burgeoning human population has
9412 increased the number of motor vehicles and the need for roads. The increase in traffic as well as
9413 the caracara's predisposition for feeding on road-killed animals has probably increased the
9414 number of caracaras killed or injured by vehicles. Morrison (2003) identifies highway collisions
9415 as a major cause of juvenile mortality. Young birds appear especially vulnerable within the first
9416 six months after fledging. The Service receives occasional reports of dead caracaras, and if the
9417 bird was found on a road or right-of-way, road-kill is the assumed cause. Rural roads with a
9418 speed limit greater than 55 mph (e.g., SR 710, SR 78, and US 98) seem to account for a

9419 disproportionate share of roadkill reports. Dwyer (unpublished data) recorded observations of
9420 road-killed bird species from July 13, 2006, to March 25, 2009, while he conducted his research
9421 on non-breeding caracaras in Florida. He reported 845 road-killed birds from 36 different species
9422 over 650 sample days, including 18 caracaras (about 2% of the total).

9423
9424 Direct human persecution continues in parts of the caracara's range (Morrison and Dwyer 2012).
9425 Caracaras are killed by some ranchers who believe that caracaras kill and eat newborn livestock.
9426 Spent lead ammunition from hunting and shooting has the potential to poison animals that feed
9427 upon the carrion (Golden *et al.* 2016).

9428
9429 The Florida population of caracaras is relatively small and isolated. Small and isolated
9430 populations are vulnerable to environmental catastrophes and to reduced reproductive rates
9431 caused by skewed sex ratios or age-specific mortality. Low numbers set the stage for reduced
9432 adaptability to environmental changes and stresses through the loss of genetic heterozygosity.
9433 Many occupied territories occur on private land that is inaccessible to surveyors, which makes it
9434 difficult to monitor and detect changes in the species' population size and distribution. This
9435 difficulty increases the possibility of not detecting a population decline that is leading to
9436 extinction.

9437
9438 Climate change and rising sea levels may shift human population centers away from the Florida
9439 coasts to the interior (see section 3.3), including the range of the caracara. The additional loss
9440 and fragmentation of caracara habitat associated with such a shift is another reasonably
9441 foreseeable threat to the species' survival and recovery.

9443 **16.1.5 Tables and Figures**

9444



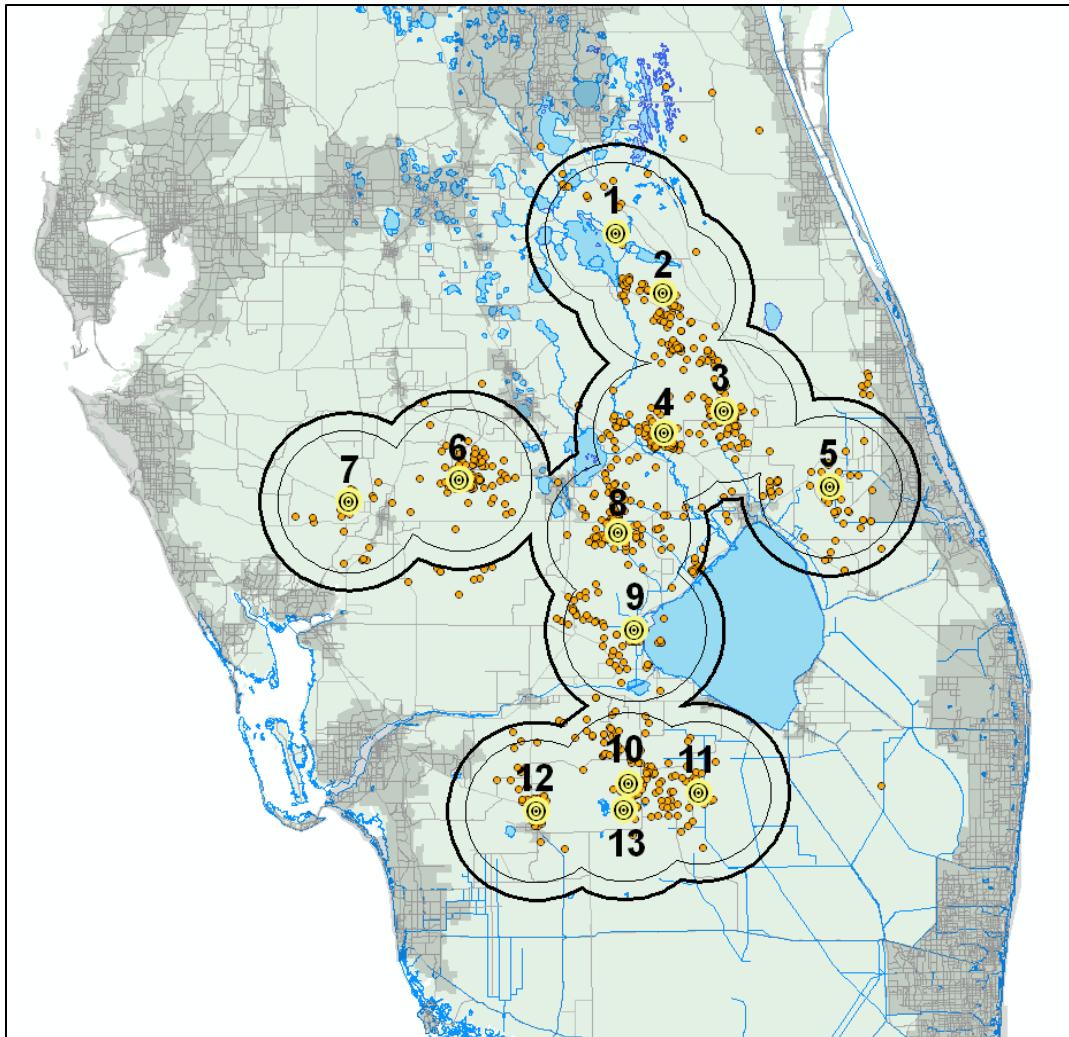
9445

9446

9447 **Figure 16-1.** Photo (8/2/2018, 7:30 am) of about 80 caracaras along US27 in the Fisheating
9448 Creek communal roost and gathering area (source: Mike Elfenbein to Dave Shindle,
9449 USFWS).

9450

9451



9452
9453
9454
9455
9456
9457
9458
9459
9460

Figure 16-2. Aerial telemetry (orange circles) and communal roost (yellow bull's eyes) locations for crested caracaras tracked from August 2006 through October 2008. Dark polygon outline = 25 km buffer around roosts. Light polygon outline = 20 km buffer around roosts.

16.2 Environmental Baseline for Audubon's Crested Caracara

This section describes the current condition of the caracara in the Action Area without the consequences to the listed species caused by the proposed Action.

16.2.1 Action Area Numbers, Reproduction, and Distribution

Breeders

The e-Bird website (<https://ebird.org/explore>) documents 566 observations of caracaras from January 2010 to May 2017, mostly along roads, within and around the Plan Area (Figure 16-3).

9471 Figure 16-4 shows the locations of four caracara nests located within the Plan Area during the
9472 past 10 years, and of another five nests immediately adjacent to or near the Plan Area
9473 boundaries. These nests were documented during studies for various development proposals
9474 (Passarella and Associates, Inc. 2017; Inwood Consulting Engineers, Inc. 2016; Turrell, Hall and
9475 Associates, Inc. 2017).

9476
9477 One of the five nests located just outside the Plan Area was within the Town of Ave Maria, a
9478 development that completed consultation associated with Federal permits several years ago (see
9479 section 2.1.1). We believe it is likely that caracaras still occupy breeding territories associated
9480 with the other eight nest locations, including the four within the Plan Area, because established
9481 territories tend to remain occupied until habitat conditions no longer support a breeding pair (see
9482 section 16.1.3, “Population Dynamics”).

9483
9484 The Applicants did not conduct surveys for caracara nests in the Plan Area, which contains a
9485 substantial acreage of pastures and other cover types that caracaras may use (see section 16.1.2,
9486 “Habitat”). The Cooperative Land Cover (CLC) classes listed in Table 2-1 (FWC and FNAI
9487 2016) that breeding caracaras may use include (listed in decreasing order of Plan Area
9488 abundance):

- 9489 • cropland/pasture (26,902 acres);
9490 • marshes (16,699 acres);
9491 • improved pasture (15,122 acres);
9492 • prairies (wet) and bogs (10,163 acres);
9493 • rural open lands (6,964 acres);
9494 • isolated freshwater marsh (1,806 acres);
9495 • mesic hammock (1,791 acres);
9496 • hydric hammock (119 acres); and
9497 • freshwater non-forested wetlands (105 acres).

9498
9499 These nine CLC classes cover 83,733 acres, or 50% of the Plan Area. Pastures, both improved
9500 and unimproved, are the primary areas of short-stature vegetation that would support breeding
9501 caracaras in the Plan Area, provided that suitable nesting trees, access to water, and prey
9502 resources are also available. Isolated or small clumps of trees located within improved pastures
9503 support more than 70% of known caracara nests (Barnes 2007). Unimproved pastures are
9504 included in the cropland/pasture class in our CLC data for the Plan Area, but row crops are
9505 among the least-used cover types by breeding caracaras (Dwyer et al. 2013).

9506
9507 Therefore, we used the land cover data of the South Florida Water Management District
9508 (SFWMD 2011), which separates unimproved pastures from various crop types, to estimate the
9509 extent of pasture-like conditions within the CLC cropland/pasture type. Within the Plan Area’s
9510 26,902 acres of the CLC cropland/pasture cover type, the SFWMD data classifies 2,245 acres as
9511 pasture or pasture-like cover types (e.g., herbaceous prairie, unimproved pasture, woodland
9512 pasture, *etc.*). Combined with the acreage of the CLC improved pasture cover type, we estimate
9513 the Plan Area contains up to $15,122 + 2,245 = 17,367$ acres of pastures that caracaras would
9514 most likely include in their breeding territories.

9516 The 17,367 acres of Plan Area pastures could support 3,000-acre territories for about 6 breeding
9517 pairs that consisted *entirely* of pastures; however the home range of a breeding caracara also
9518 includes surface water features, some amount of hammock cover, and other non-forested lands
9519 (see section 16.1.2, “Habitat”). This mix is variable, but in the home ranges of 28 breeding pairs
9520 examined by Barnes (2007), the acreage of pastures and native grasslands in each substantially
9521 exceeded that of all other cover types combined. Because the acreage of the non-pasture types
9522 listed above is more than double that of the pasture types in the Plan Area, the extent of pasture
9523 likely controls the Plan Area carrying capacity for breeding caracaras. To estimate the number of
9524 breeding territories the Plan Area is likely to support, we consider 2,000 acres of pasture cover
9525 (2/3 of the average home range size), along with 1,000 acres of other cover types (e.g.,
9526 hammocks, non-forested wetlands, ponds, streams/ditches), sufficient to support a breeding pair.
9527 We expect that 17,367 acres of pasture, plus adjacent wetlands and hammock cover in the Plan
9528 Area, would support 8–9 caracara breeding pairs. Previous studies have documented 4 nesting
9529 locations within the Plan Area boundaries (Figure 16-4). Based on habitat availability, and the
9530 general observation elsewhere that caracaras are at or near the carrying capacity of available
9531 habitat (see section 16.1.3), we estimate that another 5 breeding territories are likely to occur in
9532 the Plan Area.

9533
9534 Non-Breeders
9535

9536 The Plan Area also provides habitat for juvenile and non-breeding adult (“floater”) caracaras.
9537 The southwestern-most of 13 communal roosts and associated gathering areas that Dwyer (2010)
9538 identified throughout the Florida range of the species is located in the Plan Area north of
9539 Immokalee (the Immokalee roost; roost #12 in Figure 16-2). Dwyer radio tagged non-breeding
9540 adult caracara’s, seven of which he tracked to the Immokalee roost. He located one or more of
9541 these birds in the surrounding area 54 times from 03/20/2007–03/24/2009 (Figure 16-5). Most of
9542 the detections occurred in citrus orchards, and the rest in pastures. He detected these seven birds
9543 at more distant locations an additional 57 times, including on one occasion as far away as the
9544 Lake Placid roost in Glades County (roost #12 in Figure 16-2). Dwyer more often located these
9545 seven birds near the Devil’s Garden and Clewiston communal roosts (roosts #10 and #13 in
9546 Figure 16-2), which are the two roosts closest to the Immokalee roost. In general, the radio-
9547 tagged birds moved frequently among the roosts and gathering areas southwest of Lake
9548 Okeechobee. Dwyer counted caracaras entering the Immokalee communal roost at dusk on 3
9549 days in September 2008 (12, 28, and 24 caracaras on September 8, 10, and 18, respectively).
9550

9551 We searched recent records (January 2010 – May 2017) from the e-Bird website for locations in
9552 or near the Plan Area where six or more caracaras were observed together. Five or fewer birds
9553 together (two parents and up to three fledglings) could represent a family unit, whereas six or
9554 more are a clear indication of non-breeder activity. Figure 16-6 shows 9 such locations
9555 (observation dates between March 2012–January 2017), all within a few mi of the Immokalee
9556 roost site. On April 27, 2016, staff from Inwood Consulting reported at least 89 caracaras
9557 foraging in a pasture west of SR29 and just north of its intersection with SR82 (Figure 16-7; note
9558 the citrus orchard in the background).

9559
9560 These observations and the telemetry data of Dwyer (2010) suggest that the area north of
9561 Immokalee adjacent to SR29, SR82, and Church Road, serves as a gathering area for non-

9562 breeding caracaras. Birds likely use the pastures in this area for foraging when they can, and
9563 retreat to adjacent citrus orchards when challenged by the resident and socially dominant
9564 occupants of a breeding territory. Two of the four known caracara nesting locations within the
9565 Plan Area boundaries are in this same general area (Figure 16-4). We roughly estimate that the
9566 size of the area around the Immokalee communal roost site that encompasses the various
9567 sightings of ≥ 6 birds and Dwyer's telemetry locations of birds that roosted at Immokalee is
9568 about 25,000 acres, of which about 1/3 is within the Plan Area boundaries.

9569

9570 **16.2.2 Action Area Conservation Needs and Threats**

9571

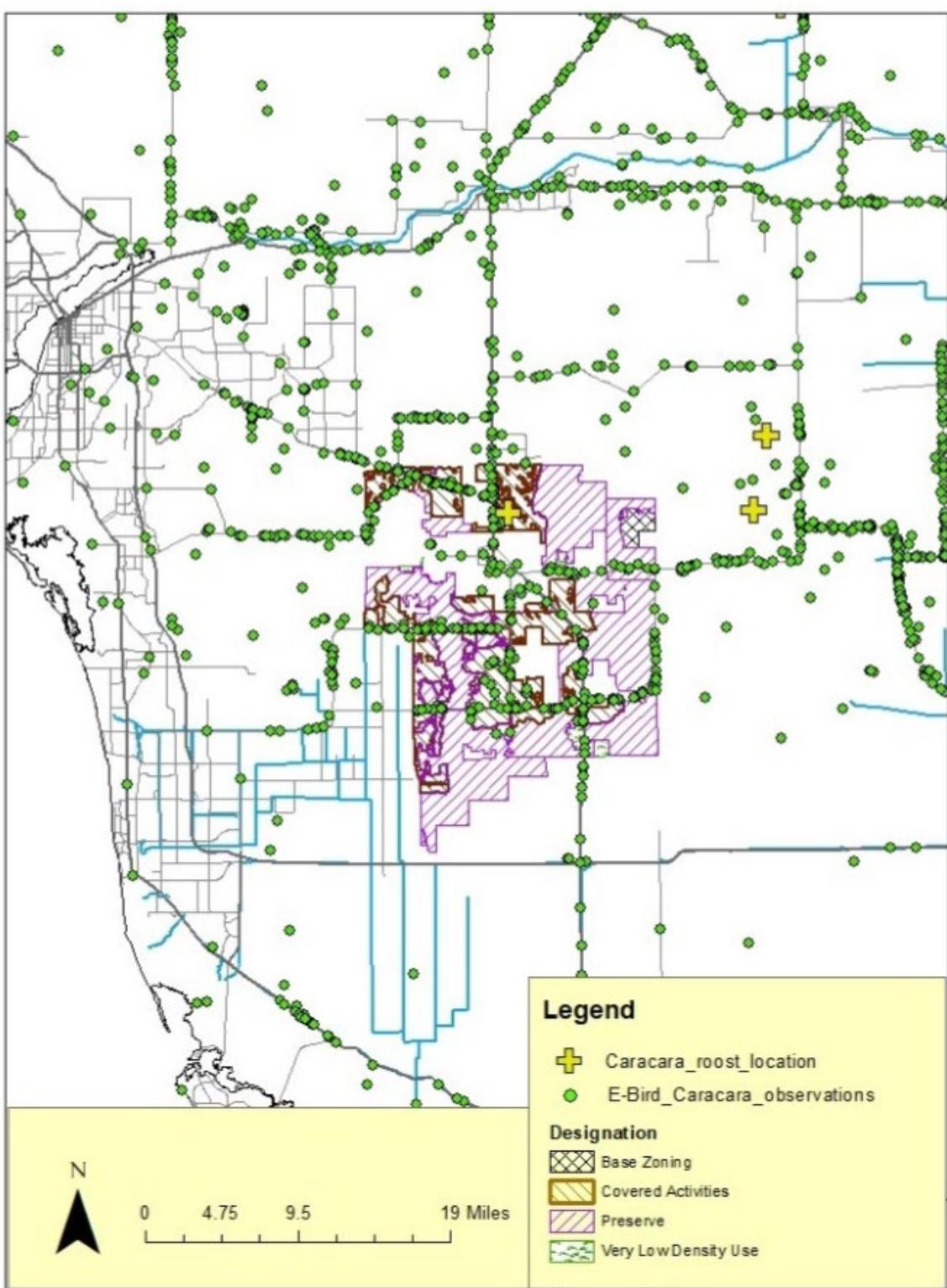
9572 Both breeding and non-breeding caracaras occupy the Plan Area. Current threats to the species
9573 range-wide (see section 16.1.4), such as loss of habitat and vehicle mortality, are applicable
9574 within the Plan Area and the larger Action Area, which includes roads we expect to experience
9575 an increase in traffic that would not occur but for the development activity. Maintaining large
9576 areas of pasture or pasture-like habitat interspersed with wetlands and cabbage palms for nesting
9577 in this area is the primary conservation need to assure long-term persistence of the caracara in the
9578 Action Area.

9579

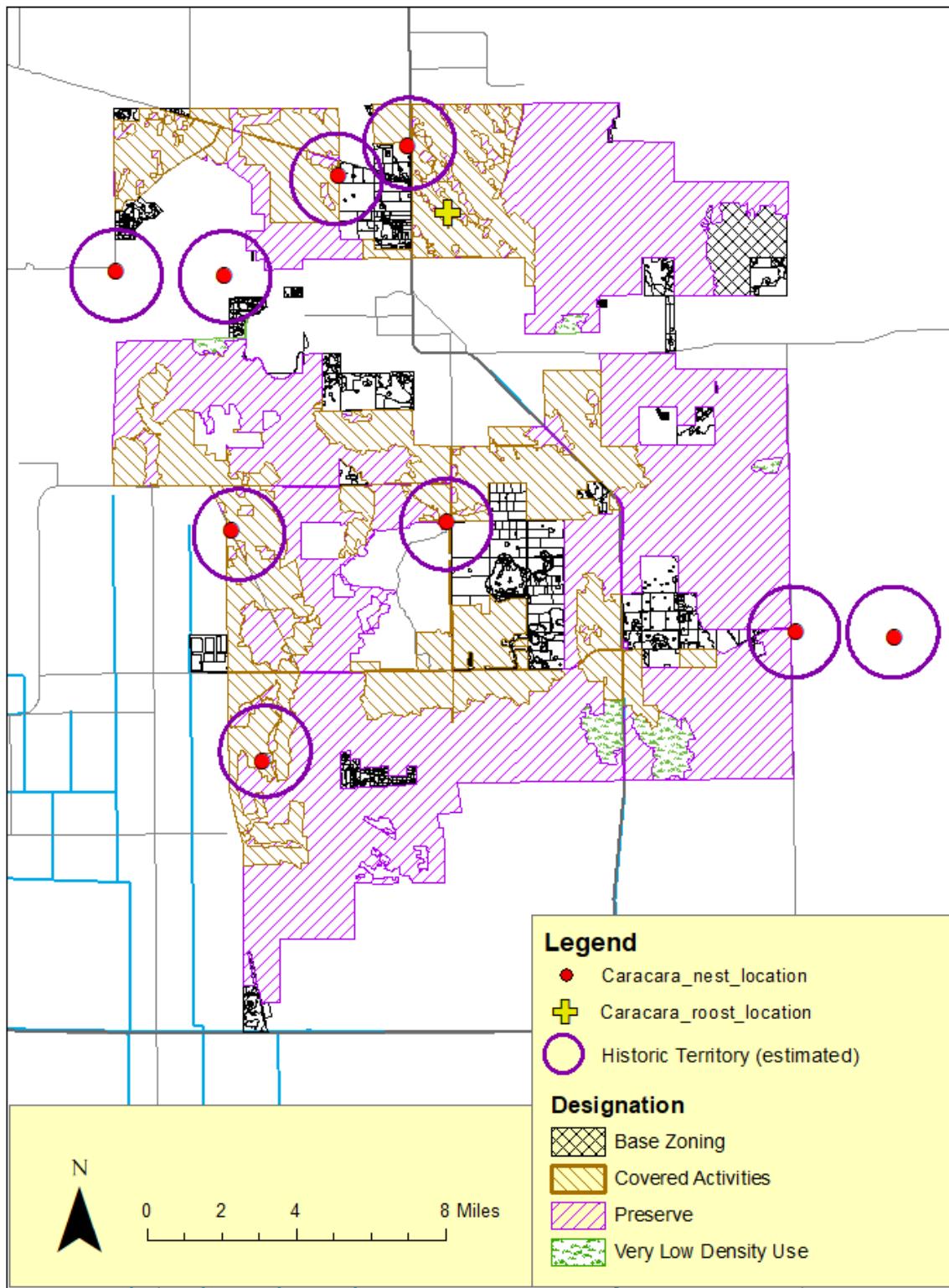
9580 We are aware of only one recent caracara road mortality within the Action Area. It occurred on
9581 or about July 27, 2018, on the four-lane section of Oil Well Road near the Arthrex facility
9582 (Danaher 2018). Danaher (2018) reported that this section of the road has at times a "...non-stop
9583 stream of cars travelling 60-70 mph in both directions...."

9584

9585 16.2.3 Tables and Figures
9586



9587
9588
9589 **Figure 16-3.** Caracara locality data in southwest Florida from e-Bird (2010-2017).
9590



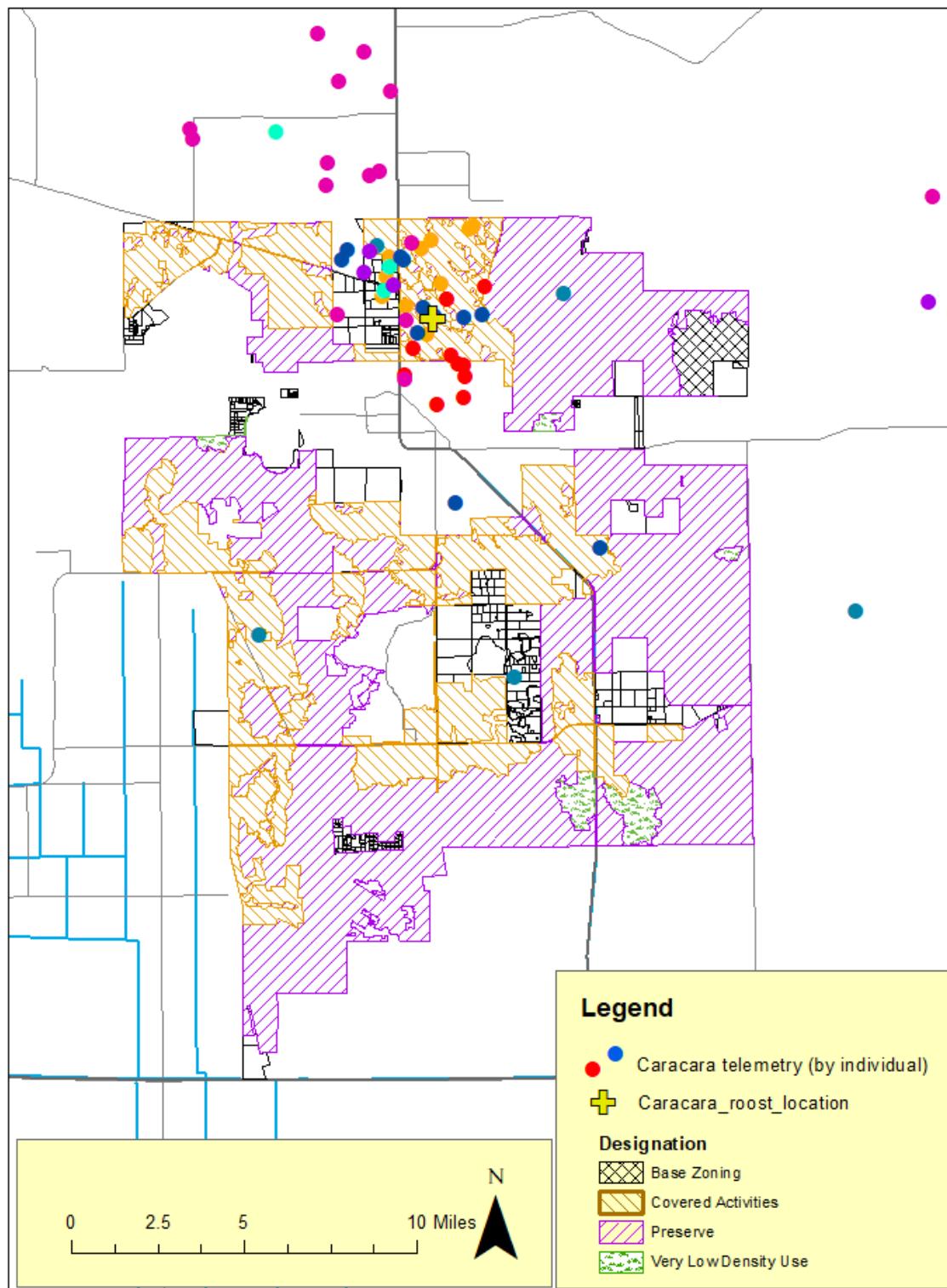
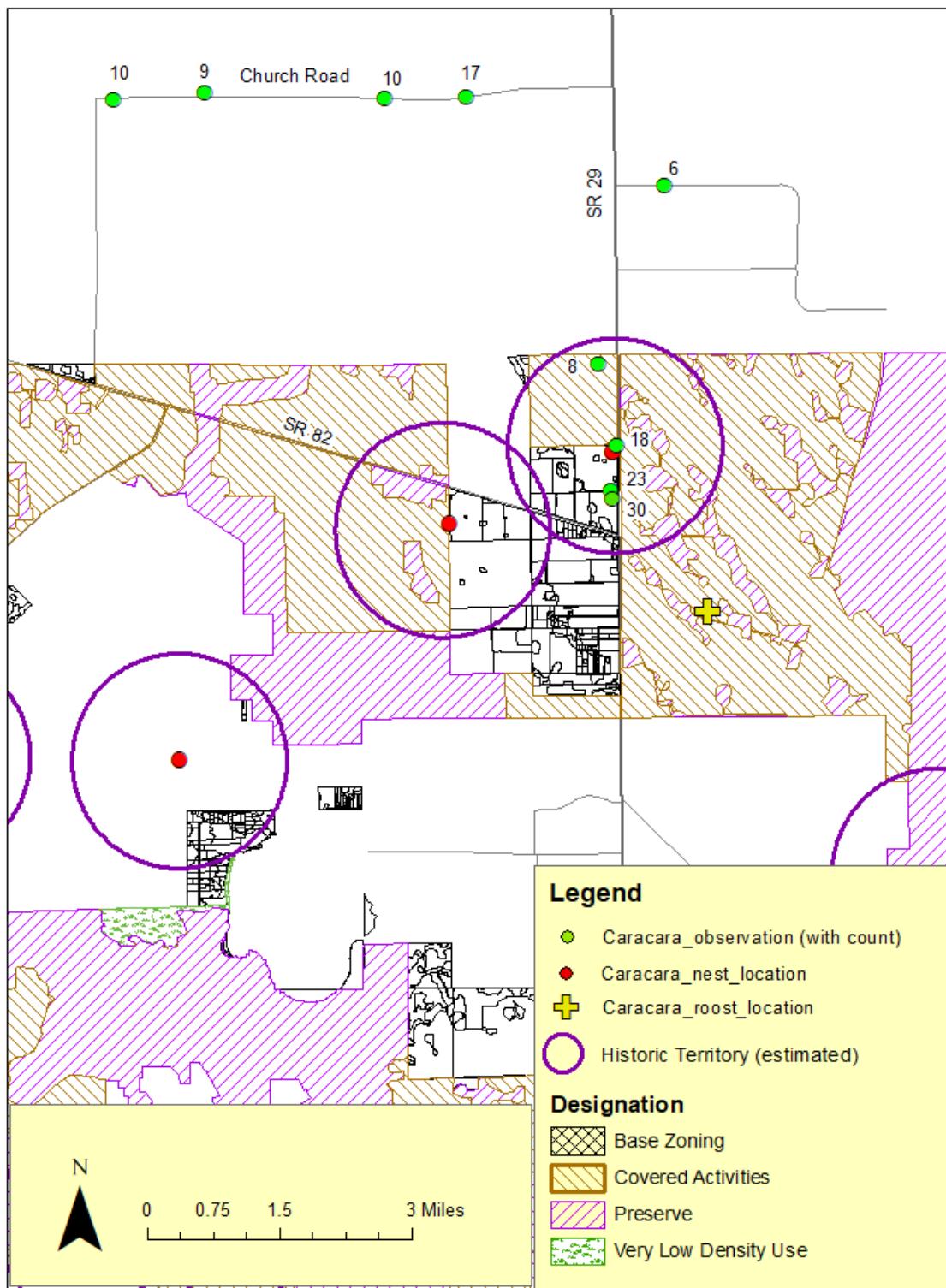


Figure 16-5. Non-breeding caracara telemetry data from Dwyer (2010), color-coded per each of seven tagged birds in and around the Plan Area.

9600



9601

9602

9603

9604

Figure 16-6. Observer locations for greater than five caracaras in the Immokalee gathering area and HCP Plan Area (data from e-Bird website; March 2012-January 2017).

9605



9606

9607

9608 **Figure 16-7.** A photograph of approximately 21 of the reported 89 caracaras occupying a pasture
9609 within the Immokalee gathering area on April 27, 2016 (west of SR29 just north of
9610 intersection with SR82; Inwood Consulting, Inc. 2016). Cattle egrets, ibises and vultures
9611 also appear in the photograph.

9612

9613

9614 **16.3 Effects of the Action on Audubon's Crested Caracara**

9615

9616 This section describes all reasonably certain consequences to the caracara that we predict the
9617 proposed Action would cause, including the consequences of other activities not included in the
9618 proposed Action that would not occur but for the proposed Action. Such effects may occur later
9619 in time and may occur outside the immediate area involved in the Action.

9620

9621 **16.3.1 Development and Mining, Base Zoning, and Lands Eligible for Inclusion**

9622

9623 Effects to Breeding Caracaras

9624

9625 The designated Development and Mining, Base Zoning, and Lands Eligible for inclusion
9626 (collectively, the development envelope of the HCP) encompass 66,245 acres (Table 2-1);

however, the HCP proposes a development cap of 39,973 acres. Table 16-1 lists by HCP land use designation the acreage of cover types that breeding caracaras are known to include in their home range (see sections 16.1.2 under “Habitat” and 16.2.1 under “Breeders”). Pastures, which constitute the majority of a breeding territory, are more likely to receive development activity than wetlands, hammocks, or water features. The total acreage of pastures in the potential development envelope is 8,340 acres, which is substantially less than the 39,973-acre development cap. Therefore, we apply the “reasonable maximum impact” method (section 2.1.4) for estimating the extent of habitat changes caracaras are likely to experience.

Using a 2:1 ratio of pasture to other caracara breeding habitat types, we estimated in section 16.2.1 that the Plan Area supports 8–9 caracara breeding territories averaging 3,000 acres in size. Pastures in the development envelope, plus adjacent wetlands, hammocks, and water features, would likely support about 4 of these territories ($8,340 \div 2,000$). The Development and Mining land-use designation, which includes 5,516 acres of pastures, would likely support 2–3 of the 4 territories in the development envelope.

The Applicants propose to avoid and minimize impacts to caracara nesting where breeding caracara pairs are present (HCP Chapter 7.2.1.1). To accomplish this objective, the Applicants propose to conduct caracara nest surveys before construction activities begin, and to preclude construction activity within 300 meters (984 ft) of a nest from November through April. These conservation measures should avoid causing reproductive failure of nests that occur in development areas during the initial year of construction activity that encompasses a nest site. However, the conversion of pasture and adjacent land cover to mining and/or commercial/residential uses within breeding territories would eventually displace the activity of resident breeders, wholly or partially, into other areas. Such displacement is likely to cause aggression with resident caracaras and/or other raptors in these areas leading to death or injury, or to reduced fitness caused by competition for food resources and reproductive failure during subsequent years. We expect such consequences for 2–4 breeding pairs, depending on the specific pattern of overlap between development activity within the development envelope and territory boundaries.

Effects to Non-Breeding Caracaras Using the Gathering Area and Communal Roost

In section 16.2.1, we roughly estimated the size of the Immokalee gathering area, based on sightings of multiple (6–89) caracaras, at about 25,000 acres. The development envelope overlaps about 40% of this area. The communal roost near Immokalee that serves as the anchor for this gathering area is a palm hammock within a narrow band ($< \frac{1}{2}$ mi wide) of wetlands designated as a Preservation Areas under the HCP. These wetlands are surrounded by a citrus grove that is part of a designated Development and Mining area. Clearing the citrus grove and its subsequent development would likely cause caracaras to abandon the communal roost, due to the proximity ($< \frac{1}{4}$ mi) of a substantial increase in human activity. Such activity would begin with the use of heavy equipment to clear and grade the grove, followed by months/years of additional activity to either convert the former grove to commercial/residential or mining uses. We believe it is unlikely that caracaras would tolerate nearly continuous disturbance so close to a roost site.

9672 Non-breeders displaced from the Immokalee roost and gathering area would need to relocate,
9673 possibly to the Devil's Garden or Clewiston roosts and gathering areas, or possibly establish a
9674 new communal roost. Dwyer (2010) observed frequent movements of tagged individuals among
9675 the roosts and gathering areas southwest of Lake Okeechobee. We would expect the
9676 displacement of some or all non-breeders the Immokalee area caused by the development
9677 activity to increase competition for and pressure on limited feeding and sheltering resources at
9678 other gathering areas and roosts; however, any population-level consequences of such
9679 displacement are unclear. These "floaters" are not part yet part of the breeding population, but
9680 serve as a reservoir of adults that replace breeders when territories become available. We are
9681 unable to predict the degree to which impacts to the Immokalee gathering area may reduce the
9682 survival of the individuals affected or reduce the productivity of breeding caracaras in the
9683 surrounding areas.

9684

Effects of Increased Traffic

9685

9686 The Action will contribute to an increase in traffic on public roads of the Action Area (see
9687 section 3.2). The main traffic arteries into the Plan Area are SR 29 (55 mph), SR 82 (45 mph),
9688 Immokalee Road (CR 846; 45 and 55 mph), and Oil Well Road (CR 858; 45 mph). We anticipate
9689 that the population and employment growth associated with the developments will increase the
9690 number of vehicles on these and other roads. If roads are widened to accommodate increased
9691 traffic in the future, speed limits may also increase. Caracaras frequently feed on road-killed
9692 animals, which puts them at risk for collisions with vehicles themselves. We do not have reliable
9693 data from which to predict caracara road mortality as a function of traffic volume. However, it is
9694 a logical inference that the mortality risk increases with traffic volume and with the speed of
9695 vehicles, especially at speeds greater than 45 mph.

9696

16.3.2 Preservation Activities

9697

9698 Using a 2:1 ratio of pasture to other caracara breeding habitat types, we estimated in section
9699 16.2.1 that the Plan Area supports 8–9 caracara breeding territories averaging 3,000 acres in size.
9700 The designated Preservation Areas contain 8,525 acres of pastures and 29,094 acres of other
9701 cover classes that support caracara breeding territories (Table 16-1). Pastures are the limiting
9702 habitat component for caracaras in the Preservation Areas, and we estimate that they likely
9703 support 4–5 (8,525 ÷ 2,000) of the 9 predicted Plan Area breeding territories.

9704 The Applicants propose a continuation of existing land uses (agriculture, silviculture, *etc.*) in the
9705 Preservation Areas, which we listed in section 2.3. All of these uses may occur to some extent in
9706 habitats that support caracaras. Land management activities in the Preservation Areas for which
9707 the Applicants seek take authorization and that may occur in caracara habitats include:
9708 prescribed burning;
9709 mechanical control of groundcover (*e.g.*, roller chopping, brush-hogging, mowing);
9710 ditch and canal maintenance;
9711 mechanical and/or chemical control of exotic vegetation; and
9712 similar activities that maintain or improve land quality.

9717 We have no evidence of prescribed burning causing harm to caracaras. A fire burning too hot
9718 beneath a cabbage palm or other tree containing a nest could conceivably kill eggs or flightless
9719 chicks. However, we have no data about the timing or location of burning relative to caracara
9720 nesting that would allow us to predict the amount or extent of such harm. The other activities
9721 listed above may temporarily disrupt caracara foraging activity, but are unlikely to harm eggs or
9722 chicks within a nest.

9723
9724 In Chapter 7.2.1.1 of the HCP, the Applicants propose to preserve and maintain caracara habitats
9725 in the Preservation and Very Low Density use designations (Objective 1), and to “restore, as
9726 needed, suitable caracara core habitat areas to mitigate for permanent caracara habitat losses
9727 associated with the Covered Activities” (Objective 2). Habitat restoration would involve
9728 replacing vegetation >12 inches tall with short-stature grasses in overgrown pastures (e.g.,
9729 reducing shrub encroachment using fire).

9730
9731 The Applicants propose to conduct such restoration to an extent that offsets permanent losses of
9732 caracara habitat caused by the Covered Activities and results in no-net loss of caracara habitat in
9733 the Plan Area. The HCP does not identify areas or estimate the total extent within the
9734 Preservation Areas on which caracaras would benefit from the restoration activity. The extent of
9735 pastures within the Preservation Areas (8,525 acres) is only slightly greater than within the full
9736 development envelope (8,340 acres), and 3,009 acres (55%) greater than within the designated
9737 Development and Mining areas. Lacking specific plans or performance measures for the
9738 restoration activities, we are unable to estimate potential benefits to caracaras. However, we do
9739 not expect the management of Preservation Areas to reduce the numbers, reproduction, or
9740 distribution of the caracara in the Preservation Areas, because these activities would, at
9741 minimum, maintain current conditions.

9742
9743 **16.3.3 Very Low Density Development**
9744

9745 The Very Low Density (VLD) use areas of the HCP do not contain pastures that would provide
9746 the core foraging habitat of a caracara breeding territory (Table 16-1). Although 16 acres of
9747 mesic hammock and cabbage palms that may occur in isolated patches in the VLD use areas
9748 could provide trees for nesting, any associated territory for foraging activity would necessarily
9749 encompass about 2,000 acres of pasture in adjacent land-use designations. We have no records of
9750 caracara nesting within the VLD use areas.

9751
9752 The Applicants’ proposals to survey for caracara nesting activity before any construction
9753 activity, and to preclude activity within 300 meters of an active nest from November through
9754 April (see section 16.3.1), would apply to the construction of isolated residences, lodges, and
9755 hunting/fishing camps in the VLD use areas. These conservation measures should avoid causing
9756 reproductive failure of nests that may occur in the VLD use areas. Removal of an unoccupied
9757 nest tree would cause the breeding pair to seek an alternative nest tree the following nesting
9758 season. We have no data that suggests the availability of trees for nesting is limiting in the Plan
9759 Area. Because the majority of a breeding territory associated with a nest in the VLD use areas
9760 would necessarily occur outside the VLD use areas, we do not expect significant adverse effects
9761 resulting from the possible loss of an unoccupied nest tree in these areas.

9762

9763 **16.3.4 Tables and Figures**

9764

9765 **Table 16-1.** Acreage of cover classes that occur in the Plan Area, by HCP land use designation,
9766 that breeding caracaras are known to include in their home range.

COOPERATIVE LAND COVER CLASS	A. DEVELOP- MENT	B. BASE ZONING	C. ELIGIBLE FOR INCLUSION	D. POTENTIAL DEVELOPMENT		E. VERY LOW DENSITY	F. PRESER- VATION	TOTAL (D+E+F)
				(A+B+C)				
Improved Pasture	4,393	1,082	1,546			502	7,599	
Unimproved Pasture (within the CLC Cropland/Pasture Class) ¹	1,123	143	53			0	926	
Pasture Subtotal	5,516	1,225	1,599		8,340	502	8,525	17,367
Mesic Hammock	417	16	167			61	1,129	
Rural (Rural Open Lands)	1,415	0	1,153			241	4,155	
Freshwater non-Forested Wetlands	6	0	0			0	99	
Prairies and Bogs	708	0	1,152			98	8,205	
Marshes	1,007	0	1,335			124	14,233	
Isolated Freshwater Marsh	9	536	102			2	1,156	
Hydric Hammock	0	2	0			0	117	
Non-Psture Subtotal	3,562	554	3,909		8,025	526	29,094	37,645
Total	9,078	1,779	5,508		16,365	1,028	37,619	55,012

9767
9768
9769 ¹Based on South Florida Water Management District (SFWMD 2011) land cover data within the extent of the
9770 “Cropland/Pasture” CLC class.

9771 **16.4 Cumulative Effects on Audubon’s Crested Caracara**

9772
9773 For purposes of consultation under ESA §7, cumulative effects are those caused by future state,
9774 tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future
9775 Federal actions that are unrelated to the proposed action are not considered, because they require
9776 separate consultation under §7 of the ESA.

9777
9778 We identified in section 3 of this BO/CO a projected increase in traffic on public roads as the
9779 sole source of effects that are consistent with the definition of cumulative effects for this Action.
9780 Increased vehicle traffic (especially at speeds greater than 45 mph) unrelated to the Action is a
9781 stressor that may adversely affect breeding and non-breeding caracaras in the Action Area. Road
9782 mortality is documented for caracaras (see section 16.1.4). As the population of southwest
9783 Florida increases, we expect more vehicle use in the Action Area, and a concomitant increase in
9784 road mortality of animals in general. This will increase the risk of injury or mortality to caracaras
9785 that forage on these road-killed animals. However, the available data on caracara road mortality
9786 is not sufficient to formulate a clear relationship between traffic volume, speed limits, caracara
9787 distribution, and other relevant factors from which we could quantify with reasonable certainty
9788 the increased risk of mortality.

9789 **16.5 Conclusion for Audubon’s Crested Caracara**

9794 In this section, we summarize and interpret the findings of the previous sections for the caracara
9795 (status, baseline, effects, and cumulative effects) relative to the species-specific purpose of a BO
9796 under §7(a)(2) of the ESA, which is to determine whether the proposed action is likely to
9797 jeopardize the continued existence of a species.

9798

9799 Status

9800

9801 Florida's population of caracaras (the entity protected under the ESA) occupies primarily
9802 pastures and native prairie habitats of the south-central region of the State. Although about 1.8
9803 million acres of such habitats remain in this region, available evidence suggests that the species
9804 is at or near carrying capacity, due in part to the relatively large size (average 3,000 acres) of a
9805 breeding territory. We estimate that the range-wide population consists of 150–612 breeding
9806 pairs (300–1,224 adults), the current year's offspring, plus non-breeding adults ("floaters") that
9807 number about 40% of the breeding population. Habitat loss caused by conversion of pasture and
9808 native prairies to other uses (e.g., residential and commercial development) is the primary threat
9809 to the species' survival and recovery. Road mortality is another recognized threat of uncertain
9810 significance.

9811

9812 Baseline

9813

9814 Caracaras are present and reproduce in the Plan Area, which is near the southwestern edge of the
9815 species' range in Florida. Forest clearing and drainage activities to facilitate agricultural uses
9816 have likely increased, relative to historic conditions, the amount of short-stature vegetation in the
9817 Plan Area that caracaras prefer as habitat. The Plan Area has supported at least 4 caracara nests
9818 since the mid-1990s. Based on inferences from habitat availability, we expect the Plan Area to
9819 support as many as 9 breeding territories. A communal roost and associated gathering area
9820 located north of Immokalee near the northern edge of the Plan Area supports relatively high
9821 numbers of non-breeding caracaras (89 observed on one occasion).

9822

9823 Effects

9824

9825 The development activity of the HCP would cause a loss of habitats that support both breeding
9826 and non-breeding caracaras. We expect caracara displacement from the developed areas to other
9827 already-occupied habitats, which would lead to the subsequent harm of 2–4 breeding pairs,
9828 depending on the specific pattern of overlap between development activity and breeding
9829 territories. Although an increase in traffic associated with the new developments would increase
9830 the risk of caracara road mortality, we do not have reliable data from which to predict such
9831 mortality as a function of traffic volume in order to quantify the risk.

9832

9833 We expect that development activity would likely cause non-breeding caracaras to abandon the
9834 communal roost near Immokalee, due to the proximity (< ¼ mi) of a substantial increase in
9835 human activity. We are unable to predict the degree to which impacts to the Immokalee
9836 gathering area may reduce the survival of the individuals affected or reduce the productivity of
9837 the breeding population.

9838

9839 The Covered Activities in the Preservation Areas would maintain conditions for 4–5 breeding
9840 pairs. We are unable to determine the extent to which habitat restoration (e.g., reducing shrub
9841 encroachment in pastures) in the Preservation Areas, which is intended to offset losses caused by
9842 development, would benefit caracaras. The HCP does not identify areas in need of, or specify the
9843 total extent of, such restoration. The Very Low Density use areas do not contain pastures that
9844 would provide the core foraging habitat of breeding territories, and we expect that Covered
9845 Activities in these areas are not likely to adversely affect the species.

9846

Cumulative Effects

9847 The available data on caracara road mortality is not sufficient to formulate a clear relationship
9848 between traffic volume, speed limits, caracara distribution, and other relevant factors from which
9849 we could predict an increase in risk of mortality.

9850

Opinion

9851 The best available data indicates that the caracara population in Florida is breeding habitat
9852 limited. The loss of pasture (up to 8,340 acres) and other habitats caused by the development
9853 activity, which we estimate support 2–4 breeding pairs, would add an increment of habitat loss to
9854 the species' range. Because we do not expect displaced pairs to continue to reproduce, we expect
9855 an eventual 0.3–2.7% reduction relative to the species' range-wide abundance of 150–612
9856 breeding pairs ($4/150=2.7\%$; $2/612=0.3\%$). The habitat loss is not likely to alter the species'
9857 overall range, as other areas that should continue to support caracaras are present in the Plan
9858 Area.

9859 The consequences of likely impacts to the non-breeding communal roost (one of 13 range wide)
9860 and associated gathering area are unclear. Three other communal roosts in adjacent Hendry
9861 County may serve floaters prospecting for vacant breeding territories in east Collier County, or
9862 non-breeders could establish a new communal roost and gathering area closer to, or even within,
9863 the Plan Area. The change to non-breeder habitats caused by the Action is not beneficial, but
9864 neither is it reasonably certain to cause a reduction in the species' numbers or reproduction.

9865 Precluding new development and mining activity in the dedicated Preservation Areas would
9866 protect 8,525 acres of pastures, and 29,094 acres of other caracara habitats, which we estimate
9867 support 4–5 breeding pairs. As these areas are brought under conservation easements, habitat
9868 restoration should benefit the caracara, but the amount or extent of an increase in numbers or
9869 reproduction is not predictable at this time. Given the small proportional impact of the
9870 development activities to the range-wide population and habitat availability, and the prospect of
9871 habitat enhancements that could offset this impact to some degree, we believe the net impact of
9872 the Action on the caracara is within the species' ability to sustain.

9873 After reviewing the current status of the species, the environmental baseline for the Action Area,
9874 the effects of the Action and the cumulative effects, it is the Service's biological opinion that the
9875 Action is not likely to jeopardize the continued existence of the Audubon's crested caracara.

9885 **17.Everglade Snail Kite**

9886

9887 This section provides the Service's biological opinion of the Action for the Everglade snail kite.

9888

9889 **17.1 Status of Everglade Snail Kite**

9890

9891 This section summarizes best available data about the biology and current condition of the

9892 Everglade snail kite (*Rostrhamus sociabilis plumbeus*) (snail kite) throughout its range that are

9893 relevant to formulating an opinion about the Action. The Service published its decision to list the

9894 snail kite, Florida population, as endangered on March 11, 1967 (32 FR 4001), and designated

9895 critical habitat for the species on August 11, 1977 (42 FR 40685–40690). Snail kite critical

9896 habitat does not occur in the Action Area, and we do not discuss it further in this BO.

9897

9898 The following Service documents, cited in this section as necessary, provide additional details

9899 about the status of the snail kite:

9900 (d) South Florida multi-species recovery plan (USFWS 1999)

9901 (e) Everglade Snail Kite 5-Year Review (USFWS 2007)

9902 (f) Recovery Plan for the Endangered Everglade Snail Kite; Draft Amendment 1 (USFWS

9903 2019)

9904 The finding of our most recent 5-year review (USFWS 2007) was to retain the species' current

9905 classification as an endangered species.

9906

9907 **17.1.1 Species Description**

9908

9909 The snail kite is a medium-sized hawk with a wingspan of about 45 inches. Its beak is slender

9910 and hooked. Adult males are slate gray with black head and wing tips, have a white patch at the

9911 base of a square tail, and red legs. Females are brown and heavily streaked with dark lines, have

9912 a white line above the eye, a white patch at the base of a square tail, and yellow legs. Immatures

9913 resemble females, but are darker.

9914

9915 **17.1.2 Life History**

9916

9917 Snail kites are dietary specialists that feed almost exclusively on apple snail species (*Pomacea*

9918 *spp.*) (Kitchens et al. 2002; Cattau et al. 2010). Both predator and prey rely on freshwater

9919 wetland habitats for all aspects of their life history. Snail kites locate snails visually from perches

9920 or while flying about 5–33 ft above the water surface (Sykes 1987c; Sykes et al. 1995). Using its

9921 talons, a kite takes a snail from wetland vegetation as far as 6 inches below the water surface,

9922 and using its greatly curved beak, extracts the snail from its shell. Snail kites concentrate hunting

9923 activity in areas of high snail abundance and aerial detectability, returning to the same areas as

9924 long as foraging conditions remain favorable (Cary 1985).

9925

9926 The breeding season varies widely from year to year depending on rainfall and water levels.

9927 Nearly all (98%) nesting attempts are initiated December–July, and 89% are initiated January–

9928 June (Sykes 1987, Beissinger 1988, Snyder et al. 1989). Snail kites often nest again following

9929 both failed and successful initial attempts (Beissinger 1986, Snyder et al. 1989).

9931 During the breeding season, adult snail kites remain close to their nest sites until the young
9932 fledge or the nest fails. Adults forage no more than 6 km (3.7 mi) from the nest (Beissinger and
9933 Snyder 1987), and generally less than a few hundred meters. Following fledging, adults may
9934 remain near the nest for several weeks until the young are fully independent.

9935
9936 Snail kites are gregarious outside of the breeding season and may roost in groups of up to 400 or
9937 more individuals (Bennetts et al. 1994). Roosting sites are usually located over water. In Florida,
9938 communal roosts are primarily in willow stands, and in some cases melaleuca and pond cypress.

9939
9940 Snail kites are not migratory (*i.e.*, undertaking predictable movements between traditional
9941 seasonal habitats), but are nomadic within their range, which is probably an adaptation to
9942 variable hydrologic conditions (Sykes 1979). Outside of the breeding season, snail kites may
9943 travel long distances (> 150 mi in some cases) within and among the major wetland systems of
9944 the species' range in Florida (Bennetts and Kitchens 1997). Most movements are probably
9945 searches for better foraging sites, but some movements occur when conditions appear favorable.
9946 Currently, there is no evidence suggesting that snail kites undertake trans-oceanic movements
9947 (*e.g.*, Florida to Cuba) or interbreed with snail kites located in other countries (Sykes 1979;
9948 Beissinger et al. 1983).

9949
9950 Adult snail kites have relatively high annual survival rates ranging from 85–98% (Nichols et al.
9951 1980; Bennetts et al. 1999; Martin et al. 2006), with higher mortality in drought years (Takekawa
9952 and Beissinger 1989; Martin et al. 2006). Adult longevity records indicate that snail kites may
9953 frequently live longer than 13 years in the wild (Sykes et al. 1995).

9954 9955 **Habitat**

9956
9957 Our South Florida Multi-Species Recovery Plan (USFWS 1999) provides a description of snail
9958 kite habitat characteristics, from which we summarize information that is relevant to this
9959 consultation in this section. Snail kite habitat consists of freshwater marshes and the shallow
9960 vegetated edges of lakes, both natural and man-made, that support apple snails. Areas that most
9961 often support snail kite foraging have emergent vegetation less than < 3 m tall interspersed with
9962 shallow (0.2-1.3 m deep) open water, which may contain relatively sparse patches of submergent
9963 vegetation. Apple snails require emergent vegetation to climb near the water surface to feed,
9964 breathe, and lay eggs. Because snail kites hunt for apple snails visually, dense herbaceous or
9965 woody vegetation precludes efficient foraging. Trees and shrubs (*e.g.*, willow and dahoon holly)
9966 interspersed with the marsh and open water provide hunting perches and roosts.

9967
9968 Roosting sites are nearly always located over water. In Florida, 91.6% are located in willows,
9969 5.6% in *Melaleuca*, and 2.8% in pond cypress. Snail kites tend to roost in willows at a height of
9970 1.8–6.1 m, in stands of 0.02–5 ha. Roosting in *Melaleuca* or pond cypress occurs in stands with
9971 tree heights of 4–12 m.

9972 9973 **Numbers, Reproduction, and Distribution**

9974
9975 In the U.S., the range of the snail kite is limited to Florida. Our South Florida Multi-Species
9976 Recovery Plan (USFWS 1999) provides a history of the species' abundance and distribution in

9977 Florida. The current range includes portions of 20 Florida counties, between Marion and Volusia
9978 counties in the north, and Miami-Dade and Monroe counties in the south. Six regional freshwater
9979 systems support most of the species' breeding activity: marshes in the upper St. Johns River
9980 basin, the Kissimmee River valley, Lake Okeechobee, Loxahatchee Slough, the Everglades (*i.e.*,
9981 areas south of Lake Okeechobee), and the Big Cypress basin.

9982
9983 Reproductive success is highly variable among years, locations, and local nest environments
9984 (Sykes 1979, 1987c; Beissinger 1986; Bennetts et al. 1988; Snyder et al. 1989). Drought reduces
9985 nesting success by depressing native apple snail populations (Beissinger and Takekawa 1983)
9986 and by increasing terrestrial predators' access to nests (Beissinger 1986).

9987 Beginning in 1997, researchers began using a mark-recapture method that accounts for detection
9988 probabilities to estimate snail kite numbers (Dreitz et al. 2002). Population estimates based on
9989 this method ranged from about 3,000 birds in 1997–1999 (Dreitz et al. 2002), to a low of 662
9990 birds in 2009 (Cattau et al. 2009), and 2,585 birds in 2017 (Fletcher et al. 2018). The most recent
9991 (2018) population estimate is 2,347 birds (Fletcher 2019).

9992 **Conservation Needs and Threats**

9993 The principal threats to the snail kite are (USFWS 1999):

- 9994 • the loss, fragmentation, and degradation of wetlands caused by residential, commercial,
9995 and agricultural development, and;
- 9996 • the alteration of wetland hydrology caused by ditches, canals, levees, water control
10000 structures, pump stations, impoundments, and the associated manipulation of water levels
10001 using this infrastructure.

10002 The species' principal conservation needs are to maintain, restore, and enhance the capacity of
10003 wetlands to produce apple snails that are accessible to snail kite foraging.

10004
10005 Nearly half of the Everglades have been drained for agriculture and residential/commercial
10006 development (Davis and Ogden 1994), and other areas have been impounded. The drainage of
10007 Florida's interior wetlands has reduced the extent and quality of habitat for both the apple snail
10008 and the snail kite (Sykes 1983a). The extensive network of ditches and canals has permanently
10009 lowered the water table and facilitated development in many areas that were once snail kite
10010 habitat. Management of this network and associated impoundments influences regional water
10011 levels and recession rates, which affects apple snails (Darby et al. 2006), and often adversely
10012 affects snail kite nesting and foraging (Sykes 1983b; Beissinger and Takekawa 1983; Beissinger
10013 1986; Dreitz et al. 2002; Martin et al. 2007; Cattau et al. 2008).

10014
10015 The discharge of domestic waste water and the runoff of nutrient-laden water from agricultural
10016 lands to surface waters in Florida promotes the growth of invasive exotic and native plants,
10017 particularly cattail (*Typha* spp.), water lettuce (*Pistia stratiotes*), water hyacinth (*Eichhornia
10018 crassipes*), and hydrilla (*Hydrilla verticillata*). High densities of these aquatic plants make apple
10019 snails inaccessible to snail kites (USFWS 2007). Controlling these plants is difficult, and some
10020 attempts involving mechanical removal and herbicides have actually destroyed snail kite nests
10021 (Rodgers and Schwikert 2001).

10023 The native apple snail, *Pomacea paludosa*, was the almost exclusive prey of the snail kite in
10024 Florida, but in the last two decades, a non-native apple snail, *P. maculata*, has become
10025 established the northern half of the snail kite's range, where snail kites are preying upon the
10026 introduced species. Cattau et al. (2016) examined the potential demographic consequences of this
10027 change in the prey base of the snail kite. The highly invasive *P. maculata* is larger, more fecund,
10028 grows faster, has a longer life span, and is more tolerant of drought than *P. paludosa*. Where the
10029 non-native snail is established, its densities are often 2–100 times higher than the native species.
10030 Kite movements and distribution of breeding individuals have tracked the spread of *P. maculata*
10031 populations. Since 2005, a substantial fraction of snail kite breeding has shifted to the northern
10032 portions of the species' range. In 2013, the Kissimmee River Valley and Lake Okeechobee
10033 supported about 80% of the observed nests, but adult survival rates are lower in the more
10034 northern breeding areas. Despite the change to this key vital rate, population monitoring and
10035 modeling suggests that changes to other demographic parameters, such as apparent juvenile
10036 survival, have had a positive influence on the rate of population growth.
10037

10038 Exposure to contaminants that accumulate in apple snails is another recognized threat to the snail
10039 kite. Apple snails absorb and ingest copper from sediments and their diet (Frakes et al. 2008;
10040 Hoang et al. 2008). Elevated copper levels are commonly detected in disturbed Everglades
10041 wetlands, where it accumulates in apple snails and may cause birth defects in snail kites (Frakes
10042 et al. 2008).

10043 **Environmental Baseline for Everglade Snail Kite**

10044 This section describes the current condition of the Everglade snail kite in the Action Area
10045 without the consequences to the listed species caused by the proposed Action.

10046 **Action Area Numbers, Reproduction, and Distribution**

10047 The Plan Area is near the southwestern edge of the species' range in Florida. The eBird website
10048 (<https://ebird.org/explore>; accessed 10/31/19) has numerous records of snail kite observations
10049 within the Plan Area in the past 10 years, generally of a single bird, but occasionally of as many
10050 as six at a single location. Meyer et al. (2017) provided the Service with data from a study
10051 tracking the movements of telemetered snail kites, including two adult birds located within the
10052 Plan Area in 2013 and 2014 (Figure 17-1) that did not nest in the Plan Area. In 2018, a Service
10053 biologist observed three immature snail kites foraging in “peripheral wetlands” (see section
10054 17.1.2, “Habitat”) of the Plan Area during a Christmas bird count (Danaher 2019).

10055 We have no records of snail kite nesting in the Plan Area. Recorded snail kite nesting activity
10056 closest to the Plan Area is about 9 mi north on private lands in Hendry County, about 12 mi
10057 northwest on private lands in Lee County, and more than 16 mi to the east and southeast on
10058 public conservation lands (see HCP Figure 5-5). While nesting, adult birds forage less than 4 mi
10059 from the nest (see section 17.1.2, “Life History”). Therefore, we believe that snail kite
10060 observations within the Plan Area represent nomadic and opportunistic use of available foraging
10061 habitats by birds that are not breeding in the Plan Area, such as the telemetered birds tracked to
10062 the Plan Area (Figure 17-1).

10069 Wetland types that are most likely to support snail kite foraging and roosting in the Plan Area
10070 include (from Table 2-1):

- 10071 1 freshwater non-forested wetlands (105 acres);
- 10072 2 prairies and bogs (10,163 acres);
- 10073 3 marshes (16,699 acres);
- 10074 4 isolated freshwater marsh (1,806 acres);
- 10075 5 isolated freshwater swamp (4,063 acres);
- 10076 6 cultural - lacustrine (1,184 acres);
- 10077 7 cultural - riverine (160 acres);
- 10078 8 lacustrine (133 acres); and
- 10079 9 natural lakes and ponds (28 acres).

10080

10081 Collectively, these types cover 34,340 acres (21.5%) of the 159,489-acre Plan Area. We have no
10082 data that would support a meaningful estimate of the numbers of snail kites that likely use the
10083 Plan Area annually during nomadic wanderings and dispersal from natal territories located
10084 elsewhere. We believe that relatively low numbers probably spend a few weeks or months of the
10085 year foraging and roosting in the Plan Area.

10086

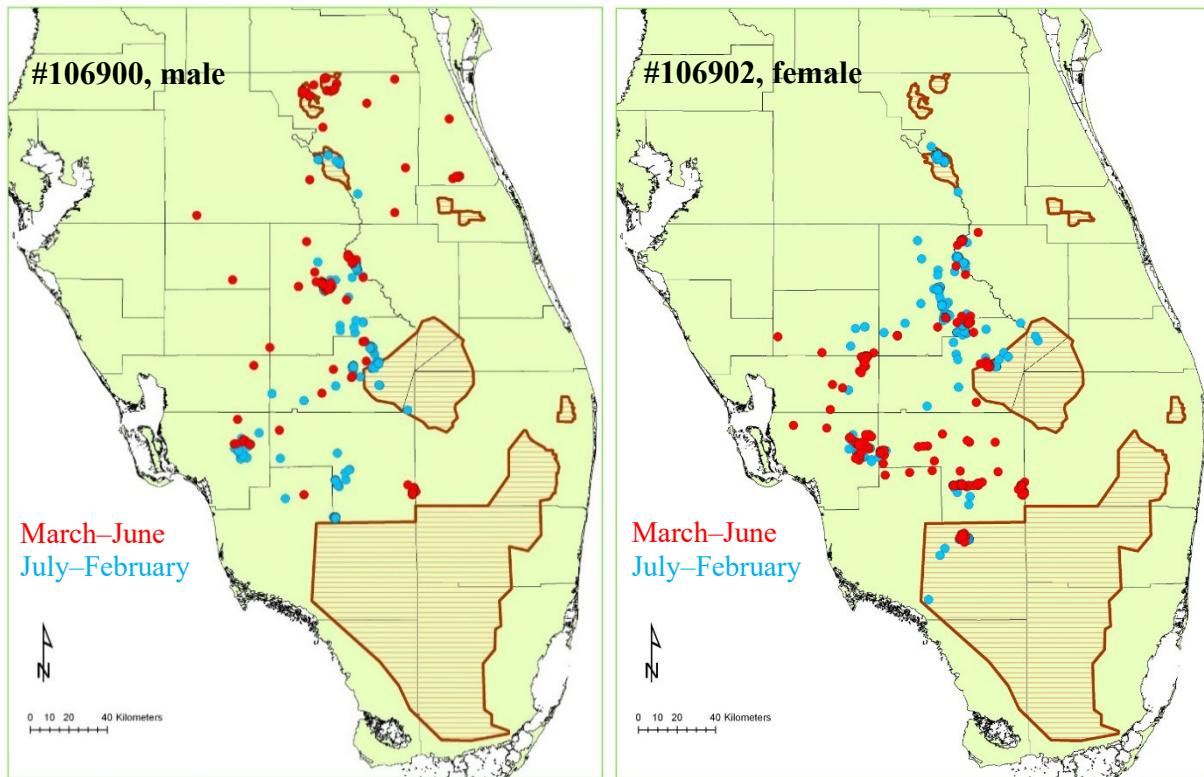
10087 **Action Area Conservation Needs and Threats**

10088

10089 Snail kite use of the Plan Area appears limited to foraging and roosting for small numbers of
10090 birds for brief periods. However, the species' primary conservation needs in this context are
10091 essentially the same as those within portions of the range that support breeding activity, *i.e.*,
10092 maintain, restore, and enhance wetlands that provide abundant populations of apple snails that
10093 are available to snail kites. The loss or degradation of such habitats caused by drainage,
10094 development activity, and/or eutrophication would correspondingly reduce the ability of the Plan
10095 Area to support snail kites.

10097
10098

Tables and Figures



10099
10100
10101

Figure 17-2. Telemetry data for two adult snail kites tracked 2013–2014 that Meyer et al. (2017) located within the Plan Area.

10102

10103

Effects of the Action on Everglade Snail Kite

10104

This section describes all reasonably certain consequences to the Everglade snail kite that we predict the proposed Action would cause, including the consequences of other activities not included in the proposed Action that would not occur but for the proposed Action. Such effects may occur later in time and may occur outside the immediate area involved in the Action.

10105

Development and Mining, Base Zoning, and Eligible Lands

10106

The designated Development and Mining, Base Zoning, and Lands Eligible for inclusion (collectively, the development envelope of the HCP) encompass 66,245 acres (Table 2-1); however, the HCP proposes a development cap of 39,973 acres. Open water cover classes are unlikely to receive development activity, and other wetlands are unlikely to receive a disproportionately large share of it, but some wetlands loss is likely. We apply the “proportional method” described in section 2.1.4 to estimate the extent of wetlands loss that development of up to 39,973 acres would cause.

10107

10108

10121 Table 17-1 shows the results of our calculations, taken from Table 2-3, for those cover classes
10122 that snail kites are likely to use. We estimate that the proposed Action could convert up to 3,133
10123 acres of wetland habitats to residential, commercial, or mining uses. The designated
10124 Development and Mining areas contain 1,969 acres of wetland types associated with snail kites,
10125 which is the maximum loss of wetlands that could occur if development is confined entirely to
10126 these areas (*i.e.*, no substitution of Base Zoning or Eligible lands in the development cap).

10127 Development and mining in wetlands would involve various activities (drainage, filling,
10128 excavation, paving, building construction, *etc.*) that would permanently eliminate 1,969–3,133
10129 acres of wetlands as snail kite habitat. We do not believe the Plan Area supports snail kite
10130 nesting; therefore, we do not expect development activities to directly kill or injure snail kite
10131 eggs or flightless young. Development of wetlands used for foraging would cause a small
10132 number of snail kites that use these areas during nomadic wanderings and dispersal to forage
10133 elsewhere. Because these kites are mobile and seeking foraging opportunities (*i.e.*, not
10134 provisioning young in a nest), we do not expect significant adverse consequences to individuals
10135 resulting from such displacement.

10136
10137 To mitigate for permanent snail kite habitat losses associated with the Covered Activities, the
10138 Applicants propose to “Preserve, and potentially restore, enhance, and/or create suitable snail
10139 kite foraging and/or nesting habitat” within the designated Preservation and Very Low Density
10140 Use areas (HCP chapter 7.2.1.5). We consider the effects of these proposals in the following
10141 section.

10142
10143 **Preservation Activities**

10144 The designated Preservation Areas of the HCP contain 27,600 acres, or 80.4% (Table 17-1), of
10145 the wetland types in the Plan Area that we consider as potential snail kite habitat. The Applicants
10146 propose a continuation of existing land uses (agriculture, silviculture, *etc.*) in the Preservation
10147 Areas, which we listed in section 2.3. All of these uses may occur to some extent in native
10148 wetlands of the Preservation Areas except crop cultivation. Land management activities in the
10149 Preservation Areas for which the Applicants seek take authorization and that may occur in
10150 wetlands include:

10151 prescribed burning;
10152 mechanical control of groundcover (*e.g.*, roller chopping, brush-hogging, mowing);
10153 ditch and canal maintenance;
10154 mechanical and/or chemical control of exotic vegetation; and
10155 similar activities that maintain or improve land quality.

10156 These activities may temporarily disrupt snail kite foraging activity, but are unlikely to harm
10157 birds that are not nesting. We believe that willow stands surrounded by standing water, the
10158 typical setting for snail kite roosting, are unlikely locations for these land management actions.

10159
10160 In Chapter 7.2.1.5 of the HCP, the Applicants propose to maintain snail kite habitats in the
10161 Preservation and Very Low Density use designations (Objective 1), and to potentially restore,
10162 enhance, or create such habitats to mitigate for permanent losses associated with the Covered
10163 Activities (Objective 2). The HCP notes that restoration/enhancement activities would typically

10167 occur in conjunction with Clean Water Act section 404 permitting processes. The HCP indicates
10168 that management would “focus on maintaining apple snail populations in wetlands, controlling
10169 exotic/nuisance wetland and aquatic plant species, and buffering nest areas from human
10170 activities” in coordination with the Service and USACE permitting. The HCP does not specify
10171 performance measures (amount or extent, functional gain) for such restoration and enhancement
10172 activities.

10173
10174 We do not expect the management of Preservation Areas to reduce the numbers, reproduction, or
10175 distribution of the snail kite in the Preservation Areas, because these activities would, at
10176 minimum, maintain current conditions. Special attention to this species in the long-term
10177 management of the Preservation Areas under conservation easements could increase the number
10178 of snail kites that the Plan Area supports, and possibly even promote nesting activity. However,
10179 lacking detailed information about how habitat management under conservation easements may
10180 benefit this species, we are unable to estimate the extent of potential benefits.

10181
10182 **Very Low Density Development**

10183
10184 The Very Low Density (VLD) use areas of the HCP contain 264 acres of native wetlands, and
10185 667 acres of lakes and ponds with peripheral wetlands (total 931 acres), that could support snail
10186 kite foraging and roosting (Table 17-1). Land uses in the VLD areas are similar to the
10187 Preservation Areas, but may also include isolated residences, lodges, and hunting/fishing camps,
10188 at a density of no more than one dwelling unit per 50 acres. The Applicants would continue
10189 current ranching/livestock operations and other management activities as described for the
10190 Preservation Areas (e.g., exotic species control, prescribed burning). As in the Preservation
10191 Areas, we do not expect adverse effects resulting from the continuation of the existing land
10192 management regimes.

10193
10194 The HCP does not specify a footprint for the isolated residences, lodges, and hunting/fishing
10195 camps, but indicates that their construction could clear up to 10% of the existing native
10196 vegetation (see section 2.5). New dwelling development could occur within any of the cover
10197 types present besides open water and existing development. It is possible that dwelling
10198 development in the VLD areas could entirely avoid wetlands, but we conservatively estimate a
10199 26-acre habitat loss (10% of the 264 acres of native wetlands). Development of wetlands used as
10200 foraging areas would cause a small number of snail kites that may use the VLD areas during
10201 nomadic wanderings and dispersal to forage elsewhere. We do not expect significant adverse
10202 consequences to individuals resulting from such displacement.

10203
10204 The general measures for enhancing snail kite habitat in the Preservation Areas apply to the VLD
10205 areas as well (see previous section 17.3.2). However, the potential to increase or enhance snail
10206 kite foraging habitat is limited due to the small extent of wetlands in the VLD areas.

10208 **Tables and Figures**

10209
10210 **Table 17-1.** Acreage of cover classes that occur in the Plan Area, by HCP land use designation,
10211 that snail kites are likely to use for foraging and roosting.

COOPERATIVE LAND COVER CLASS	C. ELIGIBLE					PLAN AREA TOTAL	Development Envelope (A+B+C)	Estimated Extent of Development ¹
	A. DEVELOP- MENT	B. BASE ZONING	C. FOR INCLUSIO N	D. VERY LOW DENSITY	E. PRESER- VATION			
Marshes	1,007	0	1,335	124	14,233	16,699	2,342	1,411
Prairies and Bogs	708	0	1,152	98	8,205	10,163	1,860	1,127
Isolated Freshwater Swamp	168	0	173	40	3,681	4,063	341	208
Isolated Freshwater Marsh	9	536	102	2	1,156	1,806	648	384
Freshwater non-Forested Wetlands	6	0	0	0	99	105	6	3
Cultural - Lacustrine	45	0	419	657	63	1,184	464	0
Cultural - Riverine	25	0	42	0	92	160	67	0
Lacustrine	0	0	75	9	48	133	75	0
Natural Lakes and Ponds	0	0	6	1	21	28	6	0
COLUMN TOTAL	1,969	536	3,304	931	27,600	34,340	5,809	3,133
COLUMN PERCENT	5.7%	1.6%	9.6%	2.7%	80.4%	100.0%	16.9%	9.1%

10213
10214
10215
10216 ¹ From column “G” of Table 2-3, which prorates the development cap among the three HCP land-use designations
10217 of the HCP development envelope.

10218 **Cumulative Effects on Everglade Snail Kite**

10219
10220 For purposes of consultation under ESA §7, cumulative effects are those caused by future state,
10221 tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future
10222 Federal actions that are unrelated to the proposed action are not considered, because they require
10223 separate consultation under §7 of the ESA.

10224 We identified in section 3 of this BO/CO a projected increase in traffic on public roads as the
10225 sole source of effects that are consistent with the definition of cumulative effects for this Action.
10226 We have no information that suggests traffic on public roads is a predictable cause of snail kite
10227 injury, mortality, or significant behavioral modification.

10228 **Conclusion for Everglade Snail Kite**

10229 In this section, we summarize and interpret the findings of the previous sections for the snail kite
10230 (status, baseline, effects, and cumulative effects) relative to the species-specific purpose of a BO
10231 under §7(a)(2) of the ESA, which is to determine whether the proposed action is likely to
10232 jeopardize the continued existence of a species.

10233 **Status**

10234 Snail kites are dietary specialists that feed almost exclusively on apple snails. Both predator and
10235 prey rely on freshwater wetland habitats for all aspects of their life history. Snail kites are
10236 nomadic, probably as an adaptation to variable hydrologic conditions. Outside of the breeding

10244 season, snail kites may travel long distances within and among the major wetland systems of the
10245 species' range in Florida. The most recent (2018) population estimate is 2,347 birds. The
10246 principal threats to the snail kite are:

1. the loss, fragmentation, and degradation of wetlands caused by residential, commercial,
10247 and agricultural development, and;
2. the alteration of wetland hydrology caused by ditches, canals, levees, water control
10249 structures, pump stations, impoundments, and the associated manipulation of water levels
10250 using this infrastructure.

10251 The species' principal conservation needs are to maintain, restore, and enhance the capacity of
10252 wetlands to produce apple snails that are accessible to snail kite foraging.

10253 Kite movements and distribution of breeding individuals have tracked the spread of non-native
10254 apple snail (*P. maculata*) populations. Since 2005, a substantial fraction (about 80%) of snail kite
10255 breeding has shifted to the northern portions of the species' range (Kissimmee River Valley,
10256 Lake Okeechobee).

Baseline

10257 Snail kites are known to use the Plan Area, but we have no records of snail kite nesting within 9
10258 mi the Plan Area, which lies on the southwestern edge of the species' range in Florida. Snail kite
10259 observations within the Plan Area most likely represent nomadic and opportunistic use of
10260 available foraging habitats by birds that do not nest in the Plan Area. The Plan Area contains
10261 34,340 acres of freshwater wetland and open water cover classes that could support foraging and
10262 roosting. We believe that relatively low numbers of snail kites probably spend a few weeks or
10263 months each year in the Plan Area. Conservation needs and threats in the Plan Area parallel the
10264 range-wide needs and threats.

Effects

10265 The development and mining in the Plan Area would involve various activities (drainage, filling,
10266 excavation, paving, building construction, *etc.*) that would permanently eliminate 1,969–3,133
10267 acres of wetlands as snail kite foraging and roosting habitat, depending on its distribution within
10268 the potential development envelope. This loss would cause a small number of snail kites that use
10269 these areas during nomadic wanderings and dispersal to forage elsewhere. We do not expect
10270 significant adverse consequences (death or injury) to individuals resulting from such
10271 displacement.

10272 The designated Preservation Areas of the HCP contain 27,600 acres, or 80.4%, of the wetland
10273 types in the Plan Area that we consider as potential snail kite habitat. The Applicants propose to
10274 preserve existing habitats, and to potentially restore, enhance, or create such habitats to mitigate
10275 for permanent losses associated with the Covered Activities. The HCP does not specify
10276 performance measures (amount or extent, functional gain) for such restoration and enhancement
10277 activities. We do not expect the management of Preservation Areas to reduce the numbers,
10278 reproduction, or distribution of the snail kite in the Preservation Areas, because these activities
10279 would, at minimum, maintain current conditions. Special attention to this species in the long-

10289 term management of the Preservation Areas under conservation easements could increase the
10290 number of snail kites that the Plan Area supports, and possibly even promote nesting activity.
10291

10292 The Very Low Density use areas of the HCP contain 931 acres of native wetlands and open
10293 water that could support apple snails and foraging for a few snail kites. Development of some
10294 portions of these for residences, lodges, hunting/fishing camps could reduce such habitat by up to
10295 26 acres, but we do not expect significant adverse consequences to snail kites resulting from such
10296 displacement.

10297

Cumulative Effects

10298 We have no information that suggests traffic on public roads, which is the sole source of
10299 cumulative effects we have identified for this Action, is a predictable cause of snail kite injury,
10300 mortality, or significant behavioral modification.

10301

Opinion

10302 The loss of about 2,000–3,000 acres of wetlands that likely support nomadic snail kite foraging
10303 activity would add an increment of habitat loss to the species' range. Because it does not appear
10304 that the Plan Area supports snail kite nesting, we do not expect this habitat loss to actually kill or
10305 injure snail kites. Another approximately 27,000 acres of freshwater wetlands and open water
10306 areas would remain in the Preservation Areas, where future management as mitigation for habitat
10307 losses may increase snail kite carrying capacity, but such enhancement is not predictable with
10308 available data.

10309 Situated on the southwestern edge of the species' range in Florida, the Plan Area does not
10310 provide a vital corridor for movement among the primary breeding regions. In recent years, most
10311 kite breeding activity is concentrated in regions to the north (Kissimmee River Valley, Lake
10312 Okeechobee). In this context, the loss of nomadic foraging habitat in the development areas,
10313 potentially offset to some degree with habitat enhancements in an acreage of Preservation Areas
10314 nine times larger than the loss, does not represent an appreciable reduction in the species'
10315 distribution. We expect no significant reductions to the species' reproduction or numbers caused
10316 by the proposed Action.

10317 After reviewing the current status of the species, the environmental baseline for the Action Area,
10318 the effects of the Action and the cumulative effects, it is the Service's biological opinion that the
10319 Action is not likely to jeopardize the continued existence of the snail kite.

10320

18. Eastern Diamondback Rattlesnake

10321 This section provides the Service's conference opinion of the Action for the eastern
10322 diamondback rattlesnake.

10323

18.1 Status of Eastern Diamondback Rattlesnake

10335 This section summarizes best available data about the biology and current condition of the
10336 eastern diamondback rattlesnake (*Crotalus adamanteus*) (EDR) throughout its range that are
10337 relevant to formulating an opinion about the Action. At this time, the EDR is not protected under
10338 the ESA, but its status relative to the ESA definitions of “endangered” and “threatened” is under
10339 review (77 FR 27403, May 10, 2012, 90-Day Finding).

10340 18.1.1 Species Description

10341 The EDR is the largest venomous snake in the U.S. The Florida Museum (2018) provides the
10342 following description:

10343 “Average adult size is 36–72 inches (91–183 cm), record is 96 inches (244 cm). A large,
10344 heavy-bodied snake with a row of large dark diamonds with brown centers and cream
10345 borders down its back. The ground color of the body is brownish. The tail is usually a
10346 different shade, brownish or gray, and toward the end of the tail the diamonds fade out or
10347 break into bands. The tail ends in a rattle. The scales are keeled. The large and thick head
10348 has a light bordered dark stripe running diagonally through the eye and there are vertical
10349 light stripes on the snout. The pupil is vertical (cat-like) and there is a deep facial pit
10350 between the nostril and the eye. The young are similar to the adults in color pattern. The
10351 tip of the tail of new born Eastern Diamondback Rattlesnake ends in a “button,” which is
10352 the first segment of the future rattle.”

10353 18.1.2 Life History

10354 The EDR is a solitary ambush predator that feeds on a variety of rodents and rabbits (Means
10355 2017). Although it uses the burrows of other animals for shelter, the EDR hunts only above
10356 ground (Timmerman and Martin 2003). Individuals do not defend a territory or den communally,
10357 and interact with others only for mating (Means 2009). Females reach sexual maturity between
10358 2–6 years (Timmerman and Martin 2003). EDRs bear live young, with a gestation period lasting
10359 from April–May through August–September (Martin and Means 2000). The natural lifespan of
10360 an EDR is probably 15–20 years, but field evidence suggests that few individuals live beyond 10
10361 years, most likely due to anthropogenic mortality (Timmerman and Martin 2003).

10362 Martin and Means (2000) described the primary habitats of the EDR as open-canopy, pyro-
10363 climax (conditions maintained by a frequent fire regime) pinelands and savannas, including
10364 longleaf pine/wire grass sandhills, clayhills, and flatwoods. The species also occurs in coastal
10365 strand forest, palmetto prairie, temperate hardwood forest, tropical hardwood hammocks, and
10366 sand pine or oak scrub, especially where these are adjacent to pine-dominated habitats. Present-
10367 day habitats include various ruderal (disturbed) situations such as berms along canals, citrus
10368 groves, spoil islands, and old-field successional habitats. The EDR may occur in agricultural
10369 areas that have patches of native or early-successional habitat nearby. Old fields and abandoned
10370 citrus groves may support relatively high densities. Planted pines are suitable habitats for 10–15
10371 years until the canopy closes.

10372 EDRs require shelter during cold weather and during fires. Gopher tortoise burrows, armadillo
10373 burrows, and stumps are typical shelter for the species (Hoss 2017; Timmerman and Martin
10374

10380 2003). In the mild winters of south Florida, EDRs often use patches of saw palmetto as cover
10381 (Martin and Means 2000).

10382
10383 Martin and Means (2000) summarized available home range studies, which report substantial
10384 differences in different portions of the species' range and by sex. Males have a larger home
10385 range. In a northeast Florida study area, average male and female home range was 208 and 115
10386 acres, respectively. In a northwest Florida study area, average male and female home range was
10387 494 and 198 acres, respectively. In a south Florida (Everglades) study area, the minimum home
10388 range (sexes not reported) was 297 acres and the maximum was 642 acres.

10390 **18.1.3 Numbers, Reproduction, and Distribution**

10391
10392 The historical (pre-European settlement) range of the EDR most likely encompassed most of the
10393 Coastal Plain of the southeastern U.S. from North Carolina to South Florida, and west to
10394 Mississippi and Louisiana, generally coinciding with the historical distribution of the longleaf
10395 pine savanna ecosystem (Martin and Means 2000). Means (2017) estimated historical range wide
10396 abundance at about 3.08 million snakes, and current range wide abundance at less than 100,000.
10397 The species is currently most abundant in south Georgia and north Florida (Martin and Means
10398 2000).

10399
10400 Citrus groves, improved pastures, and urban development have replaced a substantial fraction of
10401 EDR native uplands habitat in peninsular Florida (Martin and Means 2000). The species has
10402 become rare or extirpated from many locations in Florida, including many barrier islands and the
10403 Florida Keys. However, with the species' extirpation from many northern areas within the
10404 historical range, Florida now constitutes about half of the species' current range (Timmerman
10405 and Martin 2003). Habitat availability for gopher tortoises in Florida, a species with similar
10406 habitat associations, is estimated at about 3.3 million acres (see section 20.1.3 in "Status of
10407 Gopher Tortoise"). Due to this large amount of remaining potential habitat, the EDR is more
10408 likely to persist in Florida than in other states (Martin and Means 2000).

10409 **18.1.4 Conservation Needs and Threats**

10410
10411 The species' abundance has likely been declining since the 1930s, and more rapidly since the
10412 1970s, coinciding with substantial growth of the human population in the southeastern U.S.
10413 (Timmerman and Martin 2003). Conversion of native upland cover to agricultural, intensive
10414 silvicultural, and urban uses have caused habitat loss and fragmentation, and plant community
10415 succession resulting from fire suppression has caused habitat degradation (Timmerman and
10416 Martin 2003).

10417
10418 Ware et al (1993) estimated that only 2% remains of the historical extent of longleaf pine
10419 savannas, the primary EDR habitat. Habitat fragmentation increases the likelihood of interactions
10420 with people who may kill or injure rattlesnakes, intentionally or inadvertently. Eastern EDRs are
10421 capable of moving 0.8–1.6 km (0.5–1.0 mi) in a day (Means 2017). In fragmented habitats, these
10422 movements make them highly susceptible to road mortality. Means (2017) concluded that "road
10423 kills have a serious negative effect on EDR populations, particularly where habitat is fragmented
10424 and reduced to small patches by roads."

10426
10427 Since the 1930s, EDRs and EDR parts have been sold for meat, skins for clothing, rattles and
10428 heads for the curio trade, and venom for medical applications (e.g., antivenin to treat snake bite).
10429 Timmerman and Martin (2003) estimated that thousands were killed annually for these various
10430 commercial purposes. Today, only North Carolina classifies and protects the EDR as an
10431 endangered species under state law, which prohibits killing or disturbing the species (N.C.
10432 Wildlife Resource Commission 2017). Killing EDRs is legal without a hunting license in
10433 Alabama, Florida, Georgia, and South Carolina (but not on public lands in South Carolina), and
10434 requires a hunting license in Mississippi. Reliable estimates of numbers intentionally killed for
10435 sport or for a real or perceived human safety purpose are not available.

10436
10437 EDR “roundups” began in the 1950s. The most common roundup technique flushes snakes from
10438 a gopher tortoise burrow by blowing gasoline fumes into it. At the height of its popularity, 23
10439 towns throughout the species’ range organized an annual roundup event. All but two of these
10440 towns have discontinued the events or converted them to non-lethal snake education events
10441 (Means 2009). Only Cairo, Georgia, and Opp, Alabama, continue lethal EDR roundups (Center
10442 for Biological Diversity 2019). The roundups likely contributed to substantial local population
10443 declines. Records from the various roundups indicate a decline over time in both capture rates
10444 and snake size (Means 2009, Timmerman and Martin 2003).

10445
10446 Although protection from exploitation and killing is generally a necessary step in conserving a
10447 declining species, the EDRs primary conservation need is to maintain, restore, and enhance
10448 native upland habitats, especially longleaf pine savannas. The range and habitat preferences of
10449 the EDR substantially overlap with those of the eastern indigo snake (see section 19) and gopher
10450 tortoise (see section 20). Conservation actions intended for these and other species associated
10451 with native upland habitats of the southeast U.S. coastal plain benefit the EDR.

10452 18.2 Environmental Baseline for Eastern Diamondback Rattlesnake

10453 This section describes the current condition of the EDR in the Action Area without the
10454 consequences to the listed species caused by the proposed Action.

10455 18.2.1 Action Area Numbers, Reproduction, and Distribution

10456 The Applicants did not conduct surveys to map EDR distribution or estimate EDR abundance in
10457 the Plan Area. As evidence that the species occurs in the Plan Area, the HCP (Chapter 5.4.1.3)
10458 cites Krysko et al. (2011), which includes three records (collection sites for museum specimens)
10459 from the Plan Area, and Martin and Means (2000), which includes two additional records (also
10460 collection sites for museum specimens) from the Plan Area. These records, and the availability of
10461 native upland habitats associated with the species, support a finding that the species is reasonably
10462 certain to occur in the Plan Area.

10463 Land cover classes listed in Table 2-1 that align with the habitat descriptions of Martin and
10464 Means (2000) (see section 18.1.2; Life History) include all seven of the native upland classes
10465 that occur in the Plan Area. Martin and Means (2000) report that old fields and abandoned citrus
10466 groves can support high populations when relatively natural habitat is also available. Similarly,

10472 Hoss (2007) concluded that EDRs persist in agricultural areas only if sufficient natural habitat is
10473 nearby. Nearly half (48.3%; Table 2-2) of the Plan Area is in active agriculture (orchards, crops,
10474 pastures); however, most of this acreage is represented by large tracts that border natural habitats
10475 along the margins only. Although the home ranges of EDRs in the Plan Area probably include
10476 some extent of agricultural and wetlands cover, native uplands are most likely to support the
10477 species. Native uplands constitute 13,221 acres (8.3%) of the Plan Area.

10478
10479 Researchers report average home range sizes of 208–494 acres for males, and 115–198 acres for
10480 females (see section 18.1.2). Means (1986) estimated a density of about 1 adult EDR per 8 ha
10481 (19.8 acres) in high-quality habitat (longleaf pine savanna), which implies substantial overlap
10482 between individual home ranges. EDRs are not territorial, do not den communally, and interact
10483 with other EDRs only for mating (see section 18.1.2, Life History). The home ranges of
10484 individuals probably overlap to a degree that corresponds with prey abundance, cover
10485 availability, and other habitat factors.

10486
10487 The Plan Area does not contain high-quality longleaf pine savanna habitats, but does contain a
10488 substantial acreage of orchards, pastures, and other ruderal habitats interspersed with flatwoods
10489 and other types of native upland cover. Therefore, to estimate EDR numbers in the Plan Area, we
10490 apply the density of 1 snake per 19.8 acres in high-quality habitat to the acreage of native upland
10491 cover classes only (*i.e.*, not to the acreage of agricultural cover classes). We expect the 13,221
10492 acres of native uplands in the Plan Area, and the adjacent margins of other cover types, to
10493 support about 668 adult EDRs.

10494 10495 **18.2.2 Action Area Conservation Needs and Threats**

10496
10497 Threats to EDRs in the Action Area parallel the threats at the range wide scale: habitat loss,
10498 fragmentation, and degradation through fire suppression; and road mortality and other lethal
10499 encounters with humans. Protecting and managing large tracts of native uplands is the species'
10500 primary conservation need.

10501 10502 **18.3 Effects of the Action on Eastern Diamondback Rattlesnake**

10503
10504 This section describes all reasonably certain consequences to the EDR that we predict the
10505 proposed Action would cause, including the consequences of other activities not included in the
10506 proposed Action that would not occur but for the proposed Action. Such effects may occur later
10507 in time and may occur outside the immediate area involved in the Action.

10508 10509 **18.3.1 Development and Mining, Base Zoning, and Eligible Lands**

10510
10511 Because EDRs rely primarily on native upland cover types, and it is plausible that development
10512 would occur disproportionately in these non-wetland cover types, we use the RMI method
10513 described in section 2.1.4 to estimate the extent of development in EDR habitats. Native uplands
10514 cover 1,804, 16, and 734 acres of the Development and Mining, Base Zoning, and Eligible Lands
10515 designations, respectively (Table 2-2). These 2,554 native upland acres amount to less than the
10516 development cap of 39,973 acres that may occur within the 66,245-acre development envelope.
10517 Development confined entirely to the Development areas, or implemented with the maximum

10518 possible substitution of Base Zoning and/or Eligible lands in the accounting for the cap, could
10519 replace all of the native uplands habitats in one or more of these HCP land use designations.
10520 Using a density of 1 snake per 19.8 (see section 18.2.1), the native uplands in the Development
10521 and Mining, Base Zoning, and Eligible Lands designations would support about 91, 1, and 37
10522 EDRs, respectively (total 129).

10523
10524 The development would involve vegetation clearing, grading, excavation and piling, the use
10525 heavy equipment and other vehicles at project sites, and the construction of buildings and
10526 associated infrastructure. Such substantial alterations of habitats that support EDR feeding,
10527 breeding, and sheltering behaviors would disturb, displace, injure, or kill snakes that are present
10528 at the time of those activities, depending on site- and project-specific circumstances. An increase
10529 in human habitation of the developed areas would increase the likelihood of encounters in which
10530 people intentionally kill EDRs.

10531
10532 Displacement by habitat loss could cause EDRs to cross roads seeking alternative habitats, and
10533 increased vehicle traffic on public roads during and after construction would increase the risk of
10534 roadkill. However, lacking records of EDR roadkill numbers or locations in the Action Area, we
10535 have insufficient data to predict with reasonable certainty an expected increase in the risk of
10536 roadkill. Although some individuals may survive displacement from developed areas,
10537 conservatively, we estimate the number of adult individuals harmed by development activities as
10538 the total number (129) that we expect to use 2,554 acres of upland habitats in the development
10539 envelope.

10540 10541 **18.3.2 Preservation Activities**

10542
10543 The designated Preservation Areas contain 10,221 acres, or 77% (Table 2-2), of the native
10544 uplands cover in the Plan Area considered primary EDR habitat. We estimate Plan Area EDR
10545 numbers at about 668 adults (see section 18.2.1), and expect the Preservation Areas to support
10546 about $0.77 \times 668 = 514$ EDRs.

10547
10548 The Applicants propose a continuation of existing land uses (agriculture, silviculture, *etc.*) in the
10549 Preservation Areas, which we listed in section 2.3. Land management activities in the
10550 Preservation Areas for which the Applicants seek take authorization include:
10551 prescribed burning;
10552 mechanical control of groundcover (*e.g.*, roller chopping, brush-hogging, mowing);
10553 ditch and canal maintenance;
10554 mechanical and/or chemical control of exotic vegetation;
10555 soil tillage; and
10556 similar activities that maintain or improve land quality.

10557
10558 Prescribed burning maintains habitat quality in the native uplands that EDRs prefer (see section
10559 18.1.2). EDRs may readily avoid a slowly advancing prescribed fire by seeking refuge in
10560 burrows or other shelters. Likewise, EDRs may readily avoid slowly advancing heavy equipment
10561 engaged in vegetation management or soil tillage, and soil tillage would not occur in native
10562 uplands. Controlling exotic vegetation also maintains EDR habitat quality, and we have no data
10563 that suggests that herbicides applied according to label instructions may harm EDRs. In general,

10564 these land management practices may temporarily disrupt EDR foraging activity, but we do not
10565 expect them to kill or injure individuals.

10566
10567 The Applicants do not specifically propose to restore, enhance or create EDR habitats in the
10568 Preservations areas, but propose to maintain pine flatwoods and other upland forest types with
10569 prescribed fire and exotic plant removal. We do not expect the management of Preservation
10570 Areas to reduce the numbers, reproduction, or distribution of the EDR in the Preservation Areas,
10571 because these activities would, at minimum, maintain current conditions. Long-term
10572 management of the Preservation Areas with prescribed fire could increase EDR densities and
10573 local abundance, which we expect are currently at low levels.

10574 **18.3.3 Very Low Density Development**

10575
10576 The Very Low Density (VLD) use areas contain 447 acres, or 3.4% of the native uplands cover
10577 in the Plan Area. Using a density of 1 snake per 19.8 acres, we estimate Plan Area EDR numbers
10578 at about 668 individuals (see section 18.2.1), and expect the Preservation Areas support about
10579 $0.034 \times 668 = 23$ EDRs.

10580
10581 Land uses in the VLD areas are similar to the Preservation Areas, but may also include isolated
10582 residences, lodges, and hunting/fishing camps, at a density of no more than one dwelling unit per
10583 50 acres. The Applicants would continue current ranching/livestock operations and other
10584 management activities as described for the Preservation Areas (e.g., exotic species control,
10585 prescribed burning). As in the Preservation Areas, we do not expect continuing the existing land
10586 management regimes to harm EDRs.

10587
10588 The HCP does not specify a footprint for the isolated residences, lodges, and hunting/fishing
10589 camps, but indicates that their construction could clear up to 10% of the existing native
10590 vegetation (see section 2.5). New dwelling development could occur within any of the cover
10591 types present besides open water and existing development. It is possible that dwelling
10592 development in the VLD areas could entirely avoid native uplands, but we conservatively
10593 estimate a 45-acre habitat loss (10% of these types) affecting about $45 \div 19.8 = 2$ EDRs.
10594 Development within a portion of the home range of an EDR would cause the individual to shift
10595 its activity accordingly. However, the scale of this potential habitat loss (45 acres), which is the
10596 total for three widely separated VLD use areas, is less than half the home range size of a female
10597 and less than a quarter of the home range size of a male (see section 18.1.3). Therefore, we do
10598 not expect significant adverse consequences to individuals resulting from displacement at this
10599 scale.

10600 **18.4 Cumulative Effects on Eastern Diamondback Rattlesnake**

10601
10602 For purposes of consultation under ESA §7, cumulative effects are those caused by future state,
10603 tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future
10604 Federal actions that are unrelated to the proposed action are not considered, because they require
10605 separate consultation under §7 of the ESA.

10609 We identified in section 3 of this BO/CO a projected increase in traffic on public roads as the
10610 sole source of effects that are consistent with the definition of cumulative effects for this Action.
10611 Roadkill is a documented cause of EDR mortality (see section 18.1.4). Increased vehicle traffic
10612 unrelated to the Action is a stressor that may adversely affect EDRs in the Action Area. As the
10613 population of southwest Florida increases, we expect more vehicle use in the Action Area and a
10614 concomitant increase in the risk of road mortality of animals in general. However, lacking data
10615 about EDR roadkill numbers and locations in the Action Area, we cannot predict with reasonable
10616 certainty an increase in risk of roadkill caused by sources unrelated to the Action.
10617

10618 **18.5 Conclusion for Eastern Diamondback Rattlesnake**

10619
10620 In this section, we summarize and interpret the findings of the previous sections for the EDR
10621 (status, baseline, effects, and cumulative effects) relative to the species-specific purpose of a BO
10622 under §7(a)(2) of the ESA, which is to determine whether the proposed action is likely to
10623 jeopardize the continued existence of a species.
10624

10625 **Status**

10626
10627 The pre-European settlement range of the EDR probably encompassed most of the Coastal Plain
10628 of the southeastern U.S., generally coinciding with the historical distribution of the longleaf pine
10629 savanna ecosystem. The species has declined from an estimated historical range wide abundance
10630 of about 3.08 million to less than 100,000. The species remains most abundant in south Georgia
10631 and north Florida. Conversion of native upland cover to agricultural, intensive silvicultural, and
10632 urban uses have caused habitat loss and fragmentation, and plant community succession resulting
10633 from fire suppression has caused habitat degradation. In Florida, about 3.3 million acres of native
10634 upland habitats (based on analyses supporting gopher tortoise abundance estimates) remain. The
10635 EDR is exploited for commercial purposes, intentionally killed for sport or as a threat (real or
10636 perceived) to human safety, and incidentally killed on roads. Conserving the EDR would likely
10637 require some legal prohibitions against intentional take, which are currently in effect only in
10638 North Carolina and on public lands in South Carolina. The species' primary conservation need is
10639 to maintain, restore, and enhance native upland habitats, especially longleaf pine savannas.
10640

10641 **Baseline**

10642
10643 Previous collection records and current habitat availability support a finding that the species is
10644 reasonably certain to occur in the Plan Area. Although the home ranges of EDRs in the Plan
10645 Area probably include some extent of agricultural and wetlands cover, native uplands are most
10646 likely to support the species. We expect the 13,221 acres of native uplands in the Plan Area, and
10647 the adjacent margins of other cover types, to support about 668 adult EDRs. Threats to EDRs in
10648 the Action Area parallel the threats at the range wide scale: habitat loss, fragmentation, and
10649 degradation through fire suppression; and road mortality and other lethal encounters with
10650 humans. Protecting and managing large tracts of native uplands is the species' primary
10651 conservation need in the Plan Area.
10652

10653 **Effects**

10655 We estimate that 2,554 acres of native uplands in the Development and Mining, Base Zoning,
10656 and Eligible Lands designations (and the adjacent margins of other cover types) support about
10657 91, 1, and 37 EDRs, respectively (total 129). Activities associated with development would
10658 substantially alter EDR habitats, which would disturb, displace, injure, or kill snakes that are
10659 present at the time of those activities, depending on site- and project-specific circumstances. An
10660 increase in human habitation of the developed areas following construction would increase the
10661 likelihood of encounters in which people intentionally or incidentally kill EDRs. Although some
10662 individuals may survive displacement from developed areas, we conservatively estimate the
10663 numbers harmed by development activities as all 129 adult EDRs that we expect to occupy
10664 upland habitats in the HCP development envelope.

10665
10666 The designated Preservation Areas contain the majority (77%) of native upland cover types in
10667 the Plan Area, which we expect to support 77% of the EDRs present (about 514 adults). We do
10668 not expect the management of Preservation Areas to reduce the numbers, reproduction, or
10669 distribution of the EDR in the Preservation Areas, because these activities would, at minimum,
10670 maintain current conditions. We do not expect the small scale of potential development within
10671 the Very Low Density (VLD) use areas to cause predictable harm to EDRs. Long-term
10672 management of native uplands in the Preservation and VLD areas with prescribed fire could
10673 increase EDR densities and local abundance.

10674
10675 **Cumulative Effects**
10676

10677 Increased vehicle traffic unrelated to the Action is a stressor that may adversely affect EDRs in
10678 the Action Area. However, lacking data about EDR roadkill locations or numbers in the Action
10679 Area, we cannot predict with reasonable certainty an increase in risk of roadkill caused by
10680 sources unrelated to the Action.

10681
10682 **Opinion**
10683

10684 Developing up to 2,554 acres of native upland habitats would add an increment of habitat loss
10685 within the extant range of the EDR, which likely encompasses several million acres in multiple
10686 states. We expect this loss to reduce EDR abundance in the Plan Area by about 129 adult
10687 individuals, which represents a 0.13% percent reduction relative to range wide abundance of
10688 about 100,000. The extent of habitat enhancement that may occur in the Preservation and VLD
10689 use areas is not predictable at this time, but long-term management and protection of over 10,000
10690 acres of native upland cover classes is likely to create some benefits for EDRs. Such
10691 management and protection in the Preservation Areas would eliminate in these areas the primary
10692 threat to the species, which is habitat degradation, loss, and fragmentation. Given the small
10693 proportional impact of the Action to range-wide abundance and habitat availability, and the
10694 prospect of future habitat improvements, we believe the impact of the Action on the EDR does
10695 not represent an appreciable reduction in the species' numbers, reproduction, or distribution.

10696
10697 After reviewing the current status of the species, the environmental baseline for the Action Area,
10698 the effects of the Action and the cumulative effects, it is the Service's conference opinion that
10699 the Action is not likely to jeopardize the continued existence of the EDR.

10701
10702 **19. Eastern Indigo Snake**
10703
10704 This section provides the Service’s biological opinion of the Action for the eastern indigo snake
10705 (EIS).
10706
10707 **19.1 Status of Eastern Indigo Snake**
10708
10709 This section summarizes best available data about the biology and current condition of the
10710 eastern indigo snake (*Drymarchon corais couperi*) throughout its range that are relevant to
10711 formulating an opinion about the Action. The Service published its decision to classify the EIS as
10712 threatened on March 3, 1978 (43 FR 4026–4029). The Service has not proposed or designated
10713 critical habitat for the EIS. Our description of the species’ status in this section relies primarily
10714 upon the more comprehensive and detailed “Species Status Assessment Report for the
10715 Eastern Indigo Snake” (USFWS 2018), and other sources, as cited.
10716
10717 Although our 1978 listing decision identified the EIS as a subspecies, the scientific community
10718 currently recognizes the EIS as the distinct species *Drymarchon couperi*. The Service
10719 acknowledges this taxonomic change, which does not affect how the protections of the ESA
10720 apply to the EIS. Our most recent 5-year status review (USFWS 2019a) recommended no change
10721 to the classification of the EIS. In September 2019, the Service published a revised recovery plan
10722 for the EIS (USFWS 2019b).
10723
10724 **19.1.1 Species Description**
10725
10726 EISs are moderately heavy-bodied and iridescent bluish-black in color, including the belly. The
10727 pigment of the chin and sides of the head is reddish, orange-brown, or cream (Conant and Collins
10728 1998; Stevenson et al. 2008). The extent and intensity of head pigmentation is highly variable,
10729 lacking on many specimens, and typically most extensive on juveniles and adult males (Layne
10730 and Steiner 1996).
10731
10732 The EIS is the longest snake native to the U.S., reaching lengths of up to 8.6 ft (Conant and
10733 Collins 1998; Stevenson et al. 2008). Mature adult EIS weigh from 2 pounds to over 10 pounds.
10734 Adult males commonly attain a total length of 6.5–7.0 ft (Layne and Steiner 1996; Stevenson et
10735 al. 2009), whereas adult females reach a total length of 4.0–6.0 ft (Layne and Steiner 1996;
10736 Stevenson et al. 2009; Knafo et al. 2016).
10737
10738 **19.1.2 Life History**
10739
10740 The EIS exhibits ecological and genetic diversity across its geographic distribution, influencing
10741 many aspects of the species’ behavior. Based on these differences, the Service partitions EIS
10742 populations among four regions: the Panhandle (which includes the counties of the Florida
10743 Panhandle, a few contiguous counties in Alabama and Mississippi, and Decatur County,
10744 Georgia), Southeast Georgia, North Florida, and Peninsular (south) Florida (USFWS 2018). In
10745 this section, we focus on the species’ biology in Peninsular Florida.
10746

10747 The Peninsular Florida populations of the EIS use a wide variety of habitat types, including
10748 mesic and scrubby flatwoods, scrub, dry prairie, hardwood hammock, pine sandhill, freshwater
10749 and saltwater wetlands, and various human-altered habitats (USFWS 2018). A combination of
10750 native uplands (primary habitat) and lowlands (secondary habitat) appears to support the most
10751 resilient EIS populations. Most of the native upland cover types that EIS use depend on periodic
10752 fire to maintain good habitat quality. EIS generally avoid urbanized areas, but use of improved
10753 pastures, citrus groves, sugar cane fields, and canal banks (tertiary habitat) is common in south
10754 Florida (Bauder et al. 2018). However, across its range, EIS exhibit a strong preference year-
10755 round for native upland habitat types (Bauder et al. 2018; Hyslop et al. 2014).

10756
10757 Although the EIS is active during the day, its frequent use of underground refugia for shelter,
10758 breeding, feeding, and nesting activities makes it exceedingly difficult to detect in surveys
10759 (USFWS 2018). Shelter sites in south Florida include armadillo and gopher tortoise burrows,
10760 natural holes in the ground, leaf litter, and the crevices of rock-lined ditch walls (Layne and
10761 Steiner 1996). Reflecting the diversity of habitats the species uses, the EIS feeds on a variety of
10762 prey. Rodents, snakes, and other small reptiles represent the majority forage items (Stevenson et
10763 al. 2010).

10764
10765 Annual home range size varies by sex and region. Males have larger home ranges than females
10766 (up to 3,776 acres vs. up to 875 acres), and both sexes have larger home ranges in the northern
10767 regions than in Peninsular Florida (USFWS 2018-Appendix A). EISs typically avoid territory
10768 overlap between same-sex individuals, but male and female home ranges frequently intersect
10769 (Bauder et al. 2016a). EISs in Peninsular Florida do not exhibit seasonal movement between
10770 upland and lowland habitats (Hyslop et al. 2014), which partly accounts for smaller annual home
10771 range size compared to the northern regions. Movements spanning a linear distance of about 2.4
10772 mi in Peninsular Florida are common (Bauder et al. 2018), with one documented movement of
10773 4.3 mi (USFWS 2018).

10774
10775 The EIS mating season occurs from October through February. Females lay clutches of 4–12
10776 eggs in April and June, which hatch in August and September (USFWS 2018). Although not
10777 well understood, EIS longevity is generally 8–12 years (Stevenson et al 2009).

10778
10779 Three studies of hatchlings/juveniles (Moulis 1976, Steiner et al. 1983, Godwin et al. 2011)
10780 reported male/female ratios of about 1:1. However, sex ratios become more male-biased in adult
10781 snakes. Layne and Steiner (1996) reported an adult male/female ratio of 1.54:1 for EISs in south
10782 Florida. Stevenson et al. (2009) reported a ratio of 2.1:1 in a study at Fort Stewart, Georgia.

10783 10784 **19.1.3 Numbers, Reproduction, and Distribution**

10785
10786 The source of information in this section is our most Species Status Assessment (SSA) for the
10787 EIS (USFWS 2018), unless otherwise indicated. Recent EIS occurrence records are scattered
10788 throughout three of the four regions identified in section 19.1.2 (North Florida, Peninsular
10789 Florida, and Southeast Georgia), but are rare in the Panhandle region. The EIS is likely
10790 extirpated from the Mississippi portions of the Panhandle region.

10792 Based on a spatial analysis of EIS occurrence records (two or more records with overlapping 5-
10793 mi buffers), the SSA delineated 51 historical EIS populations (1936–2017 records) and 53
10794 current (2001–2017 records) populations across the full range of the species (Table 19-1).
10795 Although the total number of historic and current populations is about the same, the spatial
10796 extent of the current populations represents a 48% decline from the distribution of historical
10797 populations. The analysis revealed a fragmentation of the historically larger populations into 83
10798 multiple, smaller populations, of which the SSA considers 30 extirpated ($83 - 30 = 53$ current
10799 populations).

10800
10801 The SSA does not estimate range-wide EIS abundance or productivity associated with the 12.5
10802 million acres delineated as supporting 53 current populations (Table 19-1), but estimates that
10803 these areas contain about 6.4 million acres of suitable habitat. The numbers and density of EIS in
10804 these areas are largely unknown, due to the large size of the species' range and its cryptic
10805 behaviors. However, a rough estimate of maximum range wide abundance (*i.e.*, carrying capacity
10806 of suitable habitat within the extent of current populations) is possible based on male home range
10807 size, observed sex ratios, and the extent of suitable habitat within the delineated population areas.
10808 The home range of adult males does not substantially overlap with other adult males, is larger
10809 than and overlaps the home range of adult females, and adult males outnumber adult females (see
10810 section 19.1.2).

10811
10812 Appendix A of the SSA reports EIS annual home range size from telemetry studies conducted in
10813 Southeast Georgia (2 studies), North Florida (2 studies), and Peninsular Florida (12 studies). The
10814 average size of a male's home range, weighted by the number of males in each of these studies,
10815 is 1,260 acres for Southeast Georgia, 367 acres for North Florida, and 343 acres for Peninsular
10816 Florida (Table 19-2). The SSA does not report a breakdown of suitable habitat by region to
10817 which we could apply these home ranges to estimate carrying capacity. Weighting these average
10818 home range sizes by the percentage of the current spatial extent of populations in each region
10819 (27%, 10%, and 63%, respectively; Table 19-1), yields a home range of 595 acres. Dividing 6.4
10820 million acres of suitable habitat by 595 acres suggests that the 53 population areas could support
10821 up to about 10,800 male EISs. Male/female sex ratios of 1.54–2.1:1 (see section 19.1.2) applied
10822 to this estimate yields coextensive adult female abundance ranging from about 5,000–7,000, and
10823 a total carrying capacity of about 15,800–17,800 adults.

10824
10825 It is unlikely that the home ranges of EIS encompass all portions of the 6.4 million acres of
10826 suitable habitat. Actual abundance would correspond to the fraction of available habitat that EISs
10827 occupy, which is unknown. Bauder (2018) suggests that an area of suitable habitat of less than
10828 2,500 acres is insufficient to support a single pair of EISs. If so, the carrying capacity estimated
10829 above based upon a 595-acre male home range is at least 4 times too high. Dividing 6.4 million
10830 acres by 2,500 acres yields 2,560 males, with about 1,200–1,700 females based on sex ratios
10831 (total carrying capacity of about 3,760–4,260 adults).

10832
10833 Appendix B of the SSA reports the methods used for describing current conditions for the 53 EIS
10834 population areas identified, including methods for measuring the relative resilience of each
10835 population (ability to withstand disturbance). The factors evaluated for each population included:

- 10836 1 extent (size of the overlapping 5-mi buffers around occurrence records);
10837 2 connectivity with other population areas;

10838 3 habitat quantity;
10839 4 habitat fragmentation;
10840 5 tertiary road density;
10841 6 % urban area;
10842 7 shelter availability (gopher tortoise burrows); and
10843 8 habitat type (classified as primary, secondary, and tertiary).

10844 Using weighted scores for each of these factors, the SSA classified the resiliency of the 53 EIS
10845 populations as follows: 4 High, 13 Medium, 28 Low, and 8 Very Low. Among these eight
10846 factors, the SSA assigned greatest weight to habitat fragmentation. Population areas containing >
10847 75% of habitat in patches > 10,000 acres received the highest score for fragmentation (least
10848 fragmented), and those containing >50% of habitat in patches < 5,000 acres received the lowest
10849 score.

10850
10851 **19.1.4 Conservation Needs and Threats**

10852 Habitat loss, fragmentation, and degradation caused by the conversion of native habitats to urban
10853 and agricultural uses are the primary threats to this species, because EIS populations require
10854 relatively large areas of sufficient connectivity and habitat quality to persist (USFWS 2018).
10855 Range wide, the extent of EIS populations has declined from 24.0 to 12.5 million acres (Table
10856 19-1).

10857 Accompanying the loss and fragmentation of EIS habitats caused by urbanization is the risk of
10858 mortality on roads that cross EIS territories. EISs generally avoid crossing primary and
10859 secondary roads, which contributes to the isolation and fragmentation of populations (USFWS
10860 2018). However, EISs readily cross tertiary roads (paved, non-arterial 2-lane roads). Our SSA
10861 (USFWS 2018) cites unpublished data from Georgia and Florida that documents over 100
10862 instances of EIS roadkill since 2000 (the majority of about 200 sightings, dead or alive, on
10863 roads). Godley and Moler (2013) reported a 95% decline in EIS catch-per-unit effort within a
10864 Florida study area from 1981–2009, identifying roadkill as a primary factor. Minimizing road
10865 density within large tracts of suitable habitats is critical to the design of conservation areas for
10866 the EIS.

10867 Our SSA (USFWS 2018) also identifies climate change, disease, collection, deliberate killing,
10868 pesticide use, and invasive species as additional threats to the species' survival and recovery than
10869 habitat loss. However, the species' primary conservation needs are preserving, restoring, and
10870 enhancing large tracts of suitable habitat that support extant populations, and repatriating the
10871 species to such habitats where the species appears extirpated.

10876 **19.1.5 Tables and Figures**

10877

10878 **Table 19-1.** Historical (A) and current (B) number and extent (acres) of EIS populations by
 10879 region. Note: only 6.4 million acres of the 12.5 million acres delineated within the extent
 10880 of current populations is considered potential EIS habitat. (Source: USFWS 2018; Table
 10881 6).

(A) Historical: 1936-2017					
Region	Region Area (ac)	Historical Population Extent (ac)	Number of Populations	% of Region Occupied	
Southeast Georgia	16,395,372	4,963,121	10	30	
North Florida	9,556,835	2,824,993	6	30	
Panhandle	20,330,428	2,889,894	13	14	
Peninsular Florida	27,805,400	13,382,652	22	48	
Total	74,088,035	24,060,660	51	32	
(B) Current: 2001-2017					
Region	Current Population Extent (ac)	Number of Extant Populations	Number of Populations in High (H) to Medium (M) Resiliency	% of Region Occupied	% Population Extent Decline
Southeast Georgia	3,384,099	13	1 H; 4 M	21	32
North Florida	1,251,686	5	0 H; 2 M	13	56
Panhandle	84,042	1 (2R)*	0 H; 0 M	0	97
Peninsular Florida	7,780,784	32	3 H; 7 M	28	42
Total	12,500,611	53	4 H; 13 M	17	48

10882 * The spatial extent of two repatriation populations (2R) in the Panhandle are not included in the
 10883 total Current Population Extent, because these populations are not yet considered viable.
 10884
 10885
 10886

10887 **Table 19-2.** EIS average home range size (acres) from telemetry studies, weighted by the
 10888 number of snakes tracked in each study (source of study-specific data: USFWS 2018,
 10889 Appendix A).

Region	Males		Females	
	# Snakes Tracked	Weighted Average Home Range (acres)	# Snakes Tracked	Weighted Average Home Range (acres)
Southeast GA	19	1,260	13	252
North FL	6	367		
Peninsular FL	100	343	71	115
Combined	125	483	84	136

19.2 Environmental Baseline for Eastern Indigo Snake

This section describes the current condition of the EIS in the Action Area without the consequences to the listed species caused by the proposed Action.

19.2.1 Action Area Numbers, Reproduction, and Distribution

The Applicants did not conduct EIS surveys within the Plan Area, but cite sources for several verified observations on various lands immediately adjacent to (within 0.1 mi) and near (within 6 mi) the Plan Area (HCP Chapter 5.2.2.1.3; HCP Figure 5-6). Our SSA includes the records located on conservation lands straddling the northwest corner of the Plan Area (Corkscrew Swamp) as points representing current population “CF1-3” (USFWS 2018). The 5-mi buffers around occurrence records used to delineate the spatial extent of this population overlap the Plan Area. The SSA characterized the resiliency of CF1-3 as Medium Low, with the lowest possible score for population connectivity, due to its isolation from other population areas, but with intermediate scores for the seven other resiliency factors (see section 19.1.3).

In south Florida, the EIS is a habitat generalist, typically found in pine flatwoods, pine rocklands, tropical hardwood hammocks, and in most other undeveloped areas (Kuntz 1977; Enge et al. 2013). EIS use the burrows of gopher tortoise and burrowing owl as refugia (Lawler 1977; Moler 1985; Layne and Steiner 1996), which are species that occur within the Plan Area (see sections 9 and 20 of this BO). Based on recent EIS records within 0.1 mi of the Plan Area, the species’ ability to make movements of up to about 5 mi, the presence of potential EIS habitats throughout the Plan Area, and the availability of tortoise and owl burrows, we believe the EIS is reasonably certain to occur in the Plan Area.

EIS use various native wetlands, but generally exhibit a preference year-round and across the species’ range for native upland habitat types (Bauder et al. 2018; Hyslop et al. 2014). The acreage of native wetland types in the Plan Area far exceeds that of native upland types (58,543 acres vs. 13,221 acres, Table 2-2). The extent of upland habitats likely controls and limits EIS distribution and abundance in the Plan Area. The FWC developed an EIS probability of

10925 occurrence model for south Florida (FWC unpublished) using the Maxent software
10926 (https://biodiversityinformatics.amnh.org/open_source/maxent/), which assigned probabilities of
10927 67–100% to native uplands in the Plan Area, and 0–35% to the interior portions of large
10928 wetlands and agricultural areas. Therefore, we estimate EIS abundance in the Plan Area based
10929 upon the extent of native upland types.

10930
10931 Metcalf (2017) conducted a telemetry study of EISs in Collier County (Rookery Bay Reserve;
10932 east of the Plan Area) that tracked the movements of one female and three male snakes. Average
10933 home range size for the three males was 546 acres, which is larger than the Peninsular Florida
10934 regional average of 343 acres (see section 19.1.2) (note: the Peninsular Florida average includes
10935 data from Metcalf (2017)). Upland habitat types comprised an average of 46% of the home range
10936 of the four individuals (range 34–59%). Although the majority of habitats within three of the four
10937 home ranges were wetlands, all four individuals spent significantly more time in the uplands
10938 (78% of all tracked points). Due to its proximity to the Plan Area (the only EIS home range study
10939 conducted in Collier County), we apply the home range size and percentage of uplands habitats
10940 in this study to our habitat-based estimation of EIS abundance in the Plan Area.

10941
10942 Considering 13,221 acres of Plan Area native uplands as 46% of EIS home ranges, the full extent
10943 of EIS territories is $13,221 \div 0.46 = 28,741$ acres. These territories would include native
10944 wetlands and agricultural lands adjacent to the uplands. Using the 546-acre average male home
10945 range size from Metcalf (2017), 28,741 acres would support up to 53 adult males. We would
10946 expect the territories of these males to overlap with the home range of about $53 \div 1.54 = 34$
10947 females (sex ratio in Peninsular Florida), for a Plan Area population of about 87 EISs. More
10948 conservatively, Bauder (2018) suggests that more than 2,500 acres of suitable habitat is
10949 necessary to support both a male EIS and coextensive female. Using 2,500 acres as the
10950 denominator, the Plan Area habitats could support $28,741 \div 2,500 = 11$ EIS males and $11 \div 1.54$
10951 = 7 females, for a Plan Area population of about 18 EIS.

10952 19.2.2 Action Area Conservation Needs and Threats

10953
10954 Current threats to the species range-wide (see section 19.1.4), such as habitat loss, fragmentation,
10955 and roadkill, are applicable within the Plan Area and the larger Action Area, which includes
10956 roads we expect to experience an increase in traffic that would not occur but for the development
10957 activity. Numerous roads cross the Plan Area, but we have no records of EIS road mortality
10958 within the Plan Area or on roads within the larger Action Area. Primary and secondary roads
10959 likely present barriers to EIS movement that fragment the Plan Area into islands of habitat that
10960 may not sustain viable populations. As in many other portions of the EIS range, maintaining
10961 large contiguous areas of native uplands and native wetlands that support EIS prey species and
10962 species that create EIS shelter (e.g., gopher tortoises, burrowing owls) is the primary
10963 conservation need of the EIS in the Action Area.

10964 19.3 Effects of the Action on Eastern Indigo Snake

10965
10966 This section describes all reasonably certain consequences to the EIS that we predict the
10967 proposed Action would cause, including the consequences of other activities not included in the

10970 proposed Action that would not occur but for the proposed Action. Such effects may occur later
10971 in time and may occur outside the immediate area involved in the Action.

10972 10973 **19.3.1 Development and Mining, Base Zoning, and Eligible Lands**

10974
10975 Because EIS activity is concentrated in native upland cover types, and it is plausible that
10976 development would occur disproportionately in these non-wetland cover types, we use the RMI
10977 method described in section 2.1.4 to estimate the extent of development in EIS habitats. Native
10978 uplands cover 1,804, 16, and 734 acres of the Development and Mining, Base Zoning, and
10979 Eligible Lands designations, respectively (Table 2-2). These 2,554 native upland acres amount to
10980 less than the development cap of 39,973 acres that may occur within the 66,245-acre
10981 development envelope. Development confined entirely to the Development areas, or
10982 implemented with the maximum possible substitution of Base Zoning and/or Eligible lands in the
10983 accounting for the cap, could replace all of the native uplands habitats in one or more of these
10984 HCP land use designations.

10985
10986 The development would involve vegetation clearing, grading, excavation and piling, the use
10987 heavy equipment and other vehicles at project sites, and the construction of buildings and
10988 associated infrastructure. Such substantial alterations of habitats that support EIS feeding,
10989 breeding, and sheltering behaviors would disturb, displace, injure, or kill snakes that are present
10990 at the time of those activities, depending on timing and other site- and project-specific
10991 circumstances. Site preparation activities conducted from April–September (earliest egg laying
10992 through latest hatching) would likely destroy any EIS nests present at a project site.

10993
10994 Displacement by habitat loss could cause EISs to cross roads seeking alternative habitats, and
10995 increased vehicle traffic on public roads during and after construction would increase the risk of
10996 roadkill. Because EIS generally avoid primary and secondary roads, traffic on public tertiary
10997 roads (paved, non-arterial 2-lane roads) poses the greatest risk. However, lacking records of EIS
10998 locations or roadkill incidents in the Action Area, we have insufficient data to predict with
10999 reasonable certainty an expected increase in risk of roadkill in a quantifiable manner.

11000
11001 The Applicants propose (HCP Chapter 6.2.2.1) to implement the Standard Protection Measures
11002 for the Eastern Indigo Snake (USFWS 2013). These measures involve posting information about
11003 EISs at construction sites and steps to take in the event that personnel observe live or dead EIS
11004 during construction activities. These measures may avoid killing or injuring EISs detected during
11005 construction, but such detection is difficult, due to the species cryptic behaviors (spending much
11006 time in burrows, crevices, *etc.*). EIS generally avoid urban areas, and individuals displaced from
11007 development sites that are adjacent to suitable habitats within other land use designations could
11008 survive. However, an undeterminable number would die crossing roads or experience reduced
11009 reproductive success or other injury in alternative habitats, which or may not be available nearby,
11010 depending on the location of development sites within the Plan Area. Conservatively, we
11011 estimate the number of adult individuals harmed by development activities as the total number
11012 that could use 2,609 acres of upland habitats in the development envelope.

11013
11014 In a Collier County study area (Metcalf 2017), EIS adult male home ranges averaged 546 acres
11015 and included an average of 46% upland cover types (251 acres) (see section 19.1.3). The 2,554

11016 acres of native upland cover in the development envelope could support up to $2,554 \div 251 = 10$
11017 EIS male territories. Each territory of this average size would include an additional $546 - 251 =$
11018 295 acres of adjacent wetlands/agricultural. Using a male/female sex ratio of 1.54:1, these 10
11019 male territories could support about 6 females (a total of up to 16 adult EIS).

11020
11021 Bauder (2018) suggests that more than 2,500 acres of suitable habitat is necessary to support
11022 both a male EIS and coextensive female. If this habitat is 46% native uplands, as in the Collier
11023 County study cited above, the uplands component amounts to 1,150 acres. Using 1,150 acres as
11024 the denominator, the native uplands of the development envelope could support $2,554 \div 1,150 =$
11025 2 EIS males and $2 \div 1.54 = 1$ female. Upland cover types occur in patches of variable size
11026 throughout the development envelope interspersed with wetlands and agricultural cover types. If
11027 2,500 acres is a more accurate basis for estimating EIS carrying capacity than a male home range
11028 size of 546 acres, it is unlikely that the widely dispersed native uplands (many patches > 5 mi
11029 apart) within the development envelope would wholly support 2 EIS male territories. It is more
11030 likely that native uplands within the development envelope would contribute a portion of the
11031 uplands to male territories that substantially overlap with other HCP land uses. We estimate the
11032 Plan Area would support 11 EIS male territories of 2,500 acres and 7 females (see section
11033 19.1.3). The development activity would alter these territories such that the total area remaining
11034 would support 9 males and 6 females.

11035 11036 19.3.2 Preservation Activities

11037 The designated Preservation Areas contain 10,221 acres, or 77% (Table 2-2), of the native
11038 upland cover in the Plan Area considered primary EIS habitat. Native uplands cover about 11%
11039 of the Preservation Areas. We expect native uplands to constitute about 46% of EIS territories in
11040 the Plan Area (see section 19.2.1), and adjacent wetlands (secondary habitat) and agricultural
11041 lands (tertiary habitat) to constitute the remainder. Therefore, we estimate that EISs inhabit
11042 10,221 $\div 0.46 = 22,220$ acres, or about 25% of the 90,092 acres designated for Preservation.

11043
11044 Containing 77% of the Plan Area native uplands, we expect the Preservation Areas to support
11045 about 77% of the Plan Area EIS population that we estimated in section 19.2.1:

- 11046 • $0.77 \times 87 = 67$ adults, by methods using average home range size; or
- 11047 • $0.77 \times 18 = 14$ adults, considering 2,500 acres of suitable habitat as necessary to support
11048 an adult male and a coextensive female.

11049
11050 The Applicants propose a continuation of existing land uses (agriculture, silviculture, *etc.*) in the
11051 Preservation Areas, which we listed in section 2.3. Land management activities in the
11052 Preservation Areas for which the Applicants seek take authorization include:
11053 prescribed burning;
11054 mechanical control of groundcover (*e.g.*, roller chopping, brush-hogging, mowing);
11055 ditch and canal maintenance;
11056 mechanical and/or chemical control of exotic vegetation;
11057 soil tillage; and
11058 similar activities that maintain or improve land quality.

11061 Prescribed burning maintains habitat quality in the native uplands that EIS prefer (see section
11062 19.1.2). EIS may readily avoid a slowly advancing prescribed fire by moving to adjacent areas
11063 (e.g., wetlands) or seeking refuge in burrows. Likewise, EIS may readily avoid slowly advancing
11064 heavy equipment engaged in vegetation management or soil tillage, and soil tillage would not
11065 occur in native uplands. Controlling exotic vegetation also maintains EIS habitat quality, and we
11066 have no data that suggests that herbicides applied according to label instructions may harm EISs.
11067 In general, these land management practices may temporarily disrupt EIS foraging activity, but
11068 we do not expect them to kill or injure individuals.

11069
11070 The Applicants do not specifically propose to restore, enhance or create EIS habitats in the
11071 Preservations areas, but propose to maintain pine flatwoods and other upland forest types with
11072 prescribed fire and exotic plant removal. We do not expect the management of Preservation
11073 Areas to reduce the numbers, reproduction, or distribution of the EIS in the Preservation Areas,
11074 because these activities would, at minimum, maintain current conditions. Long-term
11075 management of the Preservation Areas with prescribed fire could increase EIS densities and local
11076 abundance, which we expect are currently at low levels.

11077 19.3.3 Very Low Density Development

11078 The Very Low Density (VLD) use areas contain 447 acres of native uplands considered primary
11079 EIS habitat (Table 2-2). These uplands, along with adjacent wetlands (733 acres) and agricultural
11080 areas (502 acres), figure into our estimation of EIS abundance in the Plan Area (section 19.2.1),
11081 but it is unlikely that any one of three VLD use areas themselves provide sufficient habitat to
11082 support a complete territory for one or more EISs.

11083 Land uses in the VLD areas are similar to the Preservation Areas, but may also include isolated
11084 residences, lodges, and hunting/fishing camps, at a density of no more than one dwelling unit per
11085 50 acres. The Applicants would continue current ranching/livestock operations and other
11086 management activities as described for the Preservation Areas (e.g., exotic species control,
11087 prescribed burning). As in the Preservation Areas, we do not expect continuing the existing land
11088 management regimes to harm EISs.

11089 The HCP does not specify a footprint for the isolated residences, lodges, and hunting/fishing
11090 camps, but indicates that their construction could clear up to 10% of the existing native
11091 vegetation (see section 2.5). New dwelling development could occur within any of the cover
11092 types present besides open water and existing development. It is possible that dwelling
11093 development in the VLD areas could entirely avoid native uplands and native wetlands, but we
11094 conservatively estimate a 45-acre habitat loss of uplands and a 73-acre loss of native wetlands
11095 (10% of these types). Development within a portion of the home range of an EIS would cause the
11096 individual to shift its activity accordingly. However, the scale of this potential habitat loss (118
11097 acres) is about 22% of the average male home range of 546 acres, spread across three widely
11098 separated VLD use areas. Therefore, we do not expect significant adverse consequences to
11099 individuals resulting from such displacement.

11100 19.4 Cumulative Effects on Eastern Indigo Snake

11106
11107 For purposes of consultation under ESA §7, cumulative effects are those caused by future state,
11108 tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future
11109 Federal actions that are unrelated to the proposed action are not considered, because they require
11110 separate consultation under §7 of the ESA.

11111
11112 We identified in section 3 of this BO/CO a projected increase in traffic on public roads as the
11113 sole source of effects that are consistent with the definition of cumulative effects for this Action.
11114 Road mortality is documented for EISs (see section 19.1.4). Increased vehicle traffic unrelated to
11115 the Action is a stressor that may adversely affect EISs in the Action Area. As the population of
11116 southwest Florida increases, we expect more vehicle use in the Action Area and a concomitant
11117 increase in road mortality of animals in general. Most of the predicted increase in traffic will
11118 occur on primary and secondary roads (State and Federal arterial highways that connect major
11119 population centers), which EISs generally avoid crossing. Traffic attributed to sources besides
11120 the developments within the Plan Area account for a minor share of the predicted increase on
11121 tertiary roads (paved, non-arterial 2-lane roads) affected by the Action. However, lacking records
11122 of EIS roadkill numbers or locations in the Action Area, we have insufficient data to predict with
11123 reasonable certainty an expected increase in the risk of roadkill caused by sources unrelated to
11124 the Action.

11125
11126 **19.5 Conclusion for Eastern Indigo Snake**
11127

11128 In this section, we summarize and interpret the findings of the previous sections for the EIS
11129 (status, baseline, effects, and cumulative effects) relative to the species-specific purpose of a BO
11130 under §7(a)(2) of the ESA, which is to determine whether the proposed action is likely to
11131 jeopardize the continued existence of a species.

11132
11133 **Status**
11134

11135 Based on verified occurrence records, our Species Status Assessment (SSA) for the EIS
11136 identified the locations of 53 populations in the current range of the EIS (USFWS 2018). The
11137 spatial extent of the current populations represents a 48% decline from the distribution of
11138 historical populations. The numbers and density of EIS in these areas are largely unknown, due
11139 to the large size of the species' range and its cryptic behaviors. Using the extent of suitable
11140 habitat within the 53 locations (6.4 million acres), average male home range size, and
11141 male/female sex ratios, we roughly estimate range wide abundance of about 15,800–17,800
11142 adults. Using more conservative assumptions about the extent of habitat necessary to support EIS
11143 individuals, we estimate range wide abundance of about 3,760–4,260 adults.

11144
11145 Habitat loss, fragmentation, and degradation caused by the conversion of native habitats to urban
11146 and agricultural uses are the primary threats to this species, because EIS populations require
11147 relatively large areas of sufficient connectivity and habitat quality to persist.

11149 **Baseline**

11150
11151 We have no EIS occurrence records from within the Plan Area boundaries, but the Plan Area
11152 overlaps a small portion of one of the 53 extant populations identified in our 2018 SSA
11153 (population CF1-3). Based on recent EIS records within 0.1 mi of the Plan Area, the species'
11154 ability to make movements of up to about 5 mi, the presence of potential EIS habitats throughout
11155 the Plan Area, and the availability of tortoise and owl burrows, we believe the EIS is reasonably
11156 certain to occur in suitable habitats throughout the Plan Area. EIS are habitat generalists in
11157 Peninsular Florida, but native upland cover types are essential components of the EIS habitat
11158 matrix. We use the extent of native upland cover types in the Plan Area, and the same methods
11159 we applied to estimating range wide abundance (substituting data for home range characteristics
11160 from a Collier County EIS study for range wide averages) to estimate Plan Area EIS abundance
11161 of about 87 adults. Using more conservative assumptions about the extent of habitat necessary to
11162 support EIS individuals, we estimate Plan Area abundance of about 18 adults.

11163
11164 Current threats to the species range-wide, such as habitat loss, fragmentation, and roadkill, are
11165 applicable within the Plan Area and the larger Action Area, which includes roads we expect to
11166 experience an increase in traffic that would not occur but for the development activity.
11167 Maintaining large contiguous areas of native uplands and native wetlands that support EIS prey
11168 species and species that create EIS shelter (*e.g.*, gopher tortoises, burrowing owls) is the primary
11169 conservation need of the EIS in the Action Area.

11170
11171 **Effects**
11172 The development would replace up to 2,554 acres of native uplands that serve as primary
11173 habitats within the home range of EIS individuals present in the Plan Area. We expect this
11174 habitat alteration, and alterations in adjacent secondary (wetlands) and tertiary (agricultural
11175 areas) habitats to disturb, displace, injure, or kill snakes that are present during site preparation,
11176 depending on timing and other site- and project-specific circumstances. Site preparation
11177 activities conducted from April–September would likely destroy any EIS nests present at a
11178 project site. Because the proportions of this range of potential responses are undeterminable, we
11179 estimate the number of adult individuals harmed by development activities as the total number
11180 that could use 2,554 acres of upland habitats in the development envelope. Using home range
11181 size, we estimate the harm of up to 16 adult EISs. Using more conservative assumptions about
11182 the extent of habitat necessary to support EIS individuals, we estimate the harm of 3 adult EISs.

11183
11184 The designated Preservation Areas contain the majority (77%) of native upland cover types in
11185 the Plan Area, which we expect to support 77% of the EISs present (67 adults using home range
11186 size; 14 adults using more conservative habitat assumptions). We do not expect the management
11187 of Preservation Areas to reduce the numbers, reproduction, or distribution of the EIS in the
11188 Preservation Areas, because these activities would, at minimum, maintain current conditions. We
11189 do not expect the small scale of potential development within the Very Low Density Use areas to
11190 cause predictable harm to EISs. Long-term management of native uplands in the Preservation
11191 and VLD areas with prescribed fire could increase EIS densities and local abundance.

11192
11193 **Cumulative Effects**

11195
11196 Lacking records of EIS locations or roadkill in the Action Area, we have insufficient data to
11197 predict with reasonable certainty an expected increase in the risk of roadkill caused by sources
11198 unrelated to the Action. However, most of the predicted increase in traffic will occur on primary
11199 and secondary roads (State and Federal arterial highways that connect major population centers),
11200 which EISs generally avoid.

11201
11202 **Opinion**

11203
11204 Our finding in the Baseline section that EISs are reasonably certain to occur in suitable habitats
11205 of the entire Plan Area effectively extends the range of population CF1-3 beyond the 5-mi radius
11206 of EIS occurrence records that defined the extent of this population in the SSA. Our analyses of
11207 the effects of the Action are predicated on the inferences supporting this finding.

11208
11209 The development of up to 2,554 acres of native upland habitats and adjacent EIS secondary and
11210 tertiary habitats would add a small increment of habitat loss to the estimated 6.4 million acres of
11211 suitable habitat available to the 53 range wide populations identified in the SSA. We predict the
11212 loss of 3–16 EIS adults (based on a conservative estimation of habitat requirements and a home-
11213 range-size estimation of habitat requirements, respectively) caused by this habitat loss. This loss
11214 would represent a population reduction of less than 0.1% relative to our range wide abundance
11215 estimates under both the conservative (3,760–4,260 adults) and home-range-size (15,800–17,800
11216 adults) approaches. We are unable to predict the risk of additional losses caused by an increase in
11217 traffic on public roads, attributed to developments within the Plan Area or to other sources.
11218 Because most of the increase in traffic would occur on primary and secondary roads, which EIS
11219 avoid, we believe that an increase in risk of EIS roadkill within the Action Area would represent
11220 a lesser impact than the impact associated with the action-caused habitat losses.

11221
11222 We have no information that suggests the Plan Area serves a unique or significant role in
11223 connectivity between EIS populations or in the species' recovery. Population CF1-3 is one of 53
11224 populations range wide, is isolated from other populations delineated in the SSA, and most of its
11225 extent lies to the east of the Plan Area. Most of the impacts we predict would occur in areas
11226 beyond the boundaries of population CF1-3, based on our inference of the species' presence in
11227 Plan Area habitats. Based on this same inference, 77% of native upland habitats in the Plan Area
11228 would continue to support EIS in the Preservation Areas, where the proposed Action would
11229 remove the primary threat to the species' survival and recovery (habitat loss and fragmentation).
11230 Given the small proportional impact of the Action to range-wide abundance and habitat
11231 availability, we believe the impact of the Action on the EIS does not represent an appreciable
11232 reduction in the species' numbers, reproduction, or distribution.

11233
11234 After reviewing the current status of the species, the environmental baseline for the Action Area,
11235 the effects of the Action and the cumulative effects, it is the Service's biological opinion that the
11236 Action is not likely to jeopardize the continued existence of the EIS.

11237
11238
11239 **20. Gopher Tortoise**

11240

11241 This section provides the Service's conference opinion of the Action for the gopher tortoise.

11242

11243 **20.1 Status of Gopher Tortoise**

11244

11245 This section summarizes best available data about the biology and current condition of the
11246 gopher tortoise (*Gopherus polyphemus*) that are relevant to formulating an opinion about the
11247 Action. The species is classified under the ESA as a threatened species in the western portion of
11248 its range, and as a candidate species (listing is warranted, but precluded by higher listing
11249 priorities) in the eastern portion of its range.

11250

11251 The Service listed the gopher tortoise in 1987 as a threatened species in the western part of its
11252 range, from the Tombigbee and Mobile Rivers in Alabama west to southeastern Louisiana on the
11253 lower Gulf Coastal Plain (52 FR 25376–25380). The Service has not designated or proposed CH
11254 for the western portion of the species' range.

11255

11256 The Service published on July 27, 2011, a 12-month positive finding in response to a petition to
11257 protect the eastern populations under the ESA (76 FR 45130–45162). We determined that the
11258 species' classification as threatened in the western portion of its range was appropriate, and that
11259 listing the species in the eastern portion of its range was warranted, but precluded by higher-
11260 priority listing actions. Based on information current as of 8/30/2018, the Service continues to
11261 find that listing the gopher tortoise in the eastern portion of its range is warranted, but still
11262 precluded by higher-priority listing actions (Service 2019).

11263

11264 For purposes of this Conference Opinion, we summarize information from the gopher tortoise
11265 12-month finding, the *Gopher Tortoise Management Plan* (FWC 2012), and other available data
11266 to describe the species' status.

11267

11268 **20.1.1 Species Description**

11269

11270 The gopher tortoise is the only tortoise in the U.S. that occurs east of the Mississippi River, and
11271 is the largest terrestrial turtle of this region. It has a domed, dark-brown to grayish-black shell
11272 (carapace) up to 14.6 inches long, and weighs up to 13 pounds. The lower shell (plastron) is
11273 yellowish and hingeless. Tortoises cannot completely retract their limbs within the shell. The
11274 hind feet are stumpy, and the forelimbs are shovel-like, with claws used for digging. Males are
11275 smaller than females; usually have a larger gland under the chin, a longer throat projection, and a
11276 more concave plastron. Hatchlings are up to 2 inches long, with a somewhat soft, yellow-orange
11277 shell.

11278

11279 **20.1.2 Life History**

11280

11281 The gopher tortoise typically inhabits uplands, especially those with relatively well-drained,
11282 sandy soils. The gopher tortoise is generally associated with longleaf pine (*Pinus palustris*) and
11283 xeric oak (*Quercus* spp.) sandhills, but also occurs in scrub, xeric hammock, pine flatwoods, dry
11284 prairie, coastal grasslands and dunes, mixed hardwood-pine communities, and a variety of
11285 disturbed habitats. The burrows of a gopher tortoise are the center of its activity. Gopher
11286 tortoises can excavate many burrows over their lifetime, and often use several each year.

11287 Burrows typically extend 15–25 ft and up to 12 ft deep below the surface. These burrows, which
11288 provide protection from temperature extremes, moisture loss, and predators, serve as a refuge for
11289 350–400 other species, including listed commensal species such as the gopher frog (*Lithobates*
11290 *capito*), eastern indigo snake (*Drymarchon couperi*), Florida pine snake (*Pituophis melanoleucus*
11291 *mugitus*), and Florida mouse (*Podomys floridanus*).

11292 Gopher tortoises spend most of their time within burrows and emerge during the day to bask in
11293 sunlight, feed, and mate. The gopher tortoise is slow to reach sexual maturity, has low fecundity
11294 and a long life span. Females reach sexual maturity at 9–21 years of age. Gopher tortoises breed
11295 from March–October, but females do not reproduce every year. Females excavate a shallow nest
11296 to lay and bury eggs, typically between early May and late June, and usually in the apron of soil
11297 at the mouth of the burrow. Range-wide, average clutch size varies from about 4–10 eggs per
11298 clutch, and incubation lasts 85–100 days. (FWC 2012)

11299 Gopher tortoises have a well-defined activity range where all feeding and reproduction occur.
11300 Tortoises are herbivores eating mainly grasses, plants, fallen flowers, fruits, and leaves.
11301 Generally, feeding activity is confined to within 50 meters (164 ft) of the burrow, but a gopher
11302 tortoise may travel more than 100 meters (328 ft) from its burrow for specific foraging needs.
11303 Home ranges vary from 1.2–4.7 acres for males and 0.2–1.6 acres for females (FWC 2012).

11304 20.1.3 Numbers, Reproduction, and Distribution

11305 The current range for the eastern (candidate) population of the gopher tortoise spans from
11306 southeastern South Carolina to eastern Alabama and to south Florida. The core of the current
11307 distribution of the gopher tortoise in the eastern portion of its range includes central and north
11308 Florida and southern Georgia.

11309 Our most recent status assessment (USFWS 2019) reports the most recent gopher tortoise
11310 abundance estimates from each state in the species' range as follows:

11311 Florida (adult tortoises)	785,000
11312 Georgia	350,000
11313 Alabama	30,000–130,000
11314 South Carolina	1,500–2,000

11315 These statewide estimates, each based on habitat availability data combined with existing
11316 survey-based population data, add up to a range wide total of about 1.2 million tortoises.

11317 The Florida abundance estimate (Enge *et al.* 2006) is based on the availability of about 3.3
11318 million acres of suitable habitat, a density of 0.59 tortoises/acre (adults and immatures) (McCoy
11319 *et al.* 2002), and adults representing 40% of the population (the minimum of an observed range
11320 of 40–62%; Diemer 1992). The Florida habitat availability data do not include agricultural lands,
11321 disturbed lands, and wetlands, all of which tortoises may use to some extent, especially where
11322 native upland habitats are highly fragmented or degraded. The Florida density data (McCoy *et al.*
11323 2002) are taken from 44 tracts of public lands (National Forests, National Wildlife Refuges, State
11324 Parks), which likely support higher densities than most private lands. Further, the authors of the
11325 Florida estimate note that tortoises do not occupy all lands with suitable habitat, and suggest that
11326 the number of adult tortoises in Florida is probably lower than 785,000.

11333
11334 The relatively large habitat-based statewide abundance estimates listed above are a somewhat
11335 misleading indicator of the species' status, because many small and isolated populations are
11336 likely not sustainable. Our status assessment (USFWS 2019, citing an unpublished report by the
11337 Gopher Tortoise Council 2014) described the following characteristics of a minimum viable
11338 population (MVP):

- 11339 • # adults ≥ 250 ;
- 11340 • density ≥ 0.4 tortoises/hectare (about 0.16/acre);
- 11341 • well-managed suitable habitat ≥ 100 ha (about 250 ac);
- 11342 • sex ratio approaching 1:1; and
- 11343 • evidence of active burrows representing all age classes.

11344
11345 The state wildlife agencies report the following numbers of populations that meet the MVP
11346 criteria (USFWS 2019):

11347 Florida	38
11348 Georgia	122
11349 Alabama	1–2
11350 South Carolina	2
11351 Total	163–164

11352 Three of the largest populations are on State lands within Florida: Withlacoochee State Forest
11353 (8,221); Kissimmee Prairie Preserve State Park (4,778); and Jennings State Forest (3,828).

11355 **20.1.4 Conservation Needs and Threats**

11356
11357 Gopher tortoises require well-drained, sandy soils for burrowing and nest construction, and an
11358 abundance of herbaceous ground cover for food. A relatively open forest canopy and relatively
11359 open (litter-free) ground surface is necessary for both feeding and nesting. The primary threats to
11360 the gopher tortoise are the loss, fragmentation, and degradation of such habitats. The conversion
11361 of native upland habitats to densely stocked pine plantations with a closed canopy eliminates
11362 herbaceous ground cover. The conversion of native uplands habitats to agricultural, urban, and
11363 mining uses destroys and fragments gopher tortoise habitats.

11364
11365 The availability of herbaceous ground cover along roadsides, especially in areas with highly
11366 fragmented or degraded habitats, attracts gopher tortoise foraging activity, which exposes
11367 individuals to vehicle strikes. Roadkill is a known source of tortoise mortality, but its effects on
11368 populations are not well understood. Reports cited in Enge *et al.* (2006) identified roadkill as the
11369 leading cause of tortoise mortality in one rural Georgia study area, and identified tortoises as the
11370 third-most frequently killed species on a highway north of Orlando.

11371
11372 The *Gopher Tortoise Management Plan* (FWC 2012) notes that the regular application of
11373 prescribed burning is critical for the maintenance of gopher tortoise habitat. Prescribed burning
11374 controls the density of woody species, stimulates the growth of herbaceous plants that tortoises
11375 eat, and creates conditions necessary for tortoise egg incubation.

11376
11377 Enge *et al.* (2006) summarize the available data about predation on gopher tortoises. Various
11378 mammals, birds, and snakes eat gopher tortoise eggs and hatchlings. About 80–90% of nests are

11379 depredated, primarily by mammalian predators (raccoon, striped skunk, gray fox and opossum),
11380 and more than 90% of hatchlings do not survive their first year. Populations of some egg and
11381 hatchling predators, such as raccoons and crows, are artificially elevated at the urban/rural
11382 interface. Non-native predators of eggs or hatchlings include the armadillo, monitor lizards, and
11383 fire ants. Dogs and coyotes sometimes kill adults, but generally, the rate of adult mortality from
11384 predation is very low.

11385
11386 The species' primary conservation needs address the primary threats: protect and manage upland
11387 habitats that can sustain viable populations. The *Gopher Tortoise Management Plan* (FWC
11388 2012) provides objectives and strategies for conserving the species in Florida.

11390 **20.2 Environmental Baseline for Gopher Tortoise**

11391
11392 This section describes the current condition of the gopher tortoise in the Action Area without the
11393 consequences to the listed species caused by the proposed Action.

11394 **20.2.1 Action Area Numbers, Reproduction, and Distribution**

11395 The Applicants did not conduct gopher tortoise surveys of the Plan Area during the development
11396 of the HCP. The HCP reports available occurrence data from two locations in the northwest
11397 corner of the Plan Area, three within the town of Immokalee, and four within three mi of the Plan
11398 Area's outer boundary (HCP, Figure 5-7, based on data from FWC). The gopher tortoise
11399 typically inhabits areas with relatively well-drained sandy soils (Enge et al. 2006), and the soils
11400 of eastern Collier County are generally poorly to very poorly drained (HCP Chapter 3.5). Sandy
11401 deposits are thicker (20–40 ft) in the northern half of the Plan Area near Immokalee, and are
11402 thinner or absent in the southern half. All of the gopher tortoise observations within the outer
11403 boundary of the Plan Area are in the northern half.

11404
11405 Surveys in 2004-2005 supporting State and Federal permitting associated with development of
11406 the Town of Ave Maria failed to detect gopher tortoises (B. Layman, Barron Collier Companies,
11407 personal communication). Ave Maria encompasses about 5,000 acres within the Plan Area's
11408 outer boundary, but is excluded from the Plan Area for purposes of the BO/CO (see section
11409 2.1.1). The species' apparent absence in Ave Maria, located near the geographic center of the
11410 Plan Area, suggests that large portions of the Plan Area may not support gopher tortoises, and
11411 that its distribution in the Plan Area is likely patchy.

11412
11413 Several different native upland cover classes considered suitable habitat for gopher tortoises
11414 occur in the Plan Area, including scrubby flatwoods, mesic flatwoods, scrub, palmetto prairie,
11415 mixed hardwood-coniferous, mesic hammock, shrub and brushland (total 13,221 acres; Table 2-
11416 1). In south Florida, tortoises are also known to forage on the margins of wetlands, and to dig
11417 burrows in man-made berms, but use of such non-typical habitats is poorly understood (FWC
11418 2012). Non-native cover classes in the Plan Area that also are not considered typical habitats
11419 (e.g., for the habitat-based population estimates cited in section 20.1.3), but that gopher tortoises
11420 are known to use, include rural open land, improved pasture, orchards/groves, and fallow
11421 orchards (total 57,265 acres; Table 2-1). The ratio in the Plan Area of these non-native cover
11422 classes to the native cover classes considered typical gopher tortoise habitat exceeds 4:1. We do
11423
11424

11425 not expect these non-native cover classes to contain the majority, or even a substantial fraction,
11426 of the home range of a gopher tortoise. Consistent with the methods used for estimating
11427 statewide gopher tortoise numbers cited in section 20.1.3, we base our estimation of gopher
11428 tortoise numbers in the Plan Area on the 13,221 acres of native upland cover classes present.
11429

11430 The Plan Area is located on the southern fringe of the species' range and consists entirely of
11431 private lands managed primarily for agricultural purposes. We expect the native upland cover
11432 classes of the Plan Area to support a lower density of tortoises than most public conservation
11433 lands in the species' range, including those that provided the density data for the FWC statewide
11434 habitat-based population estimate (0.59 tortoises/acre; McCoy *et al.* 2002; see section 20.1.3).
11435 The results of pre-construction surveys for a spoil disposal site located adjacent to the Plan Area
11436 on the northeast side of Lake Trafford are likely more representative of tortoise abundance in the
11437 Plan Area. The Conservancy of Southwest Florida (2004) detected 75 active gopher tortoise
11438 burrows within 352 acres consisting of disturbed scrub, abandoned citrus, disturbed flatwoods,
11439 disturbed marsh, disturbed wet prairie, abandoned fields, and ditches and berms. The surveyors
11440 examined 31 of the burrows and found 10 live tortoises (a burrow/tortoise ratio of 3:1). Applying
11441 this ratio to all 75 burrows suggests that the site supported 25 tortoises, or a density of $25 \div 352$
11442 acres = 0.07 tortoises/acre.
11443

11444 Due to its proximity to the Plan Area and its similar mix of cover classes, we consider the 0.07
11445 tortoises/acre density observed at the Lake Trafford site an appropriate proxy for the Plan Area.
11446 We estimate that the 13,221 acres of native upland habitats in the Plan Area, and some extent of
11447 adjacent non-native and wetlands cover classes, to support about 925 gopher tortoises.
11448

11449 **20.2.2 Action Area Conservation Needs and Threats**

11450 Threats to the gopher tortoise in the Action Area are similar to those occurring elsewhere the
11451 species' range: habitat loss and fragmentation, predation by native and exotic species, vehicle
11452 strikes, and insufficient fire regimes. Protecting and managing habitats that can sustain viable
11453 populations is the primary conservation need.
11454

11455 **20.3 Effects of the Action on Gopher Tortoise**

11456 This section describes all reasonably certain consequences to the gopher tortoise that we predict
11457 the proposed Action would cause, including the consequences of other activities not included in
11458 the proposed Action that would not occur but for the proposed Action. Such effects may occur
11459 later in time and may occur outside the immediate area involved in the Action.
11460

11461 **20.3.1 Development and Mining**

11462 Because gopher tortoises rely primarily on native upland cover types, and it is plausible that
11463 development would occur disproportionately in these non-wetland cover types, we use the RMI
11464 method described in section 2.1.4 to estimate the extent of development in gopher tortoise
11465 habitats. Native uplands cover 1,804, 16, and 734 acres of the Development and Mining, Base
11466 Zoning, and Eligible Lands designations, respectively (Table 2-2). These 2,554 native upland
11467 acres amount to less than the development cap of 39,973 acres that may occur within the 66,245-
11468

11471 acre development envelope. Development confined entirely to the Development areas, or
11472 implemented with the maximum possible substitution of Base Zoning and/or Eligible lands in the
11473 accounting for the cap, could replace all of the native uplands habitats in one or more of these
11474 HCP land use designations. Using a density of 0.07 tortoises/acre (see section 20.2.1), the native
11475 uplands in the Development and Mining, Base Zoning, and Eligible Lands designations would
11476 support about 126, 1, and 51 tortoises, respectively (total 178).

11477 Gopher tortoises use their burrows year-round, and conduct most breeding and feeding activities
11478 within 164 ft of their burrows (see section 20.1.2). Construction activities near burrows would
11479 disrupt these activities. Collapsing or blocking a burrow during construction activities would kill
11480 or injure adults, juveniles, or eggs that are present. The State of Florida classifies the gopher
11481 tortoise as a threatened species, and protects gopher tortoises by requiring permits before
11482 conducting construction activities within 25 ft of an active burrow. FWC's *Gopher Tortoise*
11483 *Permitting Guidelines* (2017) would apply to the development activity under the HCP, which the
11484 Applicants propose to follow (HCP Chapter 7.4.2).

11485 The *Permitting Guidelines* prescribe thorough pre-construction surveys and relocating all
11486 tortoises from construction areas to a suitable undisturbed habitat onsite or offsite. The rate of
11487 injury and mortality caused by the capture and relocation process is low (0.28% according to E.
11488 Seckinger, personal communication). We would expect the death of no more than 1 gopher
11489 tortoise (0.28% of 182 tortoises in the development envelope) caused by these intentional
11490 measures intended to avoid incidental take that would otherwise occur in the construction areas.
11491 The Applicants propose to identify suitable recipient sites within the designated Preservation and
11492 Very Low Density use areas for tortoises relocated from the Development areas (HCP Chapter
11493 7.4.2).

11494 Adhering to the FWC *Guidelines* would avoid or minimize direct harm to gopher tortoises
11495 caused by the development activity. However, the development of up to 2,554 acres of native
11496 upland cover and adjacent areas that tortoises may occupy would permanently reduce the
11497 species' distribution in the Plan Area accordingly.

11498 Increased vehicle traffic during and after construction could increase the risk of mortality and
11499 injury caused by collisions with vehicles outside the footprint of actual construction activity.
11500 Increased human population density in the developments could increase predation by both native
11501 and non-native predators that increase in local abundance at urban/rural interface. Increased
11502 numbers of dogs could increase the injury rate of adult tortoises and the destruction/disturbance
11503 of burrows located near this interface. We have no data from which we could reasonably
11504 estimate numbers of gopher tortoises located outside construction footprints that these changes
11505 associated with the developments would affect. However, we believe that the scale of any such
11506 impacts is substantially less than the impact of the habitat loss caused by development, because
11507 these changes would affect primarily tortoises that occupy the margins of remaining habitat
11508 blocks.

11509 **20.3.2 Preservation Activities**

11510

11516 The designated Preservation Areas contain 10,221 acres, or 77% (Table 2-2), of the native
11517 uplands cover in the Plan Area considered primary gopher tortoise habitat. We estimate Plan
11518 Area tortoise numbers at about 925 individuals (see section 20.2.1), and expect the Preservation
11519 Areas to support about $0.77 \times 925 = 712$ tortoises.

11520
11521 The Applicants propose a continuation of existing land uses (agriculture, silviculture, *etc.*) in the
11522 Preservation Areas, which we listed in section 2.3. Land management activities in the
11523 Preservation Areas for which the Applicants seek take authorization include:
11524 prescribed burning;
11525 mechanical control of groundcover (*e.g.*, roller chopping, brush-hogging, mowing);
11526 ditch and canal maintenance;
11527 mechanical and/or chemical control of exotic vegetation;
11528 soil tillage; and
11529 similar activities that maintain or improve land quality.

11530
11531 Prescribed burning maintains habitat quality in the native uplands that gopher tortoise prefer (see
11532 section 20.1.4). Tortoises may avoid a slowly advancing prescribed fire by seeking refuge in
11533 their burrows, from which they do not wander very far. Gopher tortoises are relatively less likely
11534 to avoid heavy equipment operating within their home ranges, but the scientific literature does
11535 not identify the use of heavy equipment as a significant threat (apart from its role in habitat loss
11536 and fragmentation) or source of mortality. Accordingly, FWC (2017) specifically exempts
11537 agricultural, silvicultural, and wildlife habitat management activities from the requirements for
11538 gopher tortoise permits, including tilling, planting, harvesting, prescribed burning, mowing,
11539 disking, roller chopping, and tree cutting.

11540
11541 We expect gopher tortoises to persist in the Preservation Areas, because the preservation and
11542 management activities will, at minimum, maintain current conditions. Long-term management of
11543 the Preservation Areas with prescribed fire could increase tortoise densities and the local
11544 population, which we expect are currently at low levels. However, lacking detailed information
11545 about gopher tortoises in the Plan Area, and the extent to which habitat management may
11546 specifically benefit this species, we are unable to estimate the extent of potential benefits.
11547 Relocating up to about 182 tortoises from the Development areas to the Preservation Areas
11548 would increase tortoise numbers in the latter. The FWC permitting process involves identifying
11549 suitable recipient sites for relocated animals, which we expect will place tortoises in habitats that
11550 can sustain them, including recipient sites located in the Preservation Areas.

11551
11552 **20.3.3 Very Low Density Development**

11553
11554 The Very Low Density (VLD) use areas contain 447 acres, or 3.4% (Table 2-2) of the native
11555 uplands cover in the Plan Area. We estimate Plan Area tortoise numbers at about 925 individuals
11556 (see section 20.2.1), and expect the VLD use areas to support about $0.034 \times 925 = 31$ tortoises.

11557
11558 Land uses in the VLD areas are similar to the Preservation Areas, but may also include isolated
11559 residences, lodges, and hunting/fishing camps, at a density of no more than one dwelling unit per
11560 50 acres. The Applicants would continue current ranching/livestock operations and other
11561 management activities as described for the Preservation Areas (*e.g.*, exotic species control,

11562 prescribed burning). As in the Preservation Areas, we do not expect such management activities
11563 to reduce the numbers, reproduction, or distribution of the gopher tortoise in the VLD use areas,
11564 because these activities would, at minimum, maintain current conditions.

11565
11566 The HCP does not specify a footprint for the isolated residences, lodges, and hunting/fishing
11567 camps, but indicates that their construction could clear up to 10% of the existing native
11568 vegetation (see section 2.5). New dwelling development could occur within any of the cover
11569 types present besides open water and existing development. It is possible that dwelling
11570 development in the VLD areas could entirely avoid native uplands, but we conservatively
11571 estimate a 45-acre habitat loss (10% of these types), affecting about 3 tortoises (about 10% of the
11572 total numbers).

11573
11574 Development activity in VLD use areas would be subject to the FWC *Gopher Tortoise*
11575 *Permitting Guidelines* (2017), which require pre-construction surveys and subsequent relocation
11576 of tortoises from the construction footprint. As in the designated Development areas,
11577 implementing the FWC *Guidelines* would avoid or minimize direct harm to gopher tortoises
11578 caused by construction activities. Developing up to 45 acres would permanently reduce the
11579 species' distribution in the Plan Area accordingly. The HCP indicates that possible recipient sites
11580 for tortoises moved away from VLD development sites include suitable habitats within either the
11581 VLD use areas or the Preservation Areas.

11582 11583 **20.4 Cumulative Effects on Gopher Tortoise**

11584
11585 For purposes of consultation under ESA §7, cumulative effects are those caused by future state,
11586 tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future
11587 Federal actions that are unrelated to the proposed action are not considered, because they require
11588 separate consultation under §7 of the ESA.

11589
11590 We identified in section 3 of this BO/CO a projected increase in traffic on public roads as the
11591 sole source of effects that are consistent with the definition of cumulative effects for this Action.
11592 Roadkill is a documented cause of gopher tortoise mortality (see section 19.1.4). Increased
11593 vehicle traffic unrelated to the Action is a stressor that may adversely affect gopher tortoises in
11594 the Action Area. As the population of southwest Florida increases, we expect more vehicle use
11595 in the Action Area and a concomitant increase in risk of road mortality of animals in general.
11596 However, lacking data about tortoise roadkill numbers and locations in the Action Area, we
11597 cannot predict with reasonable certainty an increase in risk of roadkill caused by sources
11598 unrelated to the Action in a quantifiable manner.

11599 11600 **20.5 Conclusion for Gopher Tortoise**

11601
11602 In this section, we summarize and interpret the findings of the previous sections for the gopher
11603 tortoise (status, baseline, effects, and cumulative effects) relative to the species-specific purpose
11604 of a CO under §7(a)(2) of the ESA, which is to determine whether the proposed action is likely
11605 to jeopardize the continued existence of a species.

11606 11607 **Status**

11608
11609 The current range for the eastern (candidate) population of the gopher tortoise spans from
11610 southeastern South Carolina to eastern Alabama and to south Florida. The species is most
11611 abundant in central and north Florida, and in southern Georgia. Based on the availability of
11612 preferred native upland habitats combined with existing survey-based population data, range
11613 wide abundance is at about 1.2 million adult tortoises. The extent of native upland habitats in
11614 Florida alone is about 3.3 million acres; however, many of these areas probably do not support
11615 tortoises. Range wide, only 164 areas support populations that are known to exceed the criteria
11616 for a minimum viable population (# adults ≥ 250 , density ≥ 0.4 tortoises/acre; suitable habitat
11617 ≥ 250 acres). The largest of these viable populations are on public lands, supporting a few
11618 thousand individuals. Recognized threats to the species include habitat loss and fragmentation,
11619 insufficient fire regimes to maintain habitat quality, predation by native and exotic species, and
11620 roadkill. Protecting and managing habitats that can sustain viable populations is the species'
11621 primary conservation need.
11622

Baseline

11623
11624 Gopher tortoises are known to occur in the Plan Area, but soil characteristics and the species'
11625 apparent absence in some areas suggest that distribution in the Plan Area is likely patchy. Gopher
11626 tortoises in south Florida are known to make greater use of some non-native and wetlands cover
11627 classes than elsewhere in the species' range. However, some extent of native upland cover
11628 classes are necessary to sustain the species, and the extent of native upland cover classes is the
11629 basis for regional and range wide population estimates. The Plan Area contains 13,221 acres of
11630 native upland cover classes. Using density data from a site adjacent to the Plan Area, we estimate
11631 the Plan Area supports about 925 gopher tortoises. Threats to the species in the Plan Area are
11632 similar to those elsewhere in the range: habitat loss and fragmentation, insufficient fire regimes
11633 to maintain habitat quality, predation by native and exotic species, and roadkill. Likewise,
11634 protecting and managing habitats that can sustain viable populations is the species' primary
11635 conservation need.
11636

Effects

11637
11638 Development in the Plan Area would eliminate up to 2,554 acres of native upland habitats that
11639 we estimate support about 178 gopher tortoises. Implementing the FWC *Gopher Tortoise*
11640 *Permitting Guidelines* would relocate these tortoises from construction footprints to recipient
11641 habitats in the designated Preservation or Very Low Density (VLD) use areas. We recognize the
11642 potential for increased traffic, predators attracted to the rural/urban interface, and pet populations
11643 caused by the new developments to harm tortoises in remaining habitats, but are unable to
11644 estimate the numbers affected. We believe the full scale of such effects would be less than the
11645 impact of the habitat loss caused by development.
11646

11647
11648 The designated Preservation and VLD areas contain 10,221 and 447 acres, respectively, of native
11649 upland habitats that we estimate support about 743 gopher tortoises. We do not expect the
11650 management of the Preservation and VLD areas to reduce the numbers, reproduction, or
11651 distribution of the gopher tortoise in these areas, because these activities would, at minimum,
11652 maintain current conditions. We estimate that residential/recreational construction that could
11653

11654 remove up to 10% of the native upland cover in the VLD areas would prompt the relocation of
11655 about 3 tortoises.

11656
11657 Long-term management of the Preservation Areas with prescribed fire could increase tortoise
11658 densities and local abundance, which we expect are currently low. Relocating up to about 178
11659 tortoises from the Development areas to the Preservation Areas would increase tortoise numbers
11660 in the latter. The FWC permitting process involves identifying suitable recipient sites for
11661 relocated animals, which we expect will place tortoises in habitats that can sustain them,
11662 including recipient sites located in the Preservation Areas.

11663
11664 **Cumulative Effects**

11665
11666 Increased vehicle traffic unrelated to the Action is a stressor that may adversely affect gopher
11667 tortoises in the Action Area. However, lacking data about tortoise roadkill locations or numbers
11668 in the Action Area, we cannot predict with reasonable certainty an increase in the risk of roadkill
11669 caused by sources unrelated to the Action in a quantifiable manner.

11670
11671 **Opinion**

11672
11673 Developing up to 2,554 acres of native upland habitats would add an increment of habitat loss to
11674 the species' range, which encompasses about 3.3 million acres of native upland habitats in
11675 Florida. Relocating up to 178 tortoises from developed areas (and up to 3 tortoises from
11676 construction sites within the VLD use areas) to the Preservation Areas would affect less than
11677 0.02% of the range wide population of about 1.2 million tortoises. The extent of habitat
11678 enhancement that may occur in the Preservation and VLD use areas is uncertain, but long-term
11679 management and protection of over 10,000 acres of native upland cover classes is likely to create
11680 some benefits for gopher tortoises. Such management and protection in the Preservation Areas
11681 would eliminate in these areas the primary threat to the species, which is habitat degradation,
11682 loss, and fragmentation.

11683
11684 After reviewing the current status of the species, the environmental baseline for the Action Area,
11685 the effects of the Action and the cumulative effects, it is the Service's conference opinion that
11686 the Action is not likely to jeopardize the continued existence of the gopher tortoise.

11687
11688 **21. INCIDENTAL TAKE STATEMENT**

11689
11690
11691 ESA §9(a)(1) and regulations issued under §4(d) prohibit the take of endangered and threatened
11692 fish and wildlife species without special exemption. The term "take" in the ESA means "to
11693 harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in
11694 any such conduct" (ESA §3(19)). In regulations, the Service further defines:

11695 d. "harm" as "an act which actually kills or injures wildlife. Such act may include
11696 significant habitat modification or degradation where it actually kills or injures wildlife
11697 by significantly impairing essential behavioral patterns, including breeding, feeding or
11698 sheltering;" (50 CFR §17.3) and

11699 e. “incidental take” as “takings that result from, but are not the purpose of, carrying out an
11700 otherwise lawful activity conducted by the Federal agency or applicant” (50 CFR
11701 §402.02).

11702
11703 Under the terms of ESA §7(b)(4) and §7(o)(2), taking that is incidental to and not intended as
11704 part of the agency action is not considered prohibited, provided that such taking is in compliance
11705 with the terms and conditions of an incidental take statement (ITS).

11706 Under ESA §10(a)(1)(B), the Service may authorize incidental take caused by otherwise lawful
11707 non-federal actions through an Incidental Take Permit (ITP), provided that such authorization
11708 complies with ESA §7(a)(2) and satisfies other permit issuance criteria. We determined that the
11709 proposed Action as described in the Applicants’ HCP includes activities that are reasonably
11710 certain to cause incidental take of 14 of the 20 Covered Species we identified in section 1.1 of
11711 the BO/CO.

11712
11713 The proposed Action would also cause other activities (*e.g.*, an increase in traffic associated with
11714 residents of the developments) that are reasonably certain to cause incidental take of listed
11715 species, but over which the Applicants or their agents would have no involvement or control, and
11716 which this ITS does not address. We estimated the amount or extent of taking caused by such
11717 activities, and caused by future non-Federal activities unrelated to the Action (cumulative
11718 effects) in the BO/CO. We accounted for all three sources of effects (the Applicants’ Covered
11719 Activities, consequences that would not occur but for the Applicants’ activities, and unrelated
11720 future non-Federal activities in the Action Area) in explaining our findings under ESA §7(a)(2).
11721 From these analyses, we collate our estimates of the amount or extent of taking over which the
11722 Applicants have involvement or control in section 21.1 below.

11723
11724 A proposed ESA §10 permit differs from other Federal actions that must comply with §7(a)(2) in
11725 that the anticipated incidental taking of wildlife is authorized by the ITP, rather than exempted
11726 from the applicable prohibitions through an ITS. ESA §10(a)(2) provides criteria that an HCP
11727 and an ITP must satisfy, including a specification of the steps that the applicant will take to
11728 minimize and mitigate the impacts of incidental taking to the maximum extent practicable. The
11729 Service’s direct authority under §10(a)(1)(B) to permit incidental taking caused by non-Federal
11730 actions supersedes the Service’s indirect authority under §7(b)(4) and §7(o)(2) to exempt
11731 incidental taking caused by Federal actions. Therefore, the ITS attached to the BO/CO for a
11732 proposed HCP and ITP does not need to provide:

- 11733 1. reasonable and prudent measures that are necessary or appropriate to minimize the
11734 impacts of incidental taking;
- 11735 2. terms and conditions for implementing such measures; or
- 11736 3. take monitoring and reporting requirements.

11737
11738 However, to fulfill the specific requirements for an ITS under 50 CFR §402.14(i), and to comply
11739 with policy in the Services’ 1998 Consultation Handbook (p. 4-55–56) and the 2016 HCP
11740 Handbook (p. 14–28), we hereby incorporate by reference from any §10(a)(1)(B) permit(s)
11741 issued with respect to the proposed HCP all required (non-discretionary):

- 11742 • conservation measures;
- 11743 • terms and conditions;

11745 • monitoring and reporting requirements; and
11746 • provisions for the disposition of dead or injured animals.

11747
11748 This ITS does not address the three Covered Species we dismissed from further analysis in
11749 section 1.1.1 of the BO/CO: gopher frog, Southeastern American kestrel, and Everglades mink.
11750 We lack sufficient evidence to find that these species are reasonably certain to occur in the
11751 Action Area; therefore, we do not anticipate any incidental take of these species. Similarly, we
11752 lack sufficient evidence to find that the red-cockaded woodpecker is reasonably certain to occur
11753 in the Action Area; therefore, we do not anticipate any incidental take of this species.

11754
11755 This ITS also does not address two of the Covered species that are reasonably certain to occur in
11756 the Action Area, but for which our effects analyses indicate the Action is not likely to cause
11757 incidental take: the red knot, and the Everglade snail kite. The Applicants did not request take
11758 authorization for the red knot, and based on our findings in the BO/CO, none is required. The
11759 amount or extent of take we anticipate for the snail kite is none.

11760
11761 **21.1 Amount or Extent of Take**

11762
11763 This section specifies the amount or extent of take of wildlife species caused by activities over
11764 which the Applicants would have involvement or control, which we estimated in the “Effects of
11765 the Action” section(s) of this BO/CO. We reference, but do not repeat, these analyses here. All
11766 instances of incidental take we predict are in the form of harm, *i.e.*, actual death or injury caused
11767 by significant habitat modification or degradation, associated with the development activities
11768 (operation of equipment, vegetation clearing, grading, drainage, construction, *etc.*).

11769
11770 For each Covered Species that the Action is likely to harm, Table 21-1 identifies the life stage(s)
11771 and estimated number of individuals, and the section of the BO/CO that contains the supporting
11772 analysis. In all instances, the amount of harm specified is the total we estimate for the duration of
11773 the Action, not an annual recurring level of harm. Once the habitat modification that we expect
11774 to cause take has occurred, it would not occur again.

11775
11776 For all Covered Species identified in Table 21-1 except the Florida scrub jay and gopher tortoise,
11777 the detection of take that occurs incidental to the Action is unlikely or impractical for various
11778 reasons (*e.g.*, individuals are small, cryptic, hidden in burrows, or displaced from the
11779 development footprint to other areas where death or injury occurs). For all species except the
11780 Florida scrub jay, we used estimates of the extent of habitat modification or degradation to
11781 estimate the number of individuals exposed to such changes and to predict the subsequent
11782 consequences. Therefore, we will use the estimated acreage of habitat modifications, which is
11783 where exposure to changes would occur that we expect to directly or indirectly kill or injure
11784 individuals, as surrogate measures for monitoring the extent of take (*i.e.*, a measure besides
11785 number of individuals). These measures will set a clear standard for determining when the level
11786 of anticipated take is exceeded. We report these surrogate measures, by species and by land
11787 cover class, in Table 21-2.

11788
11789 Table 21-2 notes also the method we used to estimate the acreage of exposure (see section 2.1.4),
11790 because species are associated with different cover classes, the full extent of development

11791 activity (39,973 acres) may occur within a larger portion of the Plan Area, and the cover class-
 11792 specific likelihood of development is variable. The level of species-specific taking we predict
 11793 depends on the collective change in those cover classes where we expect the species' exposure to
 11794 changes caused by development. Causing habitat modification that exceeds the total acres listed
 11795 in Table 21-2 for the set of cover classes listed for a species is the standard for determining when
 11796 the level of anticipated take of that species is exceeded.

11797
 11798 **Table 21-1.** Estimates of the amount of take (# of individuals) caused by activities over which
 11799 the Applicants would have involvement or control, by species and life stage, collated from
 11800 the cited BO/CO effects analyses.

COMMON NAME	Life Stage	Anticipated # Individuals Harmed	BO/CO Effects Analysis Section
Florida bonneted bat	adult	10	4.3.1
Florida bonneted bat	pup	9	4.3.1
Florida panther	adult	4c	5.3.1
Big Cypress fox squirrel	all	39	6.3.1
Florida sandhill crane	adult	12	7.3.1
Florida scrub jay	all	4-10 ^a	8.3.1
Burrowing owl	all	67	9.3.1
Little blue heron	adult	2-8	11.3.1
Tricolored heron	adult	3-5	12.3.1
Wood stork	adult	4-7	13.3.1
Roseate spoonbill	adult	1	15.3.1
Audubon's crested caracara	adult	4-8	16.3.1
Eastern diamondback rattlesnake	adult	132	18.3.1
Eastern indigo snake	adult	3-16	19.3.1
Gopher tortoise	adult	180 ^b	20.3.1

11801
 11802 ^a The Applicants propose to conduct pre-construction surveys and to coordinate with the USFWS for relocating
 11803 scrub jays found within construction areas. The applicable ITP(s) would authorize such relocation. The estimate
 11804 here of 4-10 individuals is the total number we expect to occur in such areas, which, if not relocated,
 11805 construction activities would harm.

11806 ^b The Applicants propose to follow FWC requirements for pre-construction surveys and obtaining State permits
 11807 that authorize the relocation of gopher tortoises found within construction areas. The estimate here of 180
 11808 adults is the total number we expect to occur in such areas, which, if not relocated, construction activities
 11809 would harm.

11810 ^c Panther take is calculated in panthers/year at full build-out.

11812 **Table 21-2.** Surrogate measures for monitoring the extent of take (acres of habitat modification
 11813 or degradation), by species and cooperative land cover (CLC) class, collated from the BO/CO
 11814 effects analyses. “n/a” (not applicable) indicates a cover class in which we do not anticipate
 11815 exposure to changes that would cause take of the species.

CLC Code	Land Cover Class Name	Species (see acronym list below) and acreage estimation method applied in effects analysis (P= Proportional; R= Reasonable Maximum Impact)											
		FBB (P)	FP (P)	BCFS (P)	FSC (P)	FBO (R)	LBH (P)	TCH (P)	WS (P)	RS (P)	ACC (R)	EDR (R)	EIS (R)
1120	Mesic Hammock	356	601	356	n/a	n/a	n/a	n/a	n/a	n/a	601	601	601
1210	Scrub	n/a	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0
1311	Mesic Flatwoods	756	1,252	756	n/a	n/a	n/a	n/a	n/a	n/a	1,252	1,252	1,252
1312	Scrubby Flatwoods	0	0	0	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0
1340	Palmetto Prairie	n/a	1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1	1	1
1400	Mixed Hardwood-Coniferous	240	405	240	n/a	n/a	n/a	n/a	n/a	n/a	405	405	405
1500	Shrub and Brushland	n/a	140	n/a	n/a	n/a	n/a	n/a	n/a	n/a	285	285	285
1800	Cultural - Terrestrial	n/a	6	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1821	Low Intensity Urban	n/a	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1822	High Intensity Urban	n/a	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1830	Rural (Rural Open Lands)	n/a	1,073	1,571	1,571	2,568	n/a	n/a	n/a	n/a	2,568	n/a	n/a
1833.1	Cropland/Pasture	n/a	7,945	n/a	11,697	17,743	n/a	n/a	n/a	n/a	17,743	n/a	n/a
1833.13	Improved Pasture	n/a	2,987	4,401	4,401	7,021	n/a	n/a	n/a	n/a	7,021	n/a	n/a
1833.2	Orchards/Groves	n/a	10,677	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1833.4	Fallow Orchards	n/a	41	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1833.5	Other Agriculture	n/a	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	n/a	n/a
1840	Transportation	n/a	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1850	Communication	n/a	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1860	Utilities	n/a	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1870	Extractive	n/a	14	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1880	Bare Soil/Clear Cut	n/a	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2100	Freshwater non-Forested Wetlands	n/a	2	n/a	3	n/a	3	3	3	3	6	n/a	n/a
2110	Prairies and Bogs	n/a	776	n/a	1,127	n/a	1,127	1,127	1,127	1,127	1,860	n/a	n/a
2120	Marsches	n/a	966	n/a	1,411	n/a	1,411	1,411	1,411	1,411	2,342	n/a	n/a
2121	Isolated Freshwater Marsh	n/a	260	n/a	384	n/a	384	384	384	384	648	n/a	n/a
2200	Freshwater Forested Wetlands	460	772	460	n/a	n/a	460	460	460	460	n/a	n/a	n/a
2210	Cypress/Tupelo	248	404	248	n/a	n/a	248	248	248	248	n/a	n/a	n/a
2211	Cypress	844	1,411	844	n/a	n/a	844	844	844	844	n/a	n/a	n/a
2213	Isolated Freshwater Swamp	208	341	208	n/a	n/a	208	208	208	208	n/a	n/a	n/a
2213.1	Dome Swamp	22	37	22	n/a	n/a	22	22	22	22	n/a	n/a	n/a
2214	Strand Swamp	9	15	9	n/a	n/a	9	9	9	9	n/a	n/a	n/a
2220	Other Coniferous Wetlands	6	11	6	n/a	n/a	6	6	6	6	n/a	n/a	n/a
2221	Wet Flatwoods	127	217	127	n/a	n/a	127	127	127	127	n/a	n/a	n/a
2230	Other Hardwood Wetlands	34	57	34	n/a	n/a	34	34	34	34	n/a	n/a	n/a
2232	Hydric Hammock	1	2	1	n/a	n/a	1	1	1	1	n/a	n/a	n/a
3000	Lacustrine	n/a	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
3100	Natural Lakes and Ponds	n/a	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
3200	Cultural - Lacustrine	n/a	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
4200	Cultural - Riverine	n/a	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
7000	Exotic Plants	n/a	161	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Total Acres	3,311	30,574	9,283	20,594	27,332	4,884	4,884	4,884	4,884	32,189	2,545	2,545

Acronym -	Common Name
FBB -	Florida bonneted bat
FP -	Florida panther
BCFS -	Big Cypress fox squirrel
FSC -	Florida sandhill crane
FBO -	Florida Burrowing owl
LBH -	Little blue heron
TCH -	Tricolored heron
WS -	Wood stork
RS -	Roseate spoonbill
ACC -	Audubon's crested caracara
EDR -	Eastern diamondback rattlesnake
EIS -	Eastern indigo snake
GT -	Gopher tortoise

11816
 11817
 11818
 11819
 11820
 11821
 11822
 11823
 11824
 11825
 11826
 11827
 11828
 11829
 11830
 11831
 11832

11833 **21.2 Effect of the Take**

11834

11835 In the accompanying BO/CO, the Service determined that the levels of incidental take reported
11836 in section 21.1 **are/are not** likely to jeopardize the continued existence of each Covered Species.

11837

11838 **21.3 Reasonable and Prudent Measures, Terms and Conditions, and Monitoring and**
11839 **Reporting**

11840 If issued, the ITPs will require the permittees to implement the HCP as proposed. The ITPs will
11841 prescribe any additional or modified measures, with non-discretionary terms and conditions, that
11842 are necessary to minimize and mitigate incidental take of the Covered Species to the maximum
11843 extent practicable. The ITPs will also prescribe any additional or modified procedures to monitor
11844 and report such take. No reasonable and prudent measures, terms and conditions, or take
11845 monitoring and reporting procedures in this ITS are necessary, because the ITP will specify all
11846 such requirements in authorizing the take under ESA §10(a)(1)(B).

11847

11848 **22. CONSERVATION RECOMMENDATIONS**

11849

11850

11851 ESA §7(a)(1) directs Federal agencies to use their authorities to further the purposes of the ESA
11852 by conducting conservation programs for the benefit of endangered and threatened species.
11853 Conservation recommendations are discretionary activities that an action agency may undertake
11854 to avoid or minimize the adverse effects of a proposed action, implement recovery plans, or
11855 develop information that is useful for the conservation of species addressed in the BO/CO. The
11856 Florida State Office (FSO) offers the following recommendations that are relevant to the
11857 Covered Species of the HCP and that we believe are consistent with the authorities of the
11858 Service's Regional Office (RO) through its permits issuance decision.

11859

11860 The HCP provides a framework to facilitate cooperation among the Service, County building
11861 authorities, highway construction agencies, and other regional conservation stakeholders to
11862 address conservation needs for the covered species throughout the region. The Service should
11863 seek formal cooperation with local and state road planning agencies in order to coordinate with
11864 and complement HCP implementation. This can take the form of entering cooperative
11865 agreements with applicable agencies for highway planning and mitigation. The Service should
11866 also invite the participation of panther conservation stakeholders for their input into the periodic
11867 HCP check-ins as described above.

11868

11869 As the Service evaluates project proposals for their consistency with the HCP, including whether
11870 they satisfy the HCP's objectives for the best management practices, we will consider the
11871 following conservation concerns for the covered species.

11872

11873 **Florida bonneted bat**

11874 1.1 Maintaining native wetland and upland forested habitats to provide roost sites, as well as
11875 vegetated and open water areas to provide foraging opportunities, is the species' primary
11876 conservation need in the Plan Area.

11877 1.2 Finding additional roost sites is a key component to better understanding the species'
11878 habitat needs, which will greatly contribute to conservation of the species. Knowing where
11879 roosts occur and determining better methods to detect them will enhance endeavors to
11880 learn more about life history and help focus habitat protection efforts on specific locations,
11881 especially if roost sites may be a limited resource for the species.

11882 **Panther**

- 11883 ○ Avoid or Minimize new road construction in the Preservation Areas.
- 11884 ○ Establish low speed limits (less than 45 mph daytime, 35 mph twilight hours and
11885 nighttime) on new roadways within the Plan Area.
- 11886 ○ Maintain internal traffic capture of each development at or above 50 percent.
- 11887 ○ Prioritize the construction of wildlife crossings and fencing on road segments
11888 within 300m of forest cover.
- 11889 ○ Install at least ½ mi of fencing on either side of new and existing wildlife
11890 crossings. Span driveways with gating to maintain continuity of winged fencing
11891 as a barrier.
- 11892 ○ Concentrate development more than 300m away from existing forest edge.
- 11893 ○ Use fencing or water barrier to separate new development from forest edges
11894 where construction can't be conducted further than 300m away.
- 11895 ○ Regularly prune dense vegetation so that edges and opportunities for concealment
11896 are unavailable to panthers near residences, paths, and recreational facilities.
- 11897 ○ Educate residents regarding safe coexistence with panthers and other wildlife.
- 11898 ○ Prohibit residents from keeping domestic animals (chickens, goats, etc.) that
11899 attract panthers and other predators.
- 11900 ○ Require full vaccination of all pets in new developments from diseases that can be
11901 acquired by panthers.
- 11902 ○ Require pets be kept indoors, leashed, or maintained in fenced enclosures at all
11903 times. Encourage residents to feed pets indoors and to not leave pet food dishes
11904 outside.
- 11905 ○ Require scavenger/wildlife proof trash containers to prevent wildlife from
11906 consuming garbage.
- 11907 ○ Encourage residents to clean grills and store them indoors when not in use.
- 11908 ○ Minimize the use of bird feeders and supplemental feeding stations for deer and
11909 other game species.
- 11910 ○ Require residents to deer proof gardens.
- 11911 ○ Encourage residents to wash recycling and trash receptacles regularly to reduce
11912 odors that attract panthers and their prey.
- 11913 ○ Encourage residents to install motion activated lighting systems.
- 11914 ○ Prohibit the use of anticoagulant and neuroactive rodenticides within the Plan
11915 Area.
- 11916 ○ Report sightings, encounters, or evidence of panthers in or near developments to
11917 neighbors, the HOA, and FWC.

- Restore agricultural lands to native habitats that are more beneficial to the panther, especially forested habitats, and maintain in perpetuity.
- Restore agricultural lands to native habitats that are more beneficial to the panther, especially forested habitats, and maintain in perpetuity.
- Widen forested corridors near wildlife crossings.
- Coordinate Preservation and VLD area monitoring and management with the Florida Panther National Wildlife Refuge, the U.S. Fish and Wildlife Service Ecological Services Program, and Florida Fish and Wildlife Conservation Commission.
- Maximize habitat suitability for panthers and prey in non-developed areas by utilizing habitat management techniques and restoration goals employed by the Florida Panther National Wildlife Refuge (https://www.fws.gov/refuge/Florida_Panther/).
- Provide information to residents regarding safe coexistence with panthers.

Big Cypress fox squirrel

- a. The designated Preservation Areas of the HCP contain the majority (47,811 acres, or 74.9 percent) of land cover that we consider as BCFS habitat within the Plan Area. We expect BCFS to persist in the Preservation Areas, because the proposed preservation and management activities will, at minimum, maintain current conditions.
- b. Attention to this species in the long-term management of the Preservation Areas under conservation easements could increase BCFS densities and the Plan Area population.
- c. The species' primary conservation need is the protection and management of open understory woodlands. FWC (2018) provides recommendations to address this need and others in its *Species Conservation Measures and Permitting Guidelines for the Big Cypress Fox Squirrel*.

Florida sandhill crane

- a. The designated Preservation Areas may support up to 51 breeding pairs of cranes. We do not expect the proposed management of Preservation Areas to reduce the numbers, reproduction, or distribution of the Florida sandhill crane to in the Preservation Areas, because these activities will, at minimum, maintain current conditions.
- b. Attention to this species in the long-term management of the Preservation Areas under conservation easements could increase crane densities and the Plan Area population.

Florida scrub-jay

- a) Precluding new development and mining activity in the dedicated Preservation Areas would protect the habitat that may still support another two scrub-jay family groups.

b) Maintaining current conditions in the Preservation Areas could maintain the resident scrub-jay groups for some time.

11960 Florida burrowing owl

a) The likely survival of displaced birds and possible increases in habitat quality in the Preservation Areas would reduce the overall impact of the Action to the Florida-wide population to a level substantially below the worst-case scenario of a 1.6 percent loss.

11965 Little blue heron

- The designated Preservation Areas may support 25–75 LBH. We do not expect the proposed management of Preservation Areas to reduce the numbers, reproduction, or distribution of the LBH in the Preservation Areas, because these activities will, at minimum, maintain current conditions.
- Attention to this species in the long-term management of the Preservation Areas under conservation easements could increase LBH densities and the Plan Area population.

Tricolored heron

- a. The designated Preservation Areas may support about 50 TCH. We do not expect the proposed management of Preservation Areas to reduce the numbers, reproduction, or distribution of the TCH in the Preservation Areas, because these activities will, at minimum, maintain current conditions. Special attention to this species in the long-term management of the Preservation Areas under conservation easements could increase TCH densities and the Plan Area population.
- b. Native wetlands in the Very Low Density (VLD) use areas may support one TCH. Clearing up to 10 percent of the native wetlands in the VLD use areas would reduce TCH habitat by 73 acres. Because the VLD area wetlands do not support known nesting colonies, we do not expect this extent of habitat modification to kill or injure TCH.

11986 Wood stork

- Special attention to this species in the long-term management of the Preservation Areas under conservation easements could increase wood stork densities and the Plan Area population.

11990 Red-cockaded woodpecker

- a) The Applicants propose to manage pine flatwoods within the Preservation Areas to benefit multiple Covered Species, including the RCW, if RCWs colonize such areas.

11994 **Roseate spoonbill**

11995 ○ Special attention to this species in the long-term management of the Preservation
11996 Areas under conservation easements could increase spoonbill densities and the
11997 Plan Area population.

11998 a. Special attention to this species in the long-term management of the Preservation
11999 Areas under conservation easements could increase the number of snail kites that
12000 the Plan Area supports, and possibly even promote nesting activity.

12001 **Eastern diamondback rattlesnake**

12002 ○ Long-term management of native uplands in the Preservation and VLD areas with
12003 prescribed fire could increase EDR densities and local abundance.

12004 **Eastern indigo snake**

12005 a. Long-term management of native uplands in the Preservation and VLD areas with
12006 prescribed fire could increase EIS densities and local abundance.

12007 **Gopher tortoise**

12008 a) Development activity in VLD use areas would be subject to the FWC *Gopher*
12009 *Tortoise Permitting Guidelines* (2017), which require pre-construction surveys
12010 and subsequent relocation of tortoises from the construction footprint. As in the
12011 designated Development areas, implementing the FWC *Guidelines* would avoid
12012 or minimize direct harm to gopher tortoises caused by construction activities.

12013 b) The extent of habitat enhancement that may occur in the Preservation and VLD
12014 use areas is uncertain, but long-term management and protection of over 10,000
12015 acres of native upland cover classes is likely to create some benefits for gopher
12016 tortoises. Such management and protection in the Preservation Areas would
12017 eliminate in these areas the primary threat to the species, which is habitat
12018 degradation, loss, and fragmentation.

23. REINITIATION NOTICE

Formal consultation for the Action considered in this BO relative to the nine ESA-listed Covered Species identified in section 1.1 is concluded. Reinitiating consultation with the Florida State Office (FSO) is required under 50 CFR §402.16 if the Service's Regional Office (RO) retains discretionary involvement or control over the Action (or is authorized by law) when:

- the amount or extent of incidental take of listed species is exceeded;
- new information reveals that the Action may affect listed species or designated critical habitat in a manner or to an extent not considered in this BO;
- the Action is modified in a manner that causes effects to listed species or designated critical habitat not considered in this BO; or
- a new species is listed or critical habitat designated that the Action may affect.

12033
12034 Formal conference for the Action considered in this CO relative to the 11 non-listed Covered
12035 Species identified in section 1.1 is concluded. When the Service issues a final rule classifying
12036 any of these species as endangered or threatened, the RO may submit a written request to the
12037 FSO to confirm the CO as a BO issued through formal consultation, if the RO retains
12038 discretionary involvement or control over the Action at that time.
12039
12040 This request should advise the FSO of any new data about the Action or its effects on such
12041 species that are relevant to adopting the CO as a BO, including the amount or extent of any
12042 taking of species that the Action has caused before the effective date of a listing decision. The
12043 FSO will review the Action and new information to determine whether modifying the opinion is
12044 appropriate. If the FSO finds no significant changes in the Action as proposed or in the
12045 information used during the conference, the FSO will confirm the CO as a BO for the Action,
12046 which shall conclude formal consultation for the newly listed species. Thereafter, the RO shall
12047 request to reinitiate formal consultation under the same circumstances listed above.
12048
12049

12050 **24. LITERATURE CITED**

12051 **24.1 Introduction**

12052 Florida Fish and Wildlife Conservation Commission (FWC). 2011. Biological status review
12053 report for the Everglades mink (*Neovison vison evergladensis*). 12 pp.
12054 <https://myfwc.com/media/1958/everglades-mink-bsr.pdf>

12055 Florida Fish and Wildlife Conservation Commission (FWC). 2013a. A species action plan for the
12056 gopher frog. Tallahassee, Florida.

12057 Florida Fish and Wildlife Conservation Commission (FWC). 2013b. A species action plan for
12058 the Southeastern American kestrel (*Falco sparverius paulus*). Florida Fish and Wildlife
12059 Conservation Commission. Tallahassee, Florida.

12060 Florida Fish and Wildlife Conservation Commission (FWC). 2013c. A species action plan for the
12061 Everglades mink (*Neovison vison evergladensis*). Florida Fish and Wildlife Conservation
12062 Commission. Tallahassee, Florida.

12063 Humphries, W. J., and M. A. Sisson. 2012. Long distance migrations, landscape use, and
12064 vulnerability to prescribed fire of the gopher frog (*Lithobates capito*). *Journal of Herpetology*
12065 46:665–670.

12066 Krysko K.L., K.M. Enge, and P.E. Moler. 2011. Atlas of amphibians and reptiles in Florida, final
12067 report, project agreement 08013. Florida Fish and Wildlife Conservation Commission,
12068 Tallahassee, Florida.

12069 Miller, K.E., and J.A. Smallwood. 1997. Natal dispersal and philopatry of Southeastern
12070 American kestrels in Florida. *Wilson Bulletin* (109):226-232.

12071 U.S. Fish and Wildlife Service. 2018. Draft Environmental Impact Statement: Eastern Collier
12072 Multiple Species Incidental Take Permit Applications and Habitat Conservation Plan.
12073 Atlanta, GA. 137 pages + appendices.

12074 Personal Communications

12079 Gore, J., 12/18/2018, Florida Fish and Wildlife Conservation Commission, pers. comm. with
12080 Heather Hitt, USFWS.
12081 Owen, M., 12/20/2018, Fakahatchee Strand Preserve State Park, pers. comm. with Heather Hitt,
12082 USFWS.
12083 Winchester, C., 12/19/2018, Florida Fish and Wildlife Conservation Commission, pers. comm.
12084 with Heather Hitt, USFWS.

12085
12086 **24.2 Proposed Action**
12087

12088 East Collier Property Owners [ECPO]. 2019. Eastern Collier Multiple Species Habitat
12089 Conservation Plan; March 2019 revision. Prepared by Stantec Consulting Services, Inc.,
12090 Lake Mary, Florida. 364 pages + appendices.
12091 Passarella and Associates, Inc. 2017. Rural Lands West Biological Assessment. Prepared for
12092 Collier Enterprises Management, Inc. Fort Myers, Florida. June 27.
12093
12094

12095 **24.3 Traffic Predictions and Sources of Cumulative Effects**
12096

12097 Florida Department of Transportation. 2016. TM-1; Introduction to the District One Regional
12098 Model (2010-2040) and Validation Report; February 2016. 30 pages. Available online at:
12099 [http://www.coliermpo.org/wp-content/uploads/2018/11/2-D1RPM-VALIDATION-
12100 REPORT.pdf](http://www.coliermpo.org/wp-content/uploads/2018/11/2-D1RPM-VALIDATION-REPORT.pdf)
12101 Florida Department of Transportation. 2019. Agency Resources; District 1. Available online at:
12102 <https://www.fdot.gov/agencyresources/districts/index.shtml>
12103 U.S. Fish and Wildlife Service. 2018. Draft Environmental Impact Statement: Eastern Collier
12104 Multiple Species Incidental Take Permit Applications and Habitat Conservation Plan.
12105 Atlanta, GA. 137 pages + appendices.
12106

12107 **24.4 Florida Bonneted Bat**
12108

12109 Arlettaz, R., C. Ruchet, J. Aeschimann, E. Brun, M. Genoud, and P. Vogel. 2000. Physiological
12110 traits affecting the distribution and wintering strategy of the bat *Tadarida teniotis*.
12111 *Ecology* 81(4):1004-1014.
12112 Arwood, R. 2012. Email to Paula Halupa. Inside-Out Photography, Inc. Everglades City, Florida.
12113 March 5, 2012.
12114 Arwood, R. 2015. Email to Paula Halupa. Everglades City, Florida. December 22, 2015.
12115 Bailey, A. M., Ober, H. K., Sovie, A. R., and McCleery, R. A. 2017. Impact of land use and
12116 climate on the distribution of the endangered Florida bonneted bat. *Journal of
12117 Mammalogy*, 98: 1586-1593.
12118 Belwood, J.J. 1981. Wagner's mastiff bat, *Eumops glaucinus floridanus* (Molossidae) in
12119 southwestern Florida. *Journal of Mammalogy* 62: 411-413.
12120 Belwood, J.J. 1992. Florida mastiff bat *Eumops glaucinus floridanus*. Pages 216-223 in S.R.
12121 Humphrey (ed.), *Rare and Endangered Biota of Florida*. Vol. I. Mammals. University
12122 Press of Florida. Gainesville, Florida.
12123 Best, T.L., W.M. Kiser, and J.C. Rainey. 1997. *Eumops glaucinus*. *Mammalian Species* 551:1-6.
12124 Braun de Torrez, E.C., H.K. Ober, and R.A. McCleery. 2016. Use of a multi-tactic approach to

12125 locate an endangered Florida bonneted bat roost. *Southeastern Naturalist* 15(2):235-242.

12126 Braun de Torrez, E.C., Ober, H.K., and McCleery, R. 2018. Activity of an endangered bat
12127 increases immediately following prescribed fire. *The Journal of Wildlife
12128 Management*, 82: 1115-1123.

12129 Florida Bat Conservancy. 2005. Florida bonneted bat (*Eumops floridanus*). Bay Pines, Florida
12130 http://www.floridabats.org/Species_EUFL.htm

12131 Florida Fish and Wildlife Conservation Commission. 2011a. Florida bonneted bat biological
12132 status review report. March 31, 2011. Florida Fish and Wildlife Conservation
12133 Commission. Tallahassee, Florida.

12134 Florida Fish and Wildlife Conservation Commission. 2011b. Supplemental information for the
12135 Florida bonneted (mastiff) bat biological status review report. March 31, 2011. Florida
12136 Fish and Wildlife Conservation Commission. Tallahassee, Florida.

12137 Florida Fish and Wildlife Conservation Commission. 2018. Conversation with C. Rizkalla.
12138 September 14, 2018. Florida Fish and Wildlife Conservation Commission. Tallahassee,
12139 Florida.

12140 Freeman, P.W. 1981. A multivariate study of the family Molossidae (Mammalia, Chiroptera):
12141 morphology, ecology, evolution. *Mammalogy Papers*: University of Nebraska State
12142 Museum. Paper 26. <http://digitalcommons.unl.edu/museummammalogy/26>

12143 Gore, J. A., M.S. Robson, R. Zambrano, and N. J. Douglass. 2015. Roosting sites of a Florida
12144 bonneted bat (*Eumops floridanus*). *Florida Field Naturalist* 43: 179-184.

12145 Gore, J., C. Marks, and H. Ober. 2010. Biological status review information findings - Florida
12146 bonneted bat (*Eumops floridanus*). In: Florida bonneted bat biological status review
12147 report. March 31, 2011. Florida Fish and Wildlife Conservation Commission.
12148 Tallahassee, Florida.

12149 Humphrey, S.R. 1975. Nursery roosts and community diversity of Nearctic bats. *Journal of
12150 Mammalogy* 56(2):321-346.

12151 Intergovernmental Panel on Climate Change. 2008. Climate Change and Water [B.C. Bates,
12152 Z.W. Kundzewicz, S. Wu, and J.P. Palutikof, Editors]. Technical paper of the
12153 Intergovernmental Panel on Climate Change. Intergovernmental Panel on Climate
12154 Change Secretariat; Geneva, Switzerland.

12155 Kern, Jr., W. 2012. Comments on proposed endangered species status for Florida bonneted bat
12156 (Document # FWS-R4-ES-2012-0078-0038). University of Florida, Fort Lauderdale
12157 Research and Education Center, Institute of Food and Agricultural Sciences. Davie,
12158 Florida. December 3, 2012.

12159 Kunz, T.H., J.O. Whitaker, Jr., and M.D. Wadanoli. 1995. Dietary energetics of the insectivorous
12160 Mexican free-tailed bat (*Tadarida brasiliensis*) during pregnancy and lactation.
12161 *Oecologia* 101(4):407-415.

12162 Kurta, A., and J.A. Teramoto. 1992. Bat community structure in an urban park. *Ecography* 15:
12163 257-261.

12164 Kurta, A., G.P. Bell, K.A. Nagy, and T.H. Kunz. 1989. Energetics of pregnancy and lactation in
12165 free-ranging little brown bats (*Myotis lucifugus*). *Physiological Zoology* 62:804-818.

12166 Kurta, A., T.H. Kunz, and K.A. Nagy. 1990. Energetics and water flux of free-ranging big brown
12167 bats (*Eptesicus fuscus*) during pregnancy and lactation. *Journal of Mammalogy* 71:59-65.

12168 Marks, C. 2013. Preliminary dietary analysis report for the Florida bonneted bat (*Eumops
12169 floridanus*). Draft copy. Florida Bat Conservancy. Bay Pines, Florida.

12170 Marks, G.E. and C.S. Marks. 2008a. Status of the Florida bonneted bat (*Eumops floridanus*).

12171 Submitted by George E. Marks and Cynthia S. Marks of the Florida Bat Conservancy for
12172 the U.S. Fish and Wildlife Service under grant agreement number 401815G192. January
12173 31, 2008. Florida Bat Conservancy. Bay Pines, Florida.

12174 Marks, G.E. and C.S. Marks. 2008b. Bat conservation and land management Kissimmee River
12175 WMA. May 2008. Submitted by the Florida Bat Conservancy. Bay Pines, Florida.

12176 Marks, G.E. and C.S. Marks. 2012. Status of the Florida bonneted bat (*Eumops floridanus*).
12177 Submitted by George E. Marks and Cynthia S. Marks of the Florida Bat Conservancy for
12178 the U.S. Fish and Wildlife Service under grant agreement number 40181AG121. May 4,
12179 2012. Florida Bat Conservancy. Bay Pines, Florida.

12180 Mikula, P., F. Morelli, R.K. Lucan, D.N. Jones, and P. Tryjanowski. 2016. Bats as prey of
12181 diurnal birds: a global perspective. *Mammal Review*. 46. 10.1111/mam.12060.

12182 Myers, J. 2014a. Email to Jeff Gore *et al.* Florida Fish and Wildlife Conservation Commission.
12183 Frostproof, Florida. May 14, 2014.

12184 Myers, J. 2014b. Email to Paula Halupa. Florida Fish and Wildlife Conservation Commission.
12185 Frostproof, Florida. May 16, 2014.

12186 Myers, J. 2014c. Email to Jeff Gore *et al.* Florida Fish and Wildlife Conservation Commission.
12187 Frostproof, Florida. May 21, 2014.

12188 NatureServe. 2019. NatureServe Explorer: An online encyclopedia of life [web application].
12189 Version 7.1. NatureServe, Arlington, Virginia. Available <http://explorer.natureserve.org>.
12190 (Accessed: December 8, 2019).

12191 Norberg, U.M. and J.M.V. Rayner. 1987. Ecological morphology and flight in bats (Mammalia;
12192 Chiroptera): wing adaptations, flight performance, foraging strategy and echolocation.
12193 *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*
12194 316 (1179):335-427.

12195 Ober, H. 2016. Annual report to USFWS for calendar year 2016. Permit number TE23583B-1.
12196 University of Florida, Department of Wildlife Ecology and Conservation, North Florida
12197 Research and Education Center. Quincy, Florida.

12198 Ober, H.K. 2014a. Conversation with Paula Halupa. University of Florida, Department of
12199 Wildlife Ecology and Conservation, North Florida Research and Education Center.
12200 Quincy, Florida. August 27, 2014.

12201 Ober, H.K. 2014b. Email to Paula Halupa and Marilyn Knight (includes data from August pit-
12202 tagging). University of Florida, Department of Wildlife Ecology and Conservation, North
12203 Florida Research and Education Center. Quincy, Florida. September 16, 2014.

12204 Ober, H.K., E.C. Braun de Torrez, J.A. Gore, A.M. Bailey, J.K. Myers, K.N. Smith, and R.A.
12205 McCleery. 2017. Social organization of an endangered subtropical species, *Eumops*
12206 *floridanus*, the Florida bonneted bat. *Mammalia* 81: 375-383.

12207 Ober, H.K., R.A. McCleery, and E.C. Braun de Torrez. 2018. Managing with fire to promote the
12208 recently listed Florida bonneted bat, *Eumops floridanus*. Final report. JFSP Project ID:
12209 14-1-05-7. University of Florida, Department of Wildlife Ecology and Conservation.
12210 Gainesville, Florida.

12211 Ridgley, F. 2013a. Email to Paula Halupa. Zoo Miami, Miami-Dade County Parks, Recreation
12212 and Open Spaces. Miami, Florida. February 20, 2013.

12213 Ridgley, F. 2013b. Email to Paula Halupa. Zoo Miami, Miami-Dade County Parks, Recreation
12214 and Open Spaces. Miami, Florida. June 3, 2013.

12215 Ridgley, F. 2013c. Email to Paula Halupa. Zoo Miami, Miami-Dade County Parks, Recreation

12216 and Open Spaces. Miami, Florida. July 13, 2013.

12217 Ridgley, F. 2013d. Email to Paula Halupa. Zoo Miami, Miami-Dade County Parks, Recreation
12218 and Open Spaces. Miami, Florida. June 12, 2013.

12219 Robson, M. 1989. Status survey of the Florida mastiff bat. Final performance report. Florida
12220 Game and Fresh Water Fish Commission. Bureau of Nongame Wildlife, Division of
12221 Wildlife. Tallahassee, Florida.

12222 Saha, A.K., S. Saha, J. Sadle, J. Jiang, M.S. Ross, R.M. Price, L.S.L.O Sternberg, K.S.
12223 Wendelberger. 2011. Sea level rise and South Florida coastal forests. Climatic Change
12224 107:81-108.

12225 Smith, K. 2010. Capture of *Eumops floridanus* in a mist net in south Florida. Florida Fish and
12226 Wildlife Conservation Commission, Big Cypress Field Office, Naples, Florida.

12227 Snow, S. 2011a. Email to Paula Halupa. Everglades National Park. Homestead, Florida.
12228 December 13, 2011.

12229 Snow, S. 2011b. Email to Paula Halupa. Everglades National Park. Homestead, Florida.
12230 December 30, 2011.

12231 Solari, S. 2016. *Eumops floridanus*. The IUCN Red List of Threatened Species 2016:
12232 e.T136433A21984011. <http://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T136433A21984011.en>

12233 Timm, R. and J. Arroyo-Cabrales. 2008. *Eumops floridanus*. In: IUCN 2011. IUCN Red List of
12234 Threatened Species. Version 2011.2. <<http://www.iucnredlist.org/>>. Downloaded on 11
12235 April 2012.

12236 Timm, R.M. 2012. Comments on proposed endangered species status for Florida bonneted bat
12237 (Document # FWS-R4-ES-2012-0078-0025). University of Kansas, Kansas University
12238 Natural History Museum. Lawrence, Kansas. November 27, 2012.

12239 Timm, R.M., and H.H. Genoways. 2004. The Florida bonneted bat, *Eumops floridanus*
12240 (Chiroptera: Molossidae): distribution, morphometrics, systematics, and ecology. Journal
12241 of Mammalogy 85(5):852-865.

12242 U.S. Fish and Wildlife Service. 2013. Endangered and threatened wildlife and plants; endangered
12243 species status for the Florida bonneted bat. Federal Register 78:61004-61043.

12244 U.S. Fish and Wildlife Service. 2019b. Consultation key and guidelines for the Florida bonneted
12245 bat. October 22, 2019, letter to the U.S. Army Corps of Engineers. Available online at:
12246 https://www.fws.gov/verobeach/ProgrammaticPDFs/20191022_letter_ServicetoCorps_F
12247 [BB-ProgrammaticKey.pdf](https://www.fws.gov/verobeach/ProgrammaticPDFs/20191022_letter_ServicetoCorps_F)

12248 Webb, E.N. 2018a. Email to Paula Halupa et al. University of Florida, Department of Wildlife
12249 Ecology and Conservation. Gainesville, Florida. April 1, 2018.

12250 Webb, E.N. 2018b. Presentation given at Florida bonneted bat working group meeting at The
12251 Conservancy of Southwest Florida. University of Florida, Department of Wildlife
12252 Ecology and Conservation. Gainesville, Florida. May 24, 2016.

12253 Wilkinson, G.S., and J.M. South. 2002. Life history, ecology and longevity in bats. Aging Cell
12254 1:124-133.

12255 Ziewitz, J. 2019. Email to Constance Cassler and Sandra Sneedenberger. U.S. Fish and Wildlife
12256 Service, Region 4 Regional Office, Atlanta, Georgia. December 12, 2019.

12257

12258

12259 **24.5 Florida Panther**

12260

12261 Abernathy, H.N., Crawford, D.A., Garrison, E.P., Chandler, R.B., Conner, M.L., Miller, K.V.
12262 and Cherry, M.J., 2019. Deer movement and resource selection during Hurricane Irma:
12263 implications for extreme climatic events and wildlife. *Proceedings of the Royal Society*
12264 *B*, 286(1916), p.20192230.

12265 Ackerman, B. B., F. G. Lindzey, and T. P. Hemker. 1986. Predictive energetics model for
12266 cougars. Pages 333-352 in S. D. Miller and D. D. Everett (eds). *Cats of the world:*
12267 biology, conservation, and management. National Wildlife Federation and Caesar
12268 Kleberg Wildlife Research Institute, Washington, D. C. and Kingsville, Texas.

12269 Alldredge, M.W., Buderman, F.E. and Blecha, K.A., 2019. Human–Cougar interactions in the
12270 wildland–urban interface of Colorado's front range. *Ecology and Evolution*, 9(18),
12271 pp.10415-10431.

12272 Allen, M.L., Elbroch, L.M. and Wittmer, H.U., 2013. Encounter competition between a cougar,
12273 *Puma concolor*, and a western spotted skunk, *Spilogale gracilis*. *The Canadian Field-*
12274 *Naturalist*, 127(1), pp.64-66.

12275 Allen, M.L., 2014. The ecology and behaviour of pumas (*Puma concolor*) in Northern
12276 California, USA.

12277 Alvarez, K. 1993. *Twilight of the panther: biology, bureaucracy, and failure in an endangered*
12278 *species program*. First edition. Myakka River Publishing, Sarasota, Florida.

12279 Ballou, J.D., T.J. Foose, R.C. Lacy, and U.S. Seal. 1989. Florida panther (*Felis concolor coryi*)
12280 population viability analysis and recommendations. *Captive Breeding Specialist Group,*
12281 *Species Survival Commission, IUCN*, Apple Valley, Minnesota.

12282 Bartoszek, I. A., P. T. Andreadis, C. Prokopervin, M. Patel, and R. N. Reed. 2018. *Python*
12283 *bivittatus* (Burmese python). Diet and prey size. *Herpetological Review* 49:139-140.

12284 Beier, P. 1993. Determining Minimum Habitat Areas and Habitat Corridors for Cougars.
12285 *Conservation Biology* 7:94-108. <<http://www.jstor.org/stable/2386646>>.

12286 Beier, P. 1995. Dispersal of juvenile cougars in fragmented habitat. *Journal of Wildlife*
12287 *Management* 59:228-237.

12288 Beier, P., M. R. Vaughan, M. J. Conroy, and H. Quigley. 2003. An Analysis of scientific
12289 literature related to the Florida panther. Final Report. Florida Fish and Wildlife
12290 Conservation Commission, Tallahassee, Florida, USA.

12291 Belden, R. C., and W. B. Frankenberger. 1977. Management of feral hogs in Florida: past,
12292 present and future. Pages 5-10 in G. W. Wood, editor. *Research and management of wild*
12293 *hog populations*. Clemson University, Georgetown.

12294 Belden, R.C. 1986. Florida panther recovery plan implementation - a 1983 progress report.
12295 Pages 159-172 in S.D. Miller and D.D. Everett (eds). *Cats of the world: biology,*
12296 *conservation, and management*. National Wildlife Federation and Caesar Kleberg
12297 *Wildlife Research Institute*, Washington, D.C. and Kingsville, Texas.

12298 Belden, R.C. 1988. The Florida panther. Pages 515-532 in *Audubon Wildlife Report*
12299 1988/1989. National Audubon Society, New York, New York.

12300 Belden, R.C., W.B. Frankenberger, R.T. McBride, and S.T. Schwikert. 1988. Panther habitat
12301 use in southern Florida. *Journal of Wildlife Management* 52:660-663.

12302 Benson, J.F., M.A. Lotz, and D. Jansen. 2008. Natal den selection by Florida panthers. *Journal*
12303 *of Wildlife Management* 72:405-410.

12304 Benson, J.F., Sikich, J.A. and Riley, S.P., 2016. Individual and population level resource
12305 selection patterns of mountain lions preying on mule deer along an urban-wildland
12306 gradient. *PLoS One*, 11(7), p.e0158006.

12307 Benson, J.F., J.A. Hostetler, D.P. Onorato, W.E. Johnson, M.E. Roelke, S.J. O'Brien, D. Jansen,
12308 and M.K. Oki. 2009. Chapter 2: Survival and cause-specific mortality of sub-adult and
12309 adult Florida panthers. Pages 10 – 61 in J.A. Hostetler, D.P. Onorato, and M.K. Oli,
12310 (eds). Population ecology of the Florida panther. Final report submitted to Florida Fish
12311 and Wildlife Conservation Commission and U. S. Fish and Wildlife Service.

12312 Benson, J. F., P. J. Mahoney, T. W. Vickers, J. A. Sikich, P. Beier, S. P. D. Riley, H. B. Ernest,
12313 and W. M. Boyce. 2019. Extinction vortex dynamics of top predators isolated by
12314 urbanization. *Ecological Applications* 29:e01868.

12315 Blecha, K.A., 2015. *Risk-reward tradeoffs in the foraging strategy of cougar (Puma concolor):*
12316 *prey distribution, anthropogenic development, and patch selection* (Doctoral dissertation,
12317 Colorado State University).

12318 Blecha, K.A., Boone, R.B. and Alldredge, M.W., 2018. Hunger mediates apex predator's risk
12319 avoidance response in wildland–urban interface. *Journal of Animal Ecology*, 87(3),
12320 pp.609-622.

12321 Boback, S. M., R. W. Snow, T. Hsu, S. C. Peurach, C. J. Dove, and R. N. Reed. 2016. Supersize
12322 me: Remains of three white-tailed deer (*Odocoileus virginianus*) in an invasive Burmese
12323 python (*Python molurus bivittatus*) in Florida. *BioInvasions Records* 5:197-203.
12324 <<http://pubs.er.usgs.gov/publication/70178552>>.

12325 Boon, J.D., 2012. Evidence of sea level acceleration at US and Canadian tide stations, Atlantic
12326 Coast, North America. *Journal of Coastal Research*, 28(6), pp.1437-1445.

12327 Bradley, C.A. and Altizer, S., 2007. Urbanization and the ecology of wildlife diseases. *Trends in
12328 Ecology & Evolution*, 22(2), pp.95-102.

12329 Brandon, A.L., 2011. Spatial and temporal trends in mercury concentrations in the blood and hair
12330 of Florida Panthers (*Puma concolor coryi*). *Unpublished MS Thesis, Florida Gulf Coast
12331 University, Ft. Myers, FL*.

12332 Burco, J., Myers, A.M., Schuler, K. and Gillin, C., 2012. Acute lead toxicosis via ingestion of
12333 spent ammunition in a free-ranging cougar (*Puma concolor*). *Journal of Wildlife
12334 Diseases*, 48(1), pp.216-219.

12335 Burdett, C.L., Crooks, K.R., Theobald, D.M., Wilson, K.R., Boydston, E.E., Lyren, L.M., Fisher,
12336 R.N., Vickers, T.W., Morrison, S.A. and Boyce, W.M., 2010. Interfacing models of
12337 wildlife habitat and human development to predict the future distribution of puma
12338 habitat. *Ecosphere*, 1(1), pp.1-21.

12339 Chapman, D. G. 1951. Some Properties of the Hypergeometric Distribution with Applications to
12340 Zoological Sample Censuses. University of California Publications in Statistics, V. 1, No.
12341 7. Berkeley: University of California Press.

12342 Charry, B. and Jones, J., 2009. Traffic volume as a primary road characteristic impacting
12343 wildlife: a tool for land use and transportation planning. In 2009 International Conference
12344 on Ecology and Transportation (ICOET 2009) Federal Highway Administration

12345 Clark J.D., D. Huber, and C. Servheen. 2002. Bear reintroductions: lessons and challenges.
12346 Ursus 13:335-345.

12347 Clark, D. A., B. K. Johnson, D. H. Jackson, M. Henjum, S. L. Findholt, J. J. Akenson, and R. G.
12348 Anthony. 2014. Survival rates of cougars in Oregon from 1989 to 2011: a retrospective
12349 analysis. *The Journal of Wildlife Management* 78:779-790.

12350 Collier County. 2019. Collier County Florida Transportation Data Management System.
12351 Naples, Florida. <https://collier.ms2soft.com/tcds/tsearch.asp?loc=Collier&mod=TCDS>.

12352 Comiskey, E.J., O.L. Bass, Jr., L.J. Gross, R.T. McBride, and R. Salinas. 2002. Panthers and
12353 forests in south Florida: an ecological perspective. *Conservation Ecology* 6:18.

12354 Coon, C.A., Nichols, B.C., McDonald, Z. and Stoner, D.C., 2019. Effects of land-use change and
12355 prey abundance on the body condition of an obligate carnivore at the wildland-urban
12356 interface. *Landscape and Urban Planning*, 192, p.103648.

12357 Cox, J.J., D.S. Maehr, and J.L. Larkin. 2006. Florida panther habitat use: New approach to an
12358 old problem. *Journal of Wildlife Management* 70:1778-1785.

12359 Crieffield, M., van de Kerk, M., Leone, E., Cunningham, M.W., Lotz, M., Oli, M.K. and Onorato,
12360 D.P., 2018. Assessing impacts of intrinsic and extrinsic factors on Florida panther
12361 movements. *Journal of Mammalogy*, 99(3), pp.702-712.

12362 Crooks, K.R., 2002. Relative sensitivities of mammalian carnivores to habitat
12363 fragmentation. *Conservation Biology*, 16(2), pp.488-502.

12364 Dalrymple, G.H. and O.L. Bass. 1996. The diet of the Florida panther in Everglades National
12365 Park, Florida. *Bulletin of the Florida Museum of Natural History* 39:173-193.

12366 Davidson, G. A., D. A. Clark, B. K. Johnson, L. P. Waits, and J. R. Adams. 2014. Estimating
12367 Cougar Densities in Northeast Oregon Using Conservation Detection Dogs. *The Journal*
12368 of *Wildlife Management* 78:1104-1114. <<http://www.jstor.org/stable/43188245>>.

12369 Davis, J. H., Jr. 1943. The natural features of southern Florida: especially the vegetation, and the
12370 Everglades. *Geological Bulletin no. 25*. State of Florida, Department of Conservation,
12371 Florida Geological Survey.

12372 Dees, C.S., J.D. Clark, and F.T. Van Manen. 2001. Florida panther habitat use in response to
12373 prescribed fire. *Journal of Wildlife Management* 65:141-147.

12374 Dickson, B.G. and Beier, P., 2002. Home-range and habitat selection by adult cougars in
12375 southern California. *The Journal of Wildlife Management*, pp.1235-1245.

12376 Dorcas, M.E., Willson, J.D., Reed, R.N., Snow, R.W., Rochford, M.R., Miller, M.A., Meshaka,
12377 W.E., Andreadis, P.T., Mazzotti, F.J., Romagosa, C.M. and Hart, K.M., 2012. Severe
12378 mammal declines coincide with proliferation of invasive Burmese pythons in Everglades
12379 National Park. *Proceedings of the National Academy of Sciences*, 109(7), pp.2418-2422.

12380 Dorazio, R. M., and D. P. Onorato. 2018. Estimating the density of Florida panthers using
12381 camera traps and telemetry – Report for Phase 1 of project _with Addendum. Florida Fish
12382 and Wildlife Conservation Commission, Naples, FL.

12383 Dove, C. J., R. W. Snow, M. R. Rochford, and F. J. Mazzotti. 2011. Birds Consumed by the
12384 Invasive Burmese Python (*Python molurus bivittatus*) in Everglades National Park,
12385 Florida, USA. *The Wilson Journal of Ornithology* 123:126-131.
12386 <<https://doi.org/10.1676/10-092.1>>.

12387 Edmunds, D.R., Kauffman, M.J., Schumaker, B.A., Lindzey, F.G., Cook, W.E., Kreeger, T.J.,
12388 Grogan, R.G. and Cornish, T.E., 2016. Chronic wasting disease drives population decline
12389 of white-tailed deer. *PloS one*, 11(8).

12390 Elbroch, L.M. and Wittmer, H.U., 2013. Nuisance ecology: do scavenging condors exact
12391 foraging costs on pumas in Patagonia? *PloS one*, 8(1).

12392 Elbroch, L.M., Lendrum, P.E., Allen, M.L. and Wittmer, H.U., 2015. Nowhere to hide: pumas,
12393 black bears, and competition refuges. *Behavioral Ecology*, 26(1), pp.247-254.

12394 Ernest, H.B., Boyce, W.M., Bleich, V.C., May, B., Stiver, S.J. and Torres, S.G., 2003. Genetic
12395 structure of mountain lion (*Puma concolor*) populations in California. *Conservation*
12396 *Genetics*, 4(3), pp.353-366.

12397 Ezer, T., 2019. Regional Differences in Sea Level Rise Between the Mid-Atlantic Bight and the
12398 South Atlantic Bight: Is the Gulf Stream to Blame? *Earth's Future*, 7(7), pp.771-783.

12399 Facemire, C.F., Gross, T.S. and Guillette Jr, L.J., 1995. Reproductive impairment in the Florida
12400 panther: nature or nurture? *Environmental Health Perspectives*, 103(suppl 4), pp.79-86.

12401 Farnsworth, M.L., Wolfe, L.L., Hobbs, N.T., Burnham, K.P., Williams, E.S., Theobald, D.M.,
12402 Conner, M.M. and Miller, M.W., 2005. Human land use influences chronic wasting
12403 disease prevalence in mule deer. *Ecological Applications*, 15(1), pp.119-126.

12404 Fill, J.M., Davis, C.N. and Crandall, R.M., 2019. Climate change lengthens southeastern USA
12405 lightning-ignited fire seasons. *Global Change Biology*, 25(10), pp.3562-3569.

12406 Fleming, M., Schortemeyer, J. and Ault, J., 1994, November. Distribution, abundance, and
12407 demography of white-tailed deer in the Everglades. In *Proceedings of the Florida panther*
12408 conference (pp. 247-274).

12409 Florida Department of Transportation Data & Analytics Office. 2019. Historical Annual
12410 Average Daily Traffic. Tallahassee, Florida.
https://ftp.fdot.gov/file/d/FTP/FDOT/co/planning/transtat/gis/shapefiles/aadt_historical.zip

12411 Florida Fish and Wildlife Conservation Commission. 2010. Statement on estimating panther
12412 population size. Tallahassee, Florida. <http://myfwc.com/news/resources/fact-sheets/panther-population/>

12413 Florida Fish and Wildlife Conservation Commission. 2013. Mortality data via email transmittal.
12414 Fish and Wildlife Research Institute and Division of Habitat and Species Conservation.
12415 Naples, Florida.

12416 Florida Fish and Wildlife Conservation Commission. 2014. Annual report on the research and
12417 management of Florida panthers: 2013-2014. Fish and Wildlife Research Institute &
12418 Division of Habitat and Species Conservation, Naples, Florida, USA.

12419 Florida Fish and Wildlife Conservation Commission. 2016. Annual report on the research and
12420 management of Florida panthers: 2015-2016. Fish and Wildlife Research Institute &
12421 Division of Habitat and Species Conservation, Naples, Florida, USA.
<https://myfwc.com/media/3125/pantherresearchmgmt2015-16.pdf>

12422 Florida Fish and Wildlife Conservation Commission. 2017. Annual report on the research and
12423 management of Florida panthers: 2016-2017. Fish and Wildlife Research Institute &
12424 Division of Habitat and Species Conservation, Naples, Florida, USA.
<https://myfwc.com/media/3114/pantherannualreport2016-17.pdf>

12425 Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute.2018.
12426 Annual Report on the Research and Management of Florida Panthers: 2017-2018.
<https://myfwc.com/media/17636/pantherannualreport2017-18.pdf>

12427 Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute.2019.
12428 Annual Report on the Research and Management of Florida Panthers: 2018-2019.
<https://myfwc.com/media/21759/pantherannualreport2018-19.pdf>

12429 Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute.
12430 2014. Florida panther (*Puma concolor coryi*) mortality locations 1972-2014. Fish and
12431 Wildlife Research Institute. Tallahassee, Florida. <http://www.floridapanthernet.org>

12432 Florida Fish and Wildlife Conservation Commission 2020. Panther Health
<https://myfwc.com/wildlifehabitats/wildlife/panther/health/> Accessed 1/30/2020.

12441 Florida Panther Protection Program Technical Review Team. 2009. Technical Review of the
12442 Florida Panther Protection Program Proposed for the Rural Lands Stewardship Area of
12443 Collier County, Florida. Final Report. 84 pp.

12444 Florida Fish and Wildlife Conservation Commission and U.S. Fish and Wildlife Service. 2017.
12445 Determining the size of the Florida panther population.
<https://myfwc.com/media/3107/determiningpantherpopulation2017.pdf>

12447 Florida Fish and Wildlife Conservation Commission 2020a. FWC Wildlife Management Area
12448 Harvest Reports. <https://myfwc.com/hunting/harvest-reports/> Accessed 6/10/2020

12449 Florida Fish and Wildlife Conservation Commission 2020b. Wildlife Crossings.
<https://myfwc.com/wildlifehabitats/wildlife/panther/wildlife-crossings/> Accessed
12450 6/10/2020

12452 Forrester, D. J. 1992. Parasites and diseases of wild mammals in Florida. University Press of
12453 Florida, Gainesville, Florida. <<http://ufdc.ufl.edu/AA00025659/00001>>.

12454 Forman, R. T. T., D. Sperling, J. A. Bissonette, A. P. Clevenger, C. D. Cutshall, V. H. Dale, L.
12455 Fahrig, R. France, C. R. Goldman, K. Heanue, J. A. Jones, F. J. Swanson, T. Turrentine,
12456 and T. C. Winter. 2003. Road Ecology: Science and Solutions. Island Press,
12457 Washington, D.C.

12458 Foster, M.L. and S.R. Humphrey. 1995. Use of highway underpasses by Florida panthers and
12459 other wildlife. *Wildlife Society Bulletin*. 23(1):95-100.

12460 Foster, R.J., Harmsen, B.J. and Doncaster, C.P., 2010. Habitat use by sympatric jaguars and
12461 pumas across a gradient of human disturbance in Belize. *Biotropica*, 42(6), pp.724-731.

12462 Frakes RA, Belden RC, Wood BE, James FE .2015. Landscape Analysis of Adult Florida
12463 Panther Habitat. *PLoS ONE* 10(7): e0133044.
<https://doi.org/10.1371/journal.pone.0133044>

12465 Game and Fresh Water Fish Commission. 1946. Biennial report: for period ending December 31,
12466 1946. State of Florida, Game and Fresh Water Fish Commission, Tallahassee, Florida.

12467 Garrison, E. P., and J. Gedir. 2006. Ecology and management of white-tailed deer in Florida.
12468 Technical report. Florida Fish and Wildlife Conservation Commission, Tallahassee, FL.

12469 Garrison, E. P., E. Leone, K. Smith, T. Bartareau, J. Bozzo, R. Sobczak, and D. Jansen. 2011.
12470 Analysis of hydrological impacts on white-tailed deer in the Stairsteps Unit, Big Cypress
12471 National Preserve. Final Report. Florida Fish and Wildlife Conservation Commission and
12472 National Park Service.

12473 Gese, E. M., and F. F. Knowlton. 2001. The role of predation in wildlife population dynamics.
12474 Pages 7-25 in T. F. Ginnett, and S. E. Henke, editors. The role of predator control as a
12475 tool in game management. Texas Agricultural Research and Extension Center, San
12476 Angelo, Texas.

12477 Gill, R. B. 2010. To save a mountain lion: evolving philosophy of nature and cougars. Pages 5-
12478 16 in M. Hornocker, and S. Negri, editors. Cougar: ecology and conservation. First
12479 edition. The University of Chicago Press, Chicago.

12480 Greenwood, P. J. 1980. Mating systems, philopatry and dispersal in birds and mammals. *Animal
12481 Behaviour* 28:1140-1162.
[<http://www.sciencedirect.com/science/article/pii/S0003347280801035>](http://www.sciencedirect.com/science/article/pii/S0003347280801035).

12483 Grigione, M.M., Beier, P., Hopkins, R.A., Neal, D., Padley, W.D., Schonewald, C.M. and
12484 Johnson, M.L., 2002. Ecological and allometric determinants of home-range size for
12485 mountain lions (*Puma concolor*). *Animal Conservation*, 5(4), pp.317-324.

12486 Hall, J.A., S. Gill, J. Obeysekera, W. Sweet, K. Knuuti, and J. Marburger. 2016. Regional Sea
12487 Level Scenarios for Coastal Risk Management: Managing the Uncertainty of Future Sea
12488 Level Change and Extreme Water Levels for Department of Defense Coastal Sites
12489 Worldwide. U.S. Department of Defense, Strategic Environmental Research and
12490 Development Program. 224 pp

12491 Hamilton, W. J. 1941. Notes on some mammals of Lee County, Florida. The American Midland
12492 Naturalist 25:686-691. <<http://www.jstor.org/stable/2420724>>.

12493 Harlow, R. F., and F. K. Jones. 1965. The white-tailed deer in Florida. Florida Game and Fresh
12494 Water Fish Commission. Technical Bulletin No. 9.

12495 Harris, L.D. 1984. The fragmented forest: island biogeography theory and the preservation of
12496 biotic diversity. University of Chicago Press, Chicago, Illinois.

12497 Harrison, R.L. 1992. Toward a theory of inter-refuge corridor design. *Conservation Biology*
12498 6:293-295.

12499 Hart, K. M., M. S. Cherkiss, B. J. Smith, F. J. Mazzotti, I. Fujisaki, R. W. Snow, and M. E.
12500 Dorcas. 2015. Home range, habitat use, and movement patterns of non-native Burmese
12501 pythons in Everglades National Park, Florida, USA. *Animal Biotelemetry* 3:8.
12502 <<http://pubs.er.usgs.gov/publication/70147326>>.

12503 Holbrook, J., and T. Chesnes. 2011. An effect of Burmese pythons (*Python molurus bivittatus*)
12504 on mammal populations in southern Florida. *Florida Scientist* 74:17-24.
12505 <<http://www.jstor.org/stable/24321784>>.

12506 Hostetler, J. A., D. P. Onorato, D. Jansen, and M. K. Oli. 2013. A cat's tale: the impact of genetic
12507 restoration on Florida panther population dynamics and persistence. *Journal of Animal
12508 Ecology* 82:608-620. <<http://onlinelibrary.wiley.com/doi/10.1111/1365-2656.12033/abstract>>.

12509 Howard, W. E. 1960. Innate and environmental dispersal of individual vertebrates. *The
12510 American Midland Naturalist* 63:152-161. <<http://www.jstor.org/stable/2422936>>.

12511 Hulme, P.E., 2008. Trade, transport and trouble: managing invasive species pathways in an era
12512 of globalization. *Journal of Applied Ecology*, 46, pp.10-18.

12513 IPCC 2013. Annex III: Glossary [Planton, S. (ed.)]. Pp. 1147-1465 In: *Climate Change 2013:
12514 The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment
12515 Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K.
12516 Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M.
12517 Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New
12518 York, New York, USA. [https://www.ipcc.ch/pdf/assessment-
12519 report/ar5/wg1/WG1AR5_AnnexIII_FINAL.pdf](https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_AnnexIII_FINAL.pdf)

12520 Interagency Florida Panther Response Team. 2015. Annual Report.
12521 <https://myfwc.com/media/17231/floridapantherresponseteam2014-2015.pdf>

12522 Interagency Florida Panther Response Team. 2016. Annual Report.
12523 <https://myfwc.com/media/17231/floridapantherresponseteam2015-2016.pdf>

12524 Interagency Florida Panther Response Team. 2017. Annual Report.
12525 <https://myfwc.com/media/17231/floridapantherresponseteam2016-2017.pdf>

12526 Iriarte, J.A., Franklin, W.L., Johnson, W.E. and Redford, K.H., 1990. Biogeographic variation of
12527 food habits and body size of the America puma. *Oecologia*, 85(2), pp.185-190.

12528 Janis, M.W. and Clark, J.D., 2002. Responses of Florida panthers to recreational deer and hog
12529 hunting. *The Journal of Wildlife Management*, pp.839-848.

12530

12531 Jansen, D. K., S.R. Schulze, and A.T. Johnson. 2005. Florida panther (*Puma concolor coryi*)
12532 research and monitoring in Big Cypress National Preserve. Annual report 2004-2005.
12533 National Park Service, Ochopee, Florida.

12534 Johnson, W.E., D.P. Onorato, M.E. Roelke, E.D. Land, M. Cunningham, R.C. Belden,
12535 R. McBride, D. Jansen, M. Lotz, D. Shindle, J. Howard, D.E. Wildt, L.M. Penfold,
12536 J.A. Hostetler, M.K. Oli, and S.J. O'Brien. 2010. Genetic restoration of the Florida
12537 panther. *SCIENCE* 329:1641-1645.

12538 Jordan, D., 1990. Mercury contamination: Another threat to the Florida panther. *Endangered
12539 Species Technical Bulletin, US Fish and Wildlife Service*, 15(2), pp.1-2.

12540 Kautz, R. S., D. T. Gilbert, and G. M. Mauldin. 1993. Vegetative cover in Florida based on
12541 1985-1989 Landsat Thematic Mapper imagery. *Florida Scientist* 56:135-154.
12542 <<http://www.jstor.org/stable/24320552>>.

12543 Kautz, R. S. 1994. Historical trends within the range of the Florida panther. Pages 285-296 in D.
12544 B. Jordan, editor. *Proceedings of the Florida Panther Conference*. U.S. Fish and Wildlife
12545 Service, Gainesville, FL.

12546 Kautz, R.S. 1998. Land use and land cover trends in Florida 1936-1995. *Florida Scientist*
12547 61:171-187. <<https://www.biodiversitylibrary.org/item/130725#page/501/mode/thumb>>.

12548 Kautz, R., R. Kawula, T. Hoctor, J. Comiskey, D. Jansen, D. Jennings, J. Kasbohm, F. Mazzotti,
12549 R. McBride, L. Richardson, and K. Root. 2006. How much is enough? Landscape-scale
12550 conservation for the Florida panther. *Biological Conservation*.

12551 Kautz, R. S., B. Stys, and R. Kawula. 2007. Florida vegetation 2003 and land use change
12552 between 1985-89 and 2003. *Florida Scientist* 70:12-23.
12553 <<http://www.jstor.org/stable/24321563>>.

12554 Kerkhoff, A.J., B.T. Milne, and D.S. Maehr. 2000. Toward a panther-centered view of the
12555 forests of south Florida. *Conservation Ecology* 4:1.

12556 Kirtman, B.P., Misra, V., Anandhi, A., Palko, D. and Infant, J., 2017. Future Climate Change
12557 Scenarios for Florida. *Florida's Climate: Changes, Variations, & Impacts*.

12558 Khorozyan, I., Soofi, M., Ghoddousi, A., Hamidi, A.K. and Waltert, M., 2015. The relationship
12559 between climate, diseases of domestic animals and human-carnivore conflicts. *Basic and
12560 Applied Ecology*, 16(8), pp.703-713.

12561 Kreling, S.E., Gaynor, K.M. and Coon, C.A., 2019. Roadkill distribution at the wildland-urban
12562 interface. *The Journal of Wildlife Management*, 83(6), pp.1427-1436.

12563 Labisky, R. F., M. C. Boulay, K. E. Miller, R. A. Sargent Jr, and J. M. Zultowsky. 1995.
12564 Population ecology of white-tailed deer in Big Cypress National Preserve and Everglades
12565 National Park. Final Report to USDI-National Park Service. Department of Wildlife
12566 Ecology and Conservation, University of Florida, Gainesville, Florida.

12567 Land, E.D., D.B. Shindle, R.J. Kawula, J.F. Benson, M.A. Lotz, and D.P. Onorato. 2008.
12568 Florida panther habitat selection analysis of Concurrent GPS and VHF telemetry data.
12569 *Journal of Wildlife Management* 72:633-639.

12570 Laundré, J.W., Hernández, L. and Clark, S.G., 2007. Numerical and demographic responses of
12571 pumas to changes in prey abundance: testing current predictions. *The Journal of Wildlife
12572 Management*, 71(2), pp.345-355.

12573 Laundré, J.W., Salazar, J.L., Hernández, L. and López, D.N., 2009. Evaluating potential factors
12574 affecting puma *Puma concolor* abundance in the Mexican Chihuahuan Desert. *Wildlife
12575 Biology*, 15(2), pp.207-212.

12576 Lindenmayer, D. B., and J. Fischer. 2006. Habitat fragmentation and landscape change: an
12577 ecological and conservation synthesis. Island Press, Washington, DC.

12578 Logan, K. A., and L. L. Sweanor. 2010. Behavior and social organization of a solitary carnivore.
12579 Pages 105-117 in M. Hornocker, and S. Negri, editors. *Cougar: Ecology and*
12580 *conservation*. The University of Chicago Press, Chicago and London.

12581 Lopez, R. R., I. D. Parker, N. J. Silvy, B. L. Pierce, J. T. Beaver, and A. A. Lund. 2016. Florida
12582 Key deer
12583 screwworm final report (Phase I). Texas A&M Natural Resources Institute, College
12584 Station, Texas.

12585 Lotz, M., D. Land, M. Cunningham, and B. Ferree. 2005. Florida panther annual report
12586 2004-05. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

12587 Loveless, C. M. 1959. The Everglades deer herd: life history and management. Technical
12588 Bulletin No. 6. Florida Game and Fresh Water Fish Commission.

12589 MacDonald-Beyers, K., and R. F. Labisky. 2005. Influence of flood waters on seasonal survival,
12590 reproduction, and habitat use of white-tailed deer in the Florida Everglades. *Wetlands*
12591 25:659-666. <[https://doi.org/10.1672/0277-5212\(2005\)025\[0659:IOFWOS\]](https://doi.org/10.1672/0277-5212(2005)025[0659:IOFWOS])>.

12592 Maehr, D.S., E.D. Land, J.C. Roof, and J.W. McCown. 1990a. Day beds, natal dens, and
12593 activity of Florida panthers. *Proceedings of Annual Conference of Southeastern Fish and*
12594 *Wildlife Agencies* 44:310-318.

12595 Maehr, D.S., R.C. Belden, E.D. Land, and L. Wilkins. 1990b. Food habits of panthers in
12596 southwest Florida. *Journal of Wildlife Management* 54:420-423.

12597 Maehr, D.S. 1990c. Florida panther movements, social organization, and habitat utilization.
12598 Final Performance Report 7502. Florida Game and Fresh Water Fish Commission,
12599 Tallahassee, Florida.

12600 Maehr, D.S., E.D. Land, and J.C. Roof. 1991. Social ecology of Florida panthers. *National*
12601 *Geographic Research and Exploration* 7:414-431.

12602 Maehr, D.S. 1992. Florida panther. Pages 176 189 in S.R. Humphrey (ed). *Rare and*
12603 *endangered biota of Florida*. Volume I: mammals. University Press of Florida,
12604 Gainesville, Florida.

12605 Maehr, D.S. and J.A. Cox. 1995. Landscape features and panthers in Florida. *Conservation*
12606 *Biology*, 9: 1008-1019.

12607 Maehr, D.S. 1997. The comparative ecology of bobcat, black bear, and Florida panther in south
12608 Florida. *Bulletin of the Florida Museum of Natural History* 40:1-176. Maehr, D.S. and
12609 J.A. Cox. 1995. Landscape features and panthers in Florida. *Conservation Biology*
12610 9:1008-1019.

12611 Maehr, D.S., E.D. Land, D.B. Shindle, O.L. Bass, and T.S. Hoctor. 2002a. Florida panther
12612 dispersal and conservation. *Biological Conservation* 106:187-197.

12613 Maehr, D.S., R.C. Lacy, E.D. Land, O.L. Bass, T.S. Hoctor. 2002b. Population viability of the
12614 Florida Panther: A multi-perspective approach. In S. Beissinger and D. McCullough
12615 (Eds). *Population Viability Analysis*. University of Chicago Press, Chicago., Illinois.

12616 Main, M.B. and Richardson, L.W., 2002. Response of wildlife to prescribed fire in southwest
12617 Florida pine flatwoods. *Wildlife Society Bulletin*, pp.213-221.

12618 Markovchick-Nicholls, L.I.S.A., Regan, H.M., Deutschman, D.H., Widyanata, A., Martin, B.,
12619 Noreke, L. and Ann Hunt, Timothy. 2008. Relationships between human disturbance and
12620 wildlife land use in urban habitat fragments. *Conservation Biology*, 22(1), pp.99-109.

12621 Mas-Coma, S., Valero, M.A. and Bargues, M.D., 2008. Effects of climate change on animal and
12622 zoonotic helminthiases. *Revue Scientifique et Technique (International Office of*
12623 *Epizootics)*, 27(2), pp.443-57.

12624 McCarthy, K.P. and Fletcher Jr, R.J., 2015. Does hunting activity for game species have indirect
12625 effects on resource selection by the endangered Florida panther? *Animal*
12626 *Conservation*, 18(2), pp.138-145.

12627 McCleery, R. A., A. Sovie, R. N. Reed, M. W. Cunningham, M. E. Hunter, and K. M. Hart.
12628 2015. Marsh rabbit mortalities tie pythons to the precipitous decline of mammals in the
12629 Everglades. *Proceedings of the Royal Society B* 282:2050120.
12630 <<http://rspb.royalsocietypublishing.org/content/282/1805/20150120.abstract>>.

12631 McClintock, B. T., D. P. Onorato, and J. Martin. 2015. Endangered Florida panther population
12632 size determined from public reports of motor vehicle collision mortalities. *Journal of*
12633 *Applied Ecology* 52:893-901. <<http://onlinelibrary.wiley.com/doi/10.1111/1365-2664.12438/abstract>>.

12634 Moriarty, J.G., Riley, S.P., Serieys, L.E., Sikich, J.A., Schoonmaker, C.M. and Poppenga, R.H.,
12635 2012. Exposure of wildlife to anticoagulant rodenticides at Santa Monica Mountains
12636 National Recreation Area: From mountain lions to rodents. In *Proceedings of the*
12637 *Vertebrate Pest Conference* (Vol. 25, No. 25).

12638 Morrison, C.D., Boyce, M.S., Nielsen, S.E. and Bacon, M.M., 2014. Habitat selection of a re-
12639 colonized cougar population in response to seasonal fluctuations of human activity. *The*
12640 *Journal of Wildlife Management*, 78(8), pp.1394-1403.

12641 Moss, W.E., M.W. Alldredge, and J.N. Pauli. 2016a. Quantifying risk and resource use for a
12642 large carnivore in an expanding urban-wildland interface. *Journal of Applied Ecology*.
12643 53:371-378.

12644 Moss, W.E., M.W. Alldredge, K.A. Logan, and J.N. Pauli. 2016b. Human expansion precipitates
12645 niche expansion for an opportunistic apex predator (*Puma concolor*). *Scientific reports* 6,
12646 39639; doi: 10.1038/srep39639 (2016). <https://www.nature.com/articles/srep39639>

12647 Newman, J., Zillioux, E., Rich, E., Liang, L. and Newman, C., 2004. Historical and other
12648 patterns of monomethyl and inorganic mercury in the Florida panther (*Puma concolor*
12649 *coryi*). *Archives of Environmental Contamination and Toxicology*, 48(1), pp.75-80.

12650 Noss, R.F. 1992. The wildlands project land conservation strategy. *Wild Earth* (Special
12651 Issue):10-25.

12652 Noss, R. F., J. S. Reece, T. Hoctor, and J. Oetting. 2014. Adaptation to sea-level rise in Florida:
12653 biological conservation priorities. Final Report. Kresge Foundation, Troy, MI.
12654 <<https://floridaclimateinstitute.org/images/reports/201409NossKresge.pdf>>.

12655 Onorato, D. P., M. Criffeld, M. Lotz, M. W. Cunningham, R. McBride, E. H. Leone, O. L. Bass,
12656 and E. C. Hellgren. 2010. Habitat selection by critically endangered Florida panthers
12657 across the diel period: implications for land management and conservation. *Animal*
12658 *Conservation* 14:196-205. <<https://doi.org/10.1111/j.1469-1795.2010.00415.x>>.

12659 Onorato, D. P., M. Criffeld, M. Lotz, M. W. Cunningham, R. McBride, E. H. Leone, O. L. Bass,
12660 and E. C. Hellgren. 2011. Habitat selection by critically endangered Florida panthers
12661 across the diel period: implications for land management and conservation. *Animal*
12662 *Conservation* 14:196-205. <<https://doi.org/10.1111/j.1469-1795.2010.00415.x>>.

12663 Onorato, D. P., D. B. Shindle, M. Criffeld, B. Kelly, D. Land, M. Lotz, L. Cusack, M.
12664 Cunningham, and C. Shea. 2020. Summary of results for the application of spatial mark-

12665

12666 resight models to trail camera data in order to estimate density of Florida panthers on
12667 public and private lands (2014-2018). Draft FWC Report.

12668 Parker, I. D., B. L. Pierce, J. T. Beaver, R. R. Lopez, N. J. Silvy, and D. S. Davis. 2017. Florida
12669 Key deer screwworm final report. Texas A&M Natural Resources Institute, College
12670 Station, Texas.

12671 Paviolo, A., Di Blanco, Y.E., De Angelo, C.D. and Di Bitetti, M.S., 2009. Protection affects the
12672 abundance and activity patterns of pumas in the Atlantic Forest. *Journal of*
12673 *Mammalogy*, 90(4), pp.926-934.

12674 Pierce, B. M., and V. C. Bleich. 2003. Mountain lion. Pages 744-757 in G. A. Feldhamer, B. C.
12675 Thompson, and J. A. Chapman, editors. Wild mammals of North America: management and
12676 conservation. Second edition. Johns Hopkins University Press, Baltimore, Maryland, USA.
12677 <https://www.researchgate.net/publication/284561468_Mountain_lion>.

12678 Quigley H, Hornocker M. Cougar population dynamics. 2010. In: Hornocker M, Negri S, editors.
12679 Cougar ecology and conservation. Chicago: The University of Chicago Press; pp. 59–75.

12680 Razgūnaitė, M., Radzijevskaja, J., Sabūnas, V., Karvelienė, B. and Paulauskas, A., 2019. Vector-
12681 borne zoonotic pathogens in cats. *Biologija*, 65(2).

12682 Richter, A.R. and Labisky, R.F., 1985. Reproductive dynamics among disjunct white-tailed deer
12683 herds in Florida. *The Journal of Wildlife Management*, pp.964-971.

12684 Riley, S.J. and Malecki, R.A., 2001. A landscape analysis of cougar distribution and abundance
12685 in Montana, USA. *Environmental Management*, 28(3), pp.317-323.

12686 Robins, C.W., Kertson, B.N., Faulkner, J.R. and Wirsing, A.J., 2019. Effects of urbanization on
12687 cougar foraging ecology along the wildland–urban gradient of western
12688 Washington. *Ecosphere*, 10(3), p.e02605.

12689 Robinson, H. S., R. Desimone, C. Hartway, J. A. Gude, M. J. Thompson, M. S. Mitchell, and M.
12690 Hebblewhite. 2014. A test of the compensatory mortality hypothesis in mountain lions: a
12691 management experiment in west-central Montana. *The Journal of Wildlife Management*
12692 78:791-807. <<http://www.jstor.org/stable/43188209>>.

12693 Rochford, M., K. L. Krysko, J. Nifong, L. Wilkins, R. W. Snow, and M. S. Cherkiss. 2010.
12694 *Python molurus bivittatus* (Burmese python). Diet. *Herpetological Review* 41:97.

12695 Roelke, M. E. 1990. Florida panther biomedical investigation. Final Performance Report 7506.
12696 Florida Game and Fresh Water Fish Commission, Tallahassee, Florida.

12697 Roelke, M.E., Schultz, D.P., Facemire, C.F., Sundlof, S.F. and Royals, H.E., 1991. Mercury
12698 contamination in Florida panthers (A report of the Florida Panther Technical
12699 Subcommittee to the Florida Panther Interagency Committee). *Gainesville: Florida*
12700 *Panther Interagency Committee*.

12701 Roelke, M. E., D. J. Forrester, E. R. Jacobson, G. V. Kollias, F. W. Scott, M. C. Barr, J. F.
12702 Evermann, and E. C. Pirtle. 1993a. Seroprevalence of infections disease agents in free-
12703 ranging Florida panthers (*Felis concolor coryi*). *Journal of Wildlife Diseases* 29:36-49.
12704 <<https://doi.org/10.7589/0090-3558-29.1.36>>.

12705 Roelke, M.E., J.S. Martenson, and S.J. O'Brien. 1993b. The consequences of demographic
12706 reduction and genetic depletion in the endangered Florida panther. *Current Biology*
12707 3:340-350.

12708 Root, K. 2004. Florida panther (*Puma concolor coryi*): Using models to guide recovery efforts.
12709 Pages 491-504 in H.R. Akcakaya, M. Burgman, O. Kindvall, C.C. Wood, P. Sjogren-
12710 Gulve, J. Hatfield, and M. McCarthy (eds). *Species Conservation and Management, Case*
12711 *Studies*. Oxford University Press, New York, New York.

12712 Ross, B. 2020a. Personal communication. Clemson University statistician. E-mail to Ken
12713 McDonald and Connie Cassler. Vero Beach, Florida. March 25, 2020.

12714 Ross, B. 2020b. Personal communication. Clemson University statistician. E-mail to Ken
12715 McDonald and Connie Cassler. Vero Beach, Florida. March 18, 2020.

12716 Schwab, A.C. and P.A. Zandbergen. 2011. Vehicle-related mortality and road crossing behavior
12717 of the Florida panther. *Applied Geography* 31:859-870

12718 Schortemeyer, J. L., D. S. Maehr, J. W. McCown, E. D. Land, and P. D. Manor. 1991. Prey
12719 management for the Florida panther: a unique role for wildlife managers. *Transactions of the*
12720 *North American Wildlife and Natural Resources Conference* 56:512-526.

12721 Seal, U.S. and R.C. Lacy (eds). 1989. Florida panther (*Felis concolor coryi*) viability analysis
12722 and species survival plan. Report to the U. S. Fish and Wildlife Service, by the Captive
12723 Breeding Specialist Group, Species Survival Commission, IUCN, Apple Valley,
12724 Minnesota.

12725 Shaffer, M.L. 1978. Determining Minimum Viable Population Sizes: A Case Study of the
12726 Grizzly Bear. Ph. D. Dissertation, Duke University.

12727 Shaffer, M.L. 1981. Minimum population sizes for species conservation. *BioScience*

12728 Shaffer, M.L. 1987. Minimum viable populations: coping with uncertainty. Pages 69-86 in
12729 M.E. Soulé (ed). *Viable populations for conservation*. Cambridge University Press,
12730 New York.

12731 Shindle D., M. Cunningham, D. Land, R. McBride, M. Lotz, and B. Ferree. 2003. Florida
12732 panther genetic restoration and management. Annual Report 93112503002. Florida Fish
12733 and Wildlife Conservation Commission, Tallahassee, Florida.

12734 Skoda, S. R., P. L. Phillips, and J. B. Welch. 2018. Screwworm (Diptera: Calliphoridae) in the
12735 United States: response to and elimination of the 2016–2017 outbreak in Florida. *Journal of Medical Entomology* 55:777-786.

12736 Smith, T.R., and O.L. Bass, Jr. 1994. Landscape, white-tailed deer, and the distribution of
12737 Florida panthers in the Everglades. Pages 693-708 in S.M. Davis and J.C. Ogden (eds).
12738 Everglades: the ecosystem and its restoration. Delray Beach, Florida.

12739 Smith, D.J., R.F. Noss, and M.B. Main. 2006. East Collier County wildlife movement study:
12740 SR 29, CR 846, and CR 858 wildlife crossing project. Unpublished report. University of
12741 Central Florida, Orlando, Florida.

12742 Smith, J. A., Y. Wang, and C. C. Wilmers. 2015. Top carnivores increase their kill rates on prey
12743 as a response to human-induced fear. *Proceedings of the Royal Society B*,
12744 282:20142711. <https://doi.org/10.1098/rspb.2014.2711>.

12745 Smith, J. A., W. Yiwei, and C. C. Wilmers. 2016. Spatial characteristics of residential
12746 development shift large carnivore prey habits. *The Journal of Wildlife Management* 80:1040-1048. <<https://doi.org/10.1002/jwmg.21098>>.

12747 Smith, J.A., Y. Wang, C. C. Wilmers. 2016. Spatial Characteristics of Residential Development
12748 Shift Large Carnivore Prey Habits. *The Journal of Wildlife Management* 80(6): 1040-
12749 1048.

12750 Snow, R. W., M. L. Brien, M. S. Cherkiss, L. Wilkins, and F. J. Mazzotti. 2007. Dietary habits of
12751 the Burmese python, *Python molurus bivittatus*, in Everglades National Park, Florida.
12752 *Herpetological Bulletin* 101:5-7.

12753 Sollmann, R., B. Gardner, R. B. Chandler, D. B. Shindle, D. P. Onorato, J. A. Royle, and A. F.
12754 O'Connell. 2013. Using multiple data sources provides density estimates for endangered

12755

12757 Florida panther. *Journal of Applied Ecology* 50:961-968. <<https://doi.org/10.1111/1365-2664.12098>>.

12759 Storm, D.J., Nielsen, C.K., Schauber, E.M. and Woolf, A., 2007. Space use and survival of
12760 white-tailed deer in an exurban landscape. *The Journal of Wildlife Management*, 71(4),
12761 pp.1170-1176.

12762 Sunquist, M., and F. Sunquist. 2002. Wild cats of the world. University of Chicago Press,
12763 Chicago. <<http://catdir.loc.gov/catdir/toc/fy034/2001052771.html>>.

12764 Sweanor, L.L., Logan, K.A., Bauer, J.W., Millsap, B. and Boyce, W.M., 2008. Puma and human
12765 spatial and temporal use of a popular California State Park. *The Journal of Wildlife
12766 Management*, 72(5), pp.1076-1084.

12767 Sweanor, L.L. and Logan, K.A., 2010. Cougar-human interactions. *Cougar: ecology and
12768 conservation*, pp.190-205.

12769 Sweet, W. V., R. E. Kopp, C. P. Weaver, J. Obeysekera, R. M. Horton, E. R. Thieler, and C.
12770 Zervas. 2017. Global and regional sea level rise scenarios for the United States. NOAA
12771 Technical Report NOS CO-OPS 083. National Oceanic and Atmospheric Administration,
12772 Silver Spring, MD.

12773 Taulman, J. F., and L. W. Robbins. 1996. Recent range expansion and distributional limits of the
12774 nine-banded armadillo (*Dasypus novemcinctus*) in the United States. *Journal of
12775 Biogeography* 23:635-648. <<http://www.jstor.org/stable/2846052>>.

12776 US Fish and Wildlife Service (USFWS). 1998. Endangered Species Consultation Handbook:
12777 Procedures for conduction consultation and conference activities under Section 7 of the
12778 Endangered Species Act. *Washington, DC*.

12779 U.S. Fish and Wildlife Service (USFWS). 2000. Florida panther final interim standard local
12780 operating procedures (SLOPES) for endangered species. Fish and Wildlife Service;
12781 Vero Beach, Florida.

12782 U.S. Fish and Wildlife Service (USFWS). 2008. Florida panther recovery plan: third revision.
12783 January 2006. Prepared by the Florida Panther Recovery Team and the South Florida
12784 Ecological Services Office. U.S. Fish and Wildlife Service; Atlanta, Georgia.

12785 U.S. Fish and Wildlife Service (USFWS). 2012. Panther Habitat Assessment Methodology.
12786 U.S. Fish and Wildlife Service; South Florida Ecological Services Offices; Vero Beach,
12787 Florida.

12788 [http://www.Service.gov/verobeach/MammalsPDFs/20120924_Panther percent20Habitat
percent20Assessment percent20Method Appendix.pdf](http://www.Service.gov/verobeach/MammalsPDFs/20120924_Panther percent20Habitat
12789 percent20Assessment percent20Method Appendix.pdf)

12790 [USFWS and NMFS] U.S. Fish and Wildlife Service and National Marine Fisheries Service.
12791 2016. Habitat Conservation Planning and Incidental Take Permit Processing Handbook.
12792 Washington (DC): US Department of the Interior, US Department of Commerce.

12793 December 21, 2016.USGCRP, 2017: Climate Science Special Report: Fourth National
12794 Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J.
12795 Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research
12796 Program, Washington, DC, USA, 470 pp., doi: 10.7930/J0J964J6.

12797 USGCRP, 2018: Impacts, Risks, and Adaptation in the United States: Fourth National Climate
12798 Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel,
12799 K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research
12800 Program, Washington, DC, USA, 1515 pp. doi: 10.7930/NCA4.2018

12801 van de Kerk, M., Onorato, D.P., Criffeld, M.A., Bolker, B.M., Augustine, B.C., McKinley, S.A.
12802 and Oli, M.K., 2015. Hidden semi-Markov models reveal multiphasic movement of the
12803 endangered Florida panther. *Journal of Animal Ecology*, 84(2), pp.576-585.
12804 van de Kerk, M., D. Onorato, J. Hostetler, B. Bolker, and M. Oli. 2019. Dynamics, persistence,
12805 and genetic management of the endangered Florida panther population. *Journal of*
12806 *Wildlife Management and Wildlife Monographs* .
12807 VanWormer, E., Carpenter, T.E., Singh, P., Shapiro, K., Wallender, W.W., Conrad, P.A.,
12808 Largier, J.L., Maneta, M.P. and Mazet, J.A., 2016. Coastal development and precipitation
12809 drive pathogen flow from land to sea: evidence from a *Toxoplasma gondii* and felid host
12810 system. *Scientific reports*, 6(1), pp.1-9.
12811 Vickers, T.W., Sanchez, J.N., Johnson, C.K., Morrison, S.A., Botta, R., Smith, T., Cohen, B.S.,
12812 Huber, P.R., Ernest, H.B. and Boyce, W.M., 2015. Survival and mortality of pumas
12813 (*Puma concolor*) in a fragmented, urbanizing landscape. *PloS one*, 10(7), p.e0131490.
12814 Virginia Institute of Marine Science (VIMS). 2020. U.S. Sea-Level Report Cards; Trends,
12815 projections, and processes to aid in coastal planning.
12816 <https://www.vims.edu/research/products/slrc/localities/index.php>
12817 Wilson, J.D., 2017. Indirect effects of invasive Burmese pythons on ecosystems in southern
12818 Florida. *Journal of Applied Ecology*, 54(4), pp.1251-1258.
12819 Williams, B.K., R.C. Szaro, and C.D. Shapiro. 2009. Adaptive Management: The U.S.
12820 Department of the Interior Technical Guide. Adaptive Management Working Group, U.S.
12821 Department of the Interior, Washington, DC.
12822 World Health Organization, and United Nations and Environment Programme. 2013. State of the
12823 Science of Endocrine Disrupting Chemicals - 2012. Å Bergman, J. J. Heindel, S. Jobling,
12824 K. A. Kidd, and R. T. Zoeller, editors. United Nations Environment Programme (UNEP)
12825 and the World Health Organization (WHO), Geneva, Geneva.
12826 Young, S.P., and E.A. Goldman. 1946. The puma-mysterious American cat. American Wildlife
12827 Institute, Washington, D.C.
12828
12829

12830 24.6 Big Cypress Fox Squirrel

12831 Florida Fish and Wildlife Conservation Commission (FWC). 2011. Big Cypress fox squirrel
12832 biological status review report. March 31, 2011. Florida Fish and Wildlife Conservation
12833 Commission. Tallahassee, Florida.
12834 Florida Fish and Wildlife Conservation Commission (FWC). 2013. A species action plan for the
12835 Big Cypress fox squirrel (*Sciurus niger avicennia*). Florida Fish and Wildlife
12836 Conservation Commission. Tallahassee, Florida.
12837 Florida Fish and Wildlife Conservation Commission (FWC). 2018. Species conservation
12838 measures and permitting guidelines for the Big Cypress Fox Squirrel (*Sciurus niger*
12839 *avicennia*). Florida Fish and Wildlife Conservation Commission. Tallahassee, Florida.
12840 Munim, D.A. 2008. The distribution, abundance, and habitat use of the big cypress fox squirrel
12841 (*Sciurus niger avicennia*). M.S. thesis; Department of Biology; University of Central
12842 Florida Orlando, Florida. 46 pp.
12843 Passarella and Associates, Inc. 2017. Rural Lands West Biological Assessment. Prepared for
12844 Collier Enterprises Management, Inc. Passarella and Associates, Inc. Fort Myers, Florida.
12845
12846

12847 Personal Communications:

12848

12849 J. Fitzgerald, 2/8/2019, von Arx Wildlife Hospital, Conservancy of Southwest Florida, phone

12850 conversation with Kenneth McDonald, USFWS.

12851

12852 **24.7 Florida Sandhill Crane**

12853

12854 eBird. 2019. eBird: An online database of bird distribution and abundance [web application].

12855 eBird, Ithaca, New York. Available: <http://www.ebird.org>. (Accessed May 15, 2019).

12856 Florida Department of Agriculture and Consumer Services. 2015. Agriculture Wildlife Best

12857 Management Practices for State Imperiled Species. DACS-P-02031. 28 pp.

12858 Florida Fish and Wildlife Conservation Commission (FWC). 2011. Florida sandhill crane

12859 biological status review report. March 31, 2011. Florida Fish and Wildlife Conservation

12860 Commission. Tallahassee, Florida.

12861 Florida Fish and Wildlife Conservation Commission (FWC). 2013. A species action plan for the

12862 Florida sandhill crane (*Grus canadensis pratensis*). Florida Fish and Wildlife

12863 Conservation Commission. Tallahassee, Florida.

12864 Florida Fish and Wildlife Conservation Commission (FWC). 2016. Species Conservation

12865 Measures and Permitting Guidelines for the Florida Sandhill Crane (*Antigone canadensis*

12866 *pratensis*). Florida Fish and Wildlife Conservation Commission. Tallahassee, Florida.

12867 Passarella and Associates, Inc. 2017. Rural Lands West Biological Assessment. Prepared for

12868 Collier Enterprises Management, Inc. Passarella and Associates, Inc. Fort Myers, Florida.

12869

12870 Personal Communications:

12871

12872 J. Fitzgerald, 2/8/2019, von Arx Wildlife Hospital, Conservancy of Southwest Florida, phone

12873 conversation with Kenneth McDonald, USFWS.

12874

12875 **24.8 Florida scrub-jay**

12876

12877 Abrahamson, W.G. 1984. Post-fire recovery of Florida Lake Wales Ridge vegetation. American

12878 Journal of Botany 71(1):9-21.

12879 Boughton, R.K. and R. Bowman. 2011. State wide assessment of Florida scrub-jays on managed

12880 areas: A comparison of current populations to the results of the 1992-93 survey. Archbold

12881 Biological Station; Venus, Florida.

12882 Boughton, R.K., J.W. Atwell, and S.J. Schoech. 2006. An introduced generalist parasite, the

12883 sticktight flea (*Echidnophaga gallinacea*), and its pathology in the threatened Florida

12884 scrub-jay (*Aphelocoma coerulescens*). Journal of Parasitology 92(5):941-948.

12885 Bowman, R. 1998. Population dynamics, demography, and contributions to metapopulation

12886 dynamics by suburban populations of the Florida scrub-jay, *Aphelocoma coerulescens*. Final

12887 report on Project No. NG94-032 to Florida Fish and Wildlife Conservation Commission;

12888 Tallahassee, Florida.

12889 Bowman, R. and L. Averill. 1993. Demography of a suburban population of Florida scrub-jays.

12890 Annual progress report to U.S. Fish and Wildlife Service; Jacksonville, Florida.

12891 Breininger, D.R. 1999. Florida scrub-jay demography and dispersal in a fragmented landscape.

12892 The Auk 116(2):520-527.

12893 Breininger, D.R. and G.M. Carter. 2003. Territory Quality Transitions and Source-Sink
12894 Dynamics in a Florida Scrub-jay Population. *Ecological applications* 13(2):516-529.
12895 Breininger, D.R., M.J. Provancha, and R.B. Smith. 1991. Mapping Florida scrub-jay habitat for
12896 purposes of land-use management. *Photogrammetric Engineering and Remote Sensing*
12897 57(11):1467-1474.
12898 Breininger, D.R., V.L. Larson, B.W. Duncan, R.B. Smith, D.M. Oddy, and M.F. Goodchild.
12899 1995. Landscape patterns of Florida scrub-jay habitat use and demographic success.
12900 *Conservation Biology* 9(6):1442-1453.
12901 Breininger, D.R., M.A. Burgman, and B.M. Stith. 1999. Influence of habitat quality,
12902 catastrophes, and population size on extinction risk of the Florida scrub-jay. *Wildlife*
12903 *Society Bulletin* 27(3):810-822.
12904 Byrd, H. 1928. Notes from correspondents: Florida jay. *Florida Naturalist* 1(4):87.
12905 Coulon, A., J.W. Fitzpatrick, R. Bowman, B.M. Stith, C.A. Makarewich, L.M. Stenzler, and I.J.
12906 Lovette. 2008. Congruent population structure inferred from dispersal behaviour and
12907 intensive genetic surveys of the threatened Florida scrub-jay (*Aphelocoma coerulescens*).
12908 *Molecular Ecology* 17:1685-1701.
12909 Cox, J.A. 1987. Status and distribution of the Florida scrub-jay. *Florida Ornithological Society*
12910 Special Publication No. 3; Gainesville, Florida.
12911 Davis, J.H., Jr. 1967. General map of natural vegetation of Florida. Agricultural Experiment
12912 Station, Institute of Food and Agricultural Sciences, University of Florida; Gainesville,
12913 Florida.
12914 DeGange, A.R., J.W. Fitzpatrick, J.N. Layne, and G.E. Woolfenden. 1989. Acorn harvesting by
12915 Florida scrub-jays. *Ecology* 70(2):348-356.
12916 Dreschel, T.W., R.B. Smith, and D.R. Breininger. 1990. Florida scrub-jay mortality on roadsides.
12917 *Florida Field Naturalist* 18(4):82-83.
12918 [FDOT] Florida Department of Transportation. 2014. SR 29 Project Development and
12919 Environment Study. Presentation to SR 29 Stakeholders Advisory Committee, January
12920 23, 2014. http://www.sr29collier.com/pdf/SAC_Pres_0114.pdf
12921 Fernald, R.T. 1989. Coastal xeric scrub communities of the Treasure Coast Region, Florida: A
12922 summary of their distribution and ecology, with guidelines for their preservation and
12923 management. Nongame Wildlife Program Technical Report Number 6. Florida Game and
12924 Fresh Water Fish Commission; Tallahassee, Florida.
12925 Fitzpatrick, J.W., G.E. Woolfenden, and M.T. Kopeny. 1991. Ecology and development-related
12926 habitat requirements of the Florida scrub-jay (*Aphelocoma coerulescens coerulescens*).
12927 Nongame Wildlife Program Technical Report No. 8. Florida Game and Fresh Water Fish
12928 Commission; Tallahassee, Florida.
12929 Fitzpatrick, J.W., B. Pranty, and B. Stith. 1994. Florida scrub-jay statewide map, 1992-1993.
12930 Archbold Biological Station; Lake Placid, Florida.
12931 Franzreb, K.E. and J. Puschock. 2004. Year 3 (FY 2003): Status, population dynamics, and
12932 habitat use of the Florida scrub-jay on the Ocala National Forest, Florida. Draft annual
12933 report 2003. Southern Region, U.S. Forest Service; Asheville, North Carolina.
12934 Hanski, I., and M. Gilpin. 1991. Metapopulation dynamics: brief history and conceptual domain.
12935 *Biological Journal of the Linnaean Society* 42:3-16.
12936 Hastie, K. and E. Eckl. 1999. North Florida team rallies around scrub-jay. Page 28 in M. Durhan,
12937 editor. *Fish and Wildlife News*. July/August 1999. U.S. Fish and Wildlife Service;
12938 Washington, D.C.

12939 Laessle, A.M. 1958. The origin and successional relationship of sandhill vegetation and sand-
12940 pine scrub. *Ecological Monographs* 28(4):361-387.

12941 Laessle, A.M. 1968. Relationships of sand pine scrub to former shore lines. *Quarterly Journal of*
12942 *the Florida Academy of Science* 30(4):269-286.

12943 Miller, K.E. 2004. Personal communication. Biologist. Email to U.S. Fish and Wildlife Service
12944 dated July 16, 2004. Florida Fish and Wildlife Conservation Commission; Miller,
12945 Gainesville, Florida.

12946 Miller, K.E. and B.M. Stith. 2002. Florida Scrub-Jay Distribution and Habitat in Charlotte
12947 County. Final Report for contract #2001000116. Avian Research Center, Incorporated;
12948 Gainesville, Florida.

12949 Mumme, R.L. 1992. Do helpers increase reproductive success? An experimental analysis in the
12950 Florida scrub-jay. *Behavioral Ecology and Sociobiology* 31:319-328.

12951 Mumme, R.L., S.J. Schoech, G.E. Woolfenden, and J.W. Fitzpatrick. 2000. Life and death in the fast
12952 lane: demographic consequences of road mortality in the Florida scrub-jay. *Conservation*
12953 *Biology* 14(2):501-512.

12954 Myers, R.L. 1990. Scrub and high pine. Pages 150-193 in R.L. Myers and J.J. Ewel, editors.
12955 *Ecosystems of Florida*. University of Central Florida Press; Orlando, Florida.

12956 Percival, H.F., D.B. McDonald, and M.J. Mazurek. 1995. Status and distribution of the Florida
12957 scrub-jay (*Aphelocoma c. coerulescens*) on Cape Canaveral, Florida. Technical Report
12958 No. 51. Florida Fish and Wildlife Research Unit; Gainesville, Florida.

12959 Schaub, R., R.L. Mumme, and G.E. Woolfenden. 1992. Predation on the eggs and nestlings of
12960 Florida scrub-jays. *The Auk* 109(3):585-593.

12961 Stith, B.M. 1999. Metapopulation viability analysis of the Florida scrub-jay (*Aphelocoma*
12962 *coerulescens*): a statewide assessment. Final Report to the U.S. Fish and Wildlife
12963 Service; Jacksonville, Florida.

12964 Stith, B.M., J.W. Fitzpatrick, G.E. Woolfenden, and B. Pranty. 1996. Classification and
12965 conservation of metapopulations: a case study of the Florida scrub-jay. Pages 187-215 in
12966 D.R. McCullough, editor. *Metapopulations and wildlife conservation*. Island Press;
12967 Washington, D.C.

12968 Thaxton, J.E. and T.M. Hingtgen. 1996. Effects of suburbanization and habitat fragmentation on
12969 Florida scrub-jay dispersal. *Florida Field Naturalist* 24(2):25-60.

12970 The Nature Conservancy. 2001. Saving the Florida scrub-jay: recommendations for preserving
12971 Florida's scrub habitat. The Nature Conservancy and Audubon of Florida; Altamonte
12972 Springs, Florida.

12973 Toland, B.R. 1991. Nest site characteristics of a Florida scrub-jay population in Indian River
12974 County [abstract]. Florida scrub-jay workshop. Florida Department of Environmental
12975 Protection; Ormond Beach, Florida.

12976 Toland, B.R. 1999. Current status and conservation recommendations for the Florida scrub-jay in
12977 Brevard County. Report to the Brevard County Board of County Commissioners. Brevard
12978 County Natural Resources Management Office; Viera, Florida.

12979 Turner, W.R., D.S. Wilcove, and H.M. Swain. 2006. State of the scrub: conservation progress
12980 management responsibilities, and land acquisition priorities for imperiled species of
12981 Florida's Lake Wales Ridge [Internet]. Archbold Biological Station; Lake Placid, Florida
12982 [Cited December 13, 2006]. Available from: [http://www.archbold-
12983 station.org/abs/publicationsPDF/Turner_et.al-2006-StateotScrub.pdf](http://www.archbold-station.org/abs/publicationsPDF/Turner_et.al-2006-StateotScrub.pdf)

12984 U.S. Fish and Wildlife Service [USFWS]. 2009. Amended Guidance for Assessing Mitigation
12985 Needs for the Florida Scrub-jay. Memorandum dated March 16, 2009, from Field

12986 Supervisor, Jacksonville Field Office, to Field Supervisor, South Florida Field Office. 7
12987 pp. https://www.fws.gov/northflorida/Scrub-Jays/fsj_mit_guide.htm

12988 U.S. Fish and Wildlife Service [USFWS]. 2019. Recovery Plan for the Florida Scrub-Jay
12989 (*Aphelocoma coerulescens*). U.S. Fish and Wildlife Service. Atlanta, GA.

12990 Woolfenden, G.E. 1974. Nesting and survival in a population of Florida scrub-jays. *The Living*
12991 *Bird* 12:25-49.

12992 Woolfenden, G.E. 1978. Growth and survival of young Florida scrub-jays. *Wilson Bulletin*
12993 90(1):1-18.

12994 Woolfenden, G.E. and J.W. Fitzpatrick. 1978. The inheritance of territory in group-breeding
12995 birds. *BioScience* 28(2):104-108.

12996 Woolfenden, G.E. and J.W. Fitzpatrick. 1984. The Florida scrub-jay: demography of a
12997 cooperative-breeding bird. Princeton University Press; Princeton New Jersey.

12998 Woolfenden, G.E. and J.W. Fitzpatrick. 1986. Sexual asymmetries in the life history of the
12999 Florida scrub-jay. Pages 87-107 in D.I. Rubenstein and R.W. Wrangham, editors.
13000 Ecological aspects of social evolution: birds and mammals. Princeton University Press;
13001 Princeton, New Jersey.

13002 Woolfenden, G.E. and J.W. Fitzpatrick. 1990. Florida scrub-jays: A synopsis after 18 years of
13003 study. Pages 241-266 in P.B. Stacey and W.B. Koenig, editors. Cooperative breeding in
13004 birds: long term studies of ecology and behavior. Cambridge University Press;
13005 Cambridge, United Kingdom.

13006 Woolfenden, G.E. and J.W. Fitzpatrick. 1991. Florida scrub-jay ecology and conservation. Pages
13007 542-565 in C.M. Perrine, J.D. Lebreton, and G.J.M. Hirons, editors. Bird population
13008 studies: relevance to conservation and management. Oxford University Press; Oxford,
13009 United Kingdom.

13010 Woolfenden, G.E. and J.W. Fitzpatrick. 1996a. Florida scrub-jay. Pages 267-280 in J.A.
13011 Rodgers, H.W. Kale, and H.T. Smith, editors. Rare and Endangered Biota of Florida,
13012 Volume V. Birds. University Press of Florida; Gainesville, Florida.

13013 Woolfenden, G.E. and J.W. Fitzpatrick. 1996b. Florida scrub-jay. Pages 1-27 in A. Poole and F. Gill,
13014 editors. The birds of North America, No. 228. The Academy of Natural Sciences,
13015 Philadelphia, and The American Ornithologists' Union; Washington, D.C.

13016

13017 **24.9 Florida Burrowing Owl**

13018

13019 Audubon of the Western Everglades (AWE). 2016. Audugram: Audubon of the Western
13020 Everglades Newsletter. November 2016. Audubon of the Western Everglades. Naples,
13021 Florida. Accessed May 16, 2019. <https://myemail.constantcontact.com/AWE-November-2016-Audugram-.html?soi=111403942537&aid=LKENUBfvF2M>

13022 Cape Coral Burrowing Owls. 2019. May 2017 Cape Coral Burrowing Owl Survey. Accessed
13023 May 15, 2019. www.capecoralburrowingowls.com

13024 Florida Department of Agriculture and Consumer Services. 2015. Agriculture Wildlife Best
13025 Management Practices for State Imperiled Species. DACS-P-02031. 28 pp.

13026 Florida Fish and Wildlife Conservation Commission (FWC). 2003, January 6. Florida's breeding
13027 bird atlas: A collaborative study of Florida's birdlife. <http://www.myfwc.com/bba/>.
13028 (Accessed May 15, 2019).

13029 Florida Fish and Wildlife Conservation Commission (FWC). 2011. Florida burrowing owl
13030 biological status review report. March 31, 2011. Florida Fish and Wildlife Conservation
13031 Commission. Tallahassee, Florida.

13032

13033 Florida Fish and Wildlife Conservation Commission (FWC). 2013. A species action plan for the
13034 Florida burrowing owl (*Athene cunicularia floridana*). Florida Fish and Wildlife
13035 Conservation Commission. Tallahassee, Florida.
13036 Florida Fish and Wildlife Conservation Commission (FWC). 2018. Species Conservation
13037 Measures and Permitting Guidelines for the Florida Burrowing Owl (*Athene cunicularia*
13038 *floridana*). Florida Fish and Wildlife Conservation Commission. Tallahassee, Florida.
13039 Mrykalo, Robert. 2005. The Florida burrowing owl in a rural environment: Breeding habitat,
13040 dispersal, post-breeding habitat, behavior and diet. Graduate Theses and Dissertations.
13041 Graduate School at Scholar Commons; University of South Florida. Tampa, Florida.
13042 Murray, M. 2011. Anticoagulant rodenticide exposure and toxicosis in four species of birds of
13043 prey presented to a wildlife clinic in Massachusetts, 2006-2010. Journal of Zoo and
13044 Wildlife Medicine 42(1):88-97.
13045 U.S. Fish and Wildlife Service (Service). 2005. BO for Ave Maria University DRI. June 29,
13046 2005. Service Log No. 4-1-04-PL-6866-R3. U.S. Fish and Wildlife Service; South
13047 Florida Ecological Services Office; Vero Beach, Florida.
13048

13049 Personal Communications:

13050
13051 J. Fitzgerald, 2/8/2019, von Arx Wildlife Hospital, Conservancy of Southwest Florida, phone
13052 conversation with Kenneth McDonald, USFWS.
13053

13054 **24.10 Red Knot**

13055
13056 Cohen, J.B., S.M. Karpanty, J.D. Fraser, B.D. Watts, and B.R. Truitt. 2009. Residence
13057 probability and population size of red knots during spring stopover in the mid-Atlantic
13058 region of the United States. Journal of Wildlife Management 73(6):939-945.
13059 Cohen, J.B., S.M. Karpanty, J.D. Fraser, and B.R. Truitt. 2009. The effect of benthic prey
13060 abundance and size on red knot (*Calidris canutus*) distribution at an alternative migratory
13061 stopover site on the U.S. Atlantic coast. Journal of Ornithology 151:355-364.
13062 Davis, T.H. 1983. Loons to sandpipers. Pages 372-375 in J. Farrand, editor. The Audubon
13063 Society master guide to birding. Knopf; New York, New York.
13064 Dey, A., L. Niles, H. Sitters, K. Kalasz, and R.I.G. Morrison. 2011. Update to the status of the
13065 red knot, *Calidris canutus* in the Western Hemisphere, April, 2011, with revisions to July
13066 14, 2011. Unpublished report to New Jersey Department of Environmental Protection,
13067 Division of Fish and Wildlife, Endangered and Nongame Species Program.
13068 eBird.org. 2019. eBird: An online database of bird distribution and abundance (web application).
13069 Cornell Lab of Ornithology; Ithaca, New York. Available from: <http://www.ebird.org/>.
13070 Harrington, B.A. 2001. Red knot (*Calidris canutus*) in A. Poole and F. Gill, editors. The Birds of
13071 North America No. 563. Philadelphia, Pennsylvania.
13072 Harrington, B.A. 2005. Unpublished information on red knot numbers and distribution in the
13073 eastern United States: Based largely on ongoing projects and manuscripts under
13074 development at the Manomet Center for Conservation Sciences and the Georgia
13075 Department of Natural Resources.
13076 Harrington, B.A., J.M. Hagen, and L.E. Leddy. 1988. Site fidelity and survival differences
13077 between two groups of New World red knots (*Calidris canutus*). The Auk 105:439-445.

13078 Niles, L. 2009. Red knots wintering on the Florida Gulf coast 2005-2009. Unpublished final
13079 report (Report on Red Knot Surveys in Florida 2008-2009). Neotropical Migrant Bird
13080 Conservation Act. Project #3556, Agreement #NJ-N31.

13081 Niles, L.J., H.P. Sitters, A.D. Dey, P.W. Atkinson, A.J. Baker, K.A. Bennett, R. Carmona,
13082 K.E. Clark, N.A. Clark, and C. Espoza. 2008. Status of the red knot (*Calidris canutus*
13083 *rufa*) in the Western Hemisphere. *Studies in Avian Biology* 36:1-185.

13084 Smith, B.S. 2010. Patterns of nonbreeding snowy plover (*Charadrius alexandrinus*), piping
13085 plover (*C. melanotos*), and red knot (*Calidris canutus*) distribution in northwest Florida.
13086 *Florida Field Naturalist* 38(2):43-54.

13087 Sprandel, G.L., J.A. Gore, and D.T. Cobb. 1997. Winter Shorebird Survey. Florida Game and
13088 Fresh Water Fish Commission. Final Performance Report. Tallahassee, Florida.

13089 Truitt, B.R., B.D. Watts, B. Brown, and W. Dunstan. 2001. Red knot densities and invertebrate
13090 prey availability on the Virginia barrier islands. *Wader Study Group Bulletin* 95:12.

13091 U.S. Fish and Wildlife Service [USFWS]. 2014. Rufa red knot background information and
13092 threats assessment; supplement to “Endangered and Threatened Wildlife and Plants; Final
13093 Threatened Status for the rufa red knot (*Calidris canutus rufa*).” Available at:
13094 https://www.fws.gov/northeast/redknot/pdf/20141125_REKN_FL_supplemental_doc_FL_NAL.pdf

13095

13096 24.11 Little Blue Heron

13099 Dahl, T.E., 2005, Florida's wetlands: An update on status and trends 1985 to 1996: Washington
13100 D.C., U.S. Fish and Wildlife Service report, 80 p.

13101 Florida Fish and Wildlife Conservation Commission (FWC). 2011. Little Blue Heron Biological
13102 Status Review Report. March 31, 2011. Florida Fish and Wildlife Conservation
13103 Commission. Tallahassee, Florida.

13104 Florida Fish and Wildlife Conservation Commission. 2013. A species action plan for six
13105 imperiled wading birds: little blue heron, reddish egret, roseate spoonbill, snowy egret,
13106 tricolored heron, and white ibis. Tallahassee, Florida. 55 p.

13107 Florida Fish and Wildlife Research Institute (FWRI). 2018. FWC Water Bird Locator. Available
13108 at <http://atoll.floridamarine.org/waterBirds/> (date Accessed: November 26, 2018).

13109 Florida Fish and Wildlife Conservation Commission (FWC). 2019. Species Conservation
13110 Measures and Permitting Guidelines: Little Blue Heron, Reddish Egret, Roseate
13111 Spoonbill, Tricolored Heron. Available at
13112 <https://myfwc.com/wildlifehabitats/wildlife/species-guidelines/> (date Accessed: July 24,
13113 2019).

13114 Rodgers Jr., J. A. and H. T. Smith (2012). Little Blue Heron (*Egretta caerulea*), version 2.0. In
13115 The Birds of North America (A. F. Poole, Editor). Cornell Lab of Ornithology, Ithaca,
13116 NY, USA. <https://doi.org/10.2173/bna.145>

13117 24.12 Tricolored Heron

13120 Dahl, T.E., 2005, Florida's wetlands: An update on status and trends 1985 to 1996: Washington
13121 D.C., U.S. Fish and Wildlife Service report, 80 p.

13122 Frederick, P. C. 2013. Tricolored Heron (*Egretta tricolor*), version 2.0. In The Birds of North
13123 America (A. F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA.
13124 <https://doi.org/10.2173/bna.306>

13125 Florida Fish and Wildlife Conservation Commission (FWC). 2011. Tricolored Heron Biological
13126 Status Review Report. March 31, 2011. Florida Fish and Wildlife Conservation
13127 Commission. Tallahassee, Florida.

13128 Florida Fish and Wildlife Conservation Commission. 2013. A species action plan for six
13129 imperiled wading birds: little blue heron, reddish egret, roseate spoonbill, snowy egret,
13130 tricolored heron, and white ibis. Tallahassee, Florida. 55 p.

13131 Florida Fish and Wildlife Conservation Commission (FWC). 2019. Species Conservation
13132 Measures and Permitting Guidelines: Little Blue Heron, Reddish Egret, Roseate
13133 Spoonbill, Tricolored Heron. Available at
13134 <https://myfwc.com/wildlifehabitats/wildlife/species-guidelines/> (date Accessed: July 24,
13135 2019).

13136 Florida Fish and Wildlife Research Institute (FWRI). 2019. FWC Water Bird Locator. Available
13137 at <http://atoll.floridamarine.org/waterBirds/> (Date Accessed: July 29, 2019).

13139 24.13 Wood Stork

13140 American Ornithologists' Union. 1983. Check list of North American birds. Lawrence, Kansas:
13141 Allen Press, Inc.

13142 Bent, A. C. 1926. *Mycteria americana* Linnaeus, wood ibis. In A. C. Bent (Ed.), Life histories of
13143 North American marsh birds: Orders Odontoglossae, Herodiones, And Paludicolae (pp.
13144 56-66). Washington, D.C. Smithsonian Institution (Government Printing Office).

13145 Borkhataria, R. B., Frederick, P. C., and Bryan, A. L. 2006. Analysis of wood stork (*Mycteria
13146 americana*) locations in florida and throughout the southeast from satellite transmitters
13147 and band returns No. Report to the U.S. Fish and Wildlife Service). Vero Beach, Florida:
13148 Unpublished.

13149 Borkhataria, R. R., Frederick, P. C., and Hylton, R. A. 2004. Nesting success and productivity of
13150 South Florida wood storks in 2004 No. Report to the U.S. Fish and Wildlife Service).
13151 Jacksonville, Florida: Unpublished.

13152 Brooks, W. B., and Dean, T. 2008. Measuring the biological status of the US breeding
13153 population of wood storks. *Waterbirds*, 31(sp1), 50-62.

13154 Browder, J. A. 1978. A modeling study of water, wetlands, and wood storks. In S. A. IV, J. C.
13155 Ogden and S. Winckler (Eds.), *Wading birds* (pp. 325-346) National Audubon Society.

13156 Browder, J. A. 1984. Wood stork feeding areas in southwest florida. *Florida Field Naturalist*,
13157 12, 81-96; 81.

13158 Bryan, A. L., Jr., Coulter, M. C., and Pennycuick, C. J. 1995. Foraging strategies and energetic
13159 costs of foraging flights by breeding wood storks. *Condor*, 97(1), 133-140; 133.

13160 Burger, J., Rodgers, J., J.A., and Gochfeld, M. 1993. Heavy metal and selenium levels in
13161 endangered woods storks *mycteria americana* from nesting colonies in Florida and Costa
13162 Rica. *Archives Environmental Contaminant Toxicology*, 24, 417-420; 417.

13163 Coulter, M. C. 1987. Foraging and breeding ecology of wood storks in east central Georgia.
13164 Paper presented at the *Third Southeastern Non-Game and Endangered Wildlife
13165 Symposium*, pp. 21-27.

13167 Coulter, M. C., and Bryan, A.L. 1993. Foraging ecology of wood storks (*mycteria americana*) in
13168 east-central Georgia: Characteristics of foraging sites. *Colonial Waterbirds*, 16, 59-70.

13169 Coulter, M. C., Rodgers, J. A., Ogden, J. C., and Depkin, F. C. 1999. Wood stork (*mycteria*
13170 *americana*). In A. Poole, and F. Gill (Eds.), *The birds of north america* (). Philadelphia,
13171 Pennsylvania: The Birds of North America, Incorporated.

13172 Crozier, G. E., and Cook, M. I. 2004. *South Florida wading bird report, volume 10* South Florida
13173 Water Management District.

13174 Dahl, T. E. 1990. *Wetlands losses in the United States 1780s to 1980s*. Washington, D.C.: U.S.
13175 Department of the Interior, Fish and Wildlife Service.

13176 Depkin, F. C., Coulter, M. C., and Bryan Jr, A. L. 1992. Food of nestling wood storks in east-
13177 central Georgia. *Colonial Waterbirds*, 15(2), 219-225.

13178 Dove, C. J., Snow, R. W., Rochford, M. R., and Mazzotti, F. J. 2011. Birds consumed by the
13179 invasive burmese python (*python molurus bivittatus*) in Everglades National Park,
13180 Florida, USA. *The Wilson Journal of Ornithology*, 123(1), 126-131.

13181 Dusi, J. L., and Dusi, R. T. 1968. Evidence for the breeding of the wood stork in Alabama.
13182 *Alabama Birds*, 16, 14-16; 14.

13183 Fleming, D. M., Wolff, W. F., and DeAngelis, D. L. 1994. Importance of landscape
13184 heterogeneity to wood storks in Florida everglades. *Environmental Management*, 18(5),
13185 743-757.

13186 Fleming, W. J., J.A., R.,Jr, and Stafford, C. J. 1984. Contaminants in wood stork eggs and their
13187 effects on reproduction, Florida, 1982. *Colonial Waterbirds*, 7, 88-93; 88.

13188 Frederick, P. C., and Meyer, K. D. 2008. Longevity and size of wood stork (*Mycteria*
13189 *americana*) colonies in Florida as guides for an effective monitoring strategy in the
13190 southeastern United States. *Waterbirds*, 31(sp1), 12-18.

13191 Gawlik, D. E. 2002. The effects of prey availability on the numerical response of wading birds.
13192 *Ecological Monographs*, 72(3), 329-346; 329.

13193 Hefner, J. M., Wilen, B. O., Dahl, T. E., and Frayer, W. E. 1994. *Southeast wetlands; status and*
13194 *trends, mid-1970's to mid-1980's*. Atlanta, Georgia: U.S. Department of the Interior, Fish
13195 and Wildlife Service.

13196 Hylton, R. A., Frederick, P. C., De La Fuente, T. E., and Spalding, M. G. 2006. Effects of
13197 nestling health on post fledging survival of wood storks. *Condor*, 108, 97-106; 97.

13198 Jordan, F., Babbitt, K. J., and McIvor, C. C. 1998. Seasonal variation in habitat use by marsh
13199 fishes. *Ecology of Freshwater Fish*, 7(4), 159-166.

13200 Jordan, F., Jelks, H. L., and Kitchens, W. M. 1997. Habitat structure and plant community
13201 composition in a northern Everglades wetland landscape. *Wetlands*, 17(2), 275-283.

13202 Kahl, M. P., Jr. 1964. Food ecology of the wood stork (*Mycteria americana*) in Florida.
13203 *Ecological Monographs*, 34, 97-117.

13204 Kushlan, J. A. 1979. Prey choice by tactile foraging wading birds. *Proceedings of the Colonial*
13205 *Waterbird Group*, 3, 133-142; 133.

13206 Kushlan, J. A., and Frohring, P. C. 1986. The history of the southern Florida wood stork
13207 population. *Wilson Bulletin*, 98(3), 368-386.

13208 Kushlan, J. A., Ogden, J. C., and Higer, A. L. 1975. *Relation of water level and fish availability*
13209 *to wood stork reproduction in the southern Everglades, Florida. U.S. geological survey*
13210 *open file report 75-434*. Washington, D.C.: U.S. Government Printing Office.

13211 Loftus, W. F., and Eklund, A. M. 1994. Long-term dynamics of an everglades small-fish
13212 assemblage. In S. M. Davis, and J. C. Ogden (Eds.), *Everglades: The ecosystem and its*
13213 *restoration* (pp. 461-483). Delray Beach, Florida: St. Lucie Press.

13214 Meyer, K. D., and Frederick, P. C. 2004. *Survey of Florida's wood stork (Mycteria americana)*
13215 *nesting colonies, 2004*. Gainesville, Florida: Avian Research and Conservation Institute.

13216 Oberholser, H. C. 1938. *The bird life of Louisiana. bulletin 28* Louisiana Department of
13217 Conservation.

13218 Oberholser, H. C., and Kincaid Jr., E.B. 1974. *The bird life of Texas*. Austin, Texas: University
13219 of Texas Press.

13220 Ogden, J., Kushlan, J. A., and Tilmant, J. T. 1978. *The food habits and nesting success of wood*
13221 *storks in Everglades National Park 1974*. Washington, D.C.: U.S. Department of the
13222 Interior, National Park Service.

13223 Ogden, J. C. 1991. Nesting by wood storks in natural, altered, and artificial wetlands in central
13224 and northern Florida. *Colonial Waterbirds*, 14(1):39-45.

13225 Ogden, J. C. 1996. Wood stork. In J. A. Rodgers, K. H. II and H. T. Smith (Eds.), *Rare and*
13226 *endangered biota of Florida*. Gainesville, Florida: University Press of Florida.

13227 Ogden, J. C., D.A., M.,Jr, Bancroft, G. T., and Patty, B. W. 1987. Breeding populations of the
13228 wood stork in the southeastern United States. *Condor*, 89, 752-759.

13229 Ogden, J. C., Kushlan, J. A., and Tilmant, J. T. 1976. Prey selectivity by the wood stork. *Condor*,
13230 78(3), 324-330.

13231 Ogden, J. C., and Nesbitt, S. A. 1979. Recent wood stork population trends in the United States.
13232 *Wilson Bulletin*, 91(4), 512-523; 512.

13233 O'Hare, N. K., and Dalyrmple, G. H. 1997. Wildlife in southern everglades wetlands invaded by
13234 melaleuca (*Melaleuca quinquenervia*). *Bulletin Florida Museum of Natural History*,
13235 41(1), 1-68.

13236 Palmer, R. S. 1962. *Handbook of North American Birds, volume 1, loons through flamingos*.
13237 New Haven, Connecticut: Yale University Press.

13238 Rand, A. L. 1956. Foot-stirring as a feeding habit of wood ibis and other birds. *American*
13239 *Midland Naturalist*, 55(1), 96-100; 96.

13240 Rehage, J. S., and Trexler, J. C. 2006. Assessing the net effect of anthropogenic disturbance on
13241 aquatic communities in wetlands: Community structure relative to distance from canals.
13242 *Hydrobiologia*, 569, 359-373.

13243 Rodgers Jr, J. A., Schwikert, S. T., and Shapiro-Wenner, A. 1996. Nesting habitat of wood storks
13244 in north and central Florida, USA. *Colonial Waterbirds*, 19(1), 1-21.

13245 Rodgers, J., J.A. 1990. Breeding chronology and clutch information for the wood stork from
13246 museum collections. *Journal of Field Ornithology*, 61(1), 47-53

13247 Rodgers, J. A., and Schwikert, S. T. 1997. Breeding success and chronology of wood storks
13248 *Mycteria americana* in northern and central Florida, U.S.A. *Ibis*, 139, 76-91; 76.

13249 Rodgers, J. A., Wenner, A. S., and Schwikert, S. T. 1987. Population dynamics of wood storks in
13250 north and central Florida, USA. *Colonial Waterbirds*, 10(2), 151-156; 151.

13251 Snow, R. W., Brien, M. L., Cherkiss, M. S., Wilkins, L., and Mazzotti, F. J. 2007. Dietary habits
13252 of the burmese python, *python molurus bivittatus*, in Everglades National Park, Florida.
13253 *Herpetological Bulletin*, (101), 5-7.

13254 Turner, A. W., Trexler, J. C., Jordan, C. F., Slack, S. J., Geddes, P., Chick, J. H., and Loftus,
13255 W.F. 1999. Targeting ecosystem features for conservation: Standing crops in the
13256 Everglades. *Conservation Biology*, 13(4), 898-911.

13257 U.S. Fish and Wildlife Service. 1997. *Revised recovery plan for the U.S. breeding population of*
13258 *the wood stork*. Atlanta, Georgia: Regional Ecological Service Office, Southeast Region.

13259 U.S. Fish and Wildlife Service. 2007. *Wood stork (mycteria americana) 5-year review: Summary*
13260 *and evlauation*. Jacksonville, Florida: Jacksonville Ecological Service Field Office,
13261 Southeast Region.

13262 U.S. Fish and Wildlife Service. 2013. Wood stork southeast U.S. productivity from 1975 to
13263 2013. Available at
13264 https://www.fws.gov/northflorida/WoodStorks/Documents/WoodStork_Southeast_US_Prod
13265 [uctivity_1975-2013.pdf](https://www.fws.gov/northflorida/WoodStorks/Documents/WoodStork_Southeast_US_Prod).

13266 U.S. Fish and Wildlife Service [USFWS]. 2019. Wood stork colonies update 2019. Jacksonville,
13267 FL, Field Office. <https://www.fws.gov/northflorida/>

13268 Wayne, A. T. 1910. *Birds of South Carolina. Contributions to the Charleston Museum no.1.*

13269

13270 **24.15 Red-cockaded Woodpecker**

13271

13272 Allen, D.H. 1991. Constructing artificial red-cockaded woodpecker cavities. U.S. Forest Service
13273 General Technical Report SE-73. U.S. Department of Agriculture, Southeastern Forest
13274 Experimental Station; Asheville, North Carolina.

13275 Beever, J.W. and K. Dryden. 1992. Red-cockaded woodpeckers and hydric slash pine flatwoods.
13276 Transactions of the 57th North American Wildlife and Natural Resources Conference
13277 57:693-700.

13278 Carlile, L.D., T.A. Beaty, E.W. Spadgenske, L.R. Mitchell, S.E. Puder, and C. Ten Brink. 2004.
13279 An intensively managed and increasing red-cockaded woodpecker population at Fort
13280 Stewart, Georgia. Pages 134-138 in R. Costa and S.J. Daniels, editors. Red-cockaded
13281 woodpecker: road to recovery. Hancock House Publishers, Blain, Washington.
13282 <https://fwslibrary.on.worldcat.org/oclc/56370940>

13283 Copeyon, C.K. 1990. A technique for constructing cavities for the red-cockaded woodpecker.
13284 Wildlife Society Bulletin 18:303-311.

13285 Costa, R. 2004. State of the red-cockaded woodpecker world: highlights of the previous decade
13286 (1992-2002). Pages 39-46 in R. Costa and S.J. Daniels, editors. Red-cockaded
13287 woodpecker: road to recovery. Hancock House Publishers; Blain, Washington.
13288 <https://fwslibrary.on.worldcat.org/oclc/56370940>.

13289 Costa, R. 2011. Personal communication. Biologist. E-mail to Dana Hartley. Vero Beach,
13290 Florida. February 18, 2011.

13291 Cox, J., W.W. Baker, and D. Wood. 1995. Status, distribution, and conservation of the red-
13292 cockaded woodpecker in Florida: a 1992 update. Pages 457-464 in D.L. Kulhavy, R.G.
13293 Hooper, and R. Costa, eds. Red-cockaded woodpecker: recovery, ecology, and
13294 management. Center for Applied Studies in Forests, College of Forestry, Stephen F.
13295 Austin State University; Nacogdoches, Texas.

13296 DeLotelle, R.S. and R.J. Epting. 1992. Reproduction of the red-cockaded woodpecker in central
13297 Florida. Wilson Bulletin 104:285-294.

13298 Doresky, J., M. Barron, and P. Swiderek. 2004. Landscape scale restoration and red-cockaded
13299 woodpecker recovery? Pages 127-133 in R. Costa and S.J. Daniels, editors. Red-
13300 cockaded woodpecker: road to recovery. Hancock House Publishers; Blain, Washington.
13301 <https://fwslibrary.on.worldcat.org/oclc/56370940>

13302 Ebersbach, P. 1996, personal communication, Biologist discussion with Avon Park AFR, Vero
13303 Beach, Florida, 1996.

13304 Engstrom, R.T. and F.J. Sanders. 1997. Red-cockaded woodpecker foraging ecology in an old
13305 growth longleaf pine forest. *Wilson Bulletin* 109:203-217.

13306 Franzreb, K.E. 1999. Factors that influence translocation success in the red-cockaded
13307 woodpecker. *Wilson Bulletin* 111:38-45.
13308 <https://fwslibrary.on.worldcat.org/oclc/5554799034>

13309 Franzreb, K.E. 2004. Habitat preferences of foraging red-cockaded woodpeckers at the Savannah
13310 River site, South Carolina. Pages: 553-561 in R. Costa and S.J. Daniels, editors. Red-
13311 cockaded woodpecker: road to recovery. Hancock House Publishers, Blain, Washington.
13312 <https://fwslibrary.on.worldcat.org/oclc/56370940>

13313 Gaines, G.D., K.E. Franzreb, D.H. Allen, K.S. Laves and W.L. Jarvis. 1995. Red-cockaded
13314 woodpecker management on the Savannah River Site: a management/research success
13315 story. Pages 81-88 in D.L. Kulhavy, R.G. Hooper, and R. Costa, editors. Red-cockaded
13316 woodpecker: recovery, ecology, and management. Center for Applied Studies in Forestry,
13317 Stephen F. Austin State University; Nacogdoches, Texas.
13318 <https://fwslibrary.on.worldcat.org/oclc/33892726>

13319 Hagan, G., R. Costa, and M.K. Phillips. 2004. Reintroduction of the first red-cockaded
13320 woodpeckers into unoccupied habitat: a private land and conservation success story.
13321 Pages 320-324 in R. Costa and S.J. Daniels, editors. Red-cockaded woodpecker: road to
13322 recovery. Hancock House Publishers, Blain, Washington.
13323 <https://fwslibrary.on.worldcat.org/oclc/56370940>

13324 Hanula, J. and S. Horn. 2004. Availability and abundance of prey for the red-cockaded
13325 woodpecker. Pages 633-645 in R. Costa and S.J. Daniels, editors. Red-cockaded
13326 woodpecker: road to recovery. Hancock House Publishers; Blain, Washington.
13327 <https://fwslibrary.on.worldcat.org/oclc/56370940>

13328 Hedman, C.W., J.R. Poirier, P.E. Durfield, and M.A. Register. 2004. International Paper's
13329 habitat conservation plan for the red-cockaded woodpecker: implementation and early
13330 success. Pages 355-360 in R. Costa and S.J. Daniels, editors. Red-cockaded woodpecker:
13331 road to recovery. Hancock House Publishers; Blain, Washington.
13332 <https://fwslibrary.on.worldcat.org/oclc/56370940>

13333 Hooper, R.G. and R.F. Harlow. 1986. Forest stands selected by foraging red-cockaded
13334 woodpeckers. U.S. Forest Service Research Paper SE-259. U.S. Department of
13335 Agriculture, Forest Service, Southeastern Forest Experiment Station; Asheville, North
13336 Carolina.

13337 Hovis, J.A. and R.F. Labisky. 1996. Red-cockaded woodpecker. Pages 81-102 in J.A. Rodgers,
13338 Jr., H.W. Kale II, H.T. Smith, eds. Rare and endangered biota of Florida. Volume v:
13339 Birds, University Press of Florida; Gainesville, Florida.

13340 Howell, A.H. 1921. A list of the birds of Royal Palm Hammock, Florida. *Auk* 38:250-263.

13341 Jackson, J.A. 1971. The evolution, taxonomy, distribution, past populations and current
13342 status of the red-cockaded woodpecker. Pages 4-29 in R.L. Thompson, ed. The ecology
13343 and management of the red-cockaded woodpecker. Proceedings of a symposium. U.S.
13344 Bureau of Sport Fisheries and Wildlife and Tall Timbers Research Station; Tallahassee,
13345 Florida.

13346 Jansen, D. 1996. Personal communication. FWS Multi-Species Recovery Team meeting, May
13347 25, 1996.

13348 Lennartz, M.R., R.G. Hooper, and R.F. Harlow. 1987. Sociality and cooperative breeding of red-
13349 cockaded woodpeckers (*Picoides borealis*). *Behavioral Ecology and Sociobiology* 20:77-
13350 88.

13351 Marston, T.G. and D.M. Morrow. 2004. Red-cockaded woodpecker conservation on Fort
13352 Jackson military installation: a small population's response to intensive management in
13353 the Sandhills region of South Carolina. Pages 378-390 in R. Costa and S.J. Daniels,
13354 editors. *Red-cockaded woodpecker: road to recovery*. Hancock House Publishers; Blain,
13355 Washington. <https://fwslibrary.on.worldcat.org/oclc/56370940>

13356 Nesbitt, S.A., A.E. Jerauld, and B.A. Harris. 1983. Red-cockaded woodpecker summer range
13357 sizes in southwest Florida. Pages 68-71 in D.A. Wood, ed. *Proceedings of the red-*
13358 *cockaded woodpecker symposium II*; Florida Game and Fresh Water Fish Commission;
13359 Tallahassee, Florida.

13360 Patterson, G.A. and W.B. Robertson, Jr. 1981. Distribution and habitat of the red-cockaded
13361 woodpecker in Big Cypress National Preserve. National Park Service, South Florida
13362 Research Center. Report T-613; Homestead, Florida.

13363 Porter, M.L. and R.F. Labisky. 1986. Home range and foraging habitat of red-cockaded
13364 woodpeckers in northern Florida. *Journal of Wildlife Management*. 50:239-247.

13365 Stober, J.M. and S.B. Jack. 2003. Down for the count? Red-cockaded woodpecker restoration on
13366 Ichauway. Pages 347-354 in R. Costa and S.J. Daniels, editors. *Red-cockaded*
13367 *woodpecker: road to recovery*. Hancock House Publishers; Blain, Washington.
13368 <https://fwslibrary.on.worldcat.org/oclc/56370940>

13369 U.S. Fish and Wildlife Service. 1999. South Florida multi-species recovery plan [Internet].
13370 Atlanta, Georgia [cited February 12, 2008]. Available from:
13371 <http://www.fws.gov/verobeach/msrp.htm>

13372 U.S. Fish and Wildlife Service. 2003. Recovery plan for the red-cockaded woodpecker (*Picoides*
13373 *borealis*): Second revision [Internet]. Atlanta, Georgia [cited January 8, 2009]. Available
13374 from: <http://www.fws.gov/rcwrecovery/files/RecoveryPlan/finalrecoveryplan.pdf>

13375 U.S. Fish and Wildlife Service. 2006. Red-cockaded woodpecker (*Picoides borealis*): 5-year
13376 review: Summary and evaluation [Internet]. Clemson, South Carolina
13377 [cited January 8, 2009]. Available from:
13378 <http://www.fws.gov/southeast/5yearReviews/5yearreviews/06-RCW.pdf>

13379 Walters, J. R. 1991. Application of ecological principles to the management of endangered
13380 species: the case of the red-cockaded woodpecker. *Annual Review of Ecology and*
13381 *Systematics* 22:505-523.

13382

13383 **24.16 Roseate Spoonbill**

13384

13385 Dumas, J.V. 2000. Roseate Spoonbill (*Platalea ajaja*), version 2.0. In *The Birds of North*
13386 *America* (A. F. Poole and F. B. Gill, Editors). Cornell Lab of Ornithology, Ithaca, NY,
13387 USA. <https://doi.org/10.2173/bna.490>

13388 eBird.org. 2019. eBird: An online database of bird distribution and abundance (web application).
13389 Cornell Lab of Ornithology; Ithaca, New York. Available from: <http://www.ebird.org/>.
13390 (Date Accessed: August 2, 2019).

13391 Florida Fish and Wildlife Conservation Commission (FWC). 2011. Roseate Spoonbill Biological
13392 Status Review Report. March 31, 2011. Florida Fish and Wildlife Conservation
13393 Commission. Tallahassee, Florida.

13394 Florida Fish and Wildlife Conservation Commission. 2013. A species action plan for six
13395 imperiled wading birds: little blue heron, reddish egret, roseate spoonbill, snowy egret,
13396 tricolored heron, and white ibis. Tallahassee, Florida. 55 p.

13397 Florida Fish and Wildlife Research Institute (FWRI). FWC Water Bird Locator. Available at
13398 <http://atoll.floridamarine.org/waterBirds/> (Date Accessed: November 26, 2018).

13399

13400 **24.17 Audubon's Crested Caracara**

13401

13402 Barnes, J.R. 2007. An integrative approach to conservation of the crested caracara (*Caracara*
13403 *cheriway*) in Florida: linking demographic and habitat modeling for prioritization. PhD
13404 Dissertation, Bowling Green State University. 133 pp.

13405 Danaher, M. 2018. Personal communication. Biologist. USFWS. Email to Kim Dryden and
13406 Steve Schubert. July 27, 2108.

13407 Dwyer, J.F. 2008. Personal communication. Email to the Service. December 22, 2008.

13408 Dwyer, J. F. 2010. Ecology of non-breeding and breeding Crested Caracaras (*Caracara*
13409 *cheriway*) in Florida. Ph.D. dissertation, Virginia Tech, Blacksburg, Virginia.

13410 Dwyer, J.F., Fraser, J.D. and Morrison, J.L. 2012. Within-Year Survival of Nonbreeding Crested
13411 Caracaras. *The Condor*: May 2012, Vol. 114, No. 2, pp. 295-301.

13412 Dwyer, J.F., J. D. Fraser, and Joan L. Morrison. 2013. Range sizes and habitat use of non-
13413 breeding Crested Caracaras in Florida. *J. Field Ornithol.* 84(3):223–233

13414 Golden, N. H., Warner, S. E., and Coffey, M. J. 2016. A Review and Assessment of Spent Lead
13415 Ammunition and Its Exposure and Effects to Scavenging Birds in the United States. *In*
13416 *Reviews of Environmental Contamination and Toxicology* Volume 237 (pp. 123-191).
13417 Springer International Publishing.

13418 Heinzman, G. 1970. The caracara survey: A 4-year report. *Florida Naturalist* 3(4):149.

13419 Howell, A.H. 1932. Florida bird life. Florida Department of Game and Fresh Water Fish;
13420 Tallahassee, Florida.

13421 Humphrey, S.R. and J.L. Morrison. 1997. Habitat associations, reproduction, and foraging
13422 ecology of Audubon's crested caracara in south-central Florida. Final Report. Florida
13423 Game and Fresh Water Fish Commission Nongame Program Project Number NG91-007,
13424 August 8, 1997.

13425 Inwood Consulting Engineers, Inc. 2016. Biological Assessment Report Prepared for Florida
13426 Department of Transportation, District One. State Road 82 from Gator Slough Lane to
13427 State Road 29 (FPN: 430849-1-52-01), and State Road 29 from State Road 82 to the
13428 Hendry County Line (FPN: 417878-4-52-01), Collier County, Florida. Oviedo, Florida.
13429 July 19.

13430 Layne, J.N. 1995. Audubon's crested caracara in Florida. Pages 82-83 in E.T. LaRoe, G.S.
13431 Farris, C.E. Puckett, P.D. Doran, and M.J. Mac, eds. *Our living resources: A report to the*
13432 *nation on the distribution, abundance, and health of United States plants, animals, and*
13433 *ecosystems.* U.S. Department of the Interior, National Biological Service; Washington,
13434 D.C.

13435 Layne, J.N. 1996. Crested caracara. Pages 197-210 *in:* J.A. Rodgers, Jr., H.W. Kale II, and H.T.
13436 Smith (eds.). *Rare and Endangered Biota of Florida. Volume V. Birds.* University Press
13437 of Florida; Gainesville, Florida.

13438 Morrison, J.L. 1999. Breeding biology and productivity of Florida's Crested Caracaras. *Condor*
13439 101(3):505-517.

13440 Morrison, J.L. 2001. Recommended management practices and survey protocols for Audubon's
13441 crested caracaras (*Caracara cheriway audubonii*) in Florida. Technical Report Number
13442 18. Florida Fish and Wildlife Conservation Commission; Tallahassee, Florida.

13443 Morrison, J.L. 2003. Semi-annual monitoring report of Audubon's crested caracara within the
13444 Kissimmee River Restoration Project area – January through June 2003. Prepared for the
13445 South Florida Water Management District. Johnson Engineering; Fort Myers, Florida
13446 33901.

13447 Morrison, J.L. 2005. Personal communication. Associate professor of biology. Caracara
13448 workshop in Vero Beach, Florida on October 31, 2005. Trinity College; Hartford,
13449 Connecticut.

13450 Morrison, J.L. and S.R. Humphrey. 2001. Conservation value of private lands for crested
13451 caracara in Florida. *Conservation Biology* 15(3): 675-684.

13452 Morrison, J.L., K.V. Root, and J. Barnes. 2006. Habitat suitability and demographic population
13453 viability models for Florida's crested caracaras. Final Report to the Florida Fish and
13454 Wildlife Conservation Commission; Tallahassee, Florida.

13455 Morrison, J.L. and J.F. Dwyer. 2012. Crested Caracara (*Caracara cheriway*), The Birds of North
13456 America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the
13457 Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/249>

13458 Morrison, J.L., J.F. Dwyer, and J.D. Fraser. 2007. Letter to the U.S. Fish and Wildlife Service
13459 dated November 8, 2007. Evidence for habitat limitation for crested caracaras in Florida.
13460 Dept. Biology, Trinity College, Hartford, CT 06106. Dept. Biology, Trinity College,
13461 Hartford, Connecticut 06106.

13462 Palmer, R.S. 1988. Crested caracara. Pp. 235-249 in: R.S. Palmer (ed.). *Handbook of North*
13463 *American birds*, Volume 5. Yale University Press; New Haven, Connecticut.

13464 Passarella and Associates, Inc. 2017. Rural Lands West Biological Assessment. Prepared for
13465 Collier Enterprises Management, Inc. Fort Myers, Florida. June 27.

13466 Smith, J.A. and M.N. Scholer. 2013. Nest components of crested caracaras (*Caracara cheriway*)
13467 breeding in Florida. *Florida Field Naturalist* 41(2): 42-48.

13468 South Florida Water Management District [SFWMD]. 2011. Land Cover Land Use 2008 (GIS
13469 data). Available at:
13470 http://my.sfwmd.gov/gisapps/sfwmdxwebdc/dataview.asp?query=unq_id=2184

13471 Turrell, Hall and Associates, Inc. 2017. Immokalee sand mine Audubon's crested caracara
13472 survey report. Prepared for CEMEX. Naples, Florida. April.

13473 U.S Fish and Wildlife Service. 1999. South Florida Multi-Species Recovery Plan. Southeast
13474 Region; Atlanta, Georgia.

13476 **24.18 Everglade Snail Kite**

13477 Beissinger, S.R. 1986. Demography, environmental uncertainty, and the evolution of mate
13478 desertion in the snail kite. *Ecology* 1445-1459.

13479 Beissinger, S.R. 1988. Snail kite, *Rosrhamus sociabilis*. Pages 148-165 In R.S. Palmer, ed.
13480 *Handbook of North American birds*, 4th. Yale University Press, New Haven, Connecticut.

13481 Beissinger, S.R. and N.F.R. Snyder. 1987. Mate desertion in the snail kite. *Animal Behavior*
13482 35:477-487.

13483 Beissinger, S.R. and J.E. Takekawa. 1983. Habitat use and dispersal by snail kites in Florida
13484 during drought conditions. *Florida Field Naturalist* 11:89-106.

13486 Beissinger, S.R., A. Sprunt, IV, and R. Chandler. 1983. Notes on the snail (Everglade) Kite in
13487 Cuba. *American Birds* 37:262-265.

13488 Bennetts, R.E., and W.M. Kitchens. 1997. The demography and movements of snail kites in
13489 Florida. Final report. Florida Cooperative Fish and Wildlife Research Unit, National
13490 Biological Service, Department of the Interior, Gainesville, Florida.

13491 Bennetts, R.E., M.W. Collopy, and S.R. Beissinger. 1988. Nesting ecology of Snail Kites in
13492 Water Conservation Area 3A. Florida Cooperative Fisheries and Wildlife Research Unit,
13493 University of Florida, Technical Report Number 31, Gainesville, Florida.

13494 Bennetts, R.E., M.W. Collopy, and J.A. Rodgers Jr. 1994. The snail kite in the Florida
13495 Everglades: a food specialist in a changing environment. Pages 507-532 *In* S. Davis, and J.
13496 Ogden, eds. *Everglades: the ecosystem and its restoration*, St. Lucie Press, Delray Beach,
13497 Florida.

13498 Bennetts, R.E., W.A. Link, J.R. Sauer, and P.W. Sykes, Jr. 1999. Factors influencing counts in
13499 an annual survey of snail kites in Florida. *Auk* 116(2):316-323.

13500 Cary, D.M. 1985. Climatological factors affecting the foraging behavior and ecology of snail
13501 kites (*Rostrhamus sociabilis plumbeus* Ridgway) in Florida. Masters Thesis. University of
13502 Miami, Miami, Florida.

13503 Cattau, C.E., J. Martin, and W.M. Kitchens. 2010. Effects of an exotic prey species on a native
13504 specialist: Example of the snail kite. *Biological Conservation* 143(2):513-520.

13505 Cattau, C.E., W.M. Kitchens, A. Bowling, B. Reichert, and J. Martin. 2008. Snail Kite
13506 demography. 2008 annual progress report prepared for the U.S. Fish and Wildlife Service,
13507 South Florida Field Office, Vero Beach, Florida.

13508 Cattau, C.E., W. Kitchens, B. Reichert, J. Olbert, K. Pias, J. Martin, and C. Zweig. 2009. Snail
13509 Kite demography. 2009 annual report for the US Army Corps of Engineers, Jacksonville,
13510 Florida.

13511 Cattau, C.E., R.J. Fletcher, Jr., B.E. Reichert, and W.M. Kitchens. 2016. Counteracting effects
13512 of a non-native prey on the demography of a native predator culminate in positive
13513 population growth. *Ecological Applications* 26(7):1952–1968.

13514 Danaher, M. 2019. Personal communication. Supervisory Wildlife Biologist. E-mail to the U.S.
13515 Fish and Wildlife Service dated February 19, 2019. U.S. Fish and Wildlife Service;
13516 Immokalee, Florida.

13517 Darby, P.C., R.E. Bennetts, and L.B. Karunaratne. 2006. Apple snail densities in habitats used by
13518 foraging snail kites. *Florida Field Naturalist* 34(2):37-68.

13519 Davis, S. and J.C. Ogden. 1994. Introduction. Pages 3-7 *In* S.M. Davis, and J.C. Ogden, eds.
13520 *Everglades: the ecosystem and its restoration*, St. Lucie Press, Boca Raton, Florida.

13521 Dreitz, V.J., J.D. Nichols, J.E. Hines, R.E. Bennetts, W.M. Kitchens, and D.L. Deangelis. 2002.
13522 The use of resighting data to estimate the rate of population growth of the snail kite in
13523 Florida. *Journal of Applied Statistics* 29(1-4):609-623.

13524 Fletcher Jr, R.J. 2019. Personal communication. Associate Professor, University of Florida,
13525 Gainesville, Florida. E-mail to the South Florida U.S. Fish and Wildlife Service office dated
13526 January 31, 2019.

13527 Fletcher Jr, R.J., E. Robertson, B. Jeffery, C. Poli, and S. Dudek. 2018. Snail kite demography:
13528 annual report on the 2017 breeding season. U.S. Geological Survey, Florida Cooperative
13529 Fish and Wildlife Research Unit, Department of Wildlife Ecology and Conservation,
13530 University of Florida, Annual Progress report, Gainesville, Florida.

13531 Frakes, R.A., T.A. Bargar, and E.A. Bauer. 2008. Sediment copper bioavailability to freshwater
13532 snails in south Florida: risk implications for the Everglade snail kite (*Rostrhamus sociabilis*
13533 *plumbeus*). *Ecotoxicology* 17: 598-604.

13534 Hoang, T.C., E.C. Rogevich, G.M. Rand, P.R. Gardinali, R.A. Frakes, and T.A. Bargar. 2008.
13535 Copper desorption in flooded agricultural soils and toxicity to the Florida apple snail
13536 (*Pomacea paludosa*): implications in Everglades restoration. *Environmental Pollution* 154:
13537 338-347.

13538 Kitchens, W.M., R.E. Bennetts, and D.L. DeAngelis. 2002. Linkages between the snail kite
13539 population and wetland dynamics in a highly fragmented South Florida hydroscape. Pages
13540 183-203 *In* J.W. Porter, and K.G. Porter, eds. *The Everglades, Florida Bay, and Coral Reefs*
13541 *of the Florida Keys: An Ecosystem Sourcebook*, CRC Press, Boca Raton, Florida.

13542 Martin, J., W. Kitchens, C. Cattau, A. Bowling, M. Conners, D. Huser, and E. Powers. 2006.
13543 Snail kite demography annual progress report 2005. U.S. Geological Survey, Florida
13544 Cooperative Fish and Wildlife Research Unit, and University of Florida, Gainesville,
13545 Florida.

13546 Martin, J., W. Kitchens, C. Cattau, A. Bowling, S. Stocco, E. Powers, C. Zweig, A. Hotaling, Z.
13547 Welch, H. Waddle, and A. Paredes. 2007. Snail kite demography annual progress report
13548 2006. U.S. Geological Survey, Florida Cooperative Fish and Wildlife Research Unit and
13549 University of Florida, Gainesville, Florida.

13550 Myer, K., G. Kent, K. Hart, A. Sartain, and I. Fujisaki. 2017. Snail Kite large-scale movements,
13551 use of non-traditional wetlands, and exposure to toxins. Presentation to the Snail Kite
13552 Coordinating Committee in Vero Beach. March 21, 2017.

13553 Nichols, J.D., G.L. Hensler, and P.W. Sykes, Jr. 1980. Demography of the Everglade kite:
13554 Implications for population management. *Ecological Modelling* 9 (1980):215-232.

13555 Rodgers Jr, J.A., and S.T. Schwikert. 2001. Effects of water fluctuations on snail kite nesting on
13556 Lake Kissimmee. Annual report. Bureau of Wildlife Diversity Conservation, Florida Game
13557 and Fresh Water Fish Commission, Gainesville.

13558 Snyder, J.R., F.R. Noel, S.R. Beissinger, and R.E. Chandler. 1989. Reproduction and
13559 demography of the Florida Everglade (snail) kite. *The Condor* 91(2):300-316.

13560 Sykes Jr, P.W. 1979. Status of the Everglade kite in Florida 1968-1978. *Wilson Bulletin* 91:495-
13561 511.

13562 Sykes Jr, P.W. 1983a. Snail kite use of the freshwater marshes of south Florida. *Florida Field*
13563 *Naturalist* 11:73-88.

13564 Sykes Jr, P.W. 1983b. Recent population trend of the snail kite in Florida and its relationship to
13565 water levels. *Journal of Field Ornithology* 54(3):237-246.

13566 Sykes Jr, P.W. 1987c. The feeding habits of the snail kite in Florida, USA. *Colonial Waterbirds*
13567 10(1):84-92.

13568 Sykes Jr, P.W., R. J.A. Jr, and R.E. Bennetts. 1995. Snail kite (*Rostrhamus sociabilis*). *In* A.
13569 Poole, and F. Gill, eds. *The birds of North America*, Number 171, The Academy of Natural
13570 Sciences, Philadelphia, and the American Ornithologists Union, Washington, D.C.

13571 Takekawa, J.E., and Beissinger, S.R. 1989. Cyclic drought, dispersal, and the conservation of the
13572 snail kite in Florida: lessons in critical habitat. *Conservation Biology* 3(3):302-311.

13573 U.S. Fish and Wildlife Service [USFWS]. 2007. Everglade snail kite (*Rostrhamus sociabilis*
13574 *plumbeus*) 5-year review: summary and evaluation. South Florida Ecological Services
13575 Office, Vero Beach, FL.

13576 U.S. Fish and Wildlife Service [USFWS]. 1999. South Florida multi-species recovery plan.
13577 Atlanta, Georgia. 2,172 pp.

13578 U.S. Fish and Wildlife Service [USFWS]. 2019. Recovery Plan for the Endangered Everglade
13579 Snail Kite; DRAFT AMENDMENT 1.
13580 <https://www.fws.gov/verobeach/MSRPPDFs/EvergladeSnailKite.pdf>

13581

13582 **24.19 Eastern Diamondback Rattlesnake**

13583

13584 Center for Biological Diversity. Available online:
13585 https://www.biologicaldiversity.org/campaigns/outlawing_rattlesnake_roundups/ Visited
13586 2/25/2019

13587 Florida Museum. *Crotalus adamanteus*. Available online:
13588 <https://www.floridamuseum.ufl.edu/herpetology/fl-snakes/list/crotalus-adamanteus/>
13589 Visited 11/26/2018

13590 Hoss, S. K. 2007. Spatial ecology of the eastern diamond-backed rattlesnake. M.S. Thesis.
13591 Auburn University, Auburn, Alabama.

13592 Krysko, K.L., K.M. Enge, and P.E. Moler. 2011. Atlas of amphibians and reptiles in Florida,
13593 final report, project agreement 08013. Florida Fish and Wildlife Conservation
13594 Commission, Tallahassee, Florida.

13595 Martin, W.H. and D.B. Means. 2000. Distribution and habitat relationships of the EDR
13596 rattlesnake (*Crotalus adamanteus*). Herpetological Natural History 7(1):9-34.

13597 Means, D.B. 1986. Life history and ecology of the EDR rattlesnake (*Crotalus
13598 adamanteus*). Final Project Report, Florida Game and Fresh Water Fish Commission,
13599 Tallahassee.

13600 Means, D.B. 2009. Effects of rattlesnake roundups on the EDR rattlesnake (*Crotalus
13601 adamanteus*). Herpetological Conservation and Biology 4(2):132-141.

13602 Means, D. B. 2017. Diamonds in the Rough: Natural History of the Eastern Diamondback
13603 Rattlesnake. Tall Timbers Press.

13604 North Carolina Wildlife Resources Commission. 2017. Available online:
13605 https://www.ncwildlife.org/Portals/0/Conserving/documents/WildlifeDiversity/ETSC_UP_DATE_040518_FINAL.pdf Visited 2/27/2019.

13606

13607 Timmerman, W. and W. Martin. 2003. Conservation guide to the EDR rattlesnake, *Crotalus
13608 adamanteus*. Society for the Study of Amphibians and Reptiles. SSAR Herpetological
13609 Circular No.32, 55 pp.

13610 Ware, Stewart, Cecil Frost, and Phillip D. Doerr. Southern mixed hardwood forest: the former
13611 longleaf pine forest. Biodiversity of the southeastern United States: lowland terrestrial
13612 communities (1993): 447-493.

13613

13614 **24.20 Eastern Indigo Snake**

13615

13616 Bauder, J.M. 2018. Population viability and connectivity of the federally threatened eastern
13617 indigo snake in central peninsular Florida. PhD dissertation. Department of
13618 Environmental Conservation Wildlife, Fish, and Conservation Biology. University of
13619 Massachusetts Amherst.

13620 Bauder, J.M., Breininger, D. R., M.R. Bolt, R. Breininger, M.L. Legare, C.L. Jenkins, B.B.
13621 Rothermel, K. McGarigal. 2018. Multi-level, multi-scale habitat selection by a wide-
13622 ranging, federally threatened snake. *Landscape Ecology*. 33:743-763.

13623 Bauder, J.M., D.R. Breininger, M.R. Bolt, M.L. Legare, C.L. Jenkins, B.B. Rothermel, K.
13624 McGarigal. 2016a. The influence of sex and season on conspecific spatial overlap in a
13625 large, actively-foraging colubrid snake. *PLoS ONE* 11(8):e0160033.
13626 doi:10.1371/journal.pone.0160033.

13627 Conant, R., and J.T. Collins. 1998. A Field Guide to Reptiles and Amphibians of Eastern and
13628 Central North America. Third Edition. Expanded. Houghton-Mifflin Company, Boston,
13629 MA. 450 pp.

13630 Enge, K.M., D. J. Stevenson, M.J. Elliott, and J.M. Bauder. 2013. The historical and current
13631 distribution of the eastern indigo snake (*Drymarchon couperi*). *Herpetological*
13632 *Conservation and Biology* 8:288–307.

13633 Florida Fish and Wildlife Conservation Commission [FWC]. Unpublished. Eastern Indigo
13634 Snake, South Florida Maxent Model – DRAFT. FWC Fish and Wildlife Research
13635 Institute.

13636 Godley, J.S. and P.E. Moler. 2013. Population declines of eastern indigo snakes (*Drymarchon*
13637 *couperi*) over three decades in the Gulf Hammock Wildlife Management Area, Florida,
13638 USA. *Herpetological Conservation and Biology* 8:359-365.

13639 Godwin, J., M. Wines, J. Stiles, S. Stiles, C. Guyer, and E.M. Rush. 2011. Reintroduction of the
13640 eastern indigo snake (*Drymarchon couperi*) into the Conecuh National Forest.
13641 Unpublished 2008-2011 Final Report, submitted to Alabama Department of Conservation
13642 and Natural Resources and The Orianne Society, Montgomery, Alabama. 93 pp.

13643 Hyslop, N.L., J. M. Meyers, R. J. Cooper, and D. J. Stevenson. 2014. Effects of body size and
13644 sex of *Drymarchon couperi* (eastern indigo snake) on habitat use, movements, and home
13645 range size in Georgia. *Journal of Wildlife Management* 78:101-111.

13646 Knafo, S.E., T. Norton, M. Mitchell, D.J. Stevenson, N.L. Hyslop, R. Poppenga, M. Oliva, T.
13647 Chenn, C. Cray, S. Gibbs, L. Durden, N. Stedman, S. Divers, and E. Dierenfeld. 2016.
13648 Health and nutritional assessment of free-ranging eastern indigo snakes (*Drymarchon*
13649 *couperi*) in Georgia. *Journal of Zoo and Wildlife Medicine* 47(3): IN PRESS.

13650 Kuntz, G.C. 1977. Endangered species: Florida Indigo. *Florida Naturalist*:15-19.

13651 Lawler, H.E. 1977. The status of *Drymarchon corais couperi* (Holbrook), the eastern indigo
13652 snake, in the southeastern U.S.A. *Herpetological Review* 8(3):76-79.

13653 Layne, J.N., and T.M. Steiner. 1996. Eastern indigo snake (*Drymarchon corais couperi*):
13654 summary of research conducted on Archbold Biological Station. Report prepared under
13655 Order 43910-6-0134 to the U.S. Fish and Wildlife Service; Jackson, Mississippi.

13656 Metcalf, M.F. 2017. Spatial Ecology of the Threatened Eastern Indigo Snake (*Drymarchon*
13657 *couperi*) in a Subtropical Coastal Landscape in the Southern Extent of its Range. M.S.
13658 Thesis, Florida Gulf Coast University. 81 pp.

13659 Moler, P.E. 1985. Home range and seasonal activity of the eastern indigo snake, *Drymarchon*
13660 *corais couperi*, in northern Florida. Final performance report, Study E-1-06, III-A-5.
13661 Florida Game and Fresh Water Fish Commission; Tallahassee, Florida.

13662 Moulis, R. 1976. Autecology of the eastern indigo snake, *Drymarchon corais couperi*. *Bulletin*
13663 of the New York Herpetological Society, Volume 12, No. 3 & 4.

13664 Steiner, T.M., O.L. Bass, Jr., and J.A. Kushlan. 1983. Status of the eastern indigo snake in
13665 southern Florida National Parks and vicinity. South Florida Research Center Report
13666 SFRC-83/01, Everglades National Park; Homestead, Florida.

13667 Stevenson, D.J., K.M. Enge, N.L. L. D. Carlile, K.J. Dyer, T.M. Norton, N.L. Hyslop, and R.A.
13668 Kiltie. 2009. An eastern indigo snake (*Drymarchon couperi*) mark-recapture study in
13669 southeastern Georgia. *Herpetological Conservation and Biology* 4:30-42.

13670 Stevenson, D.J., M.R. Bolt, K.J. Smith, K.M. Enge, N.L. Hyslop, T.M. Norton, and K.J. Dyer.
13671 2010. Prey records for the eastern indigo snake (*Drymarchon couperi*). *Southeastern*
13672 *Naturalist* 9:1-18.

13673 Stevenson, D.J., R.A. Moulis, and N. L. Hyslop. 2008. Eastern indigo snake (*Drymarchon*
13674 *couperi*). Pages 339-341 in J.B. Jensen, C.D. Camp, W. Gibbons, and M.J. Elliott, eds.
13675 *Amphibians and reptiles of Georgia*. University of Georgia Press, Athens, Georgia.

13676 U.S. Fish & Wildlife Service [USFWS]. 2018. Species status assessment report for the eastern
13677 indigo snake (*Drymarchon couperi*). Version 1.0, November, 2018. Atlanta, GA.

13678 U.S. Fish & Wildlife Service [USFWS]. 2019a. Eastern Indigo Snake (*Drymarchon corais*
13679 *couperi*) 5-Year Review: Summary and Evaluation. Southeast Region, Georgia
13680 Ecological Services Field Office, Athens, Georgia. 51 pp.

13681 U.S. Fish & Wildlife Service [USFWS]. 2019b. Recovery Plan for the Eastern Indigo Snake,
13682 First Revision. South Atlantic-Gulf Region, Atlanta, Georgia. 13 pp.

13683 U.S. Fish and Wildlife Service [USFWS]. 2013. Standard Protection Measures for the Eastern
13684 Indigo Snake. South Florida Ecological Services Office; Vero Beach, Florida.

13685 **24.21 Gopher Tortoise**

13686 Conservancy of Southwest Florida. 2004. Pre-construction Threatened and Endangered Species
13687 Survey: Lake Trafford Spoil Disposal Site. Prepared for The South Florida Water
13688 Management District. Naples, Florida.

13689 Diemer, J. E. 1992. Demography of the tortoise *Gopherus polyphemus* in northern Florida.
13690 *Journal of Herpetology* 26:281-289.

13691 Enge, K. M., J. E. Berish, R. Bolt, A. Dziewrowski, and H. R. Mushinsky. 2006. Biological status
13692 report - gopher tortoise. Florida Fish and Wildlife Conservation Commission,
13693 Tallahassee, USA. 60 pp.

13694 Florida Fish and Wildlife Conservation Commission (FWC). 2012. Gopher tortoise management
13695 plan. Florida Fish and Wildlife Conservation Commission. Tallahassee, Florida.

13696 Florida Fish and Wildlife Conservation Commission (FWC). 2017. Gopher tortoise permitting
13697 guidelines. Florida Fish and Wildlife Conservation Commission. Tallahassee, Florida.

13698 McCoy, E. D., B. Stys, and H. R. Mushinsky. 2002. A comparison of GIS and survey estimates
13699 of gopher tortoise habitat and numbers of individuals in Florida. *Chelonian Conservation*
13700 and *Biology* 4:472-478.

13701 U.S. Fish and Wildlife Service (USFWS). 2016. Species Assessment Form for the *Gopherus*
13702 *polyphemus* (eastern). U.S. Fish and Wildlife Service. Atlanta, Georgia.

13703 U.S. Fish and Wildlife Service (USFWS). 2019. Species Assessment and Listing Priority Form
13704 for *Gopherus polyphemus*. U.S. Fish and Wildlife Service. Atlanta, Georgia.

13705 Personal Communications:

13710 B. Layman, 2/14/2019, Barron Collier Companies, pers. comm. with Heather Hitt, USFWS.
13711
13712 E. Seckinger, 3/1/2019, Florida Fish and Wildlife Conservation Commission, pers. comm. with
13713 Heather Hitt, USFWS.

DRAFT