FINAL
SUMMARY REPORT

Peer Review of
Draft Status Assessment for the Alexander Archipelago Wolf
(\textit{Canis lupus ligoni})

REGION 7 OFFICE
US FISH AND WILDLIFE SERVICE

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U.S. Fish & Wildlife Service

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Executive Summary

The U.S. Fish & Wildlife Service (Service) will complete a 12-month status review and finding for the Alexander Archipelago wolf (*Canis lupus ligoni*; hereafter AA wolf) for publication in the Federal Register, in accordance with a court-agreed settlement by December 31, 2015. This settlement was triggered by a petition to list the wolves on Prince of Wales Island (POW) as a Distinct Population Segment. As part of the 12-month status review, the Service conducted a Species Status Assessment (SSA) for the AA wolf. Three external peer reviewers have completed a formal, independent, external scientific peer review of the draft SSA report.

The external peer reviewers generally agreed that the SSA was thorough and generally agreed with the conclusions reached in the report. The reviewers generally all agreed that the analysis of harvest and mortality data could be improved; that the demographic connectivity section had some logical flaws, in particular with respect to movement via swimming; and the discussion of the relationship between wolves, deer and habitat was weak. Each reviewer did include some specific recommendations for improving the SSA and strengthening its conclusions, although some of these were minor and some significant recommendations.
1.0 Background

The U.S. Fish & Wildlife Service (Service) will complete a 12-month status review and finding for the Alexander Archipelago wolf (*Canis lupus ligoni*; hereafter AA wolf) for publication in the Federal Register, in accordance with a court-agreed settlement by December 31, 2015. This settlement was triggered by a petition to list the wolves on Prince of Wales Island (POW) as a Distinct Population Segment. As part of the 12-month status review, the Service conducted a Species Status Assessment (SSA) for the AA wolf.

The SSA Framework is an analytical approach developed by the Service for informing decisions and activities under the Endangered Species Act (ESA). A SSA involves compiling and analyzing the best available scientific information, which results in a stand-alone science-based product independent of the application of policy or regulation. It provides foundational biological information, articulates key uncertainties, and, ultimately, characterizes the species’ current and future condition and viability under various scenarios and timeframes. Additionally, a SSA results in a risk assessment used to inform ESA decision makers based on the best available scientific information. The ultimate goal of the SSA is to provide decision makers with a clear characterization of viability, including risks to the species, and key uncertainties in the characterization. Therefore, the SSA does not result in a decision, but it is the scientific risk analysis portion of the decision process and supports endangered species programs decisions.

The SSA is an iterative process comprised of three basic components:

1) Determining species needs with regards to viability, defined as the likelihood that a species persists and thus avoids extinction over time;

2) Assessing the current availability or condition of those needs, including factors that may affect these needs (cause and effects analysis); and,

3) Projecting the future availability or condition of those needs and then characterizing viability using principles of resiliency (ability to withstand stochastic events), redundancy (ability to withstand catastrophic events), and representation (ability to adapt) as proxies.

The SSA report consists of six chapters: 1) Introduction; 2) Description of the AA wolf; 3) Life history and ecology; 4) Dynamics of multiple populations; 5) Current and future habitat and resource conditions; and 6) Current and projected status of the AA wolf. The Service collated existing information from published papers, final agency reports and pertinent archived datasets and considered information submitted in the petition (Center for Biological Diversity [CBD] and Greenpeace 2011), during the 90-day finding public comment period (March 31–May 30, 2014), and in response to specific data requests. In developing the SSA, the Service focused the efforts in two ways. First, the Service concentrated on information describing the Alexander Archipelago wolf, drawing on information about the gray wolf (*C. lupus*) and its’ subspecies only when necessary (e.g., significant data gap, context). Second, the Service focused on new information collected since 1997 when the Service last reviewed the status of the AA wolf (62 Federal Register 46710, September 4, 1997).
The purpose of this review is to provide a formal, independent, external scientific peer review of the information in the SSA report. Given the long-term conservation implications of the status assessment of the AA wolf, the SSA report requires this peer review before the information is used to determine whether the AA wolf is warranted or not warranted for listing under the ESA.

2.0 Peer Reviewers

The peer reviewers reviewed the scientific data used, the information presented in, and the analyses provided in the SSA for the AA wolf. The selection of peer reviewers followed the guidance provided in the Office of Management and Budget’s Final Information Quality Bulletin on Peer Review (OMB Bulletin; December 16, 2004) to ensure scientific integrity of the peer review. Appropriate expertise and an appropriate balance of that expertise was identified for this peer review panel during the process of identifying potential reviewers. Panelists with expertise in canid genetics and population dynamics were essential for this peer review. All peer reviewers were provided the language from the OMB Bulletin (2004) with regard to independence and conflicts of interest and any potential issues were identified and evaluated during the selection of the panelists, both with respect to both the Service and the report under peer review. To maintain the independence and objectivity of the peer review, a number was randomly assigned to each peer reviewer and all references in this report are to that number.

The three peer reviewers all have experience with canid genetics and/or population ecology and with peer reviews of scientific publications. The reviewers are all independent of the Service, have not taken an advocacy position with respect to this topic, and have no conflicts of interest. The resumes for the peer reviewers are presented in Appendix B and the reviewers consist of:

- Michael Chamberlain, PhD from University of Georgia;
- Dennis Murray, PhD from Trent University; and
- Benjamin Sacks, PhD from University of California at Davis.

3.0 Summary of Peer Reviewer Responses

The peer reviewers considered and responded to the Charge to the Panel, a total of three questions, provided by the Service. The following section summarizes their responses to each question, with their full responses provided in Appendix A. Table 1 below provides a summary of whether a reviewer provided a response to a question and the total pages provided by the reviewer.

<p>| Table 1: Summary of Reviewer Responses by Question |
|------------------------------|-----------------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th>Peer Reviewer</th>
<th>Question 1</th>
<th>Question 2</th>
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<td>Yes</td>
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<tr>
<td>Reviewer 2</td>
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<tr>
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<td>✓</td>
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<td>✓</td>
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The summaries provided below are brief synopses of the complete responses provided in Appendix A. Much additional detail is provided in the individual responses provided in Appendix A. Note that Geographic Management Unit 2 (GMU2) corresponds with the POW population of the AA wolf.

**Question 1**

*Did the Service consider the best available scientific information, including scientific literature, in developing the SSA report? Is there any biological, commercial, trade, or other information missing from our draft SSA necessary to our understanding of the status of the AA wolf?*

- **Reviewer 1:** Reviewer 1 felt that the synthesis was reflective of the literature as a whole. This was particularly the case with the population genetic and phylogenetic portion. Section 2.2 Taxonomy (pp. 14-21) was very important, foundational to the document as a whole. The synthesis and interpretation of relatively consistent data and conflicting conclusions was especially well balanced. The conclusion of the report that *C. lupus ligoni* was a valid subspecies was justified. Regarding the population status assessment, however, the SSA could have been a little more conservative in its assumptions (see Question 2 below), because of insufficient data, and made stronger recommendations with respect to gathering the necessary information and considered a broader approach.

- **Reviewer 2:** For the most part, the Service appeared to consult quality scientific information in the SSA report. There are some specific comments by Chapter. A more thorough assessment of taxonomic classification is necessary (see Rutledge et al. 2015 as an example for eastern wolf populations). Chapter 2 concludes noting that there is evidence that the AA wolf is an ecological and genetic unit worthy of analysis under the ESA, but there is distracting back and forth throughout. Chapter 5 leaves out some relevant data from Person and colleagues.

- **Reviewer 3:** Overall, the Service has used the best available science in its evaluation of the status of the AA wolf population. There are relatively few peer-reviewed publications that are available on this specific topic, and most of the information is provided by the relatively extensive literature on wolf ecology and genetics across North America, or in the gray literature (i.e., government reports from ADFG). Reviewer 3 did not note any key publications or reports that were omitted and was satisfied that those that were consulted received a thorough assessment.

**Question 2**

*Are the assumptions, interpretations, and any methods used in the SSA report clearly stated and logical in light of the best available information? If not, please identify the specific assumptions and methods that are unclear or illogical.*

- **Reviewer 1:** In most cases, Reviewer 1 felt that assumptions and interpretations regarding particular stressors and biological processes were clearly stated and based on available information. In many cases, the available information was clearly insufficient, however...
(which was also acknowledged). In particular, almost all of the data were from a single population (GMU 2). The data for this population were interpreted, reasonably, to indicate that the GMU 2 population was in danger “high risk” of decline. However, Reviewer 1 was less convinced of the assessments made for the four remaining populations for which data were lacking. Reviewer 1 was concerned that perhaps the assessment of the four poorly studied populations was potentially biased toward optimistic projections.

Reviewer 2: For the most part, the Service has interpreted information cited from the literature correctly and when assumptions are made, articulated the reasoning. There are, however, some specific concerns. In Chapter 3 and 4, there are contradictory arguments regarding AA wolves and whether swimming is a means of dispersal and movement for them, even though the evidence strongly indicates that AA wolves do not swim. The resulting conclusions are not well-supported. Chapter 5 also presents contradictory arguments regarding deer populations, even though the evidence indicates that AA wolves eat primarily deer. Chapter 6 presents large ranges of population size and yet draws conclusions not entirely supported by those data.

Reviewer 3: Overall, Reviewer 3 concluded that the Service conducted a sound and objective analysis of the status of the AA wolf population. Most of the conclusions drawn were in line with available evidence. Reviewer 3 had minor disagreements with some of the report relating to demographic connectivity and more significant reservations regarding the treatment of the wolf population model and the associated deer habitat model and the estimate of deer/wolf/year. Reviewer 3 had significant reservations of the way mortality and harvest data was used and the conclusions drawn from there; given the importance of identifying the sustainable human harvest level these issues could have significant implications for wolf populations. Reviewer 3 recommended a more comprehensive analysis of inbreeding, heterozygosity, demographic stochasticity, dispersal, and population responses. Reviewer 3 appreciated an attempt in the final pages to quantify the effects of multiple stressors on population dynamics in the broader region and specific GMUs.

Question 3

Have the authors of the SSA report provided reasonable and scientifically sound syntheses and interpretation from the scientific information presented in the report? Are there instances in the SSA report where a different but equally reasonable and scientifically sound scientific interpretation or synthesis might be reached that differs from the synthesis provided by the Service? If any instances are found where that is the case, please provide the specifics of that situation.

Reviewer 1: In general, Reviewer 1 thought most of the synthesis of available information was done reasonably well. A minor exception was the treatment of demographic responses to harvest regarding demographic compensation for human-caused mortality was based on a single reference, which did not adequately treat the subject.

Reviewer 2: Chapter 4 has some flaws and Reviewer 2 suggested a more thorough synthesis of metapopulation concepts. Research by Person and colleagues was not
included in this discussion and evidence suggests that AA wolves are not functioning as part of a metapopulation, which was not the conclusion drawn in Chapter 4. Chapter 5 presents some misleading information and the unreported harvest is not handled appropriately in the chapter. The application of data from GMU2 to other populations was not handled entirely appropriately and could be improved. In addition, the assumption that deer-wolf dynamics of the GMU2 population apply to other AA wolf populations is most likely incorrect. Overall, the conclusion that none of the AA wolves are isolated is not supported by the evidence available.

- Reviewer 3: Overall Reviewer 3 was satisfied with the objective synthesis and interpretation of findings, with a few minor exceptions.

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**Other Comments**

- Reviewer 1: Line comments of the draft SSA provided at the end of the Individual Memorandum. Reviewer 1 requested that the Service provide a brief synopsis of the NCEAS 2014 reference mentioned on page 20.

- Reviewer 2: As a general comment, Reviewer 2 found many instances of circular reasoning, and a distracting number of instances where the Service makes statements only to backtrack on previous statements. Reviewer 2 noted that while this SSA was triggered by a petition to list the AA wolf as a DPS, the petition and SSA make different assumptions about the taxonomic status of the AA wolf. Reviewer 2 concludes by noting that the bottom line is that substantial portions of the landscape available to wolves (particularly on POW) are in a successional state where there is no solution for improving habitat for deer and wolves. With the prospect of continued logging on POW, accelerated declines in both deer and wolf populations on POW are likely unless management of the wolves, and habitat, on POW is altered.

- Reviewer 3: The presentation in Table 8-10 could be improved. There was very inconsistent use of units for survival and mortality rates; they should be presented similarly throughout the SSA.
4.0 Overall Summary for Each Reviewer

Reviewer 1

Reviewer 1 generally agreed with the presentation and conclusions of the SSA, with the exception of the demographic discussion.

Reviewer 2

For the most part, the Service appeared to consult quality scientific information in the SSA report and Reviewer 2 seemed to generally agree with the larger conclusions of the SSA, while disagreeing with some details. There were a number of instances of illogical arguments and poor presentation of the data and some of these weakened the conclusions drawn in the SSA report. Reviewer 2 noted a number of improvements throughout the SSA with respect to additional references, data presentation and logical used to reach conclusions.

Reviewer 3

Reviewer 3 generally agreed with the presentation and conclusions of the SSA. Ultimately, the SSA concludes that while there may be some regional declines in wolf populations, overall the AA population is not imperiled because of favorable demographic compensation, dietary breadth and plasticity, and dispersal. Although Reviewer 3 generally agreed with this conclusion, his optimism is tempered by: 1) limited dispersal and questionable two-way dispersal events between wolf sub-populations on islands, and especially 2) the high rate of reported human harvest of wolves, the unknown (but potentially high) level of unreported wolf harvest, and the uncertainty regarding whether such mortality is fully additive, partially additive, or compensatory. There could be additional opportunities for answering some of these uncertainties by relating hypothetical rates of reported and unreported mortality to observed levels of wolf population change. Given the critical importance in answering the additive-compensatory question before the prognosis for the population can be fully developed, such attempts at understanding these relationships are important.

The assessment of wolf population status and sustainability is based exclusively on population size and numerical trends and does not consider the importance of maintaining appropriate pack structure and social fabric in the AA wolf population.

5.0 Conclusions and Recommendations

Overall all reviewers generally agree that the draft SSA provides a reasonable analysis of the AA wolf. The reviewers generally all agreed that the analysis of harvest and mortality data could be improved; that the demographic connectivity section had some logical flaws, in particular with respect to movement via swimming; and the discussion of the relationship between wolves, deer and habitat was weak.
APPENDIX A

Complete Individual Memoranda

Peer Review of
Draft Status Assessment for the Alexander Archipelago Wolf (*Canis lupus ligoni*)

U.S. Fish & Wildlife Service
Individual Memorandum  
Peer Review of Species Status Assessment of the Alexander Archipelago Wolf  

Reviewer 1 - 8/10/2015

1. Did the Service consider the best available scientific information, including scientific literature, in developing the SSA report? Is there any biological, commercial, trade, or other information missing from our draft SSA necessary to our understanding of the status of the AA wolf?

My background is in population genetics, phylogenetics, and population ecology of canids, although I have been most active in the former two areas over the past decade. Keeping in mind my particular areas of expertise, in general, I felt that the synthesis was reflective of the literature as a whole. This was particularly the case with the population genetic and phylogenetic portion.

Regarding Section 2.2 Taxonomy (pp. 14-21): This section was very important, foundational to the document as a whole, and, in my view, very thoroughly treated. I felt the synthesis and interpretation of relatively consistent data and conflicting conclusions of, for example, Weckworth and colleagues versus Cronin et al., was especially well balanced and conclusions of the report that *C. lupus ligoni* was a valid subspecies were justified.

Regarding population status assessment, however, in some cases where the available information was insufficient to evaluate status, I felt the SSA could have been a little more conservative in its assumptions (see #2 below) and made stronger recommendations with respect to gathering the necessary information and considered a broader approach. For example, in assessing demographic connectivity, the point was made that radiotelemetry of a large proportion of wolves from all populations would be needed to estimate emigration/immigration (p. 45, para. 2). To me, this seemed a pseudo-suggestion, as such a large and expensive study seems out of the realm of possibility. On the other hand, the use of noninvasive genetic methods was not mentioned and that could offer a more practical solution. In particular, collection of hair and fecal samples could enable more practical collection of data on many more individuals that could be used in conjunction with direct methods (e.g., genetic identity, relatedness, population assignment, admixture analysis, pedigree reconstruction) to estimate all four demographic processes (immigration, emigration, births, deaths). In fact, the Scandinavian wolf project provides an excellent model for the use of noninvasive genetic approaches for large-scale monitoring of wolves. This also is being done on similar scales with bears in the northern Rocky Mountains (e.g., see Kendall et al. 2009, Journal of Wildlife Management 73:3–17, and unpublished work on this population since then).

2. Are the assumptions, interpretations, and any methods used in the SSA report clearly stated and logical in light of the best available information? If not, please identify the specific assumptions and methods that are unclear or illogical.

In most cases, I felt that assumptions and interpretations regarding particular stressors and biological processes were clearly stated and based on available information. In many cases, the available information was clearly insufficient, however (which was also acknowledged). In particular, almost all of the data were from a single population (GMU 2). The data for this
population were interpreted, I think reasonably, to indicate that the GMU 2 population was in danger high risk of decline. However, I was less convinced of the assessments made for the four remaining populations (as they were defined in aggregate beginning on page 108) for which data were lacking. For example, at the bottom of page 85, the report states we only can assume that past and current levels of wolf harvest did not and are not having a population-level effect on because we found no evidence to suggest otherwise (other than GMU 2, see below) On the face of it, this logic seems backwards to me.

I am more inclined to agree with the contradictory point made in the same report at the top of page 85 (para. 1, last sentence) that in the absence of data to the contrary, data from the well-studied population should have been used to fill in gaps for the four poorly studied populations. That is, the ratios of total to reported harvest in GMU 2 should have been used as a multiplier of reported harvest in the populations for which unreported harvest data were lacking. Unless I misunderstood, the rates were evaluated relative to the designated mortality threshold of 29% on the basis of reported harvest only. Also, Tables 15 and 16 appear only to report reported harvests based on the text of this paragraph, but that is not clearly indicated in the tables themselves. I am concerned that perhaps the assessment of the 4 poorly studied populations was potentially biased toward optimistic projections. Additionally, although it was mentioned that populations bordering GMU 2 (GMUs 1A, 3) were proposed for wolf population reduction programs, I did not see that the effects of such reductions, should they occur, were included in any scenarios of the model.

3. Have the authors of the SSA report provided reasonable and scientifically sound syntheses and interpretation from the scientific information presented in the report? Are there instances in the SSA report where a different but equally reasonable and scientifically sound scientific interpretation or synthesis might be reached that differs from the synthesis provided by the Service? If any instances are found where that is the case, please provide the specifics of that situation.

In general, I think most of the synthesis of available information was done reasonably well (to the extent that my background allowed me to evaluate). A minor exception was the treatment of demographic responses to harvest on p. 86. The text on p. 86, para. 1 regarding demographic compensation for human-caused mortality was based on a single reference (Adams et al. 2008), which in my view did not adequately treat the subject. Specifically, the conclusion of that reference and the report was that the only process compensating for local mortality was dispersal from neighboring locations. I think that a reasonable review of the literature would not support such a conclusion. In fact, this conclusion was contradicted in the same report by subsequent text on p. 118 (last paragraph) and 119 (first paragraph), where authors correctly suggested that wolves can respond to harvest through reproductive compensation. However, these latter statements were not referenced in this summary section.

Additional Comments

At the bottom of page 20, reference is made to a NCEAS 2014 report regarding scientists’ arguments for the distinctiveness of the Alexander Archipelago wolf. It would be helpful also to have a brief synopsis of what these arguments were and what they were responding to.
Individual Memorandum  
Peer Review of Species Status Assessment of the Alexander Archipelago Wolf

I made several comments in the text of the SSA where I felt the text was unclear or could be improved in terms of technical specifics.

**Line Comments from the SSA Document**

*Figure 1:* Why is Prince of Wales Island not indicated on this map as it seems to have supplied much of the data discussed in this review?

*Page 12, Para 3, last sentence:* (In northwestern Minnesota, average weights of both sexes were lower (females=30.0 kg, males=35.9 kg; Mech and Paul 2008, p. 935) and were more similar to wolves in southeastern Alaska): May be influenced more by interbreeding with eastern wolf, which is smaller than the gray wolf.

*Page 19, Para 1 – three comments.*
( SNPs are short regions (compared to microsatellites) where different species or individuals within a species have single nucleotide differences ): Actually, SNPs ARE the single nucleotide differences, not the short regions that contain them.

( allowing researchers to take advantage of poor quality samples that are typical of noninvasive sampling ): In practice, the technologies that assay SNPs actually require better quality DNA and I believe all of von Holdt’s samples were high quality DNA as she used an Affimetrix chip, which requires this.

( the authors found that wolves on the British Columbian coast formed a genetically distinct population when compared to wolves and their relatives globally (pp. 1297, 1300). ): Although I could not see this from their assignment analysis (despite their claim), I agree that the NJ tree in fig S5 supported this statement.

*Page 20, last para:* ( The grouping of coastal wolves with C. l. nubilus has been contested by several recognized experts that believe wolves in southeastern Alaska and coastal British Columbia are ecologically and genetically distinct and warrant recognition as a distinct group (NCEAS 2014, pp. 10, 14, 17, 47–49, 61). ): Shouldn’t the specifics of these contentions be reviewed here?

*Page 27, Para 1:* This section refers to ALL wolves, including nominal C. l. nubilis.

*Page 28, Para 3:* ( See Fuller et al. (2003, pp. 176, 179) for annual survival rates of wolves elsewhere in North America. ): A general statement about how these estimates compare generally to other wolf populations would be useful. Are they similar? higher? lower?

*Page 30, Para 3:* ( One year later in fall 2014, the proportion was 0.25 (SE=0.11; ADFG 2015a, p. 2), consistent with an observed decrease in abundance (Table 3). ): Why is s reduction in proportion of females consistent with an overall population decline?

*Page 36, last para:* Can they really have obtained this type of resolution? Average SI ratios are consistent with many different compositions of prey.
Individual Memorandum
Peer Review of Species Status Assessment of the Alexander Archipelago Wolf

Page 44, Section 4.1.1: Although demographic connectivity differs from genetic connectivity in the sense of perspective, this does not negate the use of genetic approaches to studying demographic connectivity. The recommendation to radio-collar all wolves on adjacent islands seems ludicrous and unnecessary if genetic methods can be used to assess interisland dispersal via relatedness among individuals.

Page 45, Para 2 (These data could be gathered using radio-collared wolves. However, to be successful, wolves from all populations need to be collared.): This seems unrealistic and unnecessary. The use of genetic methods to directly study migration among populations via assignment approaches or reconstruction of pedigrees seems much more feasible. See for example the application of this approach by the Swedish wolf team for monitoring the demographic recovery as well as inbreeding effects in the Scandinavian wolf.

Page 45, Para 3 (Gene flow is measured by the number of migrants per generation ($N_m$) between populations.): This confuses contemporary gene flow with average levels of gene flow over many generations.

(difficult to measure gene flow directly and): Use of Bayesian assignment approaches can provide a means of measuring gene flow among populations but provides a more immediate estimate, which may or may not reflect longer time frames relevant for evolutionary consequences.

(For example, $F_{ST}$ can be used to estimate $N_m$, although see Whitlock and McCaughley (1999) for caveats associated with this approach.): Yes, agree that if the purpose is to measure contemporary gene flow (as opposed to the effective long-term gene flow), then FST-based estimates (indirect) are not likely to be very accurate. However, for assessing nuclear divergence (without assumptions about the relative roles of drift/gene flow vs. time apart), the use of non-mutating biallelic markers (SNPs) in conjunction with FST-based approaches can be useful in assessing similarity/difference as applicable to systematics or management unit questions.

Page 45, Para 4 (mtDNA is maternally inherited and does not undergo recombination, making it more useful in phylogenetic studies aimed to resolve questions about evolutionary, historical relationships within and among species.): This is correct (why it is useful for phylogenetic studies), but not a reason against it for also assessing contemporary gene flow. The main downsides of mtDNA for contemporary gene flow are (1) it reflects only a single genealogy (as opposed to multiple independently assorting nuclear loci) and (2) it reflects only maternal inheritance, potentially skewing estimates, e.g., when dispersal is male-biased.

Page 45, last para, line 2: change ‘between’ to ‘among’

Page 67, Para 1 (Once regenerating forests are >25 years old, they provide little benefits to deer (e.g., Person et al. 2009, p. 5), and this condition extends for more than 100 years (Alaback 1982, p. 1939).): This is confusing and seemingly contradictory because two sentences earlier, the statement is made that deer select old growth and then here it says regenerating forests >25 years no longer benefit deer. Is the intended point that after 100 years, they become old growth and once again benefit deer?
Page 84, last para (but not coastal British Columbia (harvest reporting required in Regions 1 and 2 only)). This is confusing. Does this mean that ALL harvest is unreported in regions other than 1 and 2 or that you suspect everyone reported harvests in regions 1 and 2?

Page 85, split para at top (Therefore the data from radio-collared wolves in GMU 2 constitute the best available measure of unreported harvest of the Alexander Archipelago wolf.). I agree. However, in the next section, it appears that this advice was ignored and estimates relative to the 29% threshold (e.g., in Tables 15 and 16) were based only on REPORTED harvest.

Page 85, last para (we found that most Alexander Archipelago wolf populations are harvested within assumed sustainable limits (i.e. 29% of the population annually; Tables 15 and 16) ). This seems to be a misleading statement given the following (and preceding text) on the high amount of unreported mortality.

(Further, these rates include reported harvest only, yet unreported harvest in some areas such as GMU 2 may be substantial and may be having an undocumented impact on some populations.). This seems like a weak statement in light of the evidence discussed above, Fig. 18. It strikes me that in the absence of data, the estimates from the better-studied populations should be adopted and assumed rather than the other way around.

(we only can assume that past and current levels of wolf harvest did not and are not having a population-level effect on because we found no evidence to suggest otherwise (other than GMU 2, see below).): See above comment.

Page 86, para 1 (Adams et al. (2008, p. 1) found that gray wolves primarily compensate for harvest via adjustments in dispersal; responses in productivity or natural mortality have little or no role in offsetting harvest.). This is a somewhat selective example (n = 1) of the literature. For example, several of the references cited in that paper (Petersen et al. 1984, Van Ballenberghe et al. 1983, Ballard et al. 1987, Fuller et al. 1983) found evidence of reproductive compensation and a couple (also, Mech et al. 2001) found evidence of density dependent mortality. Moreover, there is much evidence of reproductive compensation in other canids (e.g., coyotes, red foxes), where litters tend to increase in size and average age of reproduction decreases (coyotes) in heavily exploited populations, which is somewhat compensatory. For example, see Knowlton 1972 references from Texas and Connolly (1975) for a model.

Also, the argument made by Adams et al. (2008, p.20) for why no reproductive compensation in wolves would be expected seemed to me to be spurious. Basically, the assumption was that the only pathway by which exploitation increases reproduction was via its effect on the per-capita availability of prey. It seems more likely that this mechanical interpretation does not capture the complexities involved in the empirically well-documented relationships between human-caused mortality and litter size (for example), which also might be affected by stress and other factors either unrelated or indirectly related to the prey base.
Lastly, adjustments in dispersal could, in principle prevent adjustments via reproduction if harvest were local relative to the scale of dispersal. However, in the archipelago, such is not likely to be the case.

( This finding suggests that population estimates are not correct for this period, we are overestimating unreported harvest in the late 1990s, or that the recent population decline is driven by a combination of factors including wolf harvest. ): Are there data on annual fecundity (e.g., average litter size, proportion of females breeding)?

Page 98, Para 1 ( This decline coincided with a parvovirus outbreak in domestic dogs in Houghton, Michigan, the main departure point for visitors to the island. Parvovirus presence on the island was confirmed by positive titers in several wolves during the late 1980s (Peterson et al. 1998, pp. 834–835). ): This also coincided with parvovirus-related declines in coyote, probably throughout the continent, but at least documented in Texas and California (e.g., Windberg et al. 1995; Sacks et al. 2007).

Page 108, last para before Section 6.1.1 ( northern coastal British Columbia (Region 5/6), and southern coastal British Columbia (Region ). ): Should be 1/2 (i.e., resisting autocorrect).

Page 118, Para 2 ( densities than earlier though possible ): Previously thought(?)

Page 118, last split para ( Because of their high reproductive rates ): I agree with this synopsis, but it seems to contradict the points made earlier in referencing Adams et al. 2008.

Page 119, Para 1 ( Recently, for GMU 2, the Alaska Board of Game reduced hunting and trapping mortality from 30% of the fall wolf population to 20%, demonstrating their ability to respond to changing conditions. However, it remains to be seen whether or not the change in the harvest guideline level will result in population stabilization given the high rates of unreported harvest and the predicted declines in deer habitat capability due to past timber harvest in GMU 2. ): It also remains to be seen whether such decisions would be made if not under the threat of potential listing under the ESA (or mandated by listing).

Page 120, Para 3 ( Based on our review, we believe that the overall risk of decline of wolves throughout southeastern Alaska and coastal British Columbia is low to moderate with the exception of the GMU 2 wolf population (Table 20). ): Given that the best-studied population is apparently vulnerable, however, caution would seem to require that other populations be presumed similarly vulnerable until data can be gathered with which to adequately evaluate their vulnerability.

Page 120, last para ( be at higher risk compared to the others ): Given that GMU 2 is the only one with adequate information to make an informed assessment, it seems incongruous to draw conclusions about relative risk among these populations.
Preface – The petition (Center for Biological Diversity and Greenpeace 2011) that stimulated the reviewed Species Status Assessment (SSA) focused primarily on Alexander Archipelago (AA) wolves in southeast Alaska. Although the authors recognized that the taxonomic status of the wolves in southeast Alaska and British Columbia is still being resolved, they focused their petition on wolves in southeast Alaska under the caveat that evidence is available suggesting that, indeed, wolves in southeast Alaska are distinct and relatively isolated from wolves in British Columbia. Conversely, the SSA is prepared under the assumption/predication that wolves in southeast Alaska and British Columbia are the same population (or a metapopulation) and the synthesis of information is presented as such. My review and comments were prepared, and are presented, in a way that directly comments on the SSA while also integrating information from the petition. I chose this approach because any comments provided based on the synthesis included in the SSA are inextricably linked to the taxonomic issues being debated currently. That being said, the request in the petition to designate wolves on Prince of Wales (POW) island as a Distinct Population Segment (DPS) is not. I have provided comments in regards to this portion of the petition separately at the end of this document.

Below I have provided specific responses to the questions posed. As a general comment, I found many instances of circular reasoning, and a distracting number of instances where the Service makes statements only to backtrack on previous statements. The end result was that the SSA contained many redundancies and was unnecessarily verbose.

1. Did the Service consider the best available scientific information, including scientific literature, in developing the SSA report? Is there any biological, commercial, trade, or other information missing from our draft SSA necessary to our understanding of the status of the AA wolf?

For the most part, the Service appeared to consult quality scientific information in the SSA report. However, I have concerns relative to portions of specific Chapter presented in the SSA, hence I have presented these concerns by Chapter.

Chapter 2 – the Service uses Chambers et al. (2012) as the basis for their taxonomic classification of the AA wolf. Although I agree that this work is the most recent and comprehensive review (emphasis intended) of wolf taxonomy, it is just that, a review. The SSA presents information from the Weckworth efforts, and notes work published by vonHoldt as well, but clearly the Chambers et al. (2012) effort guides the Service’s rationale for assuming that wolves in southeast Alaska are functioning as simply a portion of a metapopulation with wolves in British Columbia. Notably, Chambers et al. (2012) was prepared by Service employees, and was published in a journal supported by the Service. On page 2 of Chambers et al. (2012), the authors directly state that their review does not evaluate or make any recommendation on whether any subspecies that is found to be valid.
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should be used as a management unit, as the object of management action, or preferred to an alternative legal classification for protection, such as a distinct vertebrate population segment recognized under the U.S. Endangered Species Act (ESA 1973, as amended; USFWS and NOAA 1995). Suitability of a subspecies as a unit for any of these purposes requires further, separate analysis weighing legal and policy considerations. Clearly, the authors’ advice has not been heeded. Furthermore, a subsequent statement notes that the review represents the views of the authors and not necessarily those of the U. S. Fish and Wildlife Service. I question this statement, because almost assuredly the Chambers et al. (2012) work was distributed for internal review before submission to the journal in which it was published. Therefore, it seems to me that the Service is in fact using the Chambers review to represent their view on wolf taxonomy. A more thorough assessment is necessary, in my opinion (see Rutledge et al. 2015 as an example for eastern wolf populations).

Chapter 2 concludes noting that there is evidence that the AA wolf is an ecological and genetic unit worthy of analysis under the ESA, but there is distracting back and forth throughout. Essentially, the reader is being asked to accept the conclusions presented in Chambers et al. (2012), while also noting that Cronin et al. (2015) reached a similar conclusion. Meanwhile, throughout the chapter, works published by Weckworth and colleagues are presented as a means to discount the work of Chambers and Cronin. I understand the perceived necessity to provide a thorough synthesis, but the conclusion of the chapter simply reaffirms that taxonomy is unclear at this point. Therefore, one could justifiably question whether it is relevant, given the demographic and environmental uncertainties facing the AA wolf (see below).

Chapter 5 – Paragraph 1, page 84 – some of information in this paragraph is inaccurate. There is not a complete lack of information detailing immigration and emigration of wolves in this population, it’s simply not cited. Person and colleagues published several works that provide relevant information to this synthesis.

Paragraph 1, page 85 – I’m unsure what point is being made here, but I’m left to assume that the Service is trying to discount findings presented in Person and Russell (2008) using the argument that some wolves in the aforementioned study could have been killed in defense of human life, and, therefore, sometimes it’s okay to illegally harvest wolves. In other words, the odd wolf in the Person and Russell (2008) study may have been illegally harvested by someone fearing their life, and therefore it’s relevant that the reader keep this fact in mind. I certainly recognize potential conflicts between aggressive wolves and humans, but this line of argument to discount the Person and Russell (2008) study seems inappropriate.

2. Are the assumptions, interpretations, and any methods used in the SSA report clearly stated and logical in light of the best available information? If not, please identify the specific assumptions and methods that are unclear or illogical.
For the most part, the Service has interpreted information cited from the literature correctly and when assumptions are made, articulated the reasoning. However, there were several instances where I was concerned with the logic and information presented.

Chapter 3 – When discussing within population dispersal, it was noted that wolves on POW do not disperse, which is consistent with peer reviewed literature on the subject published for several decades. This is extremely relevant, because it substantiates the concern over wolves on POW relative to demographic, environmental, and genetic uncertainty. However, the Service counters this point by noting that wolves can swim long distances if they choose to do so. The question is not whether wolves as a species can swim to disperse. Rather, the question is whether AA wolves on POW are swimming to adjacent islands or the mainland as a means to disperse. They are not. Likewise, the Service notes that perhaps sea currents will allow wolves to suddenly start swimming from POW, but one could not possibly predict which currents would allow such an event. There is simply too much uncertainty involved, hence this line of reasoning is inadequate.

Chapter 4 – In regards to the synthesis of demographic connectivity, I was perplexed by the information presented and the conclusions reached. First, the Service correctly notes (based on peer-reviewed literature) that water is a definite barrier for AA wolves. Second, the Service counters this notion by suggesting that movements among islands are probably common. Third, the Service proceeds to refute this second point by again noting that it appears that wolves on POW and Kosciusko Island will not swim to disperse. Fourth, it is noted that a single wolf was photographed on Shrubby Island, suggesting that wolves explore and occupy this route – although concrete evidence is lacking. The entire passage is circular and wanders around a central theme. That is, all rigorous data that have been collected (studies conducted by Person and colleagues) clearly demonstrate that wolves do not swim to disperse from POW (and Kosciusko). A single picture of a wolf collected on Shrubby Island does little to convince me that things have changed and wolves are now behaving differently in regards to dispersal. Therefore, the argument that demographic connectivity exists for wolves is poorly supported.

Chapter 5 – Clearly, wolves on POW (GMU 2) are facing considerable environmental challenges moving forward, as it’s noted that future timber harvests are slated to remove >30% of the old growth forest from the island. The modeling efforts of Gilbert et al. (2015) demonstrate that the current conditions on POW are already insufficient to maintain the deer herd, and hence a sustainable population of wolves. The Service discusses these points, but then argues that deer may not be that critical, because wolves can eat other prey items. I found this distracting, because we already know that wolves on POW do not eat other prey items, they primarily eat deer. Based on previous information collected on POW, it’s logical to assume that wolves will simply eat deer from a declining herd and continue to decline themselves, particularly as more timber harvest occurs.

Chapter 6 – The Service notes that during fall 2014, wolf populations in GMU2 had plummeted and now appear to range from 50-159 animals. This is quite a range, and I wonder what the best point estimate would be? Regardless, clearly the population on POW
has declined precipitously, yet the Service states that this represents only 14-16% of the AA wolf population. Clearly, this interpretation assumes that wolves throughout southeast Alaska and British Columbia are functioning as a metapopulation. This assumption may not be valid, given the lack of data outside of GMU2. As noted throughout the SSA, all signs point to declines in the deer and wolf population in GMU2. The subsequent sections detailing perceived wolf abundance in the remaining GMUs cause this reviewer concern. For instance, in GMU1A the Service reports that wolf abundance ranges from 170-466 but that no trend in abundance is apparent. The ranges reported are so wide that I’m skeptical of their relevance. Likewise, in GMU3 the Service notes that no data on abundance are available, and the trend in abundance is unknown. Clearly, the best available data detailing changes in wolf abundance are restricted to GMU2 and beyond that group of wolves, there is enormous uncertainty in regards to how many wolves are out there, whether they’re increasing or decreasing, and more importantly, how their populations (or subpopulations) are functioning on the landscape.

3. Have the authors of the SSA report provided reasonable and scientifically sound syntheses and interpretation from the scientific information presented in the report? Are there instances in the SSA report where a different but equally reasonable and scientifically sound scientific interpretation or synthesis might be reached that differs from the synthesis provided by the Service? If any instances are found where that is the case, please provide the specifics of that situation

Chapter 4 – In the synthesis of population processes, the Service notes that wolves appear to function as a metapopulation, which they define as sets of spatially distributed populations among which dispersal and turnover are possible but do not necessarily occur. What is the origin of this definition? I suggest a more thorough synthesis of metapopulation concepts, as I found this section inadequate. Likewise, the statement that we found no data to test this hypothesis is curious. What hypothesis? I assume the hypothesis that wolves are functioning as a metapopulation? If so, this statement is inaccurate. Person and colleagues published numerous works, that combined with current and future work on taxonomic issues, could address this hypothesis. At this time, I contend that the AA wolf is not functioning as a metapopulation, given the lack of connectivity among subpopulations.

At the conclusion of Chapter 4, a series of hedge statements are made suggesting that some subpopulations of the AA wolf may be sources, and others sinks, with support coming from gray literature. Specifically, the work of Breed (2007) is cited, and it is noted that Breed hypothesized that wolves in British Columbia serve as sources for areas in southeast Alaska. However, similar to instances throughout the document, the Service closes by saying that this work has not been substantiated because doing so would require lots of work and diligence in interpretation. I’m not sure why this line of reasoning was presented. The conclusions reached in this entire portion of Chapter 4 are not convincing.

Chapter 5, Figure 16 – here and throughout this portion of the chapter, the Service presents some misleading information. Specifically, only reported harvest is presented in the figures,
with a consistent notation that the reader needs to interpret their conclusions under a 29% harvest cap. I am perplexed, and concerned, with this presentation of information. The Service, throughout the entire chapter, recognizes and states that unreported harvest (as published by Person and Russell 2008) may equal reported harvest. However, they apparently choose to construct the figures in a way that only shows reported harvest. The apparent reason for this approach is that understanding unreported harvest is difficult. This presentation is confusing. Likewise, it’s fairly simple to understand unreported harvest. One need only tag a large sample of wolves and study mortality patterns through time that are attributable to various forms of harvest, as was done and published by Person and Russell (2008). If the reader simply glances at the suite of figures presented by the Service in regards to reported harvest through time, the inference is flawed and the data are misleading. Likewise, comparing data from 11 wolves monitored during 2012-2014 to the work of Person and Russell (2008) is tenuous. Regardless, the Service turns around and discounts their own suggestion and closes by noting that harvest (regardless of the source) is high for AA wolves.

Page 101, final sentence – I cannot follow this logic. The Service states that model inference is limited to GMU2 (which is appropriate), but that results are applicable to other GMUs and parts of British Columbia because deer and wolf response to severe winters is not expected to be different. This statement seems inappropriate, and fails to recognize that wolves and deer are functioning in a landscape context in regards to how they deal with severe winters. In other words, the juxtaposition of habitats, patch size, and successional stages interact to influence the severity of winter conditions experienced by deer herds and wolves. Furthermore, the peer-reviewed literature clearly demonstrates that the availability of old growth forests will influence how deer (and wolves) handle severe winters, so it’s inappropriate to think that model inferences from GMU2 would apply to anywhere other than GMU2. I find it difficult to believe that the authors in the Gilbert et al. (2015) study would agree with this statement. I noted that Gilbert et al. (2015) suggested that portions of their sensitivity analysis could perhaps be useful outside of GMU2, but the blanket extrapolation of suggesting that the entire wolf population model could be extended beyond GMU2 seems inappropriate.

Later in Chapter 5, the Service contends that none of the existing populations of the AA wolf appear to be functioning in complete isolation. This fails to incorporate the wide body of information for GMU2 (POW) demonstrating that wolves there are isolated both demographically and genetically. Hence, I do not understand the Service’s contention.

Likewise, the issues revolving around potential overexploitation of salmon (pointed out in the petition) are discussed, without a logical underpinning. The Service dismisses this potential, suggesting that the complete loss of a single prey item will not create problems for wolves, because they can (and will) simply shift to using alternative prey such as deer. However, earlier in the document the Service used the fact that wolves will eat salmon as an argument that declines in deer may not be cause for concern because wolves can shift to eating salmon. Similar to many passages throughout the SSA, the reasoning is circular.
Additional Comments

In the petition, a request is made for the Service to designate the wolf population on POW (GMU2) as a Distinct Population Segment (DPS). There is clear and logical evidence to support this request. Wolves on POW appear to be genetically and morphometrically distinct, and all peer-reviewed data available for wolves on POW indicate that the population is genetically and demographically isolated. Wolf abundance has drastically declined on POW, corresponding to declines in deer herds. Models presented in Gilbert et al. (2015) note that deer and wolf populations in GMU 2 (POW) will continue to decline if access (via roads) and harvest (regardless of whether it is legal or illegal) are not reduced. The proposed Big Thorne Timber Sale (BTTS) in GMU2 obviously will increase road density in an area that already has an unacceptable road density, thereby having negative influences on wolves and deer.

As a side note, the Service correctly notes that forest stands throughout southeast Alaska, not simply confined to POW, are at an age where intermediate stand treatments will fail to produce any tangible benefit to deer. This is a critical point, particularly in light of the proposed BTTS. Gilbert et al. (2015) note in their simulations that when low snowfall years occur, deer will use logged habitats. However, the Service (and Gilbert et al. 2015) freely admit that there is considerable uncertainty in regards to predicting snowfall and that deer simply remain and fight poor conditions during severe winters, rather than shift their home ranges – the end result being that deer populations decline precipitously during a harsh winter. The bottom line is that substantial portions of the landscape available to wolves (particularly on POW) are in a successional state where there is no solution for improving habitat for deer and wolves. With the prospect of continued logging on POW, accelerated declines in both deer and wolf populations on POW are likely unless management of the wolves, and habitat, on POW is altered.
1. Did the Service consider the best available scientific information, including scientific literature, in developing the SSA report? Is there any biological, commercial, trade, or other information missing from our draft SSA necessary to our understanding of the status of the AA wolf?


Overall, to the best of my knowledge the USFWS has used the best available science in its evaluation of the status of the AA wolf population. There are relatively few peer-reviewed publications that are available on this specific topic, and most of the information is provided by the relatively extensive literature on wolf ecology and genetics across North America, or in the gray literature (i.e., government reports from ADFG). I did not note any key publications or reports that were omitted and am satisfied that those that were consulted received a thorough assessment.

2. Are the assumptions, interpretations, and any methods used in the SSA report clearly stated and logical in light of the best available information? If not, please identify the specific assumptions and methods that are unclear or illogical.

Below, I outline the main assumptions made by the USFWS in its assessment, and my interpretation of their validity. Overall, the USFWS report makes sound and objective analysis of the status of the AA wolf population.

1) Taxonomic status

A critical point in this assessment is that the taxonomic status of AA wolves is that of a distinct subspecies. USFWS (2015) clearly states that the population is assumed to constitute a subspecies (p. 15), despite that recent authorities (Chambers et al. 2012, Von Holdt et al. 2010, 2011) have remained agnostic on this specific matter. In the assessment of taxonomic status, the USFWS correctly places limited emphasis on pelage or morphometric distinction between AA wolves and other populations but rather relies more heavily on recent publications comparing neutral genetic markers between coastal vs. other wolf populations (see below). It is well understood that simple phenotypic plasticity may cause observed differences without necessarily being driven by an underlying genetic link, so the emphasis on genetics is appropriate.
2) Genetic analysis

The field of functional genomics, especially in relation to free-ranging wildlife species, remains in an embryonic state despite characterization of full genomes of related species, including the domestic dog. There is some preliminary work on functional genomics in wolves but currently that work is mostly in progress and remains unpublished (and not peer-reviewed). Accordingly, at this stage it is appropriate for the USFWS to assume that usable genomics research results on wolves are not available for this assessment.

In assessing neutral marker variation, the focus is on examining more traditional questions like maternal lineages or population genetics. To some extent these data still may inform on genetic distinction and perhaps taxonomy. Table 2 appears to be a comprehensive review of the available genetic information on AA wolves, and an important point when considering the results of such studies is the type of analysis (mtDNA vs. microsatellites) as well as the reference population being used for comparison. The table and associated writeup clearly identifies that different markers and source populations underlie some of the variability in findings between studies. Ultimately, relying on several recent publications, the USFWS infers that there is distinction between inland coastal and mainland wolf populations, as seen through one or more unique haplotypes, although I must point out that whether this distinction truly is the result of selection by ecological factors, as is suggested by at least one publication (Munoz-Fuentes et al. 2009) and is referenced in the report, remains debatable. Regardless, based on the plurality of findings using both mtDNA and microsatellites/SNPs (notwithstanding arguments offered by Cronin et al. 2015), the USFWS assumes that C. l. ligoni is a valid subspecies. In my opinion this is the correct conclusion in light of the available evidence. It is also important to note that this is a conservative assumption in the context of this species status assessment.

Section 2.23 refers to other distinct characteristics of AA wolves, including food, habitat and disease resistance. Although I address these items in more detail below, I will re-iterate that it is not possible to ascribe variability in these features to genetic differentiation rather than simply owing to phenotypic plasticity (or even differential gene expression). Therefore, lesser emphasis on these distinctions is warranted.

3) Population estimation

The USFWS report correctly identifies the challenges associated with estimating wolf populations, and reviews the pros and cons of different techniques and estimators. Table 3 outlines population estimates/densities for wolves in GMU #2 and POW, and recognizes a marked decline spanning 2013-14. The cause of this decline is not known, but it is important to note that estimates for these populations likely have low precision and that there is overlap between the 95% CI for the GMU #2 during 2013 and 2014. This apparent decline is corroborated for POW during the same time period, but again, to some degree there is limited confidence in the veracity of this trend. The POW density estimate for 2014 (9.9 wolves/1000 km²) is not particularly low by most standards for Alaska or elsewhere in North America.
The report attempts to estimate the AA wolf population in British Columbia by multiplying the provincial population estimate by the area covered by the AA region, and including adjustments for prey size. Given the anticipated high level of heterogeneity in wolf numbers across their distribution (including heterogeneity reported for Alaska earlier in the USFWS document), there is room for error in this conversion. Different scenarios could be modeled assuming heterogeneity in wolf numbers in British Columbia, and factoring that the provincial estimate likely has high imprecision. Regardless, the two independent estimates for AA wolves in British Columbia are consistent, and the USFWS appropriately advises that caution should be used in interpreting these numbers.

On p. 28, the report mentions that no trend is apparent in the British Columbia wolf population estimate, but that hunters and trappers are reporting an increased abundance. I don’t know if anecdotal information is relevant here. Regardless, there are provincial fur trapping records that date back to the 1920’s which could be referenced. These are available either from the province or the Fur Institute of Canada. This is a minor point.

4) Survival estimation
The annual survival rates for yearling and adult wolves are perhaps on par with those observed elsewhere in North America (see Fuller et al. 2003), although it is important to recognize that these rates are based on small sample sizes with large confidence intervals. However, that few radio-collared wolves are succumbing to unknown fate (i.e., collar lost before the animal dies) should strengthen the confidence in survival estimates. A 0.65 survival rate for resident adult wolves (Person and Russell 2008) likely is not sustainable over the long term. Regardless, by all accounts the AA wolf population is subject to high human-caused mortality risk, much of it being unreported and probably illegal. Rates of human-caused mortality ranging from 64-87% are markedly high compared to other wolf populations, and are likely to be additive (see Murray et al. 2010, Sparkman et al. 2011). This means that at such rates, human-caused mortality surely contributes to AA wolf population decline.

5) Food habits
The USFWS report is entirely correct in advising that numbers reporting prey prevalence in scat should be interpreted with caution, as these methods are known to be biased against small or highly digestible prey or variable through seasons or among demographic groups. Nevertheless, the variability in wolf diet between islands (Table 5) is surprising and highlights wolf dietary plasticity depending on prey availability. This is further highlighted in the temporal variability shown in Table 6, which reflects a period of deer population decline on Coronation Island. Appropriately the USFWS report excludes scat analysis results from Milne et al. (1989) because relative occurrence of prey is a very different metric than frequency of prey in the diet. For full disclosure it could have been expected to show results from 1962, 1964, and 1966 in Table 6 but this is a minor point. It is also important to note that more recently diet breadth has been documented via stable isotope analysis, which offers improved detection for prey such as salmon (i.e., high digestibility and rarely detected in scat analysis). However, there currently is debate in the scientific literature regarding conversion of isotopic data from hair to prey frequency or biomass, so results from some of these studies
should be interpreted with caution. Further, it may be that some of the conflicting results (i.e.,
broad vs narrower diet on islands) are at least in part attributable to different methodologies
and these could be highlighted more clearly as the report goes through the various findings.
Likewise, USFWS is well justified in refraining from making direct comparisons of wolf
home range size using VHF vs. GPS telemetry, or from MCP vs. kernel estimators.

6) Demographic connectivity
On p. 45 of the USFWS report, it states in relation to dispersal that *longest being only about 2 km in length*. Yet in light of earlier text it seems that inter-island movements are rare and
that there is probably no evidence that the wolves swim up to 1 km, so the above statement
may be a bit misleading, although the statement that they can swim 13 km (*Darimont and
Paquet 2002*) is noted. Still, I would expect that such a long distance swim is an outlier for
coastal wolves, and whether or not this distance is attributable to the point about webbed
footing (as is stated in the USFWS report), is debatable and not necessary. So, while I don’t
doubt that long distance dispersal occurs on occasion, ultimately, I don’t think that a strong
case for inter-island dispersal has been made (although case reported by *Dungan 2015* is duly
noted). So, while I agree that some dispersal does take place, the challenge is translating the
few anecdotes to a demographic parameter that can be used to populate a population
projection model.

On p. 46, the USFWS report states that low inter-island dispersal and low survival rates of
dispersers probably means that this attribute is inconsequential from a demographic
perspective. I don’t fully agree and suggest that populations are sufficiently low on some
islands that demographic stochasticity, founder effects, and perhaps inbreeding, could be
relevant. The report correctly acknowledges that the lack of immigration and emigration rates
is a major weakness in our understanding of AA wolf population dynamics, but this concern
can’t be overlooked and should invite a sensitivity analysis on the role of this demographic
parameter on wolf populations, using a range of plausible estimates. The USFWS report
correctly uses Fst values to provide an indication regarding source-sink dynamics of the AA
wolf population, although I advise that the report should provide more contextual
information regarding individual Fst scores and whether the interpretation of unidirectional
dispersal is robust or speculative based on the actual Fst values and ancillary data. Of course,
Fst will be strongly influenced by the range of populations that are under consideration, a
point that could be further emphasized in the report. As an aside, while I understand that Fst
values were the unit available in the literature, there is evidence suggesting that Jost’s D
statistic provides a more robust metric.

7) Wolf population model
The USFWS initially restricted its population projection model to GMU #2 because it is the region
with the best demographic data, but toward the end of the document the status of other
GMUs is examined. Mortality risk in this area is high, making the initial analysis
conservative. This seems like an appropriate approach, with the caveat that the variability in
demographic parameters seen in the other regions should serve as a basis for additional
sensitivity or elasticity analysis beyond the summaries provided in the final pages of the
document. Indeed, p. 54 reports that a range of values relevant to GMU #2 were used in the
analyses and it would be appropriate to affirm that these values overlap with those expected in other areas or else that separate analyses are run. Indeed, the statement: *However, results of the sensitivity analyses are applicable to other Alexander Archipelago wolf populations.* should be supported by evidence that there is no reasonable reason to expect substantial differences between populations, which seems contradictory to the concluding statements suggesting that GMU #2 is an anomaly. Further, while caution is offered that the reader should focus attention on the relative difference between parameters that are manipulated in the sensitivity analysis, it may be that in these circumstances an elasticity analysis would be more appropriate to add proportionality and context.

In several spots (incl. p. 61) the report states that deer responses to pre-commercial thinning have not been examined. Here it might be valuable to extend the literature search outside the AA region as I am quite certain that this work has been conducted elsewhere in the Pacific region and there is no reason why, even if only qualitatively, the findings should not be transferrable.

Page 67 states: *The only potential direct effect from timber harvest to Alexander Archipelago wolves may be modification of and disturbance at den sites.* This sentence does not hold water (The only may). More importantly, I question its accuracy. There are other potential direct effects, e.g., loss of rendezvous sites, loss of traditional movement corridors, etc. While it is understood that these effects may be minor from the perspective of population projection, the above statement should be contextualized.

It is appropriate to use the deer habitat model to examine deer suitability in GMU #2 and the case is strong that timber harvest is disproportionate in that region, leading to a liberal assessment of threats of timber harvest and one that is perhaps not fully representative of the GMU. Again, sensitivity/elasticity analyses may be appropriate to provide broader regional context to the analysis. The document then goes on to report *We assumed a predation rate of 15 deer/wolf/year as estimated from Szepanski et al. 1999 (p. 331) and a beginning deer abundance as 75% of the carry capacity in 1995.* Earlier in the document a strong case is made that deer is the primary prey for the AA wolf population and from my perspective 15 deer/wolf/year seems awfully low. From what I recall from Szepanski et al. (1999), the kill rate estimates were obtained through indirect measures (e.g., stable isotope analysis), leaving some doubt about the accuracy of the kill rate estimate. I do accept that the sensitivity analyses and range of predation rates chosen for these surely encompasses the real-world rates, although the high sensitivity of the model projections to predation rates argues strongly for accurate starting estimates. A broader scan of the literature beyond Alaska could help support/refute the 15 deer/wolf/year statement.

Page 74. The study by Sparkman et al (2011) and Creel and Rotella (2010) surely support that human-caused mortality is at least partially additive, so the use of these citations should be clarified. When considered in the context of the findings by Murray et al (2010), these studies strongly support that each human-caused mortality event is at least partially additive to wolf population decline. Accordingly, I suggest that the estimated threshold for human harvest sustainability (29%) is too high. While I understand that Fuller et al. (2003)
calculated a slightly higher threshold, it is important to point out that their results were derived from a meta-analysis using wolf populations from across North America and that the predictive power of their model was relatively low. Likewise for the Adams work for mainland Alaska. In addition, demographic rates reported in the USFWS document for AA wolves (immigration/emigration, survival, productivity) do not suggest that the population is highly productive or open to ingress, implying a potentially greater sensitivity to human harvest. Therefore, as a starting point my sense is that the 29% threshold is too high. The reported 38% human-caused mortality rate (and 0.04 annual natural mortality rate) is highly suggestive of a population that is simply not regulated by natural factors, and is rather distressing as an overall finding in the context of wolf populations across North America.

In terms of the 29% threshold, this is very much context-specific. If natural mortality rate also is high, then this threshold is much too high; if natural mortality is low (i.e., human-caused mortality is fully or mostly compensatory) then the chosen threshold may be less problematic. The point is that there is a strong need for accurate annual survival rates as well as rates of cause-specific mortality. The extent of linkage between the two (i.e., additive vs. compensatory vs. something in-between) is crucial to establishing a robust threshold for sustainable human harvest. To date, wolf studies have found that human-caused mortality tends to be more additive than compensatory. However, again, the specific relationship between the two (i.e., the slope of the line between wolf population growth (or wolf survival) vs. human-caused mortality rate) is crucial.

A quick calculation using the reported wolf harvest (Fig. 11) suggests that rates vary from 100-225 wolves/year, with a mean @ 175/year (please report in the text the mean value of wolves harvested in Fig. 11a). *Person et al. (1996)* estimated 908 wolves (SE: 216) for all southwest Alaska. If we take this estimate at face value and apply a 175 reported harvest rate, we obtain a 19% reported harvest rate. The question is whether the unreported human-caused mortality accounts for an additional 10% mortality to reach or exceed the 29% threshold. This number (10%) is less than the 29–45% estimated unreported harvest for GMU #2. *Person and Russell (2008)* estimate an unreported annual mortality rate (0.19) that is almost as high as the reported harvest rate (0.23). I place greater emphasis *Person and Russell (2008)* than the more recent findings for 11 radioed wolves in POW, where unreported harvest was relatively low. *Liberg et al. (2011)* report high rates of ‘cryptic poaching’, whereas *Smith et al. (2010)* and *Sparkman et al. (2011)* report high rates of censoring among radioed wolves (i.e., wolves succumb to unknown fate, quite possibly illegal activity).

Understanding that these case studies refer to wolves subject to some form of legal protection through endangered species legislation and therefore may not be directly comparable to AA wolves, it is entirely reasonable to assume that the unreported mortality rate in AA wolves could be high as well. Although Table 15 provides some reassurance that the AA wolf population is subject to sustainable reported harvest, the USFWS report is correct to point out (p. 82) that unreported harvest could tip the balance beyond the sustainability threshold. As stated above, there is room for more comprehensive sensitivity analysis related to reported-unreported human-caused mortality, as well as to the additive-compensatory mortality relationship.
Ultimately, I agree that the USFWS has used the best information available to estimate harvest rates, but some inferences are based on a number of weak assumptions and simplifications. I do have concerns that the strength and success of the report and its recommendations are strongly reliant on the estimates of reported harvest, unreported harvest, and the relation between these two stressors (i.e., additive, partially additive, or compensatory). These concerns are grounded in the fact that, as admitted in the report, wolf population size is overestimated while harvest is underestimated. Thus, while the USFWS report has done a reasonable job of exploring how some of these differences can affect AA wolf population dynamics, there is room for caution in relation to the 29% estimate for a sustainable human harvest. Regardless, these efforts highlight the need to better understand how various sources of mortality affect AA wolf populations in order to provide a robust status assessment.

8) Effects of roads
The USFWS report correctly points out that the population model uses an oversimplified depiction of current and potential future road densities to evaluate wolf population responses. Despite this, the model shows that road density is an important predictor of human-caused mortality and that decommissioning roads could positively impact wolf population dynamics. While this assessment is sound, the report also points out that boat access may in fact be more important than road access in promoting wolf harvest and these dynamics are not fully integrated into the model. It may be possible to refine the model to include the effects of boat access on harvest, with the need to run a range of sensitivity analyses for this parameter in response to its low confidence.

9) Other stressors
Given the low rates of dispersal between islands, is inbreeding not a concern? It is debatable that at one point or another inbreeding contributed to decline in Isle Royale wolves, so it may be worth dispelling this potential criticism. I acknowledge that inbreeding and loss of heterozygosity is brought up at the end of the document, but it comes across as an afterthought. I would conduct a more comprehensive analysis of inbreeding, heterozygosity, demographic stochasticity, dispersal, and population responses. I would place this analysis more prominently in the document.

I was very pleased to see in the final pages an attempt to quantify the effects of multiple stressors on population dynamics in the broader region and specific WMUs. This is a strong way to conclude the assessment, notwithstanding the risk of compounding uncertainties.

10) Concluding statements
Ultimately, the USFWS report concludes that while there may be some regional declines in wolf populations, overall the AA population is not imperiled because of favourable demographic compensation, dietary breadth and plasticity, and dispersal. Although I generally agree with this conclusion and personally do not foresee a rapid population decline, my optimism is tempered by: 1) limited dispersal and questionable two-way dispersal events between wolf sub-populations on islands, and especially 2) the high rate of reported human harvest of wolves, the unknown (but potentially high) level of unreported wolf harvest, and
the uncertainty regarding whether such mortality is fully additive, partially additive, or compensatory. Understanding that data availability for answering these questions may be limited, there could be additional opportunities for answering some of these uncertainties by relating hypothetical rates of reported and unreported mortality to observed levels of wolf population change. For example, scenarios could be developed to explore how wolf mortality along the additive-compensatory continuum could correspond to observed changes in AA wolf abundance through time. For example, temporal changes in wolf numbers in WMU #2 could be related to rates of reported and suspected unreported mortalities to determine which unreported rates best correlate with observed population trends. It may be that such an exercise would provide limited inference given the lack of robust empirical data to use in analyses (and the high uncertainty in population and survival estimates). However, given the critical importance in answering the additive-compensatory question before the prognosis for the population can be fully developed, such exercises are important.

Second, the USFWS assessment of wolf population status and sustainability is based exclusively on population size and numerical trends. What is lacking is the additional consideration of maintaining appropriate pack structure and social fabric in the AA wolf population. As with other wolf populations under heavy exploitation (see Rutledge et al. 2010. Biol. Conserv. 143, 332) it is expected that overall pack structure for most of the AA wolf population (certainly the wolf population in WMU 2) does not reflect the family units that are characteristic of more naturally-regulated wolf populations. For example, I suspect that due to high levels of exploitation and low dispersal, the AA wolf population is comprised of mainly unrelated pack members, many dispersers and non-residents, high turnover in pack breeders, and low transferrence of knowledge regarding traditional hunting areas or denning or rendezvous sites. Increasingly, there is recognition that maintenance of carnivore populations should extend beyond merely keeping the numbers elevated, and rather that accommodations should be made for the social and other complexities that are core to their well-being. I have not seen this matter addressed here, and for a species with a complex life history and social dynamics, some review and analysis in this area would be worthwhile.

3. Have the authors of the SSA report provided reasonable and scientifically sound syntheses and interpretation from the scientific information presented in the report? Are there instances in the SSA report where a different but equally reasonable and scientifically sound scientific interpretation or synthesis might be reached that differs from the synthesis provided by the Service? If any instances are found where that is the case, please provide the specifics of that situation.

Overall I am satisfied with the objective synthesis and interpretation of findings, with a few, minor, exceptions. The few instances where alternate interpretations and conclusions could be derived are highlighted in Section #2. Note that for the most part these are minor points.
Additional Comments

Table 8-10 might be easier to interpret if presented as percentages, with total acreage in each area retained as a column. Or put the percentages in brackets after the acreage.

When dealing with survival rates and mortality rates, it would be helpful to maintain consistent units whenever possible. For example, p. 24 reports annual natural mortality rates and percent mortality from human causes. These are very different units and the presentation is confusing. There are other examples (see Survival section) elsewhere, where different survival units are interchanged.
APPENDIX B

Reviewer’s Resumes (Alphabetical)

Peer Review of
Draft Status Assessment for the Alexander Archipelago Wolf (Canis lupus ligoni)
U.S. Fish & Wildlife Service
Curriculum Vitae - Michael J. Chamberlain

Work Address
Warnell School of Forestry and Natural Resources
University of Georgia
Athens, GA 30602
(706) 542-1181
(706) 542-8356 (fax)
mchamberlain@warnell.uga.edu

Home address
1060 Apalachee Trace
Bishop, GA 30621
(706) 310-9511

Education

Ph.D., Forest Resources with major in Wildlife Ecology; Mississippi State University, Mississippi State, MS. December 1999

M. S. Wildlife Ecology; Mississippi State University, Mississippi State, MS. December 1995

B. S. Wildlife Science; Minor - Biology; Virginia Tech University, Blacksburg, VA

A. S. Biological Sciences; Danville Community College, Danville, VA

Work Experience

July 2012 – present – Professor - Warnell School of Forestry and Natural Resources – University of Georgia.

March 2011 – June 2012 – Associate Professor – Warnell School of Forestry and Natural Resources – University of Georgia.

March 2011 – present – Adjunct Professor - School of Renewable Natural Resources, Louisiana State University Agricultural Center.

June 2014 – present – Adjunct Professor – University of Tennessee, Knoxville.

July 2005 – February 2011
Associate Professor - School of Renewable Natural Resources, Louisiana State University Agricultural Center. Design, implement, and coordinate applied and basic research examining wildlife communities throughout the United States. Research foci include ecology and management of mammalian carnivores, upland game bird ecology and management, and wildlife/habitat relationships. Also serve as instructor for graduate-level course focused on population ecology and management of large mammals and graduate seminars. Undergraduate teaching responsibilities include Ecology and Management of Louisiana Wildlife (RNR 3018), Field Studies in Wildlife Habitat (RNR 3005), and portions of Natural Resource Measurements (RNR 2002), and Wildlife
Management Techniques (RNR 4011).

March 2000-June 2005
Assistant Professor - School of Renewable Natural Resources, Louisiana State University Agricultural Center. Same as above.

September 1998 - February 2000
Wildlife Research Assistant I - Mississippi State University - maintained hardware, software, and operating systems on UNIX and PC-based workstations in the Department of Wildlife and Fisheries GIS laboratory. Also provided GIS-related technical assistance to graduate students, faculty, and staff of the Department of Wildlife and Fisheries, Mississippi State University and the Mississippi Department of Wildlife, Fisheries and Parks. Developed multi-layered GIS systems of study areas used by graduate research projects. Maintained GIS systems for several state-owned wildlife management areas and data associated with Global Positioning System (GPS) base station. Used Trimble handheld GPS units to gather field locations associated with various research projects. Provided GIS technical assistance to graduate students, faculty, and staff. Assisted with capture/tagging of Northern bobwhite and analyze data from field research and surveys. Assisted with design of graduate research projects. Conducted winter and summer bobwhite calling surveys.

January 1996 - August 1998
Doctoral Graduate Research Assistant, Mississippi State University - conducted research on bobcats, coyotes, gray foxes, raccoons, opossums, and wild turkeys to examine and model the process of predation involving turkeys. Developed habitat use models to predict selection patterns of carnivores and turkey hens. Field research included capture of listed species and extensive radio-tracking. Coordinated efforts of 4 technicians. Additional field work included extensive vegetation sampling to assess microhabitat conditions of macrohabitats selected by carnivores and turkey hens. Also conducted small mammal trapping to assess habitat-specific rodent abundance for medium-sized and larger mammalian carnivores and omnivores on 2 study sites. Performed long-term dietary analysis of bobcats and coyotes. Coordinated and conducted research on Singing River Island, Mississippi assessing influence of introduced bobcats on rabbit and nutria populations.

Assisted in design, coordination, and implementation of 2 graduate research projects designed to supplement information gained directly through my doctoral research. These projects were (1) assess impacts of summer hunting on raccoon population dynamics and (2) assess relationships between carnivore densities and visitation rates using multiple index methods.

Created, coordinated, and assisted in the implementation of web-based completion report for the overall predation project my dissertation detailed. This web site served as a final completion report for the Mississippi Department of Wildlife, Fisheries and Parks, the National Wild Turkey Federation, Georgia-Pacific Corporation, and the USDA Forest
Service. Site can be viewed at http://www.cfr.msstate.edu/predator/projecthome.html

July 1993 - December 1995
Graduate Research Assistant, Mississippi State University - coordinated and conducted research on wild turkeys including capture using cannon nets, field marking, radio-telemetry, collection of harvest data, and gobbler call counts. Also coordinated and conducted baseline monitoring system for the U. S. Army Corps of Engineers to determine relative abundance of numerous species including white-tailed deer, wild turkey, small mammals, lagomorphs, tree squirrels, songbirds, reptiles/amphibians and waterfowl. Used multiple census techniques to monitor relative abundance of the aforementioned species, including spotlight counts, track counts, pellet-group counts, time-area counts, flush counts, circular bird plots, and reptile/amphibian call counts.

May - June 1993
Research Technician, Virginia Tech University - assisted with collection of vegetation data to implement a GIS-based habitat model. Field sampling techniques included line-intercept sampling and tree density surveys.

May - June 1989, 1990
General Laborer - Bryant Contracting, Inc., Toano, VA; performed various tasks including welding, painting equipment, repairing engines and transmissions, and servicing company vehicles.

Research Interests

- Wildlife Population Ecology
- Wildlife/Habitat Relationships
- Population Dynamics
- Predator-prey relationships
- Spatial technologies in Natural Resources
- Ecology and Management of Mammals

Certifications


Committee Assignments

- Curriculum Committee – 2014-present - Warnell School of Forestry and Natural Resources.

- Legislative Committee for Georgia Chapter of the National Wild Turkey Federation – 2013-present.

- Graduate Affairs Standing Committee – 2011-15 – Warnell School of Forestry and Natural Resources.
Safety Committee – 2011-15 – Warnell School of Forestry and Natural Resources

Ad Hoc Committee on Computers and Information Systems – 2011-13 – Warnell School of Forestry and Natural Resources

Chair of Wildlife Outreach Search Committee – 2015 – Warnell School of Forestry and Natural Resources – committee to identify and hire outreach faculty member

Wildlife Faculty Search Committee – 2012-13 – Warnell School of Forestry and Natural Resources - committee to identify and hire wildlife faculty member.

Wildlife Faculty Search Committee - 2000 - Louisiana State University - committee to identify and hire wildlife faculty member specializing in wetland ecology

Technology Committee - 2000-2011 - School of Renewable Natural Resources – committee to oversee computing and technology resources of the School

Natural Resource Conservation Course Committee - 2001 - committee responsible for designing class to be included in core curriculum of School of Renewable Natural Resources.

Spatial and Information Technologies in Natural Resources - 2000/2001 - Louisiana State University - committee to review proposed undergraduate course examining spatial and information technologies in the natural resource disciplines.

Criteria for Endowed Professorship Committee - 2001 - committee to draft criteria for selecting endowed professors in the School of Renewable Natural Resources.

Web-page Design Committee - 2002-2006 - School of Renewable Natural Resources - committee responsible for designing website for the School.

Assessment Committee - 2002-2003 - School of Renewable Natural Resources - committee reviewing and revising guiding principles for assessment of the School.

Renewable Natural Resources Degree Committee - 2003 - School of Renewable Natural Resources - committee responsible for determining the demand and utility of creating an undergraduate degree in Renewable Natural Resources.

Advising/Mentoring of Undergraduate Students Committee - 2002-2003 - School of Renewable Natural Resources - committee developing guidelines for decentralizing of undergraduate advising.

Programmatic Planning Committee/Advisory Panel - 2003 - Berryman Institute East -
assist in developing education and research priorities for Berryman Institute to evaluate wildlife-human interactions.

Louisiana State University Agricultural Center Institutional Animal Care and Use Committee - 2003 - 2011.

Lee Memorial Forest Committee - 2004-2011 - School of Renewable Natural Resources - committee to oversee operations of Lee Memorial Forest.

Undergraduate Education Committee – 2010 – School of Renewable Natural Resources – committee to oversee undergraduate curriculum and teaching

Newsletter/Research Matters Editorial Committee- 2008 – 2011 – School of Renewable Natural Resources – committee to coordinate editing and publication of newsletters for School

Editorial Board Member for Louisiana Agriculture (publication of LSU AgCenter) - 2004-2007 - LSU Agricultural Center - board that oversees publication and technical editing of Louisiana Agriculture.

Teaching Quality and Recognition Committee - 2005-2008 - College of Agriculture.

Louisiana Agricultural Experiment Station Awards Committee – 2006-2008 – LSU AgCenter – committee to select award recipients for Rogers, Tipton, and Chambers research awards.

College of Agriculture, Faculty Recognition Awards Committee – 2006-2008 – committee to select faculty recipients of various teaching awards in the College of Agriculture.

Search Committee for Director, School of Renewable Natural Resources - 2005/07 - Louisiana State University - committee to identify and hire director for School of Renewable Natural Resources


Gilbert Fellowship Committee – 2009-2011 – School of Renewable Natural Resources – committee to select recipients of Gilbert fellowships in the School

Peer-reviewed publications
Published, or in-press

rates on wild turkey hens in a hardwood bottomland forest and a mixed forest in Mississippi. Proceedings of the Southeastern Association of Fish and Wildlife Agencies 50:428-435.


Proceedings of the Fifth National Quail Symposium. 5:136-140.


Pine Ecosystem. American Midland Naturalist. 163:413-422.


89. Owens, F. L., P. C. Stouffer, M. J. Chamberlain, and D. A. Miller. 2014. Early-


99. Gross, J. T., A. R. Little, B. A. Collier, and M. J. Chamberlain. 2014. Space use, daily movements, and roosting behavior of male wild turkeys during spring in Louisiana and


In Review


Laufenberg, J., J. D. Clark, M. J. Chamberlain, R. B. Chandler, M. M. Davidson, M. J.


Books/Book Chapters

Hancock House Publishers, Blaine, Washington, USA.


Peer-edited publications


Non-peer reviewed publications


Abstract only.


Byrne, M. E., and M. J. Chamberlain. 2011. Area-restricted search behavior in the


Gross, J. T., B. S. Cohen, B. A. Collier, and M. J. Chamberlain. 2015. Influences of
hunting on movements of male wild turkeys during spring. Wildlife Society Annual Conference. Winnepeg, MB. Abstract only.


Unpublished Documents


Publications in Progress


**Popular articles**


Local Presentations


Chamberlain, M. J. 1995. Wild turkey hen survival rates in bottomland hardwood forests in the Mississippi Alluvial Valley. Mississippi Chapter of the Wildlife Society, Mississippi State, MS.


Chamberlain, M. J. 2004. Research on the Louisiana black bear. Dean=s Breakfast Seminar. Louisiana State University College of Veterinary Medicine, Baton Rouge, LA.


Chamberlain, M. J. 2005. Effects of silvicultural practices on non-game birds on Sherburne Wildlife Management Area. Workshop entitled AManaging non-game birds in hardwood forests and other unique habitats, jointly sponsored by LSU AgCenter and Louisiana Department of Wildlife and Fisheries, Krotz Springs, LA.


Chamberlain, M. J. 2008. Update on wild turkey research on Sherburne Wildlife Management Area. Louisiana Chapter of the National Wild Turkey Federation, Marksville, LA.


Chamberlain, M. J. 2009. Using Geographic Information System technology in wildlife management. Louisiana State University Agricultural Center, Precision Agriculture ACE meeting, Baton Rouge, LA.


North Carolina. Georgia Chapter of the Wildlife Society Annual Meeting, Athens, Georgia.


Chamberlain, M. J. 2013. Managing for bobwhite quail. The Warnell Continuing Education Program, Athens, GA.

Chamberlain, M. J. 2013. Managing for wild turkeys. The Warnell Continuing Education Program, Athens, GA.


Regional Presentations

Proceedings of the Eastern Damage Management Workshop, Jackson, MS.


Southeastern Association of Fish and Wildlife Agencies, St. Louis, MO.


Chamberlain, M. J., and D. A. Miller. 2006. Effects of 2 site preparation techniques on quantity and quality of forage plants for white-tailed deer. Annual Conference of the Southeastern Association of Fish and Wildlife Agencies, Norfolk, VA.


Turkey Federation National Convention. Nashville, TN.

Byrne, M. E., and **M. J. Chamberlain**. 2011. Seasonal Space Use and Habitat Selection of Female Wild Turkeys in a Louisiana Bottomland Hardwood Forest. Annual Conference of the Southeastern Association of Fish and Wildlife Agencies, Nashville, TN.

**Chamberlain, M. J.**. 2011. Developing a regional study to evaluate declines in wild turkey production. Southeast Directors Wild Turkey Technical Committee Meeting, Live Oak, FL.


Louisiana. Annual Conference of the Southeastern Association of Fish and Wildlife Agencies, Hot Springs, AR


International and National Presentations


Jones, B. J., G. A. Hurst, J. E. Inglis, and M. J. Chamberlain. 2002. Wild turkey nest site selection on an area managed for red-cockaded woodpecker habitat: potential impacts of spring burning and changes in vegetation structure. 9th Annual Wildlife Society


**Poster Presentations**


Effects of flooding on relative abundance and diversity of small mammals in a


Informal presentations

Southeastern Graduate Student Symposium – the Perils of Publishing. 2008. Sponsored by College of Forest Resources, Mississippi State University. Starkville, MS.

Field Day - Managing Native Vegetation for White-tailed Deer. 2006. Sponsored by LSU AgCenter and School of Renewable Natural Resources. Lee Memorial Forest, Sheridan, LA.

Field Day - Managing for Mourning Doves. 2004. Sponsored by LSU AgCenter and Louisiana Department of Wildlife and Fisheries. Idlewild Experiment Station, Clinton, LA.

Recruiting seminar for School of Renewable Natural Resources. 2003. Louisiana 4-H students. Baton Rouge, LA.

Ecology of wild turkeys in bottomland hardwood forests. 2002. Louisiana Chapter of the National Wild Turkey Federation.

Reproductive ecology of wild turkeys in bottomland hardwood forests of Louisiana. 2002. Wild Turkey Committee meeting - Southeastern Section of the Wildlife Society.

2001 Louisiana High School Science Expo - Louisiana State University - provide informal seminars to outstanding high school students regarding opportunities in wildlife and natural resources management.

10th Annual Feliciana Forestry Field Day - Idlewild Experiment Station - 2001. Wildlife Habitat Enhancement Using Herbicides

Recruiting students into the School of Renewable Natural Resources - 2000. Avoyelles
Parish Teachers Association

Jasper County Annual Forestry Field Day, Newton, MS - 1997

Lee-Davis High School, Hanover County, VA - 1994 - Topic: How to get into the wildlife management field.

Grantsmanship
Grants Awarded

Impacts of Summer Hunting of Raccoons on Selected Game Animals. 1996. Mississippi Raccoon Hunters Association. Co-Investigator with Bruce D. Leopold. Grant Amount: $2,000.00. Starting Date: 8/1/96. Project Duration: 1 year.

Monitoring of impacts of introduced bobcats upon lagomorph populations on Singing River Island, Pascagoula Naval Area Station. 1995-7. Co-Investigator with Bruce D. Leopold and Jacob L. Bowman. United States Department of the Navy. Starting Date: April 1, 1995. Amount: $1,500.00 per investigator. Project Duration: 1 year.


Effects of Forest Management on Herpetile and Bird Communities in Louisiana. 2002.
Louisiana Department of Wildlife and Fisheries. Amount: $168,000. Project Duration: 2.5 years. Starting Date: August 2002.


Assessing the effectiveness of using adult family groups of red-cockaded woodpeckers for translocation and restoration.  2006.  PlumCreek Company.  Amount: $75,103.


Influences of landscape characteristics on nesting ecology of female wild turkeys and behavior of raccoons.  2007.  Louisiana Chapter of the National Wild Turkey Federation.  Amount: $6,083.
A continuing assessment of the effects of forest management and silvicultural activities on abundance and distribution of neotropical migrant songbirds. 2007. Louisiana Department of Wildlife and Fisheries. Amount: $81,600.


Assessing the effectiveness of using adult family groups of red-cockaded woodpeckers for translocation and restoration. 2009. PlumCreek Company. Amount: $14,831.

Influences of landscape characteristics on nesting ecology of female wild turkeys and behavior of raccoons. 2009. Louisiana Chapter of the National Wild Turkey Federation. Amount: $8,700.


Using GPS telemetry to evaluate nesting and brooding of wild turkeys on Ben’s Creek Wildlife Management Area. 2011. Louisiana Chapter of the National Wild Turkey Federation. Amount: $9,000


Efficacy of Road Underpasses for Minimizing Bear-vehicle Collisions on the 4-lane
Population size, survival, and reproductive ecology of the central Georgia black bear population. 2011-2014. Georgia Department of Natural Resources. Amount: $324,293

Assessing movements and ecology of male wild turkeys during spring reproductive and hunting seasons. 2012-2014. Louisiana Chapter of the National Wild Turkey Federation. Amount: $36,000


Estimating population size and viability of the central Georgia black bear population. 2013. Georgia Department of Natural Resources. Amount: $274,586


Assessing movements and ecology of male wild turkeys during spring reproductive and hunting seasons. 2015. Louisiana Chapter of the National Wild Turkey Federation. Amount: $18,000

Movement ecology of female wild turkeys during nesting and brooding seasons on Silver
Lake Wildlife Management Area. 2014. Georgia Department of Natural Resources. Amount: $257,171

Movement, habitat use and reproductive ecology of mottled ducks along the Georgia coast. Georgia Department of Natural Resources. Amount: $353,550

Large-scale assessment of coyote spatial ecology as affected by landscape and behavioral factors. 2014. Alabama Department of Conservation and Natural Resources. Amount: $253,264

Large-scale assessment of coyote spatial ecology as affected by landscape and behavioral factors. 2014. South Carolina Department of Natural Resources. Amount: $246,263

Large-scale assessment of coyote spatial ecology as affected by landscape and behavioral factors. 2014. Georgia Department of Natural Resources. Amount: $266,714

Professional Activity

The Wildlife Society

Journal of Wildlife Management
Referee 1999-2006, 2014
Editor-in-Chief 2007-2009
Associate Editor 2010-2013

Wildlife Society Bulletin
Associate Editor 1999-2006

Wildlife Publications Committee Chair- 2010-2011
Faculty Advisor - Louisiana State University Chapter 2000-2007
President-elect - Louisiana Chapter - 2001
President - Louisiana Chapter - 2002
Past-President - Louisiana Chapter - 2003-2004
Member – Louisiana Chapter – 2000-present
Member - Mississippi Chapter - 1995 - 1999
Member - Mississippi State University Chapter - 1994-97
Committee Chairman - Mississippi State University Chapter - 1996-97

Proceedings of the Southeastern Association of Fish and Wildlife Agencies
Co-Associate Editor (Wildlife Technical Sessions) 2000, 2004
Associate Editor (Wildlife Technical Sessions) 2001-2002

Editorial Board Member – Human Wildlife Interactions (journal) – 2009-present

48
Proceedings of the National Wild Turkey Symposium
Referee 2005, 2010

National Research Initiative (NRI) Proposal Reviewer - 2004

National Science Foundation (NSF) Proposal Reviewer - 2004

National Fish and Wildlife Foundation Reviewer - 2004

Journal of Mammalogy

American Midland Naturalist
Associate Editor 2002-2004

PLos One
Referee 2011

Southwestern Naturalist
Referee 2011

Animal Conservation
Referee 2011

Canid Biology and Conservation
Referee 2013

Global Ecology and Biogeography
Referee 2005

Acta Theriologica
Referee 2004

Human-Wildlife Conflicts

Landscape Ecology
Referee 2004

Southeastern Naturalist
Guest Editor 2011
Animal Behaviour  Referee  2012

Ursus  Referee  2011


Behavioral Ecology  Referee  2007


Wildlife Biology  Referee  2003, 2010

Georgia Journal of Science  Referee  2012

Wildlife Research  Referee  2007

Wetlands  Referee  2007

Southern Journal of Applied Forestry  Referee  2001, 2004

Wildlife and Fisheries Economic Enterprises Program - Mississippi State University  Referee  2005-2006

Journal of Range Management  Referee  2000


Ecology and Management of Bottomland Hardwood Systems - Symposium  Referee  1999
CURRICULUM VITAE

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1. GENERAL INFORMATION

PRESENT POSITION
Canada Research Chair (Tier I) and Professor

LANGUAGES SPOKEN AND WRITTEN
English, French

POST-SECONDARY EDUCATION
MSc (Zoology): University of Alberta, Edmonton, AB (1991)
BSc (Agr.) (Biological Sciences): McGill University, Montréal, QC (1987)

THESES
PhD Interactive effects of sublethal parasitism, nutritional status, and predation in snowshoe hares. (1995)
MSc Aspects of winter foraging by lynx and coyotes from southwestern Yukon during an increase in snowshoe hare abundance. (1991)
BSc (Agr.) Food and density effects in northern populations of larval wood frogs. (1987)

PROFESSIONAL INTERESTS
Conservation biology; Population dynamics; Behavioural ecology; Landscape ecology; Wildlife management
Predator-prey interactions; Host-parasite interactions; Plant-herbivore interactions
Population modeling; Population viability analysis; Survival analysis; Density dependence assessment; Timeseries analysis
Integrating individual attributes (i.e., diet, condition, behaviour, genetics) and population processes (i.e., habitat occupancy, extinction/colonization)
Direct, indirect, interactive and nonlinear effects

PROFESSIONAL MEMBERSHIPS
Canadian Society for Ecology and Evolution
The Wildlife Society
PROFESSIONAL EXPERIENCE
Canada Research Chair (Tier I) and Professor, Trent University. Appointment: 65% research, 15% teaching, 20% service/administration (2014-2021)
Adjunct Professor, Department of Biological Sciences, University of Manitoba. (2012-present)
Professor, Trent University. Appointment: 40% teaching, 40% research, 20% service (2012-present)
Canada Research Chair (Tier II) and Associate Professor, Trent University. Appointment: 60% research, 20% teaching, 20% service/administration (2002-2012; renewed in 2007)
Associate Professor, University of Idaho. Appointment: 45% teaching, 45% research, 10% service (2001-2002)
Acting Department Head, University of Idaho. (May-June 2001)
Assistant Professor, University of Idaho. Appointment: 45% teaching, 45% research, 10% service (1996-2002)
Lecturer and Post-doctoral Fellow, University of Massachusetts. Appointment: 70% teaching, 20% research, 10% service (1995-1996)
Teaching Assistant, University of Wisconsin (1994-1995)
Teaching Assistant, University of Alberta (1987-1991)
Research Assistant, McGill University (1986-1987)

AWARDS
Canada Research Chair (Tier I) – Integrative Wildlife Conservation (2014-21)
Merit award, Trent University (2009)
Discovery Accelerator Supplement, NSERC (2008)
Merit award, Trent University (2006)
Merit award, Trent University (2004)
Canada Research Chair (Tier II) - Terrestrial Ecology (2002, renewed 2007)
Alumni Award for Excellence in Mentoring, University of Idaho (2001)
Outstanding Academic Advisor, College of Natural Resources, University of Idaho (2001)
Outstanding Researcher, College of Forestry, Wildlife, and Range Sciences, University of Idaho (1999)
Outstanding Undergraduate Thesis, Department of Biological Sciences, McGill University (1987)

2. PUBLICATIONS AND INVITED SPEAKING ENGAGEMENTS

REFEREED PUBLICATIONS
Bolded names for Highly Qualified Personnel under my direct supervision when the work was conducted.

a I supervised or co-supervised the student and was involved in all aspects of the work; b I was primarily involved with all aspects of the work; c I supported all aspects of the work; d I supported select aspects of the work; e I was primarily responsible for select portions, usually data analysis and study concept and design

2015 or in press

regional core-periphery gradient for prairie breeding ducks. *Global Ecology and Biogeography*

116. **Ferreira, C.** *PDF*, **Bastille-Rousseau, G.** *PhD*, **Bennett, A.M.** *PhD*, **Ellington, E.H.** *PhD*, **Terwissen, C.** *MSc*, **Austin, C.** *MSc*, **Borlestea, A.** *MSc*, **Boudreau, M.** *MSc*, **Chan, K.** *MSc*, **Forsythe, A.** *BSc*, **Hosse, T.** *PDF*, **Landolt, K.** *PhD*, **Longhi, J.** *MSc*, **Otis, J.A.** *MSc*, **Peers, M.J.L.** *MSc*, **Rae, J.** *MSc*, **Seguin, J.** *BSc*, **Watt, C.** *MSc*, **Wehtje, M.** *PhD*, **Murray, D.L.** 2015. The evolution of peer review as a basis for publication in ecology: Directional selection towards a robust discipline? *Biological Reviews* DOI: 10.1111/brv.12185.


2014


2013

99. Abele, S.L. MSc, **Wirsing, A.J.** MSc, and **Murray, D.L.** 2013. Precommercial forest thinning alters abundance but not survival of snowshoe hares. *Journal of Wildlife Management* 77:84-92.a

98. **Bennett, A.M.** PhD, **Pereira, D.** BSc, and **Murray, D.L.** 2013. Investment into defensive traits by anuran prey (*Lithobates pipiens*) is mediated by the starvation-predation risk trade-off. *Public Library of Science (ONE)* e82344a.1


96. Terwissen, C.V. MSc, Mastromonaco, G.F., and **Murray, D.L.** 2013. Influence of adrenocorticotrophin hormone challenge and external factors (age, sex, and body region) on hair cortisol concentration in Canada lynx (*Lynx canadensis*). *General and Comparative Endocrinology* 194:162-167a.1


93. **Ellsworth, E.** PhD, **Wirsing, A.J.** Other, Shipley L., **Murray, D.L.** 2013. Do measures of plant intake and digestibility from captive feeding trials align with foraging patterns of free-ranging snowshoe hares. *Wildlife Research* 40: 349-357. a.5

91. **Pickles, R.S.A.** PDF **Thornton, D.H.** PDF, **Feldman, R.** PDF, **Marques, A.** BSc, and **Murray, D.L.** 2013. Predicting shifts in parasite distribution with climate change: a multitrophic level approach. *Global Change Biology* 19: 2645-2654a.1


2012

88. **Peers, M.J.L.** BSc, **Thornton, D.H.** PDF, and **Murray, D.L.** 2012. Reconsidering the specialist-generalist paradigm in niche breadth dynamics: Canada lynx and bobcats. *Public Library of Science (One)* 7(12): e51488.a

86. **Thornton, D.H.**[PDF], **Wirsing, A.J.**[Other], **Roth, J.R.**[PDF], and **Murray, D.L.** 2012. Complex effects of site preparation and harvest on snowshoe hare abundance across a patchy forest landscape. *Forest Ecology and Management.* 280:132-139.a


80. **Murray, D.L., Hussey, K.F.**[MSc], **Finnegan, L.**[PDF], **Lowe, S.**[MSc], Price, G., Benson, J., Loveless, K., Middel, K., **Mills, K.**[MSc], Potter, D., Silver, A., Fortin, M.-J., Patterson, B., and Wilson, P.J. 2012. Assessment of the status and viability of a moose population at its range limit in southern Ontario. *Canadian Journal of Zoology* 90: 422-434.b

79. **Wirsing, A.J.**[Other], **Phillips, J.**[MSc], Obbard, M., **Murray, D.L.** 2012. Incidental nest predation in freshwater turtles: inter- and intraspecific differences in vulnerability are explained by relative crypsis. *Oecologia* 168: 977–988.a

2011


2010


2009


2008


2007


2006


2001


2000


Prior to 2000


Authored by High Quality Personnel while in my lab

Students may undertake work that is outside the direct scope of their thesis. My policy is to decline co-authorship unless I have contributed significantly to each of the following: concept, design/analysis, funding, and writeup. I have provided only normal guidance, editing and funding to the following papers emanating from my lab, and thus I declined co-authorship when it was offered:


4. McIntosh, T. PhD, Rosatte, R., Campbell, D., Welch, K., Fournier, D., Spinato, M., and Ogunremi,


**PEER-REVIEWED BOOK CHAPTERS**


**PEER-EDITED PUBLICATIONS**


**BOOKS IN PREPARATION**


**INVITED SEMINARS** (since 2000)

2015. Alliance of Canadian Comprehensive Research Universities (ACCRU), Ottawa, ON; 2014. Ecological Society of America, Sacramento, CA; 2013. University of Toronto, Scarborough, ON; 2012. University of Maine, Orono, ME; York University, Toronto, ON; University of Toronto, Scarborough, ON; 2011. University of Washington, Seattle, WA; Paul Smiths College, Saranac Lake, NY; Northern Furbearer Conference, Whitehorse, YT (keynote); Laurentian University, Sudbury, ON; 2010. University of Toronto, Toronto, ON; 2009. Grimsö Research Station, Lindesberg, Sweden; 2008. Yellowstone National Park, Mammoth, WY; University of Manitoba, Winnipeg, MB; 2007. University of Guelph, Guelph, ON; Kansas State University, Manhattan, KS; 2006. University of Alberta, Edmonton, AB; Ducks Unlimited, Winnipeg, MB; The Wildlife Society annual meeting, Anchorage, AK; 2004. The Wildlife Society annual meeting, Calgary, AB; University of Toronto, Scarborough, ON; Carleton University, Ottawa, ON; 2002. Idaho Fish and Game Commission meeting, McCall, ID; Annual Western Forest Carnivore Meeting. Spokane, ID; Utah State University, Logan, UT; U.S. Forest Service Forest Management, Missoula, MT; Trent University, Peterborough, ON; Carnivore Management Workshop, Banff, AB; 2000. University of Nevada, Reno, NV

3. **TRAINING OF HIGHLY-QUALIFIED PERSONNEL**

**POST-DOCTORAL FELLOWS**

**Current**

Thomas Hossie. Amphibian population ecology. (2014)

Catarina Ferreira. Carnivore population dynamics and source-sink dynamics (2013)

**Completed**

Robert Pickles¹. Projecting moose responses to climate change; tiger conservation in Sumatra (2011-15)


Dan Thornton. Extinction and colonization in snowshoe hares; jaguar movement corridors. (2011-13)

Jeff Row. Evolutionary divergence between lynx and bobcat. (co-supervised with P. Wilson) (2011-13)

Alban Guillaumet. Competition and cyclic attenuation in mesocarnivores. (co-supervised with J. Bowman) (2011-12) Current position: Contract Researcher, Trent University, Montpellier, FR

Céline Gomez. Landscape genetics of lynx. (co-supervised with P. Wilson) (2010)

Current position: Researcher, Institut de Recherche pour le Développement UMR, Lyon, FR

Amanda Sparkman. Life history analysis of red wolves. (2009-11)

Current position: Assistant Professor, Westmont College, Santa Barbara, CA

Laura Finnegan. Landscape genetics of moose. (co-supervised with P. Wilson) (2009)

Current position: Lecturer, Trent University, Peterborough, ON
  Current position: Post-doctoral fellow, University of Prince Edward Island, Charlottetown, PE
Todd Steury. Population viability analysis for recolonizing red wolves. (2005-08)
  Current position: Assistant Professor, Auburn University, Auburn, AB
James Roth. Lynx dietary reconstruction using stable isotope analysis. (2000-01)
  Current position: Associate Professor, University of Manitoba, Winnipeg, MB

GRADUATE STUDENTS – TRENT UNIVERSITY (2002 - present)

Current

Madison Wikston. Environmental DNA as a robust method for amphibian population assessment (MSc, 2015)
Jacob Seguin. Maternal effects of perceived predation risk in juvenile snowshoe hares (MSc, co-supervised with R. Boonstra, 2015)
Shawn MacFarlane. Limb regeneration potential in salamander larvae under predation risk (MSc, co-supervised with L. Kerr, 2014)
Amy Clement. Perceived predation risk in tadpoles under variable stress scenarios. (MSc, 2014)
Morgan Hynryk. Effect of neonicotinoids on tadpoles (MSc, 2014)
Spencer Walker. Direct and indirect effects of climate on moose range recession (MSc, 2014)
Melanie Boudreau3. Snowshoe hare responses to perceived predation risk. (PhD, 2014)
Christa Szumski. Lynx dietary fluctuations from stable isotope analysis. (MSc, co-supervised with J. Roth) (2011)
Morgan Wehtje. Lynx occupancy models and range limitation. (PhD, co-supervised with J. Bowman) (2011)

Completed

Jessica Longhi. Amphibian stress response and predation risk (MSc, co-supervised with L. Kerr, 2013-15)
Kevin Chan. Detecting and modeling animal population cycles. (MSc, 2012-15)
Jason Rae. Tradeoffs between predation and disease risk in tadpoles. (MSc, 2012-15)
Cayla Austin. Chemical cue communication in predator-prey systems. (MSc, 2012-15)
Josée-Anne Otis. Canid species distribution models in eastern North America (MSc, 2013-15)
Michael Peers3. Predicting Canada lynx range shift consequent to climate change. (MSc, 2012-14)
Christine Terwissen. Stress responses in cyclic lynx populations. (MSc, co-supervised with G. Mastromonaco) (2011-2014)
Guillaume Bastille-Rousseau3. Caribou spatial predation risk. (PhD, co-supervised with J. Schaefer) (2010-2014)
Adrian Borlestein. Theta-logistic growth in algal populations. MSc (2010-2014)
Allan Brand. Spatial autocorrelates in moose populations. (MSc, co-supervised with M.-J. Fortin) (2007-10) Current position: Spatial analyst, Montreal, QC
Jean Arseneau. Resource competition among eastern wolves. (MSc, co-supervised with B. Patterson) (2007-10) Current position: PhD candidate, University of Zurich, Zurich, SZ
Tom Hossie. Predator functional response and structural cover. (MSc, 2007-09)
   Current position: PhD candidate, Carleton University, Ottawa, ON
Josh Holloway. Population ecology of grey wolves. (MSc, co-supervised with B. Patterson) (2005-09)
   Current position: PhD candidate, University of Zurich, Zurich, SZ
Stacey Lowe. Thermal cover use by moose. (MSc, co-supervised with B. Patterson) (2007-09)
   Current position: Biologist, U.S. Fish and Wildlife Service, Anchorage, AK
Tyler Wheeldon. Landscape genetics of eastern wolves. (MSc, co-supervised with B. Patterson) (2007-09) Current position: PhD candidate, Trent University, Peterborough, ON
Nic Robar. Meta-analysis of costs of parasitism. (MSc, co-supervised with G. Burness) (2006-09)
   Current position: Law School, University of Toronto, Toronto, ON
Bastien Ferland-Raymond. Phenotypic plasticity in amphibian tadpoles. MSc (2005-07)
   Current position: Statistician, Environment Canada, Quebec, QC
Julia Phillips. Raccoon predation on turtle nests. MSc (2004-08)
   Current position: Coordinator, Toronto Zoo, Toronto, ON
Ken Mills. Wolf pup survival and dispersal. (MSc, co-supervised with B. Patterson) (2003-06)
   Current position: Biologist, Wyoming Department of Fish and Game, Laramie, WY

1Commonwealth PDF
2Ontario Trillium Scholarship PGS
3NSERC PGS
4Industrial NSERC PGS
5NSERC Paillette PGS

GRADUATE STUDENTS – UNIVERSITY OF IDAHO (1996 - 2009)
Ethan Ellsworth. Snowshoe hare food limitation. PhD (1999-2009; due to my expired standing at University of Idaho, I resigned as Supervisor 6 months prior to degree completion)
   Current position: Biologist, Bureau of Land Management, Ft. Collins, CO
Fernando Azevedo. Jaguar predation on livestock and native prey in Brazil. PhD (2000-06)
   Current position: Professor, Universidade Federal de Sao Joao, Sao Joao, BR
Andrea Kortello. Wolf and cougar spatial relationships in Banff National Park. MSc (2001-05)
   Current position: Biologist, Environment Canada, Banff, AB
Susan Able. Impacts of pre-commercial thinning on snowshoe hare populations. MSc (2000-04)
   Current position: Biologist, The Nature Conservancy, Reno, NV
   Current position: Coordinator, U.S. Fish and Wildlife Service, Albuquerque, NM
   Current position: Biologist, Idaho Department of Fish and Game, Boise, ID
Todd Steury. Territoriality and survival relationships in red squirrels. MSc (1999-2002)
   Current position: Assistant Professor, Auburn University, Auburn, AL
Aaron Wirsing. Demographic analysis of a southern snowshoe hare population. MSc (1999-2001)
   Current position: Associate Professor, University of Washington, Seattle, WA
   Current position: Biologist, National Council for Air and Stream Improvement, LaGrande, OR
UNDERGRADUATE HONOURS STUDENTS - TRENT UNIVERSITY
Jacob Seguin. Snail responses to predation risk. (2014-15)
Adrian Forsythe. Algal population cycles. (2013-14)
Danielle Porplycia. Predator infochemicals as drivers of phenotypic plasticity in algae. (2012-13)
Kyle Yurkiew. Habitat suitability in expanding coyote populations. (2011-12)
Michael Peers. Responses of Canada lynx to bobcat landscape occupancy. (2011-12)
Nicholas Hughes. Predator density and functional response. (2010-11)
Brian Atkins. Functional response of predators to toxic prey. (2009-10)
Thomas Hossie. Stress responses of tadpoles under predation risk. (2006-07)

OTHER PERSONNEL (Since 1996 I have hired >60 undergraduate students and technicians to work either for me, for research teams I directed, or for my graduate students; the list below includes only paid trainees (since 2000) who were employed for >3 months and who fell under my direct supervision; many of these individuals later joined my lab as graduate students)
Michael Peers (2012); Cayla Austin (2012); Danielle Porplycia (2012); Stephanie Barre (2011-12); Teresa Isherwood (2011); Ermina Kusari (2011); Nicholas Hughes (2010); Adrian Borelestan (2010); Brian Atkins (2009); Kristen Landolt (2009); David Pereira (2008); Jennifer Wilcox (2008); Kevin Downing (2008-09); Christine Terwissen (2008); Tom Hossie (2008); Bastien Ferland-Raymond (2007); Dave Ireland (2006-07); Kaitlin Byrick (2006); Aaron Wirsing (2001); Ryan Monello (2000)

4. GRANTSMANSHIP

GRANTS AND CONTRACTS (held since 2000)
Competitive grants
NSERC Research and Technological Instruments (RTI) Snowshoe hare GPS radio-telemetry system. $147,544 (PI with 4 others) (2015)
NSERC CREATE A world-class training program in Advanced Environmental Technologies $1,650,000 (PI with 10 others) (2015-2021)
NSERC (Strategic) Developing eDNA technologies for monitoring amphibians and their pathogens. $596,250 (PI, with 6 others) (2014-2017)
Canada Research Chair in integrative wildlife conservation, bioinformatics, and ecological modeling. $1,400,000 (2014-2021)
Canadian Foundation for Innovation. Infrastructure to support the CRC $165,000 (2014)
NSERC (Discovery) The role of predation in attenuating population cycles. $300,000 (2013-2018)
NSERC (Partnership Workshops Program) Workshop to establish a Furbearer Data Repository. $25,000 (PI, with 3 others) (2011-12) (declined)
NSERC (Strategic) Models predicting lynx population connectivity. $560,250 (PI, with 3 others) (2010-2012)
NSERC – RTI Gamma counter (R. Boonstra et al.) $34,000 (2010)
Ontario Ministry of Research Innovation. PDF salary – Lynx population genetics. $50,000 (with P. Wilson) (2009-2010)
World Wildlife Fund. Wolf and coyote hybrid zone dynamics. $40,000 (2009)
NSERC (Discovery Accelerator Supplement) $120,000 (2008-2010)
NSERC (Discovery). Lynx and eastern wolf range determinants. $175,000 (2008-2012)
NSERC (Strategic Supplement). Lynx landscape genetics in Ontario. $190,000 (P. Wilson et al.) (2008-09)
Canada Research Chair in Terrestrial Ecology (renewal) $500,000 (2007-2011)
Wildlife Conservation Society. Lynx habitat connectivity $16,000 (with M. Hornseth) (2007)
NSERC (Strategic) Modeling moose population dynamics. $559,000 (PI, with 3 others) (2006-2009)
NSERC (internal) Phenotypic plasticity in amphibians. $2,000 (2006)
NSERC (internal) Phenotypic plasticity in amphibians. $2,600 (2005)
NSERC (Discovery). Snowshoe hare responses to parasitism and predation risk. $150,000 (2003-2007)
Canada Research Chair in Terrestrial Ecology $500,000 (2002-2007)
Canadian Foundation for Innovation. Funds to support Canada Research Chair. $150,000 (2002-2005)
Charles DeVlieg Foundation, University of Idaho. Graduate student fellowship $45,000 (declined) (2001)
Wilburforce Foundation. Evaluation of dispersal corridors for northwestern wolf populations. $17,000 (with J. Oakleaf) (2001)
Idaho Commodity Commissions. Predicting vole population irruptions using environmental correlates. $27,000 (2001-2002)
University of Idaho. Demographic analysis of a declining moose population. $10,000 (2000)

Non-competitive awards
Environment Canada. Population viability assessment for sandhill cranes. $5,000
Panthera Conservation. PDF salary – Assessing jaguar dispersal corridors. $55,700 (with D. Thornton) (2012-2013)
Ducks Unlimited Canada, U.S. Fish and Wildlife Service. PDF salary – Traveling waves in duck populations. $92,000 (2011-2012)
Govt. of Newfoundland. PhD stipend - Coyote population ecology. $90,000 (2009-2012)
Govt. of Newfoundland. PhD stipend - Caribou spatial dynamics. $90,000 (with J. Schaefer) (2009-2012)
Ontario Ministry of Natural Resources. Lynx research in Ontario. $90,000 (2008-2010)
Parks Canada. Elk condition assessment. $30,000 (2008)
Govt. of Newfoundland and Labrador. Density dependence assessment in caribou herds. $12,600. (2008)
U.S. Fish and Wildlife Service. PVA funding. $20,000 (2008-2009)
Ontario Federation of Anglers and Hunters. Support for Ontario moose study. $32,000 (2006-2007)
U.S. Forest Service & Idaho Dept. Fish and Game. Snowshoe hare population analysis. $12,500 (2005-2007)
Parks Canada. Raccoon predation on turtle nests. $138,000 (with R. Rosatte) (2004-2006)
Delta Waterfowl. Analysis of carnivore diet breadth and overlap. $9,000 (2001)
Ducks Unlimited, Inc. Analysis of carnivore helminths. $10,000 (with S. Larivière) (2001)
Idaho Department of Fish and Game. Dietary reconstruction of lynx. $4,000 (with J. Roth) (2000)
University of Idaho Agricultural Experiment Station. Vole population ecology. $20,000 (2000-2003)
U.S. Forest Service & Idaho Department of Fish and Game. Snowshoe hare populations. $123,500 (1999-2002)
U.S. Fish and Wildlife Service, U.S. Forest Service, and Idaho Department of Fish and Game. Wolf-ungulate relationships in Idaho. $200,000 (with 4 others) (1999-2001)
Idaho Fish and Game & U.S. Forest Service. Snowshoe hare and red squirrel population ecology. $166,000 (1997-2000)

5. TEACHING

**TEACHING - TRENT UNIVERSITY** (2002-present)

*Graduate-level*

*Predator-Prey Interactions* (2010, 2012, enrolment=5-9)
*Analysis and Interpretation of Ecological Timeseries* (2005, enrolment=2)
*Population and Statistical Modeling* (2003, enrolment=8)

*Upper division*

*Behavioural Ecology* (2004-06, 2009-12, enrolment=50-95)

*Other*

*Current Topics in Biology* (3 guest lectures 2011, enrolment= ~400)
*Honours Thesis* (7 students)
*Undergraduate and Graduate Reading Course* (19 students)

**TEACHING - WORKSHOP**

*Applied Survival Analysis* (this was a week-long workshop I was invited to teach through the Swedish Agricultural University, Grimsö, Sweden; 2009, enrolment=10 graduate students and senior researchers)

**TEACHING - UNIVERSITY OF IDAHO** (1996-2002)

*Graduate-level*

*Fish and Wildlife Seminar* (2000-02, enrolment=20-35)
*Patterns of Prey Selection* (2001, enrolment=9)

*Upper division*
Multispecies Interactions (2000, enrolment=8)
Principles of Population Ecology (2001; enrolment=6)

Lower-division and/or College core curriculum
General Ecology (2001, co-taught, enrolment=95)

Non-major
Honors Colloquium (1998, co-taught, enrolment=12)

Other
Undergraduate and Graduate Reading Course (2003-10, 18 students)

TEACHING - UNIVERSITY OF MASSACHUSETTS (1995-96)
Graduate-level

Lower division
Wildlife Conservation (1996, enrolment=210)
Wildlife Conservation and Management Techniques (1996, enrolment=55)

Non-major
Wildlife and their Environments (1996, co-taught, enrolment=375)
Honors Colloquium (1996, co-taught, enrolment=16)

Other
Special Topics (1996; one undergraduate was taught)

6. SERVICE

EXTRAMURAL COMMITTEES
Kawartha Heritage Conservancy (Board of Directors, 2012-present); Killam Research Fellowship (reviewer, 2012); Kawarths Naturally Connected (Steering Committee member, 2012-present); Canadian Institute of Ecology and Evolution (Scientific Advisory Committee, member, 2012-present); Canadian Foundation for Innovation – LEF and NOI - radio-telemetry (Adjudication committee, member, 2012); NSERC Industrial Research Chair - site visit (Chair, 2011); NSERC GSC-18 / 1503 (Ecology and Evolution) (member, 2009-2011); The Wildlife Society, Predator management review panel (member, 2008-2009); Govt. of Newfoundland and Labrador, Scientific advisory team for caribou population recovery. (member, 2008-present); Committee on the Status of Endangered Wildlife in Canada (COSEWIC) - Terrestrial Mammal subcommittee (member, 2005-2012); World Lagomorph Society (Vice-Secretary, 2006-2012); International Union for the Conservation of Nature (member, IUCN), Lagomorph Specialist Group (member, 2004-present); U.S. Fish and Wildlife Service, Red Wolf Recovery Implementation Team (member, 2000-present); U.S. Fish and Wildlife Service, Mexican Wolf Recovery Plan Technical Sub-Committee (member, 2003-2005); Advisory Team. Carnivore 2000 Conference. (member, 1999-2000)
UNIVERSITY COMMITTEES
Trent University
Biology Research and Graduate Studies (Chair, 2013); Biology Research and Graduate Studies (Chair, 2009-12); Biology Department Chair search (Chair, 2012); NSERC Internal Research Grants and USRA’s (Chair, 2011-2012); Research Policy (member, 2011-2012); EnLS Graduate Program Director search (Chair, 2011); Dean of Graduate Studies search (member, 2010); Schindler Research Chair search (member, 2010); Research Policy (member, 2009); Institutional Post-Graduate NSERC committee (member, 2009); President’s Committee on Strategic Planning (member, 2009); Research Ethics Board (member, 2008-2009); Biology promotion (member, 2008); Biology web page (member, 2002-2005); WEGP Director search (Chair, 2005); WGEF Executive Committee (member, 2003-2006); University Senate (member, 2007); University Senate Executive (member, 2007); Nature Areas (member, 2006); Graduate student committees (currently serve as member on 11 committees other than my own students; served previously on an additional 19 committees; served as external/internal examiner on 13 defences or qualifying exams); Thesis defence or qualifying exam chairperson (11 exams).

University of Idaho
College of Natural Resources Core curriculum (member, 2000); College of Natural Resources Strategic Planning (member, 1999); Natural Resource Ecology and Conservation Biology Program Petitions (member, 1999); Search committee member - Conservation Biologist; Search committee member - Ungulate Ecologist (1999); 3rd year and 5-year review committee (member, 1996-2000); Graduate Applications Committee (member, 1999-2000); Graduate student committees (>15 students).

WORKSHOPS / SYMPOSIA ORGANIZED

EDITORSHIPS
Associate Editor – Frontiers in Population Dynamics (2014-present)
Associate Editor – MDPI Biology (2011-present)
Associate Editor - Wildlife Research (2009-present)
Associate Editor - Ecoscience (2006-present)
Associate Editor - Wildlife Society Bulletin (2003-05)

PEER-REVIEW
I review 8-12 manuscripts/proposals per year for the following:

Journals
Organizations/Institutions
Alberta Conservation Association; Cambridge University Press; Columbia University Press; Canada Research Chairs; Lincoln Park Zoo; National Science Foundation; NSERC; NSERC (Collaborative); Seattle City Light; Prentice Hall Publishers; Sustainable Ecosystems Institute; U.S. Fish and Wildlife Service; U.S. Forest Service; University of Chicago Press; University of Massachusetts (Faculty Fellowship); University College of the Cariboo (Tenure and Promotion)

OTHER EXAMPLES OF SERVICE (since 2000)
Universidad de Castilla-la-Mancha, Ciudad Real, Spain (PhD defence examiner, 2011); Alberta Conservation Association Research Chair (reviewer, 2011); University of Idaho (PhD graduate committee member, 2010-present); University of Alberta (PhD exam committee external member, 2006); Galway-Cavendish and Harvey Aggregate Resources (Steering Committee member, 2004); I have moderated 8-10 oral paper sessions at professional meetings (e.g., American Society of Mammalogists, Society for Conservation Biology); Advised USFWS on population-level requirements for delisting gray wolves (2000, 2007).

PROFESSIONAL DEVELOPMENT COURSES TAKEN
Population Cycle Analysis Workshop (2013); Media communications training (2008); Statistical programming using STATA (2003); Time Series Analysis (2002); Experimental Design (2000); Computer-based Teaching and Learning (1999); Distance Education (1998); Teaching Creative Thinking Skills (1997)

EXAMPLES OF PUBLIC OUTREACH (since 2000)
Interviewed on CBC Metro Morning (2012); Post-doctoral fellow (Amanda Sparkman) interviewed for CBC Quirks and Quarks (2010); Lecture for Centre of Knowledge in the Environment Fundraiser, Peterborough, ON (2009); Lecture for Mountain Gorilla Fundraiser, Peterborough, ON (2009); Lecture for Algonquin Provincial Park stakeholders, Whitney, ON (2006); Lecture for South Simcoe Federation of Ontario Naturalists, Georgina, ON, Canada (2002); Interviewed for commentary articles in Science, Canadian Geographic, Toronto Star, Natural History, and many local newspapers and radio stations.
Curriculum Vitae

BENJAMIN N. SACKS
(6/30/2015)

Dept. Population Health and Reproduction 1305 Chestnut Lane
Veterinary Genetics Laboratory Davis, CA 95616
University of California, Davis 530-792-1537
One Shields Avenue/Old Davis Rd. bnsacks@ucdavis.edu
Davis, California 95616-8744 USA
530-754-9088
URL: http://www.vgl.ucdavis.edu/cdcg/home.php

EDUCATION

1991 B.S. Biology. University of Maryland, College Park, MD.

ACADEMIC POSITIONS

2014– present Associate Adjunct Professor, Dept. of Population Health and Reproduction, University of California, Davis.
2008– 2014 Assistant Adjunct Professor, Dept. of Population Health and Reproduction, University of California, Davis.
2008– present Director, Mammalian Ecology and Conservation Unit, Veterinary Genetics Laboratory, University of California, Davis.
2007–2010 Assistant Professor, Dept of Biological Sciences, California State University, Sacramento.
2006–2007 Assistant Project Scientist, Director, Canid Diversity and Conservation Project, Veterinary Genetics Laboratory, University of California, Davis.
2005–2006 Assistant Project Scientist, Wildlife and Ecology Research Unit, Veterinary Genetics Laboratory, University of California, Davis.
2002–2005 Post-Doctoral Researcher, ecological genetics, Wildlife and Ecology Research Unit, Veterinary Genetics Laboratory, University of California, Davis.

PEER-REVIEWED JOURNAL PUBLICATIONS


In Press   Safra N, Hayward LJ, Aguilar M, Sacks BN, Westropp JL, Mohr FC, Mellersh CS, Bannasch DL. In Press. DNA sequence variants in the five prime untranslated region of the Cyclooxygenase-2 gene are commonly found in healthy dogs and gray wolves. *PLoS ONE*


Sacks, Benjamin N.


commercially available enzyme-linked immunosorbent assay for *Dirofilaria immitis*. *Veterinary Parasitology* 109:45-58.


Sacks, Benjamin N.

PUBLICATIONS SUBMITTED OR IN REVISION


Goddard NS, Statham MJ, Sacks BN. Mitochondrial analysis of the most basal canid reveals deep divergence between eastern and western North American gray foxes (Urocyon spp.) and ancient roots in Pleistocene California. PLOS ONE (submitted 3/12/2015; revision submitted 5/1/2015; more iacuc added 5/27/2015!!)


TECHNICAL REPORTS

In Press Sacks, B.N. In Press. Sacramento Valley red fox, Vulpes vulpes patwin. Species Account in California Mammal Species of Special Concern, California Department of Fish and Wildlife.


Sacks, Benjamin N.


GRANTS AND AWARDS


2013–2014 California Department of Fish and Wildlife, Northern Region. Identification of Sierra Nevada red foxes and other forest mammals from fecal DNA. PI: B. N. Sacks. ($9,990).


2012–2013 **California Department of Fish and Wildlife**, Northern Region. Identification of Sierra Nevada red foxes and other forest mammals from fecal DNA. PI: B. N. Sacks. ($9,975).


2009 **Student Undergraduate Research Experience (SURE):** College of Natural Sciences and Mathematics, California State University, Sacramento. The Genetic Origin of the Saluki. PI: B.N. Sacks, Undergraduate mentee: Kristin Ahrens. ($5,000).


2008–2009 **California Department of Fish and Wildlife**, Northern Region. Identification of Sierra Nevada red foxes and other forest mammals from fecal DNA. PI: B. N. Sacks. ($9,880).


2008 **UC Davis Genome Center Core Facility Pilot Project Grant**. Red fox SNP assay development. PI: B. N. Sacks. ($2,000)
Sacks, Benjamin N.

2008 **Biological Survey grant of the Goethe Bequest.** A SNP assay to survey the genomic diversity of native Sacramento Valley red foxes relative to native foxes and nonnative red foxes. PI: B. N. Sacks. ($2,500).

2008 **Project Grant, College of Natural Sciences and Mathematics,** California State University, Sacramento Undergraduate research: Use of noninvasive genetic sampling to directly assess inbreeding in native Sacramento Valley red fox foxes. PI: B.N. Sacks, Undergraduate intern: Deborah Lytle ($500).


WILDLIFE PROFESSIONAL TRAINING WORKSHOPS


Oregon Cascades Sierra Nevada red fox multiagency workshop, Leader: B.N. Sacks, Hosted by USDA/Forest Service, Deschutes National Forest, Bend, OR and Crater Lake National Park, 14-16 July 2014.

INVITED PROFESSIONAL PRESENTATIONS


2014 Yosemite National Park Sierra Nevada red fox workshop, El Portal, California. “Natural history of the Sierra Nevada red fox and allies and the importance of National Parks” (10/15/2014)

2014 Oregon Cascades Sierra Nevada red fox multiagency workshop, Bend, OR “Sierra Nevada red fox in Oregon: What do we know? What do we need to know?” (7/14/2014).

PROFESSIONAL PRESENTATIONS AND ABSTRACTS


Sacks, Benjamin N.


2015 1/29/2015 “A report on occupancy estimates, range extent, and habitat use for the Sierra Nevada red fox (Vulpes vulpes necator), coyote (Canis latrans), and the American marten (Martes americana) in the eastern Sierra Nevada.” Stermer CJ, Quinn C, Fien K, Furnas B, Sacks BN. Western Section of the Wildlife Society Annual Conference (Jan 26-30, 2015), Santa Rosa, CA.


2015 5/2/2015 “Native versus nonnative origins of red foxes (Vulpes vulpes) in the Great Basin” Alden PB, Lounsberry ZL, Statham MJ, Sacks BN. 16th Bay Area Conservation Biology Symposium (5/2/2015), Berkeley, CA.


2015 5/2/2015 “The role of inbreeding depression in limiting reproductive output of Sierra Nevada red fox” Quinn CB, Sacks BN. 16th Bay Area Conservation Biology Symposium (5/2/2015), Berkeley, CA.
<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Title</th>
<th>Authors</th>
<th>Conference/Meeting</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>8/14/2014</td>
<td>“Using a species distribution model to evaluate habitat occupancy by the native Sacramento Valley red fox.”</td>
<td>Miles K, Alden PB, Holtz MN, <strong>Sacks BN</strong>.</td>
<td>Ecological Society of America, Annual Meeting (Aug 10-15, 2014), Sacramento, CA</td>
</tr>
<tr>
<td>2014</td>
<td>8/14/2014</td>
<td>“Preliminary results from the range-wide population genetics study of the endangered salt marsh harvest mouse (Reithrodontomys raviventris).”</td>
<td>Statham M, Barthman-Thompson L, Estrella S, Fresquez S, Hernandez L, Reponen S, Tertes R, <strong>Sacks BN</strong>.</td>
<td>Western Section of the Wildlife Society Annual Conference (Jan 29-31, 2014), Reno, NV.</td>
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2014 “Density and sex ratio estimates of Columbian black-tailed deer (Odocoileus hemionus columbianus) in the Mendocino National Forest from fecal DNA.” Lounsberry ZT, Forrester TD, Olegario MT, Wittmer HU, Sacks BN. Western Section of the Wildlife Society Annual Conference (Jan 29-31, 2014), Reno, NV.


2013 “Determining haplotype diversity of modern North Pacific albatross using ancient and historic DNA Cytochrome b and D-loop sequences.” Nisan D, Sacks BN,
Abstract and presentation for UC Davis 24th Annual Undergraduate Research, Scholarship & Creative Activities Conference (Apr 26-27, 2013), Davis, CA.

2013

2013

2013
“A Dog’s Tale: Understanding the Role of Dogs in the Kotzebue Sound Region of Alaska through Ancient DNA and Stable Isotopes (Poster presentation).” Green S, Brown SK, Darwent CM, Eerkens LW, Sacks BN. Abstract for 78th Annual Meeting of the Society for American Archaeology (Apr 3-7, 2013), Honolulu, HI.

2013

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2012
Sacks, Benjamin N.

Annual Conference: Northern People and Landscapes in Times of Change (Feb 29-March 4), Seattle, WA.

2012

2012
“Evidence for the persistence of the native cascade red fox (Vulpes vulpes cascadensis) in southern Washington: preliminary results.” Akins J, Statham MJ, Reid M, Aubry KB, Sacks BN. 2012 Western Section of the Wildlife Society Annual Conference, Sacramento, CA.

2011

2011

2011

2010

2010

2009

2009

2009
“Reconstructing the evolution and geographic spread of early domestic dogs” Carnivores 2009 conference, Denver, CO; November 15-19, 2009; Brown SK, Pedersen NC, Sacks BN.

2009
“Confirming the identity of suspected predators of fishers through molecular techniques” Carnivores 2009 conference, Denver, CO; November 15-19, 2009; Wengert GM, (+12 co-authors), Sacks BN.

2009
Sacks, Benjamin N.

2009  “Occurrence of pathogens in fishers throughout their range” Carnivores 2009 conference, Denver, CO; November 15-19, 2009; Gabriel MW, (+13 co-authors), **Sacks, BN**


2009 “Use of nuclear DNA microsatellites to determine evidence of interbreeding between the native Sacramento Valley red fox and the nonnative red fox.” Moore M, Brown S, Statham M, Wittmer H, **Sacks B**. 2009 Western Section of the Wildlife Society Annual Conference, Sacramento, CA.


2009 “The geographic spread of early dogs in Island South East Asia.” Brown S, **Sacks BN**, Pedersen NC; Fourth International Biogeography Society Conference, Merida, Mexico.


2008 “Native red foxes in the Sacramento Valley: Research update and implications” Western Section of the Wildlife Society Annual Conference, Redding, CA. **Sacks BN**, Wittmer H

2008 “Assessing the conservation status of the native Sacramento Valley red fox” Western Section of the Wildlife Society Annual Conference, Redding, CA. Wittmer H, **Sacks BN**.

2007 “Is the Sacramento Valley red fox an overlooked native population?” Wildlife Society, Western Section Annual Conference, Monterey, CA. **Sacks BN**.


PUBLIC TALKS FOR COMMUNITY OUTREACH


2011 Student and Landowner Education and Watershed Stewardship (SLEWS) program administered by the Center for Land-Based Learning. “Natural history of the Sacramento Valley red fox.” (3/15/11)

2011 Winters Rotary Club “Using genetic tools to reconstruct the history and status of California’s red fox populations.” (4/22/10)
Sacks, Benjamin N.

2009  Yolo Flyways Lecture Series “The Sacramento Valley red fox (Vulpes vulpes ssp. nov.)” (12/3/09)
2008  California Parks Conference, Lake Tahoe.”History and current research on California red fox populations: Disentangling the roles of biogeography and human introductions.” (4/2/08)

FILM AND RADIO INTERVIEWS

2011  “Bali—Island of the dogs.” (Interview in documentary film by L. Blair).
2007  “The Diversity of Life, part 2: Migration.” Natural History Museum of Los Angeles County (Interview in documentary film By P. Kirby)

TEACHING

University of California, Davis

Introduction to Forensic Science (Lecture Spring 2015)
Applications of Next Generation Sequencing technology for Conservation Biology. Advanced Topics in Conservation Genetics (Fall 2013)
Changing Patterns of Vector-borne Infections. (Annual lectures, fall 2008–2012)
Population Genetics software. Advanced Topics in Conservation Genetics (Fall 2012)
Genetics of Small populations. Advanced Topics in Conservation Genetics (Fall 2011)
Genetics of hybrid zones. Advanced Topics in Conservation Genetics (Spring 2010)
Noninvasive genetic methods for wildlife populations. Advanced Topics in Conservation Genetics (Spring 2009)

California State University, Sacramento

Field Methods in Conservation Biology (Spring 2009)
Mammalogy (Spring 2008)
General Ecology (Fall 2007, Spring 2008, Spring 2009)

Off-Campus Invited Lectures

Sacks, Benjamin N.

2012 California State University Sacramento. Ecological and Environmental Issues seminar at (lecture topic: Natural history of the Sierra Nevada red fox)

UC DAVIS GRADUATE GROUP MEMBERSHIP

2011–present Forensic Sciences Master’s Program
2010–present Genetics
2010–present Animal Biology
2008–present Ecology
2008–2014 Comparative Pathology

CURRENT ADVISEES

Project Scientist
Dr. Mark Statham (2010–present; Post-doc 2007-2010)

Post-doctoral scholars
Dr. Sarah Brown (2011–present; co-advise with Christyann Darwent, UC Davis, Anthropology)
Dr. Karin Norén (2011–present; co-advise with Anders Angerbjörn, Stockholm University)

INTERNATIONAL DISSERTATION OPPONENT

2012 Invited Faculty Opponent at Ph D dissertation defense. Dept. Gene Technology, KTH Royal Institute of Technology (Sweden)
2010 Invited Faculty Opponent at Ph D dissertation defense. Board of Natural Sciences, Stockholm University (Sweden)

EXTERNAL DISSERTATION EXAMINER

2012 External dissertation examiner (Faculty reviewer) University of Pretoria (South Africa)
2011 External dissertation examiner (Faculty reviewer) University of Western Australia

VISITING SCHOLARS HOSTED
Professor Shannon Datwyler, (Sabbatical Fall 2011, California State University, Sacramento)
Dr. Lorna Kennedy (Spring 2012, University of Manchester, Centre for Integrated Genomic Medical Research)

CAMPUS ACADEMIC SERVICE

UC Davis

2013–present Graduate Advisor, Ecological Genomics and Genetics Area of Emphasis, Graduate Group in Ecology
2013–present Graduate Advisor Forensic Sciences Masters Program
2012–present Veterinary Genetics Laboratory, Science Advisory Committee
2011–present Forensic Sciences Graduate Group, Membership Committee
2010 Francine Bradley Avian Sciences Awards Committee
2009– present Graduate Group in Ecology, Admissions Committee
2008– present Department of Population Health and Reproduction, Resources Committee
2008–2012 Veterinary Genetics Laboratory, Executive Committee
2002 School of Veterinary Medicine, Wildlife Health Center, competitive grants committee

California State University, Sacramento

2008–2009 Graduate Committee, Dept. Biological Sciences
2008 Science II building planning committee, College of Natural Sciences and Mathematics
2008–2009 Van pool committee Chair, College of Natural Sciences and Mathematics

Extracurricular University Service

2013–2014 Diversity Committee, Graduate Group in Ecology

OFF-CAMPUS ACADEMIC AND PROFESSIONAL SERVICE

Editorial

2012–present Editorial Review Board for Molecular Ecology
2012 Top Reviewer for Molecular Ecology
2012 Associate Editor (Ad-hoc) for Ecological Society of America (Ecology)

Conservation organizations and endangered species reviews

Ahwahnee Lodge, Yosemite National Park
Sacks, Benjamin N.

2013–present International Union for the Conservation of Nature (IUCN)/ Canid Taxonomy and Nomenclature Working Group
2013–present International Union for the Conservation of Nature (IUCN)/ Canid Specialist Group
2012 Review of 90-day findings on the listing petition for the Sierra Nevada red fox (*Vulpes vulpes necator*) for the US Dept. of the Interior, Fish and Wildlife Service

**Conference and meeting organization**

2015 Moderator Conservation Genetics Session of 16th Bay Area Conservation Biology Symposium, Berkeley, CA (5/2/2015)
2013 Co-Chair Session: Ancient DNA and Zooarchaeology, Society for American Anthropology 78th Annual Meeting, Honolulu, HI (4/3-7/13)
2008 Chair of Carnivores session in 2008 Western Section of the Wildlife Society Annual Conference, Redding, CA (2/6/08)
2008 Co-Chair Symposium at the 2008 Western Section of the Wildlife Society Annual Conference, Redding, CA: "Managing California's Native Red Fox: Recent Findings and Implications" (2/6/08)
2004 Co-Chair, Moderator Conservation Genetics Session of Bay Area Conservation Biology Symposium (1/31/04)

**Grant Reviewer**

2015 Natural Sciences and Engineering Research Council (NSERC)
2014 Natural Sciences and Engineering Research Council (NSERC)
2013 Central Valley Project Conservation Program (CVPCP)
2012 Portuguese Foundation for Science and Technology (FCT)
2012 National Geographic Society Research and Exploration Grant
2010, 2013 National Sciences and Engineering Research Council of Canada
2010 University of Crete, Greece
2008 Kansas State University Ecological Genomics Institute

**Book chapter reviews**

Sacks, Benjamin N.


**Journal Reviewer**