

**Thick-billed Parrot (*Rhynchopsitta pachyrhyncha*)
Recovery Plan Addendum**

**Adenda al PACE: “Programa de Acción para la Conservación de las Especies:
Cotorras Serranas (*Rhynchopsitta* spp.)”**



Photo by Jim Rorabaugh

**Including the English translation of the PACE, published by
Mexico’s National Commission of Protected Areas (CONANP) 2009**

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TABLE OF CONTENTS

DISCLAIMER	ii
ACKNOWLEDGEMENTS	iii
EXECUTIVE SUMMARY	1
Actions Needed	5
RESUMEN EJECUTIVO	8
1.0. BACKGROUND	16
1.1. Brief Overview	16
1.2. Description and Taxonomy	18
1.3. Distribution and Habitat Use	18
1.4. Critical Habitat	22
1.5. Life History	22
1.6. Abundance and Trends	26
1.7. Threats	26
1.8. Conservation Measures	38
2.0. RECOVERY STRATEGY, GOAL, OBJECTIVES, CRITERIA	47
2.1. Recovery Strategy and Goals	47
2.2. Recovery Criteria	48
2.3. Actions Needed	51
2.4. Threats Tracking Table (those with an asterisk do not appear in the PACE)	53
3.0. RECOVERY PROGRAM	58
3.1. Outline of Recovery Actions	58
3.2. Narrative of Recovery Actions	63
3.3. Research Needs	63
4.0. IMPLEMENTATION SCHEDULE	64
4.1. Responsible Parties and Cost Estimates	64
4.2. Recovery Action Priorities and Abbreviations	65
4.3. Implementation Schedule	67
5.0. LITERATURE CITED	62
APPENDIX A. Figures Cited in Text	73
APPENDIX B. Thick-billed Parrot Program of Action for the Conservation of the Species: (<i>Rynchopsitta</i> spp.). English translation.	71
I. INTRODUCTION	73

II. BACKGROUND.....	75
III. BIOLOGY, ECOLOGY, AND THREATS.....	78
Species Description	78
Distribution.....	78
Main Threats	87
Habitat Destruction.....	87
Illegal Trade.....	89
Breeding Population	89
Feeding specialization	90
IV. OBJECTIVES.....	91
V. GENERAL GOALS.....	91
VI. GOALS (2012)	91
VII. CONSERVATION STRATEGIES (SUBPROGRAMS)	92
1. Protection	92
2. Management	94
3. Restoration	95
4. Research	96
5. Outreach and Education	98
6. Human and Financial Resources; Partnerships	100
VIII. INDICATORS OF SUCCESS.....	102
IX. TABLE OF PLANNED ACTIVITIES.....	104
X. LITERATURE CITED	116
APPENDIX 1	119
APPENDIX 2.....	120

EXECUTIVE SUMMARY

Current Status of the Species: The thick-billed parrot (*Rhynchopsitta pachyrhyncha*) is listed as endangered throughout its range, including Mexico and the United States (U.S.). The parrot is considered endangered in Mexico by the Norma Oficial Mexicana: NOM-059-SEMARNAT-2010 (Gobierno Federal 2010), and in the U.S. is listed as endangered under the authority of the Endangered Species Act (ESA) (74 FR 33958). Mexico's National Commission of Protected Areas (CONANP) published a recovery plan for thick-billed and maroon-fronted parrots in 2009, entitled the "Programa de Acción para la Conservación de las Especies: Cotorras Serranas (*Rhynchopsitta* spp.)" (hereafter cited as PACE). The PACE guides recovery of the parrot throughout its current range in Mexico. The USFWS is adopting Mexico's PACE for thick-billed parrot recovery and adding an addendum to meet the statutory requirements of the ESA. Together, the PACE and the USFWS addendum form the U.S. recovery plan for the thick-billed parrot. The PACE represents the best available scientific information on thick-billed parrots, and the USFWS supports the strategy for recovering the species set forth in the PACE (Appendix B). The primary focus of the recovery plan addendum is to assist Mexico in recovering the thick-billed parrot within Mexico. The U.S. will be following Mexico's lead on recovering this species, not only because the birds occur in Mexico, but because the USFWS has little authority and limited resources to address threats to listed species outside the country. This binational coordination provides the possibility to share objectives and resources, and the USFWS is grateful to Mexico's CONANP for the opportunity to adopt the Mexican recovery plan (PACE) for the thick-billed parrot.

Historically the thick-billed parrot's range extended as far north as the mountains of southeastern Arizona and possibly southwestern New Mexico, but whether the species ever bred historically in the U.S. has not been confirmed. The last confirmed sighting of a naturally occurring flock in the U.S. was in 1938 in the Chiricahua Mountains of Arizona. Excessive unregulated shooting in the late 1800s and early 1900s likely eliminated thick-billed parrots occurring in the U.S. The parrot's current range is limited to the Sierra Madre Occidental of Mexico, extending from northwestern Chihuahua and northeastern Sonora into Durango and continuing southward into Jalisco, and east through the Transvolcanic Belt of Colima and Michoacán. The northern-most breeding area is Mesa de las Guacamayas, located approximately 80 kilometers (km) (50 miles [mi]) south of the U.S./Mexico border. The recovery priority number for the thick-billed parrot is a 5C, indicating a high degree of threat, a low recovery potential, and the taxonomic classification of a species. Critical habitat has not been proposed for the thick-billed parrot.

This addendum to the PACE describes the species' historical occurrence in the U.S. and presents additional information required by U.S. recovery planning policy. Recovery actions identified herein are focused primarily on conservation within the current range of this species in Mexico (as guided by the PACE) and to a lesser degree on the potential for expansion into areas of its historical range. We also summarize information from the PACE as well as incorporate supplemental information from scientific literature and U.S. and Mexican biologists regarding the status of and threats to the thick-billed parrot, and recommend actions for addressing these threats and evaluating recovery.

Habitat Requirements, Threats, and Limiting Factors: Thick-billed parrots are long-lived, gregarious, and form social groups; therefore, parrots revisit preferred forest areas over time. Furthermore, thick-billed parrots migrate seasonally from their primary breeding (summering) grounds in Chihuahua and northwestern Durango to wintering areas farther south, possibly travelling $\geq 1,000$ kilometers (621 miles). As of 2012, the population of thick-billed parrots in the wild was estimated at 2,097 individuals, across 5 breeding areas; however, this is likely an underestimate. The small populations of parrots concentrated in fewer sites, combined with the low number of breeding pairs in the remaining mature and old-growth forests, have made thick-billed parrots vulnerable to stochastic events.

Thick-billed parrot populations have experienced significant historical declines, corresponding to loss of mature and old-growth conifer forests in the Sierra Madre Occidental. Loss of habitat has been primarily driven by extensive logging of large mature pines since the early 1940s, removal of nesting snags, and to a lesser degree, high-intensity forest fires. Large areas of old-growth forest are no longer found in the Sierra Madre Occidental, and as the available conifer forest decreases, so do parrot nesting sites and food resources. For thick-billed parrots, habitat destruction and fragmentation remain major threats.

These old-growth forests within the parrot's range evolved with frequent surface fires. By the mid-20th century the natural occurrence of fires had been disrupted due to heavy livestock grazing. The lack of frequent fires and resulting increased fuel loads have resulted in atypical high-intensity wildfires. In Mexico, from 2004 to 2008, 3,947 hectares (9,753 acres) of forest habitat within the thick-billed parrot's range were destroyed by wildfire. Climate change may be a threat to the parrot, by not only increasing fire frequency and intensity, but also by reducing available habitat and food resources as a result of predicted warmer and drier conditions.

The removal of birds from the wild for the illegal pet trade remains a threat to the species. In 2008, Mexico banned the capture and export of all native parrots, and the species is listed in CITES Appendix I.

Recovery Strategy: The thick-billed parrot has been absent from the U.S. for over 70 years and now only occurs in Mexico. Thus, the focus of recovery conservation actions should occur in Mexico. Since the mid-1990s, conservation organizations and the Mexican government have been implementing conservation actions focused on research, monitoring, and protection of key breeding areas. Furthermore, as part of a federal initiative, Mexico convened a group of parrot experts and in 2009 published a recovery plan (the PACE) addressing both the maroon-fronted and thick-billed parrots. The focus of the PACE (CONANP 2009) is on extant populations of the thick-billed parrot; it does not address thick-billed parrot historical records or historical range in the U.S.

Therefore, our approach in this Addendum to the PACE is to:

- Summarize information on thick-billed parrot's historical occurrence in the U.S.;
- Synthesize or reference information (when feasible) from the PACE to formulate recovery planning components as are required by the ESA;
- Incorporate supplemental information received from Mexico and U.S. partners since publication of the PACE;

- Identify broad actions necessary to address conservation of the species within its U.S. historical range;
- Identify partnerships and opportunities to facilitate recovery of extant populations.

To accomplish the recovery of the thick-billed parrot, the recovery strategy has five key elements:

- 1) protect existing populations and their habitat;
- 2) survey, monitor, and research the population and habitat;
- 3) manage habitat for future thick-billed parrot population growth;
- 4) reduce or eliminate threats, such as illegal trade, timber harvesting, and high-intensity fire; and,
- 5) build partnerships and educate the public.

These elements are covered in the PACE and updated in the Addendum. Understanding needs for feeding, breeding, watering, roosting, migrating, and wintering are integral to developing conservation actions for recovering the species. Protecting, maintaining, and enhancing old-growth and mature forests used by thick-billed parrots is key to recovery. Implementing strategies to minimize the threat of high intensity fires are needed, including restoring frequent surface fires (through fire management) that prevent the accumulation of fuels. Although actions to conserve remaining mature and old-growth forests from timber removal are ongoing in Mexico under the PACE, incentives for local communities to further conserve habitat would benefit the thick-billed parrot.

Conservation actions in the U.S. include maintaining forested habitat in southeastern Arizona and southwestern New Mexico for potential use by parrots dispersing north from the Sierra Madre Occidental, and preventing illegal trade of thick-billed parrots into this country. To the extent practicable, the USFWS will offer technical expertise and financial opportunities through established programs working to conserve habitat and support the persistence and expansion of Mexican thick-billed parrot populations. Recovery progress will be monitored and recovery tasks may be revised by the USFWS in coordination with Mexican partners as new information becomes available.

Recovery Goals: The intermediate goal of this recovery plan addendum is to downlist the thick-billed parrot from endangered to threatened status. The long-term goal is to recover and delist the thick-billed parrot. Once more biological information is obtained, the USFWS can develop appropriate delisting criteria to recover the species.

Recovery Criteria: Recovery criteria for downlisting focus on conserving populations and breeding habitat, locating and conserving wintering habitat in Mexico, and managing threats of illegal timber removal and parrot trade. Recovery criteria for delisting are difficult to establish due to the lack of information. Some general preliminary recommendations are outlined below. As additional data are obtained, more specific delisting recommendations could be developed.

Downlisting Criteria: The downlisting criteria are based on the recovery actions in the PACE, with additional contributions from Mexican and U.S. biologists. Some of the criteria address more than one recovery action in the PACE.

The thick-billed parrot should be considered for downlisting to threatened status when all of the following conditions have been met:

Demographic Criteria:

- 1) A self-sustaining population of thick-billed parrots is maintained, sufficient to ensure the species' survival and to address threats of small population size, such as demographic and genetic stochasticity. A stable or increasing trend over a 20 year period is documented in at least 5 known wild thick-billed parrot breeding populations. (Factors A, B, C, D, E)

Threats-based Criteria:

- 1) Sufficient thick-billed parrot habitat (patch size, forest composition and structure, distribution) is conserved (protected, managed, and restored) that includes foraging, breeding, and wintering habitat to ensure the species' survival despite environmental alteration and the threat of climate change. (Factors A, D, E)
 - a) A long-term, thick-billed parrot habitat conservation plan (encompassing the current range of the species in Mexico) is completed and implemented, based on sound science, species expert knowledge, and predicted effects of climate change. The habitat conservation plan provides goals for a) the location, size, and spatial distribution of thick-billed parrot habitat; b) forest composition, structure, and future forecasted changes due to climate change; and c) guidelines for forest management plans of the Sierra Madre Occidental. (Factors A, D, E)
 - b) Breeding areas are conserved for the foreseeable future through protected status designation, Units for the Management and Wildlife Conservation (UMAs), voluntary landowner cooperatives, land purchase, long-term conservation easements, acquisition of lumbering rights, or other mechanisms. (Factors A, D, E)
 - i) Core Areas (nesting, drinking, roosting, and perching sites) for at least five known breeding areas, such as Mesa de las Guacamayas, Madera, Tutuaca, Papigochic, and Campo Verde, are permanently conserved. (Factors A, D, E)
 - ii) At least an additional four known breeding areas and two suspected breeding areas are assessed for conservation potential in the states of Chihuahua and Durango. (Factors A, D, E)
 - iii) At least three breeding areas are placed under effective conservation schemes. (Factors A, D, E)
 - c) The wintering range for at least five breeding populations is verified and mapped, and those areas are conserved for the foreseeable future through protected status designation, Units for the Management and Wildlife Conservation (UMAs), voluntary landowner cooperatives, land purchase, long-term conservation easements, acquisition of lumbering rights, or other mechanisms. (Factors A, D, E)

- i) Currently designated protected areas within the winter range (with significant numbers of verified thick-billed parrot occurrence) are mapped and conserved (protected, managed, and restored) (CONANP 2009). (Factors A, D, E)
 - ii) An assessment for at least three other wintering areas with thick-billed parrot occurrence is completed and placed under effective conservation schemes. (Factors A, D, E)
- 2) Illegal timber harvesting, tree clearing, and high-intensity wildfires in thick-billed parrot habitat have been reduced to the point that they are no longer threats to thick-billed parrots. (Factors A, D, E)
 - 3) Threats of illegal collecting and poaching of thick-billed parrots for the pet trade have been reduced to the point that they no longer impact thick-billed parrots. (Factors B, D)

Delisting Criteria: Delisting criteria for the thick-billed parrot have not been established due to the lack of information concerning population status, biology, and specific habitat requirements. Further research is needed to recommend additional recovery tasks and measures, and to establish delisting criteria to determine that the species is no longer in danger of extinction throughout all or a significant portion of its range and no longer likely to become endangered in the foreseeable future (fully recovered). Considering the loss of suitable habitat and length of time needed for forest regeneration to attain suitability, low percentage of breeding pairs, and need for habitat conservation, downlisting is unlikely to be reached before year 2050. It is unrealistic to predict the environmental conditions and threats to the species that will prevail at that time. Future revisions of this recovery plan are anticipated, and a goal for removing the thick-billed parrot from the List of Threatened and Endangered Species will be set prior to downlisting.

Actions Needed

Some preliminary recommendations are outlined below, which include more specific tasks than the general recovery actions in the PACE (CONANP 2009) and additional contributions from Mexican and U.S. biologists. Some of the Actions Needed address more than one recovery action in the PACE (CONANP 2009).

Factor A= Habitat modification or loss

- Identify home ranges and migration patterns of reproductive and non-reproductive thick-billed parrot groups during the breeding and non-breeding season and evaluate habitat use and availability.
- Conduct studies on the relationship between food availability, forest altitude and composition, and thick-billed parrot movement and nesting.
- Develop predictive parrot occurrence models such as ecological niche modeling and verify, evaluate, and quantify occurrence sites.

- Characterize the habitat requirements of thick-billed parrots based on all aspects of the species' life history, and develop a habitat suitability model to understand, manage, and restore habitat areas and features for the parrot.
- Complete and implement a long-term thick-billed parrot habitat conservation plan (encompassing the current range of the species in Mexico), based on sound science, species expert knowledge, and predicted effects of climate change. The plan provides goals for a) the location, size, and spatial distribution of thick-billed parrot habitat; b) forest composition, structure, and future forecasted changes due to climate change; and c) guidelines for forest management plans of the Sierra Madre Occidental.
- Permanently protect core areas (nesting, drinking, roosting, and perching sites).
- Identify and map unprotected, occupied breeding and wintering habitat and priority areas within those; evaluate their potential for protection under appropriate conservation schemes (e.g., Wildlife Management and Use Unit (UMAs), voluntary landowner cooperatives, land purchase, long-term conservation easements, acquisition of lumbering rights, or protected area designation).
- Effectively protect, restore, and manage currently designated protected areas within the winter range (with significant numbers of verified thick-billed parrot occurrence).
- Develop (or revise) and implement site-specific forest management plans that incorporate habitat and foraging needs, including longer rotational cycles and maintenance of mature trees, snags, fire management, and current and future states of forest health and vegetation distribution, including climate change scenarios of future potential vegetation.
- Plan and implement prescribed burns where needed to manage thick-billed parrot habitat.
- Assess the potential for the U.S. to support naturally dispersing or actively relocated thick-billed parrots, including a review of U.S. historical habitat, current habitat management, and habitat connectivity with Mexico. Include the need and efficacy of translocating parrots in the assessment, and implement translocations if supported by Mexico and considered appropriate in the assessment.

Factor B= Overutilization

- Reduce illegal collection and poaching of thick-billed parrots by enforcing existing environmental laws, regulations, plans, and policies for parrot protection.
- Emphasize importance of TBPA conservation to the public.

Factor C= Disease or predation

- Formulate a health assessment protocol for wild thick-billed parrot populations to better understand any impact of disease, and mitigate any disease risks.
- Develop effective tests and assess transmission risks for diseases carried by captive thick-billed parrot populations.
- Develop an ectoparasite management plan that identifies effective treatment protocols and control measures to reduce ectoparasite levels in the nest or local environment.

Factor D= Inadequacy of regulations

- Enforce existing laws, regulations, plans, and policies to protect thick-billed parrot habitat from illegal harvesting, clearing, and fires.

Factor E= Other natural or manmade factors

- Develop a statistically sound and peer reviewed parrot monitoring protocol to document population status and trends.
- Conduct a range-wide population survey for the species using standardized peer reviewed methodology.
- Determine the minimum viable population size, temporal and spatial distribution, and number of breeding colonies needed for recovery. Abundance estimates may be accomplished through occupancy surveys and integrating remotely sensed data (metrics of habitat).
- Create climate models predicting future suitable nesting areas and develop strategies that ensure the availability of keystone conifer species for use by thick-billed parrots in forest management plans.

Total Estimated Cost of Recovery

Costs in \$1,000. Priorities defined in 4.2. *Recovery Action Priorities and Abbreviations.*

Year	Priority 1	Priority 2	Priority 3	Total*
2013	501	258	295	1,054
2014	769	266	309.5	1,345
2015	716	255	278.5	1,250
2016	614	249	276	1,130
Total*	\$2,990	\$1,570	\$1,907	\$6,467

*Annual costs do not add up to Total costs because some tasks continue beyond 2016. These additional costs are included in the Total.

Date of Recovery

The date of recovery for the thick-billed parrot is unknown at this time. Additional information is needed before delisting goals can be established. Habitat regeneration is a long-term process and 100 to 300 years may be needed to fully restore habitat. Time estimates for these immediate actions are presented in the Implementation Schedule. Success in the conservation of habitat (protected, managed, and/or restored) during the downlisting period will help determine the remaining effort necessary to reach recovery.

RESUMEN EJECUTIVO

Estado Actual de la Especie: La cotorra serrana occidental (*Rhynchopsitta pachyrhyncha*) está clasificada como en peligro de extinción en todo su rango de distribución, incluyéndose México y los Estados Unidos. En México la cotorra serrana occidental esta enlistada como especie en peligro de extinción en la Norma Oficial Mexicana: NOM-059-SEMARNAT-2010 (Gobierno Federal 2010), y en los EEUU en el Acta de Especies en Peligro de Extinción (ESA por sus siglas en inglés) (74 FR 33958). La Comisión Nacional de Áreas Naturales Protegidas (CONANP) de México publicó un plan de recuperación para las cotorras serrana occidental y serrana oriental (*Rhynchopsitta terrisi*) en 2009 con el título “Programa de Acción para la Conservación de las Especies: Cotorras Serranas (*Rhynchopsitta* spp.)” (De aquí en adelante citado como PACE). El PACE guía la recuperación de la cotorra serrana occidental por todo su rango de distribución actual en México. El USFWS está adoptando el PACE de México para la recuperación de la cotorra serrana occidental y anexando una adenda para cumplir con los requisitos legales del ESA. Juntos, el PACE y la adenda del USFWS forman el plan de recuperación para la cotorra serrana occidental de los EEUU. El PACE representa la mejor información científica disponible sobre las cotorras serranas occidentales, y el USFWS apoya la estrategia para recuperar la especie descrita en el PACE (Apéndice B). El enfoque primario de la adenda es asistir a México en recuperar la cotorra serrana occidental dentro de México. Los EEUU seguirán a México en los esfuerzos de recuperación de esta especie, no solo porque la cotorra ocurre en México, sino también porque el USFWS tiene recursos limitados y poca autoridad para abordar las amenazas a las especies enlistadas fuera de los EEUU. Esta coordinación binacional da la posibilidad de compartir objetivos y recursos, y El USFWS agradece a la CONANP de México por darnos la oportunidad de adoptar el plan de recuperación de México (PACE) para la cotorra serrana occidental.

Históricamente, el rango de distribución de la cotorra serrana occidental se extendía hacia el norte hasta las montañas del sureste de Arizona y posiblemente a las montañas del suroeste de Nuevo México, pero no se ha confirmado si la especie se reproducía históricamente en los EEUU. El último avistamiento confirmado de una parvada de origen natural fue en 1938 en las montañas Chiricahuas de Arizona. La extirpación de la cotorra serrana occidental en los EEUU fue probablemente causada por la cacería excesiva no regulada. El rango de distribución actual de la cotorra está limitado a elevaciones altas de la Sierra Madre Occidental de México, extendiéndose del noroeste de Chihuahua y el noreste de Sonora hacia Durango y continuando hacia el sur hasta Jalisco, y al este por la franja transvolcánica de Colima y Michoacán. El área de anidación más norteña es la Mesa de Guacamayas, ubicada aproximadamente a 80 kilómetros (Km.) (50 millas [mi]) al sur de la frontera entre EEUU y México. El número de prioridad para la recuperación es 5C, indicando un grado alto de amenaza, un potencial bajo para la recuperación, y la clasificación taxonómica como especie. No se ha propuesto Hábitat Crítico para la cotorra serrana occidental.

Esta adenda al PACE describe la ocurrencia histórica en los EEUU y presenta información adicional requerida por los reglamentos de los EEUU sobre los planes de recuperación. Las acciones de recuperación identificadas aquí están enfocadas principalmente en la conservación dentro del rango de distribución actual de esta especie en México (según guiada por el PACE) y en menor parte en el potencial de una expansión hacia áreas dentro de su rango de distribución

histórica. También resumimos la información de la literatura científica y de biólogos de los EEUU y de México con respecto al estado de la cotorra serrana occidental y sus amenazas y hacemos recomendaciones de acciones para enfrentar estas amenazas y para evaluar su recuperación.

Requerimientos de Hábitat, Amenazas, y Otros Factores Limitantes: Las cotorras serranas occidentales son longevas, gregarias y forman grupos sociales; debido a esto, con el tiempo las cotorras vuelven a visitar los bosques que son de su preferencia. Además, las cotorras serranas occidentales migran estacionalmente de sus áreas de anidación (áreas de verano) en Chihuahua y el noroeste de Durango hacia áreas invernales más al sur, posiblemente viajando $\geq 1,000$ kilómetros (621 mi) entre ambas áreas. En 2012, se estimó que la población de cotorras serranas occidentales silvestres contaba con 2,097 individuos abarcando 5 áreas de anidación; sin embargo, este dato probablemente está subestimado. Las pequeñas poblaciones de cotorras concentradas en pocos sitios, combinado con el número bajo de parejas anidantes en los bosques antiguos que aún quedan, significa que las cotorras serranas occidentales son vulnerables a eventos impredecibles.

Las poblaciones de la cotorra serrana occidental han experimentado declives históricos significativos, que corresponde con la pérdida drástica de bosques de coníferas mixtas de elevación alta en la Sierra Madre Occidental. La pérdida de hábitat ha sido principalmente impulsada por la tala extensiva de árboles maduros de pino desde la década de los 1940s, la remoción del arbolado muerto en pie (de uso para nidos), y en menor parte, incendios forestales. Grandes áreas del bosque antiguo ya no se encuentran en la Sierra Madre Occidental, y el bosque de coníferas disponible va disminuyendo y con él los sitios de anidación y la disponibilidad de alimento. Para las cotorras serranas occidentales, la destrucción y fragmentación del hábitat siguen siendo amenazas mayores.

Estos bosques antiguos dentro del rango de la cotorra, evolucionaron con regímenes de incendios superficiales frecuentes. Pero a partir de mediados del siglo 20, la ocurrencia natural de estos incendios ha sido perturbada debido al pastoreo intensivo de ganado. La falta de incendios frecuentes y el subsecuente aumento de cargas de combustible, han originado incendios forestales atípicos de alta intensidad. En México, desde 2004 al 2008 3,947 hectáreas (9,753 acres) de hábitat arbolado dentro del rango de las cotorras serranas occidentales, fueron destruidas por un incendio forestal. El cambio climático puede ser una amenaza para la cotorra, no solo por aumentar la frecuencia e intensidad de los incendios, sino también por presentar condiciones más calurosas y más secas, que pueden reducir el hábitat y la disponibilidad de alimento para las cotorras serranas occidentales.

La remoción de aves silvestres para el comercio ilegal de mascotas ha sido y sigue siendo una amenaza a la especie. En 2008, México prohibió la captura y exportación de todas las cotorras nativas, y la especie está enlistada en el Apéndice 1 del CITES.

Estrategia de Recuperación: La cotorra serrana occidental ha sido extirpada de los EEUU por más de 70 años y ahora solo ocurre en México. Por lo tanto, el enfoque principal para las acciones de recuperación y conservación deben ocurrir dentro de México. Desde mediados de la década de los 1990's, las organizaciones de conservación y el gobierno de México han estado implementando acciones para su conservación basadas en investigación, monitoreo, y la

protección de áreas claves de anidación. Además, como parte de una iniciativa nacional, México convocó a un grupo de expertos de cotorras y en 2009, publicó un plan de recuperación (el PACE) abordando la cotorra serrana occidental y la cotorra serrana oriental. El enfoque del PACE (CONANP 2009) está en la población actual de la cotorra serrana occidental; no aborda los registros históricos de la cotorra serrana occidental ni el rango histórico en los EEUU.

Por lo tanto, el enfoque del USFWS en esta adenda al PACE es:

- resumir la información sobre la ocurrencia histórica de las cotorras serranas occidentales en los EEUU;
- sintetizar o hacer referencia a la información (cuando sea posible) del PACE para formular los componentes de los planes de recuperación requeridos por el ESA;
- incorporar información suplementaria recibida de los socios en México y en los EEUU desde la publicación del PACE;
- identificar acciones amplias para abordar la conservación de la especie dentro del rango histórico de la especie en los EEUU;
- identificar alianzas y oportunidades para facilitar la recuperación de las poblaciones existentes.

Para lograr la recuperación de la cotorra serrana occidental, la estrategia de recuperación tiene cinco elementos claves:

- 1) proteger las poblaciones existentes y su hábitat;
- 2) muestreo, monitoreo, e investigación de la población y su hábitat;
- 3) manejo del hábitat para el crecimiento futuro de la población;
- 4) reducir o eliminar las amenazas, como el comercio ilegal, la tala y los incendios de alta intensidad; y
- 5) construir alianzas y educar al público.

Estos elementos se abordan en el PACE y se actualizan en la adenda. El entendimiento sobre las necesidades de alimento, anidación, agua, perchado, migración, y la temporada no reproductiva es integral para el desarrollo de acciones de conservación que conduzcan a recuperar la especie. La protección, mantenimiento y mejoras de los bosques maduros y antiguos utilizados por las cotorras serranas occidentales es la clave para la recuperación. La implementación de estrategias para disminuir la amenaza de incendios forestales de alta intensidad es necesaria, incluyendo la restauración de un régimen de incendios superficiales frecuentes (por medio del manejo de incendios) que previenen la acumulación de material combustible. Aunque las acciones para prevenir la tala de árboles en los bosques maduros y antiguos restantes continúan en México bajo el PACE; incentivos para las comunidades con el fin de promover aún más la conservación del hábitat sería de beneficio para la cotorra serrana occidental.

Las acciones de conservación en los EEUU incluyen el mantenimiento de hábitat arbolado en el sureste de Arizona y el suroeste de Nuevo México para el uso potencial de las cotorras que se dispersen hacia el norte de la Sierra Madre Occidental y la prevención del comercio ilegal de esta ave en los EEUU. Hasta donde sea posible, el USFWS ofrecerá asistencia técnica y oportunidades de financiamiento por medio de programas existentes para restaurar el hábitat y apoyar la persistencia y expansión de las poblaciones de la cotorra serrana occidental. Los avances en la recuperación serán monitoreados y las tareas de recuperación podrían ser ajustadas

por el USFWS en coordinación con los socios Mexicanos cuando haya nueva información disponible.

Meta de Recuperación: El objetivo a mediano plazo de esta adenda al plan de recuperación, es la reclasificación de la cotorra serrana occidental de *en peligro de extinción a amenazada*. El objetivo a largo plazo es recuperar a la cotorra serrana occidental y su remoción de la Lista de Especies Amenazadas y en Peligro de Extinción bajo el ESA (lista). Una vez que se tenga más información biológica, el USFWS puede desarrollar criterios de recuperación para su remoción de la lista.

Criterios de Recuperación: Los criterios de recuperación para reclasificar a la especie como amenazada se enfocan en proteger el hábitat de reproducción, la localización y protección de hábitat de invierno en México y en manejar las amenazas de tala y comercio ilegal de las cotorras. Los criterios de recuperación para la remoción de la lista son difíciles de establecer debido a la falta de información. Algunas recomendaciones generales preliminares se mencionan abajo. Conforme se obtengan datos adicionales, se podrán desarrollar recomendaciones más específicas para su remoción de la lista.

Los criterios de recuperación para reclasificar a la especie como amenazada: Los criterios de recuperación para reclasificar a la especie como amenazada se basan en las acciones de recuperación del PACE, con contribuciones adicionales de biólogos de México y de los EEUU. Algunos de los criterios atienden a más de una de las acciones de recuperación en el PACE.

La cotorra serrana occidental debe considerarse para reclasificación a amenazada cuando se cumplan todas las siguientes condiciones:

Criterios demográficos:

- 1) Mantener una población de cotorra serrana occidental autosustentable, que asegure la sobrevivencia de la especie y que enfrente amenazas de una población pequeña, como la estocasticidad demográfica y la genética. Se documente una tendencia poblacional estable o en aumento por un periodo de 20 años en por lo menos 5 poblaciones reproductoras existentes de la cotorra serrana occidental (Factores A, B, C, D, E).

Criterios basados en amenazas:

- 1) Suficiente hábitat (tamaño, composición y estructura forestal, distribución) esta conservado (protegido, manejado y restaurado) que incluya hábitat de forrajeo, reproducción, y de invierno, para asegurar la sobrevivencia de la cotorra serrana occidental a pesar de la alteración ambiental y la amenaza del cambio climático. (Factores A, D, E)
 - a) Se elabore e implemente un plan de conservación del hábitat (por todo el rango actual de distribución de la especie en México), a partir de procedimientos validados científicamente, del conocimiento de los expertos en la especie, y de los efectos predicados del cambio climático. El plan de conservación de hábitat provee metas para a) definir la ubicación, tamaño y distribución del hábitat de la cotorra serrana

- occidental; b) definir la composición y estructura del bosque y los cambios futuros pronosticados debido al cambio climático; y c) directrices para planes de manejo forestal de la Sierra Madre Occidental. (Factores A, D, E)
- b) Las áreas de anidación estén conservadas efectivamente para el futuro previsible por medio de la designación oficial de un estado de protección, Unidad de Manejo Ambiental (UMA), compra de terrenos, servidumbres para la conservación a largo plazo, adquisición de los derechos de tala u otros mecanismos (Factores A, D, E).
 - i) Las zonas núcleo (sitios de anidación, perchas, bebederos y dormideros) para al menos cinco áreas de anidación conocidas están permanentemente conservadas, tales como Mesa de las Guacamayas, Madera, Tutuaca, Papigochic, y Campo Verde. (Factores A, D, E).
 - ii) Por lo menos otras cuatro áreas de anidación conocidas y dos presuntas áreas sean evaluadas para su potencial de conservación en los estados de Chihuahua y Durango (Factores A, D, E).
 - iii) Por lo menos tres áreas de anidación se conservan bajo programas efectivos de conservación (Factores A, D, E).
 - c) El rango de distribución invernal de por al menos cinco poblaciones reproductivas esté verificado y mapeado, y estas zonas de invierno estén efectivamente conservadas en un futuro previsible por medio de la designación oficial de un estado de protección, Unidad de Manejo Ambiental (UMA), compra de terrenos, servidumbres para la conservación a largo plazo, adquisición de los derechos de talado u otros mecanismos. (Factores A, D, E).
 - i) Las áreas actualmente designadas como protegidas dentro del rango invernal (con cantidades significantes de ocurrencia de la cotorra serrana occidental) estén mapeadas y conservadas (protegidas, manejadas, y restauradas) (CONANP 2009) (Factores A, D, E).
- 2) La cosecha ilegal, tala e incendios forestales de alta intensidad en el hábitat de las cotorras serranas occidentales sean reducidos al punto que ya no representen amenazas a las cotorras serranas occidentales (Factores A, D, E).
- 3) Las amenazas de colección y captura ilegal de cotorras serranas occidentales para el comercio de mascotas sean reducidas al punto que ya no impacten a las cotorras serranas occidentales (Factores B, D).

Criterios para remoción: Los criterios de recuperación que permitan la remoción de la cotorra serrana occidental de la lista no se han establecido debido a la falta de información relacionada con el estado de la población, la biología, y los requisitos específicos de hábitat. Se necesita más investigación para recomendar tareas y medidas específicas adicionales, y establecer los criterios (que permitan su remoción de la lista) para determinar que la especie ya no se encuentra en peligro de extinción a través de todo su rango o una parte significativa de él y que sea poco

probable que peligre nuevamente en el futuro inmediato (recuperada completamente). Considerando la pérdida de hábitat adecuado, y el tiempo necesario para la regeneración del bosque con condiciones adecuadas, el porcentaje bajo de parejas anidantes, y la necesidad de conservar el hábitat, es poco probable que la cotorra se reclasifique de especie en peligro de extinción a especie amenazada antes del 2050. No es realista predecir las condiciones ambientales y amenazas a la especie que prevalecerán en ese tiempo. Se anticipan revisiones futuras de este plan de recuperación y se establecerá una meta para remoción de la cotorra serrana occidental de la Lista de Especies Amenazadas y en Peligro de Extinción antes de ser reclasificada a amenazada (reclasificación estimada para el 2050).

Acciones Necesarias

Se resumen algunas recomendaciones preliminares abajo, incluyendo tareas más específicas que las acciones generales en el PACE, y contribuciones adicionales de los biólogos de México y de los EEUU. Algunas de las Acciones Necesarias que se resumen abajo abordan más de una acción para la recuperación que son descritas en el PACE (CONANP 2009).

A= Modificación o pérdida de hábitat

- Identificar los territorios y patrones de migración de grupos reproductivos y no reproductivos de la cotorra serrana occidental y evaluar el uso y disponibilidad de hábitat.
- Realizar estudios de la relación entre la disponibilidad de alimento, altura y composición y aspectos estructurales del bosque, y el movimiento y la anidación de la cotorra serrana occidental.
- Desarrollar modelos predictivos de ocurrencia de cotorras como un modelo de nicho ecológico y verificar, evaluar, y cuantificar los sitios de ocurrencia.
- Caracterizar los requisitos de hábitat de las cotorras serranas occidentales en base a la historia natural de la especie, y desarrollar un modelo de idoneidad de hábitat para entender y manejar las áreas de hábitat y sus características para la cotorra.
- Elaborar e implementar un plan de conservación del hábitat para la cotorra serrana occidental (por todo el rango actual de distribución de la especie en México) en base a ciencia y el conocimiento de los expertos de la especie, y los efectos previstos de cambio climático. El plan provee metas para a) la ubicación, tamaño, y distribución del hábitat de la cotorra serrana occidental; b) la composición y estructura del bosque; y c) directrices para planes de manejo forestal de la Sierra Madre Occidental.
- Proteger permanentemente las áreas clave (sitios de anidación, perchas, bebederos, y dormideros).
- Identificar y mapear áreas no protegidas de hábitat ocupado en zonas invernales y de anidación y áreas prioritarias dentro de los mismos; evaluar su potencial para protección bajo un programa de conservación apropiado [por ejemplo la Unidad de Manejo Ambiental (UMA), convenios voluntarios con propietarios privados, compra de terrenos, servidumbres para la conservación a largo plazo, adquisición de los derechos de tala u otra designación de área protegida].
- Efectivamente proteger, restaurar, y manejar áreas actualmente designadas como protegidas dentro del rango invernal (con cantidades significativas de ocurrencia de la cotorra serrana occidental).

- Desarrollar (o revisar) e implementar Planes de Manejo Forestal para sitios específicos que incorporen las necesidades de hábitat y forraje, incluyendo ciclos rotacionales más largos y mantenimiento de árboles maduros, árboles muertos en pie requeridos para anidación, el manejo de incendios, y el estado actual y futuro de la salud del bosque y distribución de vegetación; incluyendo escenarios futuros de vegetación potencial en base al cambio climático.
- Planificar e implementar incendios controlados donde sea necesario para manejar el hábitat de la cotorra serrana occidental.
- Evaluar el potencial en los EEUU para sostener cotorras serranas occidentales que se dispersan naturalmente o por medio de la translocación activa, incluyendo una revisión del hábitat histórico de los EEUU, el manejo del hábitat actual, y la conectividad del hábitat con México. Incluir la necesidad y eficacia de la translocación de cotorras en la evaluación e implementar translocaciones si son apoyadas por México y se considera apropiado en la evaluación.

B= Sobreutilización

- Disminuir la colecta y captura ilegal de cotorras serranas occidentales por medio de la aplicación de leyes ambientales, normas, planes, y políticas de protección de la cotorra.
- Enfatizar la importancia de la conservación de la cotorra serrana occidental con el público.

C= Enfermedades o depredación

- Formular un protocolo para evaluar la salud de la cotorra serrana occidental para mejorar el entendimiento del impacto de cualquier enfermedad y minimizar cualquier riesgo de enfermedades.
- Desarrollar exámenes efectivos y evaluar riesgos de transmisión de enfermedades portadas por poblaciones de la cotorra serrana occidental en cautiverio.
- Desarrollar un plan de manejo de ectoparásitos que identifique protocolos de tratamiento efectivo y medidas de control para reducir los niveles de ectoparásitos en el nido o el ambiente local.

D= Regulaciones inadecuadas

- Aplicar las leyes ambientales, normas, planes, y políticas existentes para proteger el hábitat de la cotorra serrana occidental contra la cosecha, tala e incendios.

E= Otros factores naturales o antropogénicos

- Desarrollar e implementar un protocolo estadísticamente comprobado y revisado por expertos para documentar la tendencia y estado poblacional.
- Realizar una evaluación poblacional de la especie a través de todo su rango usando una metodología estandarizada y revisada por expertos.
- Determinar el tamaño mínimo de viabilidad de la población, la distribución espacial y temporal, y el número de colonias reproductivas necesarias para la recuperación. Se

pueden lograr las estimaciones de abundancia por medio de conteos (para obtener grados de ocupación) y la integración de datos obtenidos por detección remota (parámetros de hábitat).

- Crear modelos climáticos pronosticando áreas futuras de anidación y desarrollar estrategias que aseguren la disponibilidad de especies de coníferas claves para el uso de las cotorras serranas occidentales en planes de manejo forestal.

Costo Total Estimado de la Recuperación

Costos en \$1,000 USD. Las prioridades son definidas en 4.2. *Recovery Action Priorities and Abbreviations*.

Año	Prioridad 1	Prioridad 2	Prioridad 3	Total
2013	501	258	295	1,054
2014	769	266	309.5	1,345
2015	716	255	278.5	1,250
2016+	614	249	276	1,130
Total*	\$2,990	\$1,570	\$1,907	\$6,467

*Costos por año no suman a Costos Totales porque algunas acciones sobrepasan el año 2016. Estos costos adicionales son incluidos en el Total.

Fecha de Recuperación

No se conoce en este momento la fecha de recuperación para la cotorra serrana occidental. Se necesita información adicional antes de que se puedan establecer criterios para la recuperación de la cotorra y su remoción de la lista. La regeneración de hábitat es un proceso a largo plazo y de 100 a 300 años pueden ser necesarios para la restauración completa del hábitat. El tiempo que se estima para estas acciones inmediatas es presentado en la Tabla de Implementación. El éxito en la conservación del hábitat (protección, manejo y restauración) durante el período de reclasificación ayudará a determinar los esfuerzos necesarios para lograr la recuperación.

1.0. BACKGROUND

1.1. Brief Overview

The Endangered Species Act of 1973 (ESA) calls for preparation of recovery plans for threatened and endangered species likely to benefit from the effort, and authorizes the Secretary of the Interior to appoint recovery teams to prepare the plans (U.S. Congress 1988). According to section 4(f)(1) of the ESA, recovery plans must, to the maximum extent practicable, describe site-specific management action as may be necessary to achieve the plan's goals, incorporate objective and measurable delisting criteria, and estimate the time and cost required for recovery. A recovery plan is not self-implementing, but presents a set of recommendations that are endorsed by an official of the Department of Interior for managers. Recovery plans also serve as a source of information on the overall biology, status, and threats of a species. It is the intent of the U.S. Fish and Wildlife Service (USFWS) to modify this recovery plan addendum in response to management, monitoring, and research data.

Our approach in this Thick-billed Parrot Recovery Plan Addendum to Mexico's PACE (CONANP 2009), which we will use to guide recovery of the thick-billed parrot, is to address the status of biological information and habitat and to identify actions to conserve the species within its historical range in the U.S., and promote conservation for the thick-billed parrot within Mexico, where the species still occurs. We adopt Mexico's PACE (CONANP 2009) for recovery actions in Mexico and add an addendum to meet the statutory requirements of the ESA. We focus primarily on conservation within Mexico and to a lesser degree on the potential for expansion into areas of its historical range. Mexico's PACE represents the best available scientific information on thick-billed parrots, and the USFWS supports the strategy for recovering the species set forth in the PACE (CONANP 2009) (Appendix B).

Our primary goal is to assist Mexico in recovering the thick-billed parrot within Mexico, following Mexico's lead. Additional detail in this recovery plan addendum on the recovery actions in Mexico was provided by some of the Mexican thick-billed parrot researchers and managers who also helped with development of the PACE (CONANP 2009). Together, the PACE (CONANP 2009) and the USFWS addendum form the U.S. recovery plan for the thick-billed parrot. This binational coordination provides the opportunity to share objectives and resources. Prior to the preparation of the PACE, the Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM), Pronatura Noreste, and the Arizona Game and Fish Department organized a series of meetings to discuss conservation of the thick-billed parrot, with participation from non-government organizations, agencies, and researchers from Mexico and the U.S. Conservation strategies discussed included monitoring, disease sampling of wild birds, nest box experiments, and translocations within Mexico and north of the border. To date, an additional experimental translocation in Mexico, disease sampling of wild birds, and nest box experiments have been implemented. These and other conservation outcomes (resulting from a comprehensive conservation program ongoing since the mid-1990s) contributed toward the PACE and this recovery plan addendum.

1.1.1. Global and National Conservation Status

Thick-billed parrots have been listed as endangered on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species since 1994, with a currently decreasing population trend (BirdLife International 2012). The parrot also has been covered under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendix I since 1975, which includes species threatened with extinction and prohibition of trade except in exceptional circumstances, as well as under Appendix II, which also controls trade to ensure a species' survival (UNEP-WCMC 2012). The parrot is considered endangered in Mexico by the Norma Oficial Mexicana: NOM-059-SEMARNAT-2010 (Gobierno Federal 2010). The thick-billed parrot in the U.S. is listed as endangered under the authority of the ESA (74 FR 33958).

1.1.2. Recovery Priority Number

The thick-billed parrot has a recovery priority number of 5C, meaning that the species has a low potential for recovery and faces a high degree of threat, with a relatively high degree of conflict from development projects such as construction, clearing for logging, cattle ranching, agriculture, and other economic uses. The degree of threat is high based upon the extensive loss and destruction of their preferred breeding and nesting habitat: old-growth, high elevation forests dominated by pines and other conifers. The entire range of the thick-billed parrot has been affected by logging throughout the 20th century, and their habitat will likely take generations to recover while also facing continued threats from climate change and high-severity fire. The thick-billed parrot's low population numbers, combined with limited habitat availability, increases their vulnerability to stochastic events. Their potential for recovery is low due to intrinsic life history traits such as: long lifespan, relatively late sexual maturity, low percentage of pairs breeding, monogamy, highly social group behaviors, learned foraging and migratory patterns, and selectivity of obligatory tree cavity-nesting sites as well as pine seed specialization for diet. Extrinsic factors that could also affect their recovery are: fragmented and limited habitat facing continued direct human pressure, increase in drought conditions possibly related to climate change, and illicit collection of parrots for the pet trade.

1.1.3. Mexico's Program of Action for Conservation of the Species

The 2007 Mexican "Commitment to Conservation" is a series of programs to prevent the deterioration of Mexican ecosystems and biodiversity. The programs are being implemented through the National Commission of Protected Natural Areas (CONANP). Under its Conservation Program for Species at Risk (PROCER), the objective is to design the framework, and coordinate, promote, and link (with diverse sectors of society) the federal government's efforts to recover over 35 priority and endangered species. More than 60 people from a cross-segment of society participated in a comprehensive analysis to select these target species for which recovery plans -- known as Programs of Action for the Conservation of the Species (PACE) -- are being developed. Within this framework, Mexico convened a group of parrot experts and in 2009 published a recovery plan (a PACE) addressing both the maroon-fronted and thick-billed parrot species. The focus of the PACE (CONANP 2009) is on extant populations of

the thick-billed parrot; it does not address thick-billed parrot historical records or historical range in the U.S.

A translated version of the thick-billed parrot PACE (CONANP 2009) is provided in Appendix B. The original Spanish document is available at: <http://procer.conanp.gob.mx/>.

1.2. Description and Taxonomy

Thick-billed parrots are members of the parrot family, Psittacidae. The genus *Rhychopsitta* is found only in Mexico, and the two members of the genus, *Rhychopsitta pachyrhyncha* (Swainson 1827), thick-billed parrot, and *R. terrisi*, maroon-fronted parrot, are similar in appearance. The genus is believed to be related to macaws, based on a similar body shape (Forshaw 1989). Each species has a green body with red shoulder patches, amber eyes, yellow eye-rings, and black beaks. The maroon-fronted parrot has a maroon cap on the forehead, while the thick-billed parrot has a bright red forehead cap. The thick-billed parrot has a wide yellow wing stripe visible from below, which the maroon-fronted parrot lacks. The thick-billed parrot is approximately 38 centimeters (cm) (15 inches [in]) in length, while the maroon-fronted parrot is slightly larger at 40 to 45 cm (16 to 18 in) long (CONANP 2009). The appearance of females and males is virtually identical in both species. The thick-billed parrot's long, tapered wings allow for fast flight and maneuvering, and they are excellent fliers (Snyder et al. 1999). More information is available in the PACE (Appendix B).

1.3. Distribution and Habitat Use

U.S. Historical Range

Historically, the thick-billed parrot's range in the U.S. extended as far north as the mountains of southeastern Arizona and possibly southwestern New Mexico (Snyder et al. 1999; Map 1 in Appendix A). The extent of the historical range in the U.S. may have been tied in large part to the distribution of Chihuahua pine (*Pinus leiophylla*) (Snyder et al. 1994, 1995, 1999); see *Food Resources* section).

The now extinct Carolina parakeet (*Conuropsis carolinensis*) and the thick-billed parrot are the only parrot species with a known distribution that once ranged into the continental U.S. (Snyder et al. 1999). The last thick-billed parrot sighting of a flock was in 1938 in the Chiricahua Mountains of Arizona (Monson and Phillips 1981 in Snyder et al. 1999); there is also an unconfirmed 1964 report of a flock seen in New Mexico's Animas Mountains (Woodward 1980 in Snyder et al. 1999, Williams 2007, 2011). The disappearance of thick-billed parrots in the U.S. was very likely caused by excessive, unregulated hunting (Snyder et al. 1999).

There are no formal historical nesting records for the U.S., but thick-billed parrots were regular visitors in southeastern Arizona, and in some years big flocks were seen. Much of the ornithological literature concludes that parrots were not an established U.S. resident in historical times, due to the absence of historical nesting records and the irregular observation of large flocks (Snyder et al. 1999). Alternatively, Snyder et al. (1999) provide speculation for the likelihood that some parrots did breed in the U.S., as nesting evidence may have been overlooked by both the first thick-billed parrot observers who were not trained biologists looking for nests

and by early ornithologists who did not conduct much work in southeastern Arizona, particularly in the Chiricahua Mountains. Other than loggers and prospectors, few residents of southern Arizona and New Mexico visited the high-elevation pine forests historically. Thick-billed parrot nests are aggregated in small, condensed areas in mid-summer to fall, a time when most ornithologists are not looking for nests. Thus, the lack of nest searches, combined with the parrot's high-elevation nesting habitat in condensed areas and late season breeding may explain the absence of nest records (Snyder et al. 1994). The thick-billed parrot's nearly annual presence in the Chiricahua Mountains of Arizona in the early 1900s during the breeding season suggests that breeding may have occurred at least irregularly in the U.S. (Snyder et al. 1999). From July, 1917, until late March, 1918, Wetmore (1935) reports accounts of the presence of thick-billed parrots in several canyons in the Chiricahua Mountains. Although no nests were reported, the documented presence of parrots from the summer of 1917 through the spring of 1918 in the Chiricahua Mountains encompasses the known breeding season for this species. When birds first appeared in Pinery Canyon in August, 1917, resident F. Hands stated that he was certain from their plumage that many of them were young of the year (Wetmore 1935).

Habitat within the U.S. historical range is fragmented, with several small mountain ranges each separated by large expanses of unsuitable habitat, unlike the more contiguous habitat in the Sierra Madre Occidental of Mexico. Maps 2, 3a, and 3b in Appendix A show conifer and aspen plant communities above 1,900 m (6,233 ft) and 2,300 m (7,545ft) in the U.S. that may provide potential thick-billed parrot habitat, based on Southwest Regional Gap Project data (Lowry et al. 2005). Mapped habitat represents climax vegetation and does not represent current stand conditions (such as those that may have been recently impacted by fire or drought). Therefore, currently available suitable habitat, the extent of which has not been assessed, would be a subset of the mapped habitat. Plant communities include Aspen Forest and Woodland, Madrean Encinal Woodland, Madrean Pine Oak Woodland, Mixed Conifer Forest, and Ponderosa Pine Forest.

New Mexico

There are historical reports of the species in New Mexico (Animas and Peloncillo Mountains), but no verified records or physical evidence exist. Thick-billed parrots are not included on the list of confirmed, naturally occurring species in the state (NMDGF 2011; Williams 2007, 2011). Although verifiable thick-billed parrot records do not exist for the Peloncillo or Animas Mountains of New Mexico, their geographic proximity to the Sierra de San Luis (Mexico's northernmost extension of the Sierra Madre Occidental) may provide potential habitat connectivity (Maps 1 and 2 in Appendix A). Thick-billed parrot sightings have been reported for the Sierra de San Luis, a small range that runs north-south with an elevation of 1,310 to 2,530 m [4,300 - 8,300 ft] (N. Snyder pers. comm. 2005 via Bodner et al. 2005). According to experts from ITESM/Pronatura Noreste, this small range is considered to contain suitable habitat (Cruz-Nieto 2012). The Sierra de San Luis is approximately 80 km (50 mi) north (slightly west) of Mesa de las Guacamayas, the northern-most thick-billed parrot breeding area (Snyder et al.1999). The southern portion of the Peloncillo Mountains reaches an elevation of only 2,019m (6,625 ft) (straddling the Arizona/New Mexico border) and contains the 7,075 hectares (ha) (17,482 acres [ac]) Bunk Robinson Wilderness Study Area and the 4,407 ha (10,889 ac) Whitmire Canyon Wilderness Study Area (U.S. Forest Service 2011a). The Animas Mountains extend north-south, with Animas Peak in the northern end reaching an elevation of 2,600 m

(8,531 ft). Most of this range is owned and managed by the Animas Foundation as part of the 129,904 ha (321,000 ac) Diamond A. Ranch (The Nature Conservancy 2012). Mixed-conifer habitats occur at the highest elevations of the Animas and Sierra de San Luis mountains, but appear to be more limited in the Animas mountains (Williams 2012) Although no mixed conifer habitat exists in the Peloncillos, Madrean pine-oak habitat may serve as foraging habitat (Bodner et al. 2005, Coronado Planning Partnership 2008).

Arizona

Throughout the early 1900s, parrots were seen in several high elevation mountain ranges of southeastern Arizona, including the Chiricahua, Dragoon, Pinaleño, Galiuro, Santa Catalina, Whetstone, Huachuca, Patagonia, and Santa Rita Mountains; presence and number of birds varied by year and season (Phillips et al. 1964). Thick-billed parrot sightings were more common in the Chiricahua Mountains than in any of the other mountain ranges. Incursions of thousands of parrots into the U.S., like the one documented in 1917-1918 by Wetmore (1935), occurred infrequently and were most likely the result of regional drought and the failure of the seed crop in northern Mexico (Snyder et al. 1999).

Mature high-elevation conifer forests in southeastern Arizona exist on several mountain ranges, and virtually all of these areas are Federal lands, with most under the jurisdiction of the Coronado National Forest (U.S. Forest Service 2011a). The forested habitat from 1,900 m (6,233 ft) to 3,275 m (10,750 ft), known as the Sky Islands (encompassing southeastern Arizona and southwestern New Mexico), consists of aspen (*Populus tremuloides*), spruce (*Picea* spp.), a variety of oak species (*Quercus* spp.), Chihuahuah pine (*Pinus leiophylla*), Apache pine (*Pinus engelmannii*), Douglas-fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), Ponderosa pine (*Pinus ponderosa*), Arizona pine (*Pinus arizonica*), Border piñon (*Pinus discolor*), and southwestern white pine, also known as Mexican white pine (*Pinus strobiformis*) [= *P. ayacahuite*] (AZFirescape 2012). The Chiricahua Mountains, the most common Sky Island historically frequented by thick-billed parrots, reach an elevation of 2,987 m (9,800ft) and encompass 117,964 ha (291,496 ac) (U.S. Forest Service 2011a).

Some of the more accessible pine forests in Arizona were historically impacted by timber production, but significant portions remained intact and in suitable condition (Snyder et al. 1999). Although these forests are now primarily managed for their recreation and watershed values, with no active timbering (Snyder et al. 1999), some potential parrot habitat in the U.S. has recently been destroyed by wildfire. High-severity fires are now occurring more frequently than historically due to fire suppression policies that have resulted in the accumulation of fuels since the early 1900s (and other factors, like effects from climate change, etc.). For example, the 2011 Horseshoe 2 wildfire, the fourth largest fire recorded in Arizona, burned 80 percent of the Chiricahua Mountain Range, primarily in the Coronado National Forest, and impacted areas used historically by the thick-billed parrot (U.S. Forest Service 2011a) (*see Factor A. Habitat Loss*).

Mexico Range

The parrot's current range is the whole Sierra Madre Occidental; extending from northwestern Chihuahua and northeastern Sonora into Durango and continuing southward into Jalisco, and then east through the Transvolcanic Belt of Colima and Michoacán. The nesting/breeding habitat is found in old-growth remnants and mature forests at elevations above 2,000 m (6,562 ft)

in the Sierra Madre Occidental (from northwestern Chihuahua and northeastern Sonora south to northwestern Durango). Thick-billed parrots migrate seasonally from their primary breeding (summering) grounds in Chihuahua to wintering areas farther south. Birds arrive in Chihuahua by late May and have departed by early November, possibly migrating $\geq 1,000$ km (621 mi) between their summering and wintering areas (Snyder et al. 1999, CONANP 2009).

There are accounts of birds being seen year-round in the Las Bufas area of central-western Durango (Lammertink et al. 1996), and in the south-western Durango localities of San Francisco de Lajas and Cumbre de milpillas (Cruz-Nieto 2013). The winter range mainly encompasses portions of southern Durango, Nayarit, Jalisco, Colima, and Michoacán (CONANP 2009, Snyder et al. 1999). Winter range observations are primarily historical, and the extent of occupied habitat is poorly understood (Schnell et al. 1974, Snyder et al. 1999, CONANP 2009). Parrots form large wintering flocks (12-120 individuals), and it is believed that they do not remain at one given site, but instead search across the landscape for suitable forest patches with abundant food resources (Schnell et al. 1974, Lammertink et al. 1996, Snyder et al. 1999). There are significant gaps in our understanding of the migratory patterns of this species, including 1) whether all populations migrate, 2) whether breeding populations form mixed flocks during migration or at wintering areas, 3) how habitat is used during migration, and 4) where in the winter range do the main breeding populations over-winter (Snyder et al. 1999, Guerra et al. 2008). Aside from regular migration patterns between the breeding and wintering areas, the species is also known to make irregular nomadic excursions to areas beyond its normal range, responding to disruptions in food resources (Snyder et al. 1999).

Archaeological Record in U.S.

Thick-billed parrot remains in the Southwest present archaeologists with a dilemma in identifying their place of origin (Ferg 2007). Burials have been found at Wupatki Pueblo in the San Francisco Mountains near Flagstaff, Arizona (Hargrave 1939), at the Curtis site along the Gila River in southeastern Arizona (Emslie and Hargrave 1979), and at Pueblo Bonito, in Chaco Canyon, New Mexico (Ferg 2007). Thick-billed parrots bones were found in Wupatki Pueblo (Hargrave 1939), and at the Curtis site (Emslie and Hargrave 1979). The bones described by Hargrave (1939) do not necessarily indicate former presence of the species in the wild, because they were found in association with human artifacts and bones of scarlet macaws (*Ara macao*). More likely, the presence of macaw bones is an indication of live bird trade among Native American tribes; the same may have been true of the thick-billed parrot remains. Thick-billed parrot bones at the Curtis site were similarly associated with human artifacts (Snyder et al. 1999). Thick-billed parrots occurred in the Sierra Madre Occidental, thus the birds or their feathers presumably could have been obtained there; but the source for the scarlet macaw could only have been acquired from southern Mexico, or perhaps from communities farther south where macaws may have been bred in captivity (Creel and McKusick 1994). These thick-billed parrots could have been traded in from Mexico (like macaws), but some speculate that it is not impossible that they were taken from mountain ranges in Arizona or New Mexico (Ferg 2007). On May 5, 1583, Spanish explorers led by Antonio de Espejo reported parrots on what is probably Beaver Creek, near the Verde Valley (Wetmore 1931, Ferg 2007). The status of thick-billed parrots in the southwest prior to the late 1800s is unknown, but winter detections were reported as far north as the Pinaleno Mountains, near Safford between 1886 and 1936 (Ferg 2007).

Their occurrence in the Mimbres area, as well as the circumstances of their disposal, suggests that macaws, thick-billed parrots, and their feathers were likely of ceremonial importance in some Mimbres communities by ca. A.D. 1000 (Creel and McKusick 1994). So far as is now known, this was at least 500 years before the early Spanish explorers entered the Southwest and recorded trade in feathers and the keeping of macaws and parrots by Puebloan groups (Creel and McKusick 1994).

1.4. Critical Habitat

Critical habitat has not been proposed for the thick-billed parrot.

1.5. Life History

The thick-billed parrot has a relatively long life-span in captivity of over 30 years. Behavior is highly social and the parrots are found in flocks while foraging, roosting, and migrating. Migration flocks number from 12 to over 100 individuals (Schnell et al. 1974), and historically, groups numbered as large as 1,500 individuals (Wetmore 1935). Guerra et al. (2008) theorized that individuals from the different breeding populations may intermix during migration. Young develop slowly, are cared for by both parents, remain dependent on their parents for over a year, and exhibit the learning of behaviors (Snyder et al. 1999). Preliminary studies indicate that the home range of reproductive pairs may vary from an estimated average of 17,861 ha (44135 ac) in the Madera breeding area (5 pairs tracked) to 50,305 ha (124,306 ac) in Papigochic breeding area (2 pairs tracked) (Pronatura 2012). Foraging habits are nomadic depending on food and water availability, and thick-billed parrots are capable of flying distances from 3.6 to 15.8 km (2.2 to 9.8 mi), averaging 9.7 km (6 mi) per foraging trip, and totaling an average of 50 km (31 mi) in daily movements (Snyder et al. 1999). Productivity and nest success in the breeding populations are high, up to 80 percent (Monterrubio et al. 2002), but only a small percentage of the individuals are breeding pairs (CONANP 2009). Approximately one-third of pairs using cavities do not produce eggs (Cruz-Nieto 1998 in Snyder et al. 1999, Monterrubio-Rico in Snyder et al. 1999). Recruitment rate is believed to be low (CONANP 2009), although the rate of mortality for juveniles or adults has not been quantified (Monterrubio et al. 2002).

Food Resources

The thick-billed parrot's diet primarily consists of seeds of various conifers. Frequency of cone production and seasonal availability of seeds for parrots varies markedly by pine species (Snyder et al. 1995). Pine seeds are most abundant in summer and early fall (coinciding with the parrot's breeding season) and least abundant in late spring (Snyder et al. 1995). In the U.S., released parrots (1986-1993) primarily fed on seeds from Chihuahua pine, ponderosa pine, Arizona pine, and Apache pine (Snyder et al. 1995, 1999). Border piñon (*Pinus cembroides*) and Douglas-fir cones were also sources of food and to a lesser extent acorns and terminal buds of pine trees (Snyder et al. 1999). Overall, Chihuahua pine was a highly important food source for released parrots in the U.S. because this pine produces cones regularly and seeds are available year round (Snyder et al. 1995; see Table 1 below). Most other pines will open and drop their seed over a narrower season (Dick-Piddie 1993). Chihuahua pine is the dominant pine of the Madrean Pine-Oak vegetation community which comprises about 8 percent of the Coronado National Forest (e.g., Sky Islands) and is even more extensive in Northwestern Mexico (Wilcox 2012). Snyder

et al. (1994, 1995, 1999) suggest that the extent of the parrot's historical range in the U.S. may have been tied in large part to the distribution of Chihuahua pine and that the occurrence of this conifer is uncommon north of the mountain ranges of the southeastern portion of Arizona.

Conifer species diversity and the extent of conifer forest decline from the Sierra Madre Occidentals northward through Arizona and New Mexico, with a corresponding decline in food availability (Snyder et al. 1995). Compared to the more regular seed provisions found in the Sierra Madre Occidental, the food supplies in the Sky Islands seem to be less reliable (Snyder 1995). Severe droughts (such as in 1989 and 1990) can result in regional collapse of cone production and a disruption in food supply. A near total collapse of the cone crop in 1989 in southern and central Arizona resulted in the dispersal of the nucleus of released thick-billed parrots (Snyder et al. 1994). A later thick-billed parrot release in late 1992 was limited to West Turkey Creek of the Chiricahuas because there were no good cone supplies in other canyons. Within a half year, the birds consumed all the available cones visible in the West Turkey Creek release area and dispersed, first to high elevations where there was still a Douglas fir cone crop, and then to unknown destinations. There were no other potential foods available in any abundance in the Chiricahua Mountains in that year (Snyder 2012).

North of the Chiricahua Mountains, into central Arizona, slopes are gentler and logging is much more prevalent compared to the steeper ranges of southern Arizona. The potential for thick-billed parrots to become fully established in the central region is likely limited, due to the generally younger ages of forest stands from logging, the lower diversity of conifer species, and the absence of Chihuahua pine (Snyder et al. 1994).

Table 1. Summary of distributional and cone production data of major thick-billed parrot food species in Arizona from 1986-1993. Adopted from Snyder et al. 1995.

Species	Arizona Distribution	Regularity of cone production	Seasonal availability of seeds
Chihuahua pine (<i>Pinus lieophylla</i>)	SE	Most years	All seasons
Apache pine (<i>Pinus engelmannii</i>)	SE	<< Half of years	Summer to Spring
Arizona pine (<i>Pinus arizonica</i>)	SE	< Half of years	Summer to Spring
Ponderosa pine (<i>Pinus ponderosa</i>)	N, Cen., SE	Half of years	Summer to Winter
Pinon pine (<i>Pinus edulis</i> and <i>discolor</i>)	N, Cen., SE	Half of years	Summer and Fall
Southwestern white pine (<i>Pinus strobiformis</i>)	N, Cen., SE	Most years	Summer and Fall
Douglas fir (<i>Pseudotsuga menziesii</i>)	N, Cen., SE	All years	Summer and Fall

In Mexico, nesting above 2,000 m (6,562 ft) in elevation may be tied to the high elevation occurrence of Mexican white pine (*Pinus strobiformis*), Arizona pine, and Durango pine (*P.*

durangensis). The seeds of these species are a major food source during the breeding season (Monterrubio-Rico et al. 2002).

Breeding Habitat

As an obligate cavity nester, the thick-billed parrot requires large-diameter trees and snags; with pines, Douglas-fir, quaking aspen, and white fir used as nest-trees (Lanning and Shiflett 1983, Monterrubio-Rico and Enkerlin-Hoeflich 2004). Logging of these mature and old-growth forests has reduced nest site availability for the species (Monterrubio-Rico and Enkerlin-Hoeflich 2004). Observations indicate that the species is not completely dependent on old growth forests for food supplies and can survive in some areas subject to moderate timber harvest so long as nest sites continue to be available. Nest cavities are probably a greater limiting factor than food in Mexico (Snyder et al. 1999). For example, seven pine nest-trees were removed at one nesting site from 1995 to 2007 (ITESM 2010). Thick-billed parrots exhibit nest size selection, including internal diameter of the cavity, entrance width, and entrance height above ground (Lanning and Shiflett 1983, Cruz-Nieto 1998 in Snyder et al. 1999).

Accompanying the loss of large-diameter trees is the disappearance of a primary cavity-builder that historically provided at least some of the nest cavities for the parrot. The Imperial woodpecker (*Campephilus imperialis*), now believed to be extinct or nearly so (Lammertink et al. 2011), declined dramatically by the 1950s due to loss of old-growth habitat and to a lesser extent shooting and poisoning.

Based on nesting patterns where tree species' availability changed over time, it appears that thick-billed parrots are opportunistic nesters. Following removal of pine nest trees between the early 1980s and 1996, thick-billed parrots nested in the remaining fir and aspen if cavities within the preferred size range were available (Snyder et al. 1999, Monterrubio-Rico and Enkerlin-Hoeflich 2004).

Within the species' breeding range, nesting is primarily limited to a small number of areas in Chihuahua (Map 2 in Appendix A), with the five most important areas being Madera, Tutuaca, Mesa de las Guacamayas, Papigochic, and Vergel-Guanacevi (El Vergel, la Medalla, and La Lagunita; localities straddling the Chihuahua/Durango border) (Monterrubio-Rico and Enkerlin-Hoeflich 2004, ITESM 2011, Cruz-Nieto. 2012). Other suspected or known breeding localities in Chihuahua include Sierra del Nido and Namiquipa. Little is known about the southern portion of the breeding range in the state of Durango; known or suspected areas include Torre de Santiago Papasquiario and San Diego de Tenzains. Other areas in Durango with thick-billed parrot sightings include Las Cuevas (Tamazula), Bastantita (Tamazula), Guarisamey, and San Jose de Causas (Cruz-Nieto 2012, Monterrubio-Rico 2012). Some areas in Durango are known or suspected of harboring parrots year round [e.g., Las Bufas, San Francisco de Lajas (Pueblo Nuevo), Cumbre de milpillas (Pueblo Nuevo)] (Lammertink et al. 1996, Cruz-Nieto 2013).

Madera and Tutuaca have the highest concentration of nest sites, with 82 nests reported for Madera in 2011 and 48 for Tutuaca (Monterrubio-Rico and Enkerlin-Hoeflich 2004, ITESM 2011). Madera (until recently the only known location where nesting occurred in aspen) has high nest site density and significant re-use of cavities, which may reflect a shortage of suitable nest-trees (Monterrubio-Rico and Enkerlin-Hoeflich 2004). The northern-most breeding area is Mesa de Guacamayas, located just within 80 kilometers (km) (50 [mi]) south of the U.S. border

(Snyder et al. 1999). In 1997, a group of approximately 100 birds and 11 nests was documented (Snyder et al. 1999). For the 2011 breeding season, 13 nests (all in Douglas-fir trees) were documented at this location, along with a high count of 110 individuals (ITESM 2011).

As part of a comprehensive conservation program ongoing since the mid-1990s, several of these key breeding areas have recently been protected (CONANP 2009, Cruz-Maldonado 2010). Of the five most important breeding areas mentioned above, only the Vergel-Guanacevi area has not been designated as a protected area. The level of protection afforded to a given area depends on the type of official designation (Biosphere Reserve, Area for Protection of Flora and Fauna, or Priority Conservation Region) and whether core areas of parrot habitat have been established. Establishment and conservation of core areas effectively protects nesting, drinking, roosting, or perching sites through zoning, conservation easements, or other mechanisms (Cruz-Nieto 2012). Concerns persist for long-term conservation in protected areas with inadequate protection (Guerra et al. 2008). Ongoing measures to maintain or expand protection of these most vulnerable areas include fostering community support and stewardship, payments for environmental services (or other conservation legal instruments), and revision of forest management plans to segregate core areas of parrot habitat (CONANP-Pronatura Sur 2008). For the long term, old-growth forest management standards and indicators should be developed that provide habitat conditions needed by parrots (Cortés-Montaña 2011).

Wintering Habitat

The extent of occupied habitat in the wintering range is not known, and only a few wintering areas with thick-billed parrot occurrences have been documented (Snyder et al. 1999, CONANP 2009). Protected areas within the winter range (Map 2 in Appendix A) identified in the PACE as having thick-billed parrots are based primarily on historical records or anecdotal observations (Blake and Hanson 1942 in Snyder et al 1999, Schnell et al. 1974, Cruz-Nieto 2012). The amount of suitable habitat within these protected areas in the winter range has not been quantified. Known or suspected wintering areas in Durango include Las Bufas, California, San Miguel de las Cruces, San Francisco de Lajas (Pueblo Nuevo), Cumbre de milpillas (Pueblo Nuevo), El Maguey, San Dimas, Taxicaringa, Las coloradas, and Michilia (Lammertink et al. 1996, Cruz-Nieto 2013).

Exploratory surveys in Durango high-elevation forests during the non-breeding season in 2007 revealed thick-billed parrot activity in potential suitable nesting habitat, according to ecological niche modeling (Monterrubio-Rico 2012). The localities where thick-billed parrots were found are El Salitre [2540 m (8,333 ft)], Cebollas [2641 m (8,665 ft)], Agua del Pino [3020m (9,908 ft)], Arroyo hondo [2820 m (9,251 ft)], Cienega de la Vaca [3020m (9,908 ft)], Las mangas [3060m (10,039 ft)], Lajas [2690m (8825 ft)], Peñas Azules [2140m (7020 ft)], and Guanaceví [2060m (6758 ft)]. Flocks ranged from approximately 12 to 110 parrots. A foraging flock of 30 thick-billed parrots was seen on February 23, 2010, at Cumbre de milpillas, municipality of Pueblo Nuevo Durango, at approximately 2,213 m (7260 ft). Another record corresponded to a roosting pair observed in an egg-cone pine, also known as Mexican yellow pine (*Pinus oocarpa*), on March 3, 2010, in San Francisco de Lajas, Pueblo Nuevo Durango at 1,528 m (5013 ft). Evidently there is a clear need to increase surveys in high elevation forests to assess the population size, productivity, and habitat use (including the need to determine whether a given area is a breeding, wintering, or year-round locality).

1.6. Abundance and Trends

Breeding Population

The parrot exhibits a patchy distribution across its vast range in Mexico. Moreover, many of these areas have difficult access because of their remoteness and potential danger. Therefore accurately estimating range-wide population numbers for the species has been challenging (Snyder 1999, Monterrubio et al. 2002). Estimates vary on the number of thick-billed parrots remaining in the wild. Lammertink et al. (1996 in BirdLife International 2012) estimated between 1,000 and 4,000 birds. Key breeding areas are periodically surveyed, and parrot counts from 3 areas (including the 2 most important breeding sites of Madera and Tutuaca) in 2008 totaled close to 3,500 individuals (CONANP-Pronatura Sur 2008). Monthly surveys (July-October) in 2012 across 5 breeding areas (including Madera and Tutuaca) counted a minimum of 1,870 and a maximum of 2,097 individuals (Pronatura 2012). However, this number may be a conservative estimate because not all known breeding areas are surveyed annually and other more remote or potential breeding areas have not yet been inventoried (Cruz-Nieto 2012).

Productivity and nest success in the breeding populations are high (Monterrubio et al. 2002), but only a small percentage of the individuals are breeding pairs (CONANP 2009). In Chihuahua in 1995 and 1996, 5 of 18 and 28 of 58 pairs using cavities in respective breeding seasons did not produce eggs (Cruz-Nieto 1998 in Snyder et al. 1999). In Chihuahua in 1998, one-third of 160 pairs using cavities did not produce eggs (T. Monterrubio pers. Comm. in Snyder et al. 1999). Across all breeding areas monitored, only 155 pairs initiated nesting in 2011 and 91 pairs in 2012 (ITESM 2011, Pronatura 2012). Additionally, recruitment rate is believed to be low (CONANP 2009), although the rate of mortality for juveniles or adults has not been quantified (Monterrubio et al. 2002).

1.7. Threats

Reasons for Listing/Threats

Section 4(a)(1) of the ESA outlines five factors to consider when a species is a candidate for listing as threatened or endangered. The following analysis considers these factors in contributing to the endangered status of the thick-billed parrots. Below, we address threats throughout the species' range.

Factor A. The present or threatened destruction, modification, or curtailment of its habitat or range

Habitat Loss

The thick-billed parrot has experienced significant historical declines in Mexico, corresponding to loss of high elevation mixed conifer forests from extensive logging of large, mature pines, removal of nesting snags (Snyder et al. 1999), and to a lesser degree, high-severity forest fires (CONANP 2009). Habitat loss and modification continue to be the main threats to the species (CONANP 2009). The estimates of remaining mature and old-growth forest vary. For example, Lammertink et al. (1996) estimated that less than one percent of the old-growth forests in the Sierra Madre Occidental remain. However, this estimate, based on the mapped area above the

2,000 m (6,562 ft) elevational contour lines, was assumed to represent the historical cover of old-growth temperate forest habitat. The estimate is not based on structure data and assumes that all forests found at or above that altitude were old-growth. The lack of “old-growth” definitions for temperate forests in the Sierra Madre Occidental poses another problem to assertions about the extent of its cover. Perhaps a more useful approach is that of Sánchez Colón et al. (2009), estimating that between the 1970s and 2002, México’s temperate forest cover decreased by 25 percent and became increasingly fragmented, mostly due to agricultural clearing. Commercial forestry has been the most important agent of human induced change in the Sierra Madre Occidental since the early 1900s and Chihuahua remains one of the most important timber producing states in Mexico (Challenger et al. 2009, CONAFOR 2009 in Cortés-Montaña et al. 2012).

Dominant tree species in occupied breeding habitat include Mexican white pine, Arizona pine, Durango pine, and Douglas-fir, and in some areas white fir and quaking aspen are also present (Monterrubio-Rico and Ernesto Enkerlin-Hoeflich 2004). At one site the average age (12 samples) of Mexican white pine used as nest trees was 326 years (CONANP-Pronatura Sur 2008). The average elevation of nesting thick billed parrots increased from above 2,000 m (6,561 ft) to greater than 2,400 m (7,874 ft) in more recent times (Snyder et al. 1999) as habitat at the lower elevations was logged.

Unlike Mexican forests, the rather inaccessible southeastern Arizona forests were not subjected to the same timber harvest pressure common to so many other forests in the 20th century. They are, however, vulnerable to large-scale loss to high-intensity wildfire after many years of fire suppression. Lack of surface fires on the Coronado National Forest has caused a shift toward less desirable plant communities with an increase in fire hazard, decrease in forage production, and declining wildlife habitat. These changes are evident in the amount of fuels that have built up over time, the change in the frequency of natural fires (fire regimes), and the intensity of wildland fires. Exotic grass invasions in desert regions can change the fire regime by providing fuel for fire where fire was once rare, and can spread to forested habitat at higher elevation (U.S. Forest Service 2011a).

The mature and old-growth forests in southeastern Arizona, extreme southwestern New Mexico, and northern Mexico are adapted to frequent surface fires. In the past century this relationship of fire and forests in the southwestern U.S. has been disrupted mainly by heavy livestock grazing (that eliminated the fine fuels that carry the fires), and active fire suppression (AZFirescape 2012). In northern Mexico, fire exclusion has been primarily driven by land-use change, especially increased livestock grazing, associated with land redistribution in the first half of the 20th century (Fulé et al. 2005). Fire exclusion can threaten forest sustainability, because accumulated fuels can support uncharacteristically severe wildfires. Recent 40-to 70-year periods of fire exclusion in the Sierra Madre Occidental were associated with increased tree regeneration and tree density, changes in species composition and tree spatial patterns, and forest floor fuel buildup (Fulé and Covington 1994; Fulé et al. 2000). Two such sites recently burned with high-intensity fires (Fulé and Covington 1998; Fulé et al. 2000), a distinct change from predisruption fire behavior, altering or even supplanting natural successional trajectories (Romme et al. 1998). Severe fires killed many or all overstory trees, exposed soils to erosion,

and altered successional pathways to favor sprouting species and shrubs (Fulé et al. 2000; Barton 2002).

Where frequent fires once kept forests more open, increased tree density and fine and coarse fuels make forests more vulnerable to large-scale high-intensity wildfire. Combined with effects of climate change, increased tree density and fine/coarse fuels allow high-severity wildfires to eliminate desired ecosystem components, intensify the spread of unwanted non-native species, and result in dramatically different effects on watersheds than what would have occurred with natural fire.

In the U.S., active fire suppression since the 1940s has corresponded with an increased demand for wildland fire suppression to protect life and property (AZFirescape 2012). The increasing human populations at the wildland urban interface combined with their attendant infrastructure sites are high priorities for wildfire suppression. These areas encompass not only the sites themselves, but also the continuous slopes and fuels that lead directly to the sites, regardless of the distance involved. Illegal land use, specifically, migrant traffic and international drug running, pose a significant challenge when choosing the appropriate response to unplanned ignitions and providing for safety (U.S. Forest Service 2012).

Since about the mid-1970s, the total acreage area burned and the severity of wildfires in pine and mixed-conifer forests have increased on the Coronado National Forest (U.S. Forest Service 2011a). Five of the 16 largest fires ever documented in Arizona occurred on the Coronado National Forest between 1990 and 2011, ranging in size between 11,128.9 ha (27,500 ac) and 90,226.3 ha (222,954 ac) (Southwest Coordination Center 2013; <http://gacc.nifc.gov>). Between 1991 and 2011, 2,376 fires were reported, burning a total of 348,931 ha (862,227 ac); with the 2011 fire season contributing approximately 137,593 ha (340,000 ac). Forty-five percent of all these fires were lightning-caused whereas 55 percent were human-caused (U.S. Forest Service 2012). The two largest fires on the Coronado National Forest, the 1994 Rattlesnake and 2011 Horseshoe 2 fires, were human-caused and impacted historical thick-billed parrot habitat (Southwest Coordination Center 2013, <http://gacc.nifc.gov>). The 11,331 ha (28,000-ac) Rattlesnake Fire in the Chiricahua Mountains demonstrated the severe effects possible under such conditions (AZFirescape 2012). The 2011 Horseshoe 2 wildfire, the fourth largest fire recorded in Arizona, burned 80 percent of the Chiricahua Mountain Range, primarily in the Coronado National Forest, covering 90,226 ha (222,954 ac), with 12 percent of the fire area classified as a high-severity burn, 30 percent as a moderate-severity burn, and 38 percent as low-severity burn, and 20 percent as unchanged (U.S. Forest Service 2011b). The severity classes are determined by the effect of fire in upper layer canopy replacement, with low-severity as 6-25 percent replacement, moderate-severity as 26-75 percent replacement, and high-severity as > 75 percent replacement (U.S. Forest Service 2011a). Post-burn tree loss is expected to continue if Douglas-fir beetle outbreaks are not controlled (Allen et. al. 2006). (*See 1.3. Distribution and Habitat Use U.S. Historical Range. Arizona*)

In Mexico, occupied habitat has also been impacted by catastrophic fires, but less so than in recent years in the Sky Islands region of the U.S. likely due to Mexico's practice of setting fires to clear brush build-up periodically (Snyder 2012). For example from 2004 to 2008, 3,947 ha (9,753 ac) of forest habitat crucial to thick-billed parrots were destroyed by wildfire (CONANP-

Pronatura Sur 2008). Fires periodically destroy nesting trees; Cruz-Nieto (ITESM 2010) reported that for the 1995-2007 period, 12 quaking aspen were lost at the Madera breeding site, while several Douglas-fir at the Tutuaca (2) and Mesa de las Guacamayas (13) breeding sites were destroyed during the same period. A review of the fire histories at the Tutuaca and Mesa de las Guacamayas breeding areas noted that fires were frequent through the mid-20th century, followed by extended fire-free periods (Fulé et al. 2005, Fulé et al. in review in Cortés-Montaña 2011). Fulé et al. (2005) observed that “frequent fire played a long-term role in the ecosystem, the pattern of fire occurrence has changed in recent decades, and it will be important for managers to develop strategies for managing future fires” (page 328). Strategies for managing these forests include restoring frequent surface fires (through fire management) and protecting large diameter trees and snags to achieve structural characteristics needed by thick-billed parrots (Fulé et al. 2005, Cortés-Montaña 2011).

Forest Management

In the U.S., with the recognition that these heavy fuel loads need to be reduced, and fire needs to be reintroduced as a natural process to restore the ecological balance, the FireScape program (AZFirescape 2012) has taken a landscape-scale approach for fire management across multiple land ownerships in the mountains of southeastern Arizona including the Forest Service, The Nature Conservancy, the University of Arizona, Bureau of Land Management, National Park Service, and other southeastern Arizona land managers. Because the 2011 Horseshoe 2 fire has altered the mosaic of vegetation on the landscape, projects that were planned to be implemented through the Firescape program are being re-evaluated (Fisher 2012).

Planned vegetation treatments within the Coronado National Forest’s Ecosystem Management Areas are detailed in the draft land management plan (U.S. Forest Service 2011a) and the annual fire plans (U.S. Forest Service 2012). The types of treatments include wildland fire (planned and unplanned ignitions), forest thinning, vegetation mastication, fuelwood sales, and salvage sales to reduce the probability of a high-severity fire. The 117,964 ha (291,496 ac) Chiricahua EMA and the 65,606 ha (87,985 ac) Peloncillo EMA (Chiricahua and southern Peloncillo mountains respectively; Map 1 in Appendix A) are close to the extant populations in Mexico and within the historical range of the thick-billed parrot in Arizona and possibly New Mexico. Within 10 years of the draft Coronado National Forest Plan approval and pending availability of resources, the vegetation on 20 percent of the landscape in the Chiricahua EMA and 35 percent of the landscape in the Peloncillo EMA are planned to be treated to create resiliency to un-natural disturbances (U.S. Forest Service 2011a).

Sanitation/salvage has been performed since commercial logging first began prior to the 1900s. This type of intermediate treatment has declined in recent years; however, today salvage harvesting treatment is getting greater attention due to the increasing number of large, high intensity fires and increased insect-induced mortality in ponderosa pine and mixed conifer forests. Those treatments are generally located in high-severity burned areas and areas of extensive beetle-killed trees. In addition, Forest Service salvage operations in Arizona and New Mexico generally involve no new road construction, logging only on slopes <30–40 percent, and removing only trees that are completely dead or determined to be dying (USFWS 2011).

There is considerable controversy over the effects of salvage logging following high intensity fire, and most salvage projects are appealed and/or litigated in the courts (Karr et al. 2004 in USFWS 2011). Proponents of salvage logging believe that harvesting dead trees will reduce the need to harvest live trees and see the failure to log some of the dead trees as a waste of a valuable natural resource; many also see salvage logging as a way to help reduce future burn severity or provide biomass to the forest floor to help minimize erosion. Others think that the severe fire had already caused substantial environmental harm and that salvage logging may result in more environmental damage (e.g., Donato et al. 2006, Lindenmayer et al. 2009 in USFWS 2011).

White Pine Blister Rust

White pines in New Mexico and Arizona are threatened by an invasive fungus, white pine blister rust (*Cronartium ribicola*) (Conklin et al 2009). First found in the southwest on the Lincoln National Forest in 1990, it has now been discovered on the Alpine District of the Apache-Sitgreaves National Forest. It has not been found in Southwestern white pine on the Coronado but it is expected to appear within the next several decades (Wilcox 2012). This exotic disease is a significant threat to white pines and has become a major tree disease in many parts of the US and is expected to become a major disease of white pines throughout their range in North America (Tomback and Achuff 2010) including Mexico. Zeglen et al. (2010) provides an excellent review of silvicultural practices for addressing this disease in white pine stands in the west.

Management Benefitting both Thick-billed Parrots and Mexican Spotted Owls

Extensive overlap exists between the range and habitat used by the Mexican spotted owl and thick-billed parrot in Mexico. The maintenance and creation of large diameter trees and snags are an important factor in managing for nesting and roosting habitat for both species. Collaborating on conservation actions in Mexico that promote and maintain habitat in mature mixed conifer forest and reduce the risk of high-severity fire will benefit both species where their ranges overlap (USFWS 2012).

Factor B. Overutilization for commercial, recreational, scientific or educational purposes

Disappearance of the thick-billed parrot from the U.S. has been attributed to excessive shooting. Various accounts from the early 1900s indicate that shooting of birds was probably a frequent occurrence (Wetmore 1935; Snyder et al. 1994, 1999). Accounts of shooting thick-billed parrots have been reported in the literature (Lusk 1900 and Smith 1907 in Snyder et al. 1994, Wetmore 1935). Flocks of noisy, gregarious, and relatively tame thick-billed parrots were likely an easy target. Wetmore (1935) reported 75 or possibly 100 thick-billed parrots were believed to be shot out of curiosity in one canyon of the Chiricahua Mountains in 1917-1918. In addition, many residents in the remote southeastern Arizona mountains in the late 1800s and early 1900s relied on subsistence-hunting and likely shot thick-billed parrots for food (Snyder et al. 1994). Concern over the risk to the bird's long-term survival was even reported by Vorhies (1934 in Snyder et al. 1994). Arizona Game and Fish Department agent Ralph Morrow, who lived in the Chiricahua Mountains from 1903 to the mid-1970s, provided convincing testimony that shooting may have led to the thick-billed parrot's disappearance (Snyder et al. 1994). He observed widespread shooting of thick-billed parrots in the early 1900s and willingly participated by killing "many dozens of individuals." A 1904 National Park Service photograph from the

Chiricahua Mountains provides some evidence of loss by shooting, showing armed soldiers with dead thick-billed parrots (in Snyder et al. 1994).

There is little indication that shooting has been much of a threat in Mexico (Lanning and Shiflett 1983). The trapping of adults, and on occasion the taking of nestlings, for the local pet trade has been more of a threat (Lanning and Shiflett 1983 in Snyder et al. 1999, Cantu-Guzman et al. 2007, CONANP 2009). In some areas mature nest trees have been cut down to access the nests, not only reducing the number of young from the population, but also the number of available nest trees (CONANP-Pronatura Sur 2008). From 1984 to 1994 more than 1,000 thick-billed parrots were estimated to be captured and illegally smuggled into the U.S. for the pet market (Snyder et al. 1994; SEMARNAP-INE 2000). Although other parrot species are in much higher demand for the illegal U.S. pet trade, thick-billed parrots were 8th in a list of the top 10 parrot species seized at the southern border by USFWS for the period 1995-2005, with 26 thick-billed parrots seized by authorities during these years (Cantu-Guzman et al. 2007). However, most of the illegal trapping of parrot species in Mexico is for the domestic trade, not for exporting to the U.S. (Cantu-Guzman et al. 2007). Mexico's General Wildlife Law (Decree 60 Bis 2) bans the capture and export of all native parrots (Gobierno Federal 2008), and the species is listed in CITES Appendix I (UNEO-WCMC2012). The removal of birds from the wild for the illegal pet trade remains a threat to the population (CONANP2009).

Factor C. Disease or predation

Disease

Health assessments on wild thick-billed parrot populations have not been extensive, and the role of disease in wild population declines is not known (Snyder et al. 1999, Lamberski 2010). Although no information is available on wild populations, other diseases significant to captive-held parrots that may also adversely impact wild birds include West Nile virus (WNV), and salmonellosis (Lamberski 2005).

In 1995-1996, institutions comprising the ¹Thick-billed Parrot Species Survival Plan (SSP) Management Group conducted health assessments on 70 percent of their captive population (i.e. 73/105 birds). Thirty-nine birds were tested for Pacheco's disease (37 percent of the SSP population). Of the birds tested, 7 (18 percent) tested positive for Pacheco's disease antibodies. Although Pacheco's disease, a psittacid herpesvirus, has not been identified as a cause of death in any of these captive birds, it has been implicated in the death of birds involved in the Arizona releases (1986-1993). Disease can occur when a non-adapted Pacheco disease virus enters a new bird host; host-adapted strains cause a mild, latent, and subclinical infection in their host. Birds that recover from the virus may develop low levels of virus-neutralizing antibodies as well as long lasting immunity to the same strain of virus. Viral shedding occurs during times of stress

¹The Thick-billed Parrot Species Survival Plan (SSP) Management Group is the primary conservation effort of the American Zoo and Aquarium Association. SSPs are management plans directed at various species held in captivity at American Zoo and Aquarium Association-accredited facilities. Recommendations are made in regards to husbandry, nutrition, breeding, veterinary medicine, and reintroduction. Most thick-billed parrots held in zoos or by a few private individuals are managed as a single population. One of the SSP's goals is to address the disease problems discovered in the captive population and early releases (Lamberski and Healy 2002). The captive thick-billed parrot population in accredited facilities can be used as a resource for disease susceptibility, management, and prevention.

and often with no clinical signs of disease; therefore the Pacheco's disease can unknowingly be transmitted from a latently infected bird to an uninfected bird (Lamberski et al. 2000). Nine latently infected parrots as determined by detection of neutralizing antibodies to Pacheco disease during the 1995 SSP disease survey were retested for the neutralizing antibody to Pacheco's disease (Lamberski et al. 2000). Only one of the nine birds demonstrated the neutralizing antibody of Pacheco's disease during the 12 month study period and this bird also shed virus in its feces during the study period.

Diseases such as WNV are linked to habitats with human disturbance. WNV has been spreading in the U.S and Mexico since 1999, and captive thick-billed parrots are susceptible to this infection. In 2003, almost 20 percent of the captive population mortalities were confirmed cases of WNV (Lamberski 2005). WNV in wild birds in the Sierra Madre could have a devastating impact on the populations. Mosquito vectors for WNV and St. Louis encephalitis occur in some thick-billed parrot habitat. Serum samples from 24 wild chicks were negative for both these diseases (Lamberski et al. 2010).

Additionally, cases of salmonella septicemia have resulted in acute death in captive thick-billed parrots. *Salmonella arizona* was identified as the specific organism in three cases (Lamberski 2005). While salmonella is ubiquitous, close association of parrots with poultry, reptiles, livestock, and contaminated environments can increase exposure. Two birds of these three mentioned cases were housed in an enclosure with reptiles.

More research is needed on the disease status of wild populations. The limited studies have focused mainly on nestlings. A 1997 disease survey of 24 nestlings from 4 different sites resulted in negative tests for avian influenza, Newcastle disease, Pacheco's disease, or polyomavirus (Stone et al. 2005). In 2008, samples collected from 4 adults and 9 chicks were negative for avian polyomavirus, Pacheco's disease, *Chlamydophila* spp., salmonella, St. Louis encephalitis, WNV, avian influenza, and Newcastle's disease. In 2009, samples collected from 29 chicks at 3 nest sites were negative for St. Louis encephalitis and WNV (Lamberski 2012). Ectoparasites, including cimicid bugs (*Ornithocoris* spp.), fleas (*Psittipsylla mexicana*), and lice (*Heteromenopon* sp. and *Psittacobrosus* sp.), have been documented at nests and evidently have contributed to nest failures (Stone et al. 2005, Monterrubio et al. 2002). Chicks in parasitized nest exhibited severe anemia (Stone et al. 2005 in Monterrubio et al. 2002). Botflies have also been observed on some chicks (Monterrubio et al. 2002). In 2012, of all the nests monitored across 6 breeding areas, 7.14 percent of nests were abandoned because of the presence of cimicid bugs (Cimicidae). Additionally, the primary cause of chick mortality was attributed to an outbreak of cimicid bugs with 25 percent of chicks not reaching fledgling stage, while botflies contributed to chick mortality in 17.84 percent of nest-trees monitored (Pronatura 2012). The frequency of nest failures due to ectoparasites (levels of ectoparasite infestations vary by year and nest sites), predation, and other factors is relatively low, and the species exhibits high nest success (approximately 80 percent) and productivity at known breeding sites (Monterrubio et al. 2002, ITESM 2011, Cruz-Nieto 2012).

The impact that Pacheco's disease, WNV, and salmonellosis could have on free-living populations is speculative as very little is known about the health status of wild birds (Lamberski 2005). Testing wild populations will determine if Pacheco's disease is endemic to both free-

living and captive birds or if it is just a product of captivity. Vector borne diseases (e.g., WNV and St. Louis encephalitis) should be monitored in breeding areas, as mosquito vectors occur near wild populations of thick-billed parrots, and an outbreak of WNV could be devastating to the wild population. Annual health assessments and serosurveys of chicks should also be conducted across the main breeding areas to evaluate each locality as some infections (such as ectoparasites) may be site specific (Lamberski 2012). This becomes increasingly important if adaptive management measures include moving eggs, chicks, or adults from one nest site to another. Other diseases that are important to monitor in wild thick-billed parrots include paramyxovirus (Newcastle's disease), and avian influenza (Lamberski 2012).

Disease Risk Using Captive-Bred or Wild-Caught Birds

The thick-billed parrot reintroduction program in the late 1980s and early 1990s demonstrated the high risk in releasing captive-bred and confiscated wild birds without the ability to detect some dangerous and untreatable diseases in carrier birds, even with extended quarantine periods (Snyder et al. 1994). Diseases that cannot be reliably detected include parrot wasting disease (psittacine pro-ventricular dilation syndrome) and Pacheco's disease (Derrickson and Snyder 1992). Rigorous disease prevention and screening procedures may be sufficiently expensive to preclude captive breeding as a recovery approach for many species (Snyder et al. 1996). Based on the Arizona parrot release results, the disease risk is too great to attempt reestablishment with captive-bred or confiscated wild birds (Snyder et al. 1994). The presence of pasteurilla (avian cholera), and possibly parrot wasting disease and Pacheco's disease among the released birds in Arizona may have been a contributing factor to poor survival (*see 1.8.1. Reintroductions*).

Predation

Naturally-occurring thick-billed parrot populations in Mexico exhibit sentinel, flocking, and social behavior to avoid potential predators (Snyder et al. 1994). Birds released in Arizona, many of which were held in captivity for years, lacked these learned skills. Raptors, mainly red-tailed hawks (*Buteo jamaicensis*) and northern goshawks (*Accipiter gentilis*), were the primary source of mortality for wild-flighted, released birds in Arizona. Ring-tailed cats (*Bassariscus astutus*) have been documented preying on adult parrots at roosts sites (Snyder et al. 1999). Less abundant than the ring-tailed cat in most of the parrot's range, the raccoon (*Procyon lotor*) is known to prey upon nestlings, based on a single record (Cruz-Nieto 1998 in Snyder et al. 1999). Predators at nests are an unusual occurrence; for example, Monterrubio et al. (2002) documented only eight known predation events by ringed-tailed cats and avian predators.

The PACE does not identify disease or predation as major threats to the thick-billed parrot. The data are too limited to draw any conclusions about the impact of disease on wild thick-billed parrots (Lamberski 2012). West Nile virus, salmonella, and Pacheco's disease found in captive thick-billed parrots are cause for concern and should be monitored in wild populations. The impact of disease will be intensified as populations decline, become fragmented, or are stressed due to other factors such as reduced food availability and habitat disturbances.

Factor D. The inadequacy of existing regulatory mechanisms

The thick-billed parrot was listed as an endangered species on June 3, 1970 (35 FR 8491), pursuant to the Endangered Species Conservation Act (ESCA), the precursor of the Endangered Species Act. Based on the different listing procedures for foreign and domestic species under the ESCA, the thick-billed parrot was listed as a “foreign” species. When the Endangered Species Act replaced the ESCA, the thick-billed parrot was not carried forward onto the Federal List of Endangered and Threatened Wildlife and Plants for the United States due to an oversight, although the thick-billed parrot remained listed in Mexico. Subsequently, the parrot was proposed to be listed in the United States on July 25, 1980, wherein the proposed listing rule acknowledged that it was always the intention of the Service to list the thick-billed parrot as endangered in the United States (see 45 FR 49844, page 49845). In 2009, the U.S. Department of the Interior’s Assistant Solicitor for Fish and Wildlife provided an explanation stating that the species has always been listed as endangered throughout its entire range (see 74 FR 33958). Today, the thick-billed parrot remains listed throughout its range, including Mexico and the United States; critical habitat has not been proposed for the thick-billed parrot. Mexico also lists the parrot as endangered in its Norma Oficial Mexicana: NOM-059-SEMARNAT-2010 (Gobierno Federal 2010, Monterrubio-Rico and Enkerlin-Hoeflich 2008).

In Arizona the species is protected under Title 17 within the general provisions for native birds. Additionally, regulation R12-4-406 of the Arizona Game and Fish Commission classifies the species as “Restricted live Wildlife” which means it cannot be imported, exported, or possessed without a special license or lawful exemption (AAC Title 12). New Mexico’s Statutes Annotated Chapter 17 also affords the species a level of protection (NMDGF 2012).

The U.S. has little authority to implement actions needed to recover species outside its borders, especially when recovery requires the employment of laws and regulations. The main threat to the parrot in Mexico is habitat destruction, with illegal capture for the pet trade being a secondary threat. The powers that the USFWS can employ in this regard are limited to prohibiting unauthorized importation of listed species into the U.S., prohibiting persons subject to U.S. jurisdiction from engaging in commercial transportation or sale of listed species in foreign commerce, and assisting foreign entities with education, outreach, and other aspects of conservation through our authorities in section 8 of the ESA. The “take” prohibitions of section 9 of the ESA only apply within the U.S., within the territorial seas of the U.S., and on the high seas. They do not apply in Mexico (where the thick-billed parrot occurs) or any other foreign country. Section 7 of the ESA, which provides for all Federal agencies to utilize their authorities to carryout programs for the conservation of the species, and to ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of listed species or adversely modify its critical habitat, is the primary tool within the ESA to address conflict with development or construction. The USFWS has no section 7 authority outside the boundaries of the U.S.

E. Other natural or manmade factors affecting its continued existence

Population Size

The parrot exhibits a patchy distribution across its vast range in Mexico (see Map 2 in Appendix A for recent verified records) and many of these areas are difficult to access because of their

remoteness and potential danger; therefore accurately estimating range-wide population numbers for the species has been challenging (Snyder et al. 1999, Monterrubio et al. 2002). Estimates vary on the number of thick-billed parrots. Lammertink et al. (1996, in BirdLife International 2012) estimated between 1,000 and 4,000 birds. Key breeding areas are periodically surveyed, and parrot counts from 3 areas (including the 2 most important breeding sites of Madera and Tutuaca) in 2008 totaled close to 3,500 individuals (CONANP-Pronatura Sur 2008 in CONANP 2009). Monthly surveys (July-October) in 2012 across 5 breeding areas (including Madera and Tutuaca) counted a minimum of 1,870 and a maximum of 2,097 individuals (Pronatura 2012). However, this number may be a conservative estimate because not all known breeding areas are surveyed annually and other more remote or potential breeding areas have not yet been inventoried (Cruz-Nieto, pers. comm. 2012).

Productivity and nest success in the breeding populations are high (Monterrubio et al. 2002), but only a small percentage of the individuals are breeding pairs (CONANP 2009). In Chihuahua in 1995 and 1996, 5 of 18 and 28 of 58 pairs using cavities in respective breeding seasons did not produce eggs (Cruz-Nieto 1998 in Snyder et al. 1999). In Chihuahua in 1998, one-third of 160 pairs using cavities did not produce eggs (T. Monterrubio, pers. comm. in Snyder et al. 1999). Additionally, recruitment rate is believed to be low (CONANP 2009), although the rate of mortality for juveniles or adults has not been quantified (Monterrubio et al. 2002). Reduced population size is considered a threat to the species, because the breeding populations are relatively small and concentrated in a handful of sites, which makes them vulnerable to catastrophic events (CONANP 2009). Large areas of old-growth forest are no longer found in the Sierra Madre Occidental and as the average age of trees and conifer forest decreases, so do parrot nesting sites and food resources. The reduced seed production in these younger forests is accompanied by an increase in the frequency of sterile cones, further exacerbating the inadequate food supply (Monterrubio-Rico and Enkerlin-Hoeflich 2004, Monterrubio-Rico et al. 2006). Thus, the thick-billed parrot is further threatened by small population size and the low number of breeding pairs in the remaining old-growth and mature forests.

Climate Change

Our analyses under the Endangered Species Act include consideration of ongoing and projected changes in climate. The terms “climate” and “climate change” are defined by the Intergovernmental Panel on Climate Change (IPCC). The term “climate” refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007a). The term “climate change” thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007a).

Scientific measurements spanning several decades demonstrate that changes in climate are occurring, and that the rate of change has been faster since the 1950s. Examples include warming of the global climate system, and substantial increases in precipitation in some regions of the world and decreases in other regions. (For these and other examples, see IPCC 2007a and Solomon et al. 2007). Results of scientific analyses presented by the IPCC show that most of the observed increase in global average temperature since the mid-20th century cannot be explained

by natural variability in climate, and is “very likely” (defined by the IPCC as 90 percent or higher probability) due to the observed increase in greenhouse gas (GHG) concentrations in the atmosphere as a result of human activities, particularly carbon dioxide emissions from use of fossil fuels (IPCC 2007a and Solomon et al. 2007). Further confirmation of the role of GHGs comes from analyses by Huber and Knutti (2011), who concluded that it is extremely likely that approximately 75 percent of global warming since 1950 has been caused by human activities.

Scientists use a variety of climate models, which include consideration of natural processes and variability, as well as various scenarios of potential levels and timing of GHG emissions, to evaluate the causes of changes already observed and to project future changes in temperature and other climate conditions (e.g., Meehl et al. 2007, Ganguly et al. 2009, Prinn et al. 2011). All combinations of models and emissions scenarios yield very similar projections of increases in the most common measure of climate change, average global surface temperature (commonly known as global warming), until about 2030. Although projections of the magnitude and rate of warming differ after about 2030, the overall trajectory of all the projections is one of increased global warming through the end of this century, even for the projections built upon scenarios that assume that GHG emissions will stabilize or decline. Thus, there is strong scientific support for projections that warming will continue through the 21st century, and that the magnitude and rate of change will be influenced substantially by the extent of GHG emissions (IPCC 2007a Meehl et al. 2007, Ganguly et al. 2009, Prinn et al. 2011). (See IPCC 2007b for a summary of other global projections of climate-related changes, such as frequency of heat waves and changes in precipitation. Also see IPCC 2011 for a summary of observations and projections of extreme climate events.)

Various changes in climate may have direct or indirect effects on species. These effects may be positive, neutral, or negative, and they may change over time, depending on the species and other relevant considerations, such as interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007). Identifying likely effects often involves aspects of climate change vulnerability analysis. Vulnerability refers to the degree to which a species (or system) is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the type, magnitude, and rate of climate change and variation to which a species is exposed, its sensitivity, and its adaptive capacity (IPCC 2007a, see also Glick et al. 2011). There is no single method for conducting such analyses that applies to all situations (Glick et al. 2011). We use our expert judgment and appropriate analytical approaches to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

Although many species already listed as endangered or threatened may be particularly vulnerable to negative effects related to changes in climate, we also recognize that, for some listed species, the likely effects may be positive or neutral. In any case, the identification of effective recovery strategies and actions for recovery plans, as well as assessment of their results in 5-year reviews, should include consideration of climate-related changes and interactions of climate and other variables. These analyses also may contribute to evaluating whether an endangered species can be reclassified as threatened, or whether a threatened species can be delisted.

Global climate projections are informative, and, in some cases, the only or the best scientific information available for us to use. However, projected changes in climate and related impacts can vary substantially across and within different regions of the world (e.g., IPCC 2007a). Therefore, we use “downscaled” projections when they are available and have been developed through appropriate scientific procedures, because such projections provide higher resolution information that is more relevant to spatial scales used for analyses of a given species (see Glick et al. 2011, for a discussion of downscaling).

Exactly how climate change will affect precipitation within the range of the thick-billed parrot in the Southwest is uncertain. However, consistent with recent observations of regional effects of climate change, the projections presented for the Southwest predict warmer, drier, and more drought-like conditions (Hoerling and Eischeid 2007, Seager et al. 2007). For example, climate simulations of the Palmer Drought Severity Index (PDSI) (a calculation of the cumulative effects of precipitation and temperature on surface moisture balance) for the Southwest for the periods of 2006 to 2030 and 2035 to 2060 show an increase in drought severity with surface warming. Additionally, drought still increases even during wetter simulations because of the effect of heat related moisture loss through evaporation and evapotranspiration (Hoerling and Eischeid 2007). Annual mean precipitation is likely to decrease in the Southwest, as is the length of snow season and snow depth (IPCC 2007b). Most models project a widespread decrease in snow depth in the Rocky Mountains and earlier snowmelt (IPCC 2007b).

Sky Islands in the Southwest and Mexico are already being affected by processes associated with climate change, by increases in drought, fire, and invasive insects (Williams et al. 2010 in U.S. Forest Service 2011a). By the end of the 21st century, the Southwest, including the Coronado National Forest, is likely to experience: temperature increases of five to eight degrees Fahrenheit (or about half a degree Fahrenheit per decade on average); an increase in the number of hot days, with summer heat waves lasting two weeks or longer; warmer winters with reduced snowpack; a later monsoonal season; a 10 percent drop in annual precipitation in Southern Arizona; and an increase in extreme flood events following an overall increase in tropical storms (U.S. Forest Service 2011a). Based on projections of future climate change for the region, the Sky Islands of Arizona, New Mexico, and northern Mexico are susceptible to the following conditions: decreases in plant productivity from water limitations and increased heat, effects on phenology and changes in the date of flowering and associated pollination and food-chain disruptions, long-term shifts in vegetation patterns including cold-tolerant vegetation moving upslope or disappearing in some areas and migration of some tree species to the more northern portions of their existing range; shifts in the timing of snowmelt (already observed) and increases in summer temperatures affecting the availability of flowing surface water and survival of aquatic species; increases in insect attacks, colonization of invasive species (including insects, plants, fungi, and vertebrates); longer and more severe fire seasons; and altered frequency, severity, timing, and spatial extent of disturbance events (e.g. droughts, flash floods, landslides, and wind storms) (Joyce et al. 2006, Westerling et al. 2006, IPCC 2007, Millar et al. 2007, Clark 1998, Swetnam et al. 1999 in U.S. Forest Service 2011a).

Increases in drought and heat stress associated with climate change could alter the future composition, structure, and biogeography of forests (Allen et al. 2010), including old-growth forests thick-billed parrots depend on. Some forest ecosystems in different parts of the world

may already be responding to climate change, raising concerns that forests may become increasingly vulnerable to higher tree mortality rates and die-off in response to future warming and drought (Allen et al. 2010). Large-scale tree mortality can occur abruptly when climate change exceeds species-specific physiological thresholds, or if climate triggers associated irruptions of insect pests in weakened forests (Allen et al. 2010). This could impact habitat for thick-billed parrots.

Sky Island forests could become even more fragmented in the future as forest habitats shift upward in elevation (U.S. Forest Service 2011a). Temperature increases of as little as a few degrees could cause forest habitats to shift to higher elevations, reducing their area, altering phenologies of food availability, and potentially causing local extinction of endemic taxa and unique genetic and phenotypic diversity (Kupfer et al. 2005, U.S. Forest Service 2011a). A recent assessment of climate change in the Southwest found that many Sky Islands forest systems are among the most vulnerable to climate change because of the combination of recent temperature increases and a high number of species of conservation concern (Robles and Enquist 2010, U.S. Forest Service 2011a). We expect long-term climate trends associated with a hotter, drier climate to have an overall negative effect on the available habitat and food resources in the historical and current range of the thick-billed parrot.

Climate change may also threaten parrots by altering vector prevalence and exposing parrots to novel diseases (Lamberski 2012).

1.8. Conservation Measures

Populations at the edge of their range can be important in maintaining genetic diversity and evolutionary potential (Channell and Lomolino 2000) and the successful establishment of a U.S. breeding population at the northern edge of the parrot's range could help mitigate future catastrophic loss due to stochastic events farther south. However, given that a U.S. population is not essential for conservation of the species and may not be sustainable in the future if the remaining potential habitat is lost to high-intensity fire and climate change, conserving thick-billed parrot habitat and populations in northern Mexico is likely to provide greater recovery benefit (Snyder 2012). If conditions are suitable, a successful U.S. breeding population may eventually be established through natural expansion as a result of efforts to conserve thick-billed parrot habitat and populations in northern Mexico.

1.8.1. Reintroductions

The IUCN (1998) defines a reintroduction as “an attempt to establish a species in an area which was once part of its historical range, but from which it has been extirpated or become extinct,” while a translocation is defined as the “deliberate and mediated movement of wild individuals or populations from one part of their range to another.” The PACE (CONANP 2009) briefly addresses reintroductions within the context of research needed to aid in conservation of the thick-billed parrot in Mexico. More specifically, it outlines research needs on the biological limitations and adaptability of the species to inform potential translocations as well as the need to identify and evaluate potential areas for releases. Although the PACE uses the broader term “reintroductions”, its focus is only on translocations and not on captive-breeding programs (Cruz-Nieto 2013).

Background

Reintroductions have been used as a conservation strategy for several threatened parrot species (White et al. 2012). However, there are a number of reasons to be cautious about initiating another thick-billed parrot reintroduction program in the U.S., despite advances in captive-breeding and release techniques.

Some experienced scientists involved in captive-breeding programs for species recovery caution that conducting such programs should be considered only as a last-resort recovery strategy (Snyder et al. 1996). Not only are these programs expensive and difficult to sustain, but also they have fundamental limitations to producing long-term conservation benefits (Snyder et al. 1996). Instead, Snyder et al. (1996) advocate that captive breeding be recommended or initiated only after field studies lead decision-makers to the conclusion that no other conservation alternatives are immediately available or feasible and that captive breeding is essential for near-term survival of a species.

Funding for endangered species recovery is limited, especially for a species that no longer occurs in the U.S. In general, the financial resources needed for captive breeding and reintroduction of endangered species are not likely to be available from zoological institutions, private captive breeders, or government sources (Snyder et al. 1996). In comparison, the funding needed for effective recovery through in-situ conservation efforts and, in particular, habitat conservation, is often much lower and serves to protect entire ecosystems (Leader-Williams 1990; Balmford et al. 1995; in Snyder et al. 1996).

Ensuring adequate administrative continuity under varying social and economic conditions is among the most serious problems faced by most captive breeding programs, governmental or private (Snyder et al. 1996). The probability of future administrative or financial constraints must be weighed against the perceived long-term benefits of the captive breeding program. =Short-term successes in conserving a few endangered species through captive breeding have led to enthusiasm that assumes unattainable success rates in breeding and genetic/behavioral management in many species unrealistic probabilities of successful reintroduction to the wild, and a sustained availability of resources that is unlikely (Snyder et al. 1996).

Even populations that fall below the minimum viable size may be far more viable than captive populations given the many problems associated with captive breeding and reintroduction (Snyder et al. 1996). In many cases there is enough time to develop alternative, non-captive approaches that may be more effective, economical, and safe than captive approaches in achieving recovery.

Disease risks and overall costs (e.g., labor, construction, transportation) can be minimized by conducting recovery captive breeding programs in countries of origin rather than in ex situ environments (Snyder et al. 1996). If after further evaluation a captive breeding program is determined to be warranted, such a program in Mexico, near to the U.S. former range, would likely be less expensive than in the U.S. and may generate additional public support for habitat conservation.

Past Arizona Reintroductions

The Arizona Game and Fish Department, USFWS, and others, conducted a reintroduction program during 1986-1993 when 88 birds were released in the Chiricahua Mountains of southeastern Arizona (Snyder et al. 1994). These 88 individuals consisted of 65 presumed-wild (confiscated by USFWS and believed to be of wild origin from Mexico) and 23 captive-reared birds. These parrots were released in varying numbers over the 8 years and as the project progressed it became clear that a larger number of birds was needed to achieve success (Snyder et al. 1994). Flock size was insufficient to contend with high degree of vigilance and the “critical mass” needed to contend with the heavy predation pressures from raptors (Snyder et al. 1994).

Social behaviors of a species or individuals influence the success of reintroductions and translocations (Brightsmith et al. 2005, Teixeira et al. 2007, Guerra et al. 2008). Many species, including thick-billed parrots, depend on interactions with conspecifics for settlement decisions, efficient foraging, access to mates, reduction of energetic costs of movement, and protection from predators (Stamps 2001, Krause and Ruxton 2002, Guerra et al. 2008). A newcomer may have difficulty integrating into a new social environment if it is not accepted into the group. Translocations and reintroductions that force integration of parrots from different social groups may exacerbate the physical stress experienced by birds already searching for new sources of food, water, and shelter (Kikusui et al. 2006, Teixeira et al. 2007). Chronic stress can result in diminished cognitive abilities, reduced growth, suppression of the immune system, and other negative effects (Bergman et al. 2005, Kikusui et al. 2006, Teixeira et al. 2007, Guerra et al. 2008). The development of social behaviors directly impacted the survivability of thick-billed parrots during reintroductions and translocations into Arizona.

The reintroduction program did not succeed in the reestablishment of a viable wild thick-billed parrot population primarily due to substantial deficiencies in basic survival skills, insufficient flock size, and perhaps a lack of suitable habitat with the capacity to provide sufficient food availability (cone production) (Snyder et al. 1994, Snyder 2012). Wild-caught thick-billed parrots had better success with integrating with existing released flocks than did captive-reared thick-billed parrots, as demonstrated by the release of 16 wild-caught adults in Arizona as singletons, pairs, and one trio during 1987, 1988, 1989, and 1993 (Snyder et al. 1994). These releases were generally successful, with released birds integrating with the flocks within a few days and sometimes within a single day. Contrastingly, almost all captive-bred individuals were lost within a few days of release from predation by northern goshawks, red-tailed hawks, and ring-tailed cats. Birds with sub-par behavior usually survived only briefly in the wild. Captive-reared birds in general showed little tendency to flock properly, had difficulties recognizing and remaining in appropriate habitat, fed poorly, and usually perished very quickly either from food stress or predation. Training captive-reared birds even to feed competently on pine cones was a laborious process taking many months before release; even fledglings in the wild often take 4-5 months to achieve competence in removing cones from branches and removing seeds from cones. Although captive-reared birds were caged with wild-caught birds prior to release, the only birds that showed any tendency to flock with wild-caught birds were ones that had been parent-reared in huge aviaries. Even so, the hawks quickly and selectively picked captive-reared birds out of mixed release flocks that included both wild-caught and captive-reared birds. Considering the huge expense and trouble in producing captive-bred birds with even modest behavioral competence, Snyder et al. (1994, 2012) do not recommend releasing captive-bred

birds. Moreover it is unnecessary when better alternatives are available. Additionally, some of the birds coming into the program from captive breeding facilities in the 1980s and 1990s proved to be birds carrying serious diseases. Few captive breeding facilities practice the rigorous sorts of procedures necessary to prevent such risks (Snyder et al. 1994, Snyder 2012). Snyder et al. (1994) conclude that establishment of a viable wild population using captive-bred birds would necessitate the rearing, training, and release of large numbers of individuals, perhaps in the thousands.

The released birds made several long-distance movements from the Chiricahua Mountains, presumably to find food. Two of the more notable movements in response to the lack of food availability were the disappearances of released thick-billed parrot flocks in 1989, following a near total collapse of the cone crop, and in 1993 within half a year of release, after the birds consumed all available cones visible in West Turkey Creek, moved to higher elevation to consume a Douglas-fir cone crop, and then to an unknown destination when food was no longer available in the Chiricahua Mountains (Snyder et al. 1994; Snyder 2012). Food availability was a limiting factor for birds released in Arizona, and could be limiting for thick-billed parrots into the future if predicted climate trends of drier conditions continue.

Species Survival Plan Management Group's Redefined Goals

In the mid-1990s, the Thick-billed Parrot Species Survival Plan Management Group redefined its goals to de-emphasize the release of captive birds, address the problems discovered in the early releases, and to increase SSP support of free-living populations. The goal of the Thick-billed Parrot SSP is to ensure the survival of the thick-billed parrot within its historical range by maintaining a captive population, educating the public regarding the conservation of native endangered species, and supporting the wild populations and their habitat within North America (Lamberski and Healy 2002). The captive population is important for enhancing knowledge of thick-billed parrot biology, serving as representatives to educate the public about this species, and creating a refugium for conservation options. Currently, the Association of Zoos and Aquarium facilities hold approximately 95 thick-billed parrots in the U.S. (Healy and Barkowski 2012).

Cost Estimates for Future Releases (captive breeding)

The Thick-billed Parrot SSP Management Group estimates it may take 20-25 years to build up the population to 200 birds, which would increase the captive bird population stability. It would take about 50 years to build up the captive thick-billed parrot population to numbers needed for wild release (300-400 birds) (Healy and Barkowski 2012). In addition to the lengthy time period needed to build up parrot numbers, captive-raised thick-billed parrot candidates for release must overcome a number of behavioral and social challenges to survive in the wild, as mentioned previously. These include learning how to a) extract seeds from pine cones, b) function as a cohesive flock to evade aerial and arboreal predators common to southern Arizona, and c) find food sources that may be available for short periods of time across unfamiliar habitat in the Sky Islands and adjacent northern Mexico.

Cost estimates for implementing a thick-billed parrot captive breeding and reintroduction program were based on costs of the Puerto Rican parrot captive breeding and reintroduction program and input from Thick-billed Parrot SSP Management Group members. The ongoing Puerto Rican parrot captive breeding and reintroduction program, which began in 1972 (USFWS

2002), costs about \$1.5 million annually for aviary operations, field operations, and personnel (Lopez 2013). The Puerto Rican parrot program costs do not include start-up construction or costs incurred by the U.S. Fish and Wildlife Service partners, Puerto Rico Department of Natural and Environmental Resources, and the U.S. Forest Service. More specifically, costs include personnel salaries, aviary security, parrot food and supplies, maintenance of sophisticated equipment, veterinary services, medicine, quarantine costs, volunteer personnel subsistence, nest guarding, releases, radio-telemetry monitoring of released parrots, and travel, utilities, and overhead. Personnel costs, the greatest annual expense at \$905,500, consist of 14.25 full-time employees: a project leader, aviary coordinator, release program coordinator, field coordinator, eight biological technicians, office assistant, and maintenance worker.

Using the \$1.5 million annual Puerto Rican parrot captive breeding and reintroduction program base costs, we estimate a similar thick-billed parrot program will need additional funding as follows: a) \$0.5 - \$1.0 million start-up funds for constructing large, complex flight pens for acclimation, flight, breeding, and quarantine; b) \$50,000 start-up funds for five years for a nutritional consultant; and c) \$115,000 annually for a half-time position for a veterinarian and a half-time position for a veterinary technician to address thick-billed parrot disease issues and testing (Healy and Barkowski 2013, Lamberski 2013).

The cost of the thick-billed parrot captive breeding and reintroduction program for 15 years, which is the estimated amount of time it will take to increase the size of the captive population to 150 individuals, will be at least \$25 million; costs are projected out to 50 years in Table 2. These costs do not include a) captive breeding and reintroduction planning costs incurred by U.S. Fish and Wildlife Service, the Arizona Game and Fish Department, and the U.S. Forest Service, and the participating SSP Thick-billed Parrot Management Group zoos; b) ongoing administrative costs incurred by the Arizona Game and Fish Department and U.S. Forest Service once reintroductions begin; c) costs of supplying parrots pine branches bearing ripe cones; or d) adjustment for inflation.

Table 2. Estimated costs of a thick-billed parrot captive breeding and reintroduction program in the U.S. Estimates were based on costs of the Puerto Rican parrot captive breeding and reintroduction program and input from SSP Thick-billed Parrot Management Group members.

Type of program or service	15 year Costs (\$ million)	25 year Costs (\$ million)	50 year Costs (\$ million)
Puerto Rican Parrot program ²	22.5	37.5	75.0
Additional thick-billed parrot costs - facility construction, veterinary services	2.9	3.0	6.0
Total thick-billed program ³	25.4	40.5	81.0

²based on Puerto Rican parrot captive breeding and reintroduction operations (including 14.25 full-time personnel equivalents), food, medicine, care supplies, building maintenance, utilities, quarantine costs (M. Lopez, USFWS, pers. com. 2013).

³estimates do not include a) captive breeding and reintroduction planning costs incurred by U.S. Fish and Wildlife Service, the Arizona Game and Fish Department, and the U.S. Forest Service, and the participating SSP Thick-billed Parrot Management Group zoos; b) ongoing administrative costs incurred by the Arizona Game and Fish Department and U.S. Forest Service once reintroductions begin; c) costs of supplying captive parrots pine branches bearing ripe cones; and d) adjustment for inflation.

Using wild-caught birds with wild behavioral skills intact would require less funding and fewer individuals for release. However, the U.S. is unlikely to receive wild-caught birds in the near future both because wild thick-billed parrot population may not be large enough to contribute the number of birds needed for translocation and because current Mexican law (General Wildlife Law Decree 60 Bis 2) bans the exportation of all parrot species (Gobierno Federal 2008). An alternate strategy is to explore the potential of translocating parrots within Mexico near the U.S. border. Augmenting the small population in Mesa de Las Guacamayas or releasing parrots in suitable habitat in the border area of Mexico may increase the likelihood that birds will disperse to suitable habitat in the U.S.

Disease Risk Using Captive-Bred or Wild-Caught Birds

The potential risk of spreading disease from birds in confiscation and captive-breeding facilities to wild parrots and other sympatric species must be evaluated as part of a reintroduction program (Snyder et al. 1994, 2000). The presence of pasteurilla (avian cholera), and possibly parrot wasting disease (psittacine pro-ventricular dilation syndrome) and Pacheco's disease among the released birds in Arizona may have been a contributing factor to poor survival. Pacheco's disease has been detected in captive populations of the parrot. More problematic is that diseases such as parrot wasting disease and Pacheco's disease cannot be reliably detected in carrier individuals even with extended quarantine periods (Derrickson and Snyder 1992).

Information on disease occurrence in wild populations is very limited, and more research is needed on the disease status of wild and captive populations. For example, testing is needed on wild populations to determine whether Pacheco's disease is endemic to both free-living and captive birds or if it is only a product of captivity. Additionally, diagnostic capabilities for diseases in captive zoo and wild animals are not equivalent with those for human diseases, and advanced testing and vaccines are not available for many pathogens. The standard length of quarantine periods are too short for accurate detection of many slow-acting diseases. As with Pacheco's disease, some diseases can remain latent until periods of high stress. Because slow-acting diseases like Pacheco's disease cannot be reliably detected in carriers, reintroduction programs run the risk of inadvertently infecting wild populations with pathogens to which there is no resistance (Snyder et al. 1996). This risk exists even with intensive pre-release screening for diagnosable diseases.

Snyder et al. (1996) discussed basic veterinary principles that captive breeding programs should follow. One of these principles is that founder stock for a captive breeding program should not be obtained from multi-species facilities, but rather should be taken directly from the wild populations or single species facilities with good histories of disease prevention. Facilities housing birds that have tested positive for diseases such as Pacheco's disease, West Nile Virus, and salmonella should not be used in a captive breeding program.

Although the 1986-1993 reintroduction effort was unsuccessful, encouraging results were: 1) wild-caught birds experienced higher survival rates, 2) some flocks established a migratory pattern within Arizona, and 3) several breeding attempts were documented, including the successful fledging of young by a pair that bred along the Mogollon Rim in central Arizona. Based on these results, Snyder et al. (1994, 2000) suggested that future reintroduction efforts

should rely on birds removed from sustainable wild populations, and those that have been thoroughly vetted for any potential pathogens.

Experimental Translocations in Mexico

More recently (1999-2007), several small scale experimental translocations consisting of one or two pairs have been conducted within Mexico (Enkerlin-Hoeflich et al. 2001, Ortiz-Maciel, 2007). The translocated pairs either joined the local population or returned to their original nesting site. In the most recent effort (June 2007), a joint ITESM/Pronatura Noreste team moved two breeding pairs from Madera to the Mesa de las Guacamayas breeding site located approximately 140km (87 mi) apart. Post-release monitoring indicated that both pairs had returned to Madera after 10 days (Ortiz-Maciel 2007). Experimental translocations continue to be considered within Mexico to evaluate different approaches (e.g., breeders vs nonbreeders, etc.). A rough estimate for a potential translocation within Mexico, including costs of nest monitoring and protection, selecting individuals, captures, releases, post-release tracking, and indirect costs are presented in Table 3 (Cruz-Nieto 2013).

Table 3. Estimated costs (in U.S. dollars) of a thick-billed parrot translocation project within Mexico (Cruz-Nieto 2013).

Category	Description	Cost (\$)
Monitoring and Protection	Nest monitoring and protection	24,100.00
Translocation	Captures, release, and cost of radios, equipment, permit processing	18,300.00
Indirect Costs	Office rent, supplies and utilities, vehicle maintenance (6 mo)	8,250.00
Total		50,650.00

Summary

Results from both the reintroductions in Arizona, the experimental translocations in Mexico, and advances with reintroductions of other parrot species (White et al. 2012) will help inform any future reintroduction efforts. In particular, when designing a translocation or reintroduction program, consideration should be given to habitat condition, the source of birds, disease testing and quarantines, optimal release site selection, supplemental feeding, predator migrations, predator aversion training, nest box placement, age of birds, social structure, number of birds, distance from nearest parrot population, time of year, and financial resources.

Lessons learned from 1986 to 1993 thick-billed parrot reintroduction efforts suggest that if benefits of future releases outweigh the costs, they should be limited to:

- 1) Birds that can be reliably identified as low risk from a disease standpoint. Birds from confiscations and multispecies zoo and aviculture environments should not be considered as candidates, while direct translocations, wild to captivity to wild, are a promising way to go so long as temporary captive environments are very carefully protected from exposure to all disease sources. Intrinsic to this approach is quarantine of captured birds in special isolated facilities different from standard quarantine of birds coming in from Mexico (Snyder 1994, 2012).

- 2) Birds with extensive prior experience coping with wild existence. By far the best birds for release from a survival standpoint are experienced free-flying birds that are captured from the wild in Mexico. Using such birds is also presumably far cheaper than the captive-breeding approach, which should not be considered a promising approach for this species on behavioral grounds alone. Although the species breeds quite readily in captivity, even parent-reared individuals raised in huge cages and integrated with wild-reared experienced birds have demonstrated poor survival after release. Birds under parental care in the wild learn survival skills that are very difficult to duplicate in captivity. The period of fledgling dependency on adults in the wild extends many months beyond fledging (Snyder 1994, 2012).
- 3) Birds from source populations large enough to donate some individuals without themselves being threatened by the process. Marginally viable populations should not become source populations for such efforts, and so far as is possible, translocations should be limited to nonbreeding birds to protect the viability of source populations (Snyder 1994, 2012).

The PACE does not specifically identify reintroductions (translocations) into the U.S. historical range as a specific action to assist with recovery of the species; rather, the focus is on protection of mature and old-growth forests, and persistence and expansion of Mexican thick-billed parrot populations. The Canada/Mexico/U.S. Trilateral Committee for Wildlife and Ecosystem Conservation and Management has in the past endorsed reintroductions (translocations) of thick-billed parrots within the species' historical range (Mexico and the U.S.) as one of several conservation strategies for the species, but with the adoption of the PACE and this recovery plan addendum, the revised focus is on conserving habitat and thick-billed parrot populations in Mexico. Although translocations are recognized as a conservation strategy, their feasibility, appropriateness, and possible approaches need further evaluation, particularly given the low populations of remaining wild thick-billed parrots, the importance of preserving the remaining mature and old-growth forest habitat, the bird's social nature and minimum flock size necessary for success, predator avoidance, food availability, adaptive behavior to a new location, past responses to relocation, and potential for spreading disease. U.S. habitat within the historical range of the thick-billed parrot is fragmented (small mountain ranges separated by unsuitable habitat), at risk of high-intensity fire, and may not provide a reliable food supply (Maps 3 and 4 in Appendix A). Additionally, with the current Mexican (General Wildlife Law Decree 60 Bis 2) ban on exportation of all parrot species, it is not evident that an exemption exists under the legislation to allow for translocation of birds into the U.S. (Gobierno Federal 2008).

1.8.2. Conservation Efforts

An overview of conservation measures to date is provided within the Background section of the PACE (CONANP 2009) (Appendix B). Some nesting sites have been designated as protected natural areas and efforts continue to increase the level of protection at these sites and to place specific nesting, drinking, roosting, and perching sites under effective conservation schemes.

CONANP is responsible for the implementation of the PACE, with conservation actions performed by local Protected Areas and Regional Offices of CONANP and/or with the participation of various third parties and communities (Fueyo-Mac Donald 2012). Likewise,

implementation of the proposed actions in this recovery plan addendum will be coordinated with the appropriate partners in Mexico.

In Mexico, there are various types of protected areas: federal, state, municipal, community, ejido and private. Protected areas at the federal level are created by presidential decree and the activities that can be conducted in them are set in accordance with the General Act of Ecological Equilibrium and Environmental Protection. Protected area conservation consists of protection, management (including sustainable use), and restoration. CONANP manages 173 federal natural areas that include Biosphere Reserves, National Parks, Natural Monuments, Protection Areas of Natural Resources, Protection Areas of Flora and Fauna, and Sanctuaries. Although the focus of these protected areas is on the ecosystem and biodiversity, maintaining decent living conditions and opportunities for all people is an integral part of continuing conservation in Mexico. CONANP involves government, civil society, and rural and indigenous communities in promoting a culture of conservation and sustainable development of communities (CONANP 2010).

In addition to the establishment of natural areas at the federal (or state) level, other habitat conservation mechanisms exist such as Wildlife Management and Use Units (UMAs), voluntary landowner cooperatives (Ejido/Private preserves), land purchase, long-term conservation easements, Payment for Environmental Services (PES), and acquisition of lumbering rights (Pronatura 2010).

The majority of old-growth forests in the Sierra Madre Occidental are under communal ownership (ejidos) (CONANP-Pronatura Sur 2008). Agreements with ejido communities to preserve habitat through land conservation mechanisms are not in perpetuity and may expire because of specific program limitations (e.g., funding, duration of agreement) or a community's desire to engage in timber harvest. This poses a challenge to the long-term conservation of thick-billed parrot habitat (Cruz-Nieto 2013).



Thick-billed parrot at cavity in aspen tree, el Santuario Madera, Ejido El Largo, Chihuahua, Sept 2012.
Photo courtesy of Bill Howe.

2.0. RECOVERY STRATEGY, GOAL, OBJECTIVES, CRITERIA

2.1. Recovery Strategy and Goals

Recovery Strategy: The thick-billed parrot has been absent from the U.S. for over 70 years and now only occurs in Mexico, thus the focus of recovery conservation for the thick-billed parrot must be within Mexico. Since the mid-1990s, conservation organizations and the Mexican government have been implementing a major conservation program focused on research, monitoring, and protection of key breeding areas. Furthermore, as part of a federal initiative, Mexico convened a group of parrot experts and in 2009 published a recovery plan (the PACE) addressing both the maroon-fronted and thick-billed parrots. The focus of the PACE (CONANP 2009) is on extant populations of the thick-billed parrot; it does not address thick-billed parrot historical records or historical range in the U.S.

Therefore, our approach in this Addendum to the PACE is as follows:

- Summarize information on thick-billed parrot's historical occurrence in the U.S.;
- Synthesize or reference information (when feasible) from the PACE to formulate recovery planning components as are required by the ESA;
- Incorporate supplemental information received from Mexico and U.S. partners since publication of the PACE;
- Identify broad actions necessary to address conservation of the species within its U.S. historical range;
- Identify partnerships and opportunities to facilitate recovery of extant populations.

To accomplish the recovery of the thick-billed parrot, the recovery strategy has five key elements designed to conserve the species throughout its range: 1) protecting existing populations and their habitat; 2) surveying, monitoring, and researching the population and habitat; 3) managing for habitat into the future; 4) managing threats, such as illegal trade, timber harvesting, and high intensity fire; and, 5) building partnerships and educating the public to facilitate recovery. These elements are covered in the PACE and updated in the Addendum. Understanding needs for feeding, breeding, watering, roosting, migrating, and wintering are integral to protecting thick-billed parrot populations. Long-term conservation of old-growth and mature forests used by thick-billed parrots is key to recovery. Strategies for minimizing the threat of high intensity fires are needed, including restoring frequent surface fires (through fire management) that prevent the accumulation of fuels. Arrangements to conserve remaining mature and old-growth forests from timber removal are ongoing in Mexico under the PACE; incentives for local communities to further conserve habitat would benefit the thick-billed parrot. Actions in the U.S. include maintaining forested habitat in southeastern Arizona and southwestern New Mexico for potential use by parrots dispersing north from the Sierra Madre Occidental, and preventing illegal trade of thick-billed parrots into this country. To the degree practicable, the USFWS will offer technical expertise and financial opportunities through established programs working to conserve habitat and support the persistence and expansion of Mexican thick-billed parrot populations. Recovery will be monitored and recovery tasks may be revised by the USFWS in coordination with Mexican partners as new information becomes available.

Recovery Goals: The intermediate goal of this recovery plan addendum is to downlist the thick-billed parrot from endangered to threatened status. The long-term goal is to recover and delist the thick-billed parrot once more biological information is obtained and we can develop appropriate delisting recovery criteria.

2.2. Recovery Criteria

Recovery criteria for downlisting focus on conserving populations and breeding habitat, locating and conserving wintering habitat in Mexico, and managing threats of illegal timber removal and parrot trade. Recovery criteria for delisting are difficult to establish due to the lack of information. Further research is needed to recommend additional recovery tasks and measures, and to establish delisting criteria that determine whether the species is no longer in danger of extinction throughout all or a significant portion of its range and no longer likely to become endangered in the foreseeable future (fully recovered). We offer recommendations below regarding the data needed and a general approach to development of delisting criteria.

Downlisting Criteria: The downlisting criteria are based on the recovery actions in the PACE, with additional contributions from Mexican and U.S. biologists. Some of the criteria address more than one recovery action in the PACE.

The thick-billed parrot should be considered for downlisting to threatened status when all of the following conditions have been met:

Demographic Criteria:

- 1) A self-sustaining population of thick-billed parrots is maintained, sufficient to ensure the species' survival and to address threats of small population size, such as demographic and genetic stochasticity. A stable or increasing trend over a 20 year period is documented in at least 5 known wild thick-billed parrot breeding populations. (Factors A, B, C, D, E)

Justification for 1: Thick-billed parrots are long-lived (exceeding 30 years in captivity), breed in mature and old-growth forests, are known from a small number of breeding populations (5 main populations), only a small proportion of individuals breed, they do not breed until 3 to 5 years old, and only produce only 1 or 2 young per year (Lammertink et al. 1996, Snyder et al. 1999, CONANP-Pronatura Sur 2008, PACE 2009). Although nest success is greater than other parrot species (80 percent) (Monterrubio et al. 2002, ITESM 2011), not all parrots exhibiting nesting behavior actually breed. Typically 28 to 48 percent of pairs using cavities in respective breeding seasons did not produce eggs (Cruz-Nieto 1998 in Snyder et al. 1999; Monterrubio, pers. comm. in Snyder et al. 1999). Reasons why a large proportion of parrot pairs do not breed in a given year are not understood. At least 15 years of data would likely be needed to capture response of a truly increasing trend for a species with a long lifespan, delayed breeding age, significant parental investment, and low reproductive rate. The number of sites and years of monitoring needed will be determined from a statistically sound and peer reviewed monitoring protocol to determine population trend. At least 5 breeding populations have demonstrated stability over a few decades; therefore maintaining this baseline without a loss of breeding populations over at least 15 years (actual number of years

to be determined by model) would indicate a continuing stable trend in population group number. Populations such as Mesa de las Guacamayas, Madera, Tutuaca, Papigochic, and Campo Verde would be considered.

Threats-based Criteria:

- 1) Sufficient thick-billed parrot habitat (patch size, forest composition and structure, distribution) is conserved (protected, managed, and restored) that includes foraging, breeding, and wintering habitat to ensure the species' survival despite environmental alteration and the threat of climate change. (Factors A, D, E)
 - a) A long-term, thick-billed parrot habitat conservation plan (encompassing the current range of the species in Mexico) is completed and implemented, based on sound science, species expert knowledge, and predicted effects of climate change. The habitat conservation plan provides goals for a) the location, size, and spatial distribution of thick-billed parrot habitat; b) forest composition, structure, and future forecasted changes due to climate change; and c) guidelines for forest management plans of the Sierra Madre Occidental. (Factors A, D, E)

Justification for 1a: With habitat loss, degradation, and fragmentation as the primary threat to thick-billed parrots, preserving the remaining habitat as quickly and effectively as possible could thwart future parrot declines. The development of a long-term habitat conservation plan would direct the evaluation of habitat availability and use for thick-billed parrots, and would guide habitat restoration for the species on actual foraging areas and historical nesting sites. A long-term habitat conservation plan is needed because: the level of protection at some occupied breeding habitat is inadequate; not all breeding sites are known or surveyed; some wintering habitat has not been confirmed to be occupied in recent years; not all wintering habitat is known or surveyed; migration routes from breeding areas to wintering areas are unknown; the extent of foraging habitat in breeding areas is unknown; forest characteristics in wintering areas are unknown; and the potential effects of climate change are unknown. The plan should incorporate a) a greater number of local breeding populations within historical nesting range to offset habitat loss caused by a predicted increase in forest wildfires associated with climate change, b) predicted suitable habitat in the future as a result of climate change, and c) recommendations for Forest Management Plans to be developed (or revised) and implemented to maintain or restore healthy forest conditions for thick-billed parrot recovery.

- b) Breeding areas are conserved for the foreseeable future through protected status designation, Units for the Management and Wildlife Conservation (UMAs), voluntary landowner cooperatives, land purchase, long-term conservation easements, acquisition of lumbering rights, or other mechanisms. (Factors A, D, E)
 - i) Core Areas (nesting, drinking, roosting, and perching sites) for at least five known breeding areas, such as Mesa de las Guacamayas, Madera, Tutuaca, Papigochic, and Campo Verde, are permanently conserved. (Factors A, D, E)

- ii) At least an additional four known breeding areas and two suspected breeding areas are assessed for conservation potential in the states of Chihuahua and Durango. (Factors A, D, E)
- iii) At least three breeding areas are placed under effective conservation schemes. (Factors A, D, E)

Justification for 1.b: Breeding areas need to be effectively conserved to prevent further loss from logging, disturbance, overgrazing, and high-severity wildfire. Suspected or known breeding localities are verified and assessed for conservation potential; including areas in Chihuahua such as Sierra del Nido, and Namiquipa; areas in Durango such as, Guanacevi-El Vergel (including El Vergel, La Medalla and La Lagunita; localities straddling the Chihuahua/Durango border), Torre de Santiago Papasquiario and San Diego de Tenzains. Other areas in Durango with thick-billed parrot sightings include Las Cuevas (Tamazula), Bastantita (Tamazula), Guarisamey, and San Jose de Causas. Surveys are needed in higher elevation forests in the state of Durango, identifying historical and current nesting/wintering sites, and evaluating the persistence of breeding populations.

- c) The wintering range for at least five breeding populations is verified and mapped, and wintering areas are conserved for the foreseeable future through protected status designation, Units for the Management and Wildlife Conservation (UMAs), voluntary landowner cooperatives, land purchase, long-term conservation easements, acquisition of lumbering rights, or other mechanisms. (Factors A, D, E)
 - i) Currently designated protected areas within the winter range (with significant numbers of verified thick-billed parrot occurrence) are mapped and conserved (protected, managed, and restored) (CONANP 2009). (Factors A, D, E)
 - ii) An assessment for at least three other wintering areas with thick-billed parrot occurrence is completed and placed under effective conservation schemes. (Factors A, D, E)

Justification for 1.c: Baseline thick-billed parrot occupancy and habitat information is needed on the wintering range. Specific wintering areas for the main breeding populations are unknown, such as wintering areas for the Mesa de las Guacamayas, Madera, Tutuaca, Papigochic, and Campo Verde populations. The condition, food resources, and extent of wintering habitat are not well understood. Some areas likely are located within currently designated protected areas and provide a point from which to build conservation efforts for thick-billed parrots. Occupied wintering areas need effective habitat conservation because thick-billed parrots spend a significant portion of their lives in these regions. Known or suspected wintering areas in need of surveys include; state of Durango; Las Bufas, California, San Miguel de las Cruces, San Francisco de Lajas (Pueblo Nuevo), Cumbre de milpillas (Pueblo Nuevo), El Maguey, San Dimas, Taxicaringa, Las coloradas, Michilia, states of Jalisco and Colima; Sierra de Manantlan, Nevado de Colima, El Jabali (Colima), state of Michoacan; Pico de Tancitaro (CONANP 2009).

- 2) Illegal timber harvesting, tree clearing, and high-intensity wildfires in thick-billed parrot habitat have been reduced to the point that they are no longer threats to thick-billed parrots. (Factors A, D, E)

Justification for 2: Continued loss of mature and old-growth habitat is the greatest threat to thick-billed parrot recovery. Formulating and enforcing regulations will help recover the species.

- 3) Threats of illegal collecting and poaching of thick-billed parrots for the pet trade have been reduced to the point that they no longer impact thick-billed parrots. (Factors B, D)

Justification for 3: Loss of thick-billed parrots from the breeding population limits recovery progress.

Delisting Criteria: Delisting criteria for the thick-billed parrot are difficult to establish due to the lack of information concerning its population status, biology, and specific habitat requirements. More research is needed to recommend specific delisting criteria and recovery tasks. Considering the loss of suitable habitat, and length of time needed for forest regeneration to attain suitability, low percentage of breeding pairs, and need for habitat conservation, downlisting is unlikely to be reached before year 2050. It is unrealistic to predict the environmental conditions and threats to the species that will prevail at that time. Additional information is also needed regarding the conservation biology of small populations, including impacts of stochastic and catastrophic events on survival. Delisting criteria will require the establishment of a population target with a high level of confidence. Without knowledge of a minimum population size needed to ensure species survival, it would be unreasonable to provide delisting criteria. With additional knowledge regarding the elements of a population model, such as reproductive capacity, natality and mortality rates, migration patterns and survivorship, or genetic information, we would be more prepared to determine whether the species is no longer in danger throughout all or a significant portion of its range (downlisted to threatened) and no longer likely to become endangered in the foreseeable future (delisted, or recovered). New information gathered through recovery actions will be incorporated into additional population viability assessments as the population approaches its downlisting goals. Delisting criteria will be established at that time, and the overall recovery strategy and actions will be revised as appropriate. Future revisions of this recovery plan are anticipated, and a goal for removing the thick-billed parrot from the List of Threatened and Endangered Species will be set prior to downlisting anticipated in 2050.

2.3. Actions Needed

Factor A= Habitat modification or loss

- Identify home ranges and migration patterns of reproductive and non-reproductive thick-billed parrot groups during the breeding and non-breeding season and evaluate habitat use and availability.
- Conduct studies on the relationship between food availability, forest altitude and composition, and thick-billed parrot movement and nesting.

- Develop predictive parrot occurrence models such as ecological niche modeling and verify, evaluate, and quantify occurrence sites.
- Characterize the habitat requirements of thick-billed parrots based on all aspects of the species' life history, and develop a habitat suitability model to understand, manage, and restore habitat areas and features for the parrot.
- Complete and implement a long-term thick-billed parrot habitat conservation plan (encompassing the current range of the species in Mexico), based on sound science, species expert knowledge, and predicted effects of climate change. The plan provides goals for a) the location, size, and spatial distribution of thick-billed parrot habitat; b) forest composition, structure, and future forecasted changes due to climate change; and c) guidelines for forest management plans of the Sierra Madre Occidental.
- Permanently protect core areas (nesting, drinking, roosting, and perching sites).
- Identify and map unprotected, occupied breeding and wintering habitat and priority areas within those; evaluate their potential for protection under appropriate conservation schemes (e.g., Wildlife Management and Use Unit (UMAs), voluntary landowner cooperatives, land purchase, long-term conservation easements, acquisition of lumbering rights, or protected area designation).
- Effectively protect, restore, and manage currently designated protected areas within the winter range (with significant numbers of verified thick-billed parrot occurrence).
- Develop (or revise) and implement site-specific forest management plans that incorporate habitat and foraging needs, including longer rotational cycles and maintenance of mature trees, snags, fire management, and current and future states of forest health and vegetation distribution, including climate change scenarios of future potential vegetation.
- Plan and implement prescribed burns where needed to manage thick-billed parrot habitat.
- Assess the potential for the U.S. to support naturally dispersing or actively relocated thick-billed parrots, including a review of U.S. historical habitat, current habitat management, and habitat connectivity with Mexico. Include the need and efficacy of translocating parrots in the assessment, and implement translocations if supported by Mexico and considered appropriate in the assessment.

Factor B= Overutilization

- Reduce illegal collection and poaching of thick-billed parrots by enforcing existing environmental laws, regulations, plans, and policies for parrot protection.
- Emphasize importance of TBPA conservation to the public.

Factor C= Disease or predation

- Formulate a health assessment protocol for wild thick-billed parrot populations to better understand any impact of disease, and mitigate any disease risks.
- Develop effective tests and assess transmission risks for diseases carried by captive thick-billed parrot populations.
- Develop an ectoparasite management plan that identifies effective treatment protocols and control measures to reduce ectoparasite levels in the nest or local environment.

Factor D=Inadequacy of regulations

- Existing laws, regulations, plans, and policies to protect thick-billed parrot habitat from illegal harvesting, clearing, and fires are enforced.

Factor E= Other natural or manmade factors

- Develop a statistically sound and peer reviewed parrot monitoring protocol to document population trends.
- Conduct a range-wide population survey for the species using standardized peer reviewed methodology.
- Determine the minimum viable population size, temporal and spatial distribution, and number of breeding colonies needed for recovery. Abundance estimates may be accomplished through occupancy surveys and integrating remotely sensed data (metrics of habitat).
- Create climate models predicting future suitable nesting areas and develop strategies that ensure the availability of keystone conifer species for use by thick-billed parrots in forest management plans.

2.4. Threats Tracking Table (those with an asterisk do not appear in the PACE)

SUMMARY OF THICK-BILLED PARROT LISTING FACTORS AND THREATS AND RECOVERY ACTIONS TO CONTROL THOSE THREATS					
Listing Factor	Threats	Recovery Criteria		Recovery Actions	
		Demographic	Threats		
All	All threat factors	1	1,2,3	2.1. Keep stakeholders informed on relevant TBPA legislation.	
(A, B, C, D, E Collectively)	A= habitat modification or loss	1	1,2,3	2.2. Continuously assess the legal framework for TBPA conservation.	
	B= overutilization	1	1,2,3	2.4. Share species technical information with government entities.	
	C= disease, predation	1	1,2,3	3.2. Establish local community watch groups.	
	D= inadequacy of regulations	1	1,2,3	3.3. Encourage the public to report habitat/species violations.	
	E= other natural or manmade factors	1	1,2, 3	4.3. Work with private landowners.	
			1	1,2,3	4.8. Complete and implement long-term TBPA habitat conservation plan.
			1	1,2,3	5.4. Evaluate ecotourism impacts to species.
			1	1,2,3	7.4. Monitor main threats and their effects.
			1	1,2,3	9.9. Study various aspects of species ecology.
			1	1,2, 3	10.3. Develop relevant GIS layers.
		1	1,2,3	11.5. Conduct outreach and education activities in local communities.	
		1	1,2,3	12.3. Prepare and distribute informational videos.	
		1	1,2,3	12.4. Inform the public on conservation successes and actions.	
		1	1,2,3	12.5. Inform and engage local communities.	
		1	1,2,3	12.6. Emphasize importance of TBPA conservation to the public.	
		1	1,2,3	13.2. Develop sustainable community ecotourism projects.	
		1	1,2,3	13.6. Encourage species research by academia.	
		1	2,3	13.7. Train CONANP personnel on monitoring protocols.	
		1	1,2,3	14.1. Develop partnerships with Mexican NGOs and	

				agencies.*
Factor A	Population and habitat loss	1	1,2,3	1.1. Have Madera and Las Pomas (Chihuahua) decreed federally protected.
		1	1,2,3	1.2. Protect trees for nesting and feeding.
		1	1,2	1.3. Protect habitat through conservation easements and on-the-ground actions.
		1	1,2,3	1.4. Strengthen protection of private reserves.
		1	1,2,3	1.7. Promote sound land use planning at key sites.
		1	1,2	1.8. Establish Forest Fire Management programs.
		1	1,2,3	3.1. Request from PROFEPA law enforcement actions.
		1	1,2,3	3.4. Reinforce law enforcement inspections and monitoring activities.
		1	1,2	4.2. Exclude mature tree stands and snags from forest harvesting.
			1,2	4.4. Promote the use of different legal tools to protect habitat.
		1	1,2,3	4.6. Promote environmentally friendly projects.
		1		5.1. Build, install, and monitor artificial nest boxes.
		1		8.4. Estimate population numbers in priority areas.
			1,2	8.5. Estimate available habitat in priority areas.
		1	1,2	9.2. Quantify availability of nest sites.
		1	1,2	9.3. Determine level of pine cone production in nesting areas.
		1	1,2	9.8. Evaluate habitat composition and quality for potential reintroductions (translocations).
		1		10.1. Monitor breeding populations.
		1		10.2. Estimate population size.
			1,2	10.4. Monitor habitat changes at nesting sites.
		1	1,3	10.7. Conduct range-wide population survey.
		1	1,3	10.8. Determine minimum viable population size, distribution, number of breeding colonies for recovery.
		1	1,2	13.1. Encourage low environmental impact activities.
		1	1,2,3	13.2. Develop sustainable community ecotourism projects.
		1	1,2,3	13.3. Train local guides on developing ecotourism projects.
		1	1,2,3	13.4. Train community members on 'nature appreciation' themed projects.
		1	1	13.5. Include indigenous groups in ecotourism planning and implementation.
		1	2,3	13.7. Train CONANP personnel on monitoring protocols.
		1	1,2,3	14.1. Develop partnerships with Mexican NGOs and agencies.*
		1	1,2	14.3. Support efforts in Mexico to conserve habitat.*
		1	1	15.3. Encourage U.S. researchers and institutions in conservation of Mexican parrot populations close to U.S.*
Factor A	Habitat Modification (Management)	1	1,2,3	1.4. Strengthen protection of private reserves.
		1	1,2,3	1.5. Identify and control access points to key nesting and perching areas.
		1	1,2,3	1.6. Install educational and regulatory signage in nesting areas.
		1	1,2	1.7. Promote sound land use planning at key sites.
			1,2	1.8. Establish Forest Fire Management programs.
			1,2	1.9. Identify and control pests and diseases of trees in parrot habitat.*
		1	1,2	2.3 Address habitat development through legal prevention and mitigation measures.
		1	1,2	4.5. Encourage sustainable management of watersheds
		1	1,2,3	4.7. Promote payments for environmental services to landowners
		1	1,2	4.9. Develop and implement forest management plans.
		1	1,2	8.6. Promote land use planning processes to benefit

				priority areas.
		1		9.4. Determine a suitable design for artificial nests.
		1	1,2,3	11.1. Design school environmental education curriculum
		1	1,2,3	11.2. Prepare outreach materials.
		1	1,2,3	11.3. Prepare information handbook for environmental educators.
		1	1,2,3	11.4. Organize community training workshops.
		1	1,2,3	11.5. Conduct outreach and education activities in local communities.
		1	1,2,3	12.1. Design and distribute outreach and educational materials.
		1	1,2,3	12.2. Broadcast informational radio spots.
		1	1,2,3	12.3. Prepare and distribute informational videos.
			1	15.1. Implement strategies to preserve U.S. historical habitat.*
		1	1	15.2. Collaborate binationally to conserve borderlands habitat.*
Factor A	Habitat Degradation	1	1,2	1.7. Promote sound land use planning at key sites.
		1	1,2	2.3. Address habitat development through legal prevention and mitigation measures.
		1	1,2	6.1. Identify degraded areas for restoration.
		1	1,2	6.2. Implement soils and forest restoration and conservation actions
		1	1,2	7.1. Develop a forest fire danger map
		1	1,2	7.2. Implement wildfire prevention measures
		1	1,2	7.3. Implement reforestation programs.
		1	1,2	8.6. Promote land use planning processes to benefit priority areas.
		1	1,2	10.4. Monitor habitat changes at nesting sites.
Factor A	Information Needs		1,2	1.9. Identify and control pests and diseases of trees in parrot habitat
		1	1, 2	4.1. Identify new nesting and feeding areas.
		1	1,2,3	8.1. Compile historical and current species distribution information
		1	1,2,3	8.2. Identify key sites (nesting, feeding, and migration areas).
		1	1,2,3	8.3. Field-verify site occupancy and suitable habitat.
		1	1,2,3	9.1. Determine migration and dispersal patterns.
		1	1	9.5. Research feasibility of reintroductions in Mexico.
		1		9.7. Evaluate genetic variability and population dynamics.
		1	1	9.10. Identify home ranges and migration patterns; evaluate habitat use and stability.
		1	1	9.12. Characterize habitat requirements of TBPA.
		1	1	10.5. Evaluate winter habitat.
		1	1,2,3	13.6. Encourage species research by academia.
		1	1,2,3	14.2. Support field work in Mexico to improve knowledge of species ecology.*
		1		14.4. Support work in Mexico to better assess population numbers and trends.*
		1		15.4. Support research efforts to evaluate translocations.*
			1	16.1. Conduct a review of U.S. historical habitat.*
		1	1,3	16.2. Assess the feasibility, risks, and appropriateness of translocating parrots into historical and potential habitats in the U.S.; implement translocations if supported by Mexico and considered appropriate in the assessment. *
Factor B	Overutilization	1	1,2,3	3.1. Request from PROFEPA law enforcement actions.
		1	1,2,3	3.4. Reinforce law enforcement inspections and monitoring activities.
			1,2	4.4. Promote the use of different legal tools to protect habitat.

		1	1,2,3	4.7. Promote payments for environmental services to landowners
		1	3	5.2. Develop guidelines for handling of confiscated parrots.
		1	3	5.3. Develop handbooks for dealing with parrots held in captivity.
		1		9.4. Determine a suitable design for artificial nests.
		1	1,2	10.4. Monitor habitat changes at nesting sites.
		1	1	10.5. Evaluate winter habitat.
		1		10.6. Develop standardized monitoring protocol.
		1		10.7. Conduct range-wide population survey.
		1	1,2,3	11.1. Design school environmental education curriculum
		1	1,2,3	11.2. Prepare outreach materials.
		1	1,2,3	11.3. Prepare information handbook for environmental educators.
		1	1,2,3	11.4. Organize community training workshops.
		1	1,2,3	12.1. Design and distribute outreach and educational materials.
		1	1,2,3	12.2. Broadcast informational radio spots.
		1	1,2,3	12.3. Prepare and distribute informational videos.
		1	1,2,3	13.3. Train local guides on developing ecotourism projects.
		1	1,2,3	13.4. Train community members on 'nature appreciation' themed projects.
		1	1	13.5. Include indigenous groups in ecotourism planning and implementation.
		1	3	14.6. Encourage enforcement of parrot regulations in Mexico.*
Factor C	Disease, Predation	1	1,2,3	1.9. Identify and control pests and diseases of trees in parrot habitat.*
		1	3	5.2. Develop guidelines for handling of confiscated parrots.
		1	3	5.3. Develop handbooks for dealing with parrots held in captivity.
		1	1,3	9.6. Conduct an assessment of current diseases in TBPA wild populations.
		1	1,2,3	14.2. Support field work in Mexico to improve knowledge of species ecology.*
		1	1	15.3. Encourage U.S. researchers and institutions in conservation of Mexican parrot populations close to U.S.*
		1	1,3	16.2. Assess the feasibility, risks, and appropriateness of translocating parrots into historical and potential habitats in the U.S.; implement translocations if supported by Mexico and considered appropriate in the assessment.*
		1	1,3	16.3. Develop a health assessment protocol for TBPAs to understand and mitigate disease patterns and risks.*
Factor D	Inadequacy of Regulation	1	3	1.1. Have Madera and Las Pomas (Chihuahua) decreed federally protected. 14.6. Encourage enforcement of parrot regulations in Mexico
		1	1,2,3	1.2. Protect trees for nesting and feeding.
		1	1,2	1.3. Protect habitat through conservation easements and on-the-ground actions.
		1	1,2,3	1.4. Strengthen protection of private reserves.
		1	1,2,3	1.5. Identify and control access points to key nesting and perching areas.
		1	1,2,3	1.6. Install educational and regulatory signage in nesting areas.
		1	1,2	1.7. Promote sound land use planning at key sites.
			1,2	1.8. Establish Forest Fire Management programs.
		1	1,2	2.3. Address habitat development through legal prevention and mitigation measures.
		1	1,2,3	3.1. Request from PROFEPA law enforcement actions.
		1	1,2,3	3.4. Reinforce law enforcement inspections and

				monitoring activities.
			1,2	4.4. Promote the use of different legal tools to protect habitat.
		1	1,2,3	4.7. Promote payments for environmental services to landowners
		1	1,2	4.9. Develop and implement forest management plans.
		1		10.2. Estimate population size.
		1	1,2	14.3. Support efforts in Mexico to conserve habitat.*
		1	3	14.6. Encourage enforcement of parrot regulations in Mexico.*
		1	1,3	16.2. Assess the feasibility, risks, and appropriateness of translocating parrots into historical and potential habitats in the U.S.; implement translocations if supported by Mexico and considered appropriate in the assessment.*
Factor E	Other Natural or Manmade Factors	1	1, 2	4.1. Identify new nesting and feeding areas.
		1	1,2	4.5. Encourage sustainable management of watersheds
		1	1,2,3	4.7. Promote payments for environmental services to landowners
		1	1,2	4.9. Develop and implement forest management plans.
		1		5.1. Build, install, and monitor at artificial nest boxes.
		1	1,2	6.1. Identify degraded areas for restoration.
		1	1,2	6.2. Implement soils and forest restoration and conservation actions
		1	1,2	7.1. Develop a forest fire danger map
		1	1,2	8.2. Identify key sites (nesting, feeding, and migration areas).
		1	1,2,3	8.3. Field-verify site occupancy and suitable habitat.
		11		8.4. Estimate population numbers in priority areas.5.1. Build, install, and monitor at artificial nest boxes.
			1,2	8.5. Estimate available habitat in priority areas.
		1	1,2	8.6. Promote land use planning processes to benefit priority areas.
		1	1,2,3	9.2. Quantify availability of nest sites.
		1	1,2	9.4. Determine a suitable design for artificial nests.
		1	1,3	9.5. Research feasibility of reintroductions.
		1		9.7. Evaluate genetic variability and population dynamics.
		1	1	9.8. Evaluate habitat composition and quality for potential reintroductions.
		1		10.1. Monitor breeding populations.
		1	1,2	10.4. Monitor habitat changes at nesting sites.
		1		10.6. Develop standardized monitoring protocol.
		1	1,3	10.7. Conduct range-wide population survey.
		1	1,3	10.8. Determine minimum viable population size, distribution, number of breeding colonies for recovery.
		1	1,2,3	12.1. Design and distribute outreach and educational materials.
		1	1,2,3	12.2. Broadcast informational radio spots.
		1	1,2,3	12.3. Prepare and distribute informational videos.
		1	1,2,3	14.2. Support field work in Mexico to improve knowledge of species ecology.*
		1	1,2	14.3. Support efforts in Mexico to conserve habitat.*
		1		14.4. Support work in Mexico to better assess population numbers and trends.*
		1		14.5. Support work by biologists in Mexico to actively monitor and manage breeding populations.*
			1	16.1. Conduct a review of U.S. historical habitat.*
		1	1,3	16.2. Assess the feasibility, risks, and appropriateness of translocating parrots into historical and potential habitats in the U.S.; implement translocations if supported by Mexico and considered appropriate in the assessment.*
		1	1,3	16.3. Develop a health assessment protocol for TBPA's to understand and mitigate disease patterns and risks.*

3.0. RECOVERY PROGRAM

3.1. Outline of Recovery Actions

The most stepped-down recovery actions are discrete, specific actions and are the actions listed in the Implementation Schedule found in Section 4.3. Recovery actions 1 through 13 were derived from the PACE (CONANP 2009), unless indicated otherwise, and these actions address recovery in Mexico. Recovery actions with an asterisk at the end have been added to those set forth in the PACE. PACE actions that address how to implement the PACE are not repeated; although important, they are not included in the body of a U.S. recovery plan. Recovery actions 14 through 16 were developed for U.S. lead actions. “Thick-billed parrot” is abbreviated as “TBPA”.

Recovery Actions Derived from the PACE for Mexico

1. Strengthen or implement protection measures in parrot nesting and dispersal areas, and establish new areas for protection

- 1.1. Undertake all the necessary steps to decree Madera and Las Pomas (Chihuahua) as Federal Sanctuaries.
- 1.2. Identify priority habitat to facilitate forest resource planning through Forest Management Units with the goal of protecting trees for nesting and feeding.
- 1.3. Take actions to protect habitat through signing legal agreements, fencing properties, building fire barriers, and signage.
- 1.4. Strengthen protection of private reserves through the implementation of ecological easements, conservation certifications, and other programs.
- 1.5. Identify and control access points to primary nesting and perching areas.
- 1.6. Install educational and regulatory signage in primary nesting areas.
- 1.7. Promote sound land use planning and its application in known TBPA sites.
- 1.8. Establish Forest Fire Management programs in collaboration with CONAFOR.
- 1.9. Evaluate forest health to identify and control pests and diseases of trees in parrot habitat.*
- 1.10. Identify unprotected, occupied breeding and wintering habitat and priority areas within those; evaluate their potential for protection under appropriate conservation schemes.*

2. Educate the various government entities and the public on the importance of enforcing existing laws and regulations to protect parrots.

- 2.1. Keep all stakeholders informed on current national and international legislation relevant to the protection of the TBPA.
- 2.2. Promote evaluation methods to the legal framework related to the protection and management of the parrot and suggest modifications when needed.
- 2.3. Establish legal prevention and mitigation measures to address development or land-use changes within TBPA distribution areas.
- 2.4. Share species technical information to help government officials in decision-making, as requested.

3. Increase surveillance and prevent illegal activities related to poaching and illegal trade of parrots, and illegal modification of parrot habitat.

- 3.1. Request that PROFEPA conduct law enforcement inspections and surveillance at critically important TBPA sites.
- 3.2. Promote the establishment or enhancement of local community watch groups to identify and control habitat destruction and capture of parrots for the illegal pet trade.
- 3.3. Encourage the general public to report violations dealing with the illegal capture and trade of TBPA and any unlawful habitat modifications.
- 3.4 Reinforce law enforcement inspections and monitoring activities in coordination with the state and municipal governments.

4. Develop and implement actions to protect the habitat necessary to support viable parrot populations. Maintain mature trees and snags with characteristics that provide nesting and feeding areas.

- 4.1. Identify areas with suitable habitat currently used or that could potentially be used for nesting and feeding.
- 4.2. Recommend to SEMARNAT areas to exclude from authorized use of forestry resources within current and potential habitat, including mature tree stands and snags with characteristics that provide necessary nesting and feeding areas.
- 4.3. Promote protection of the parrot to landowners of private parcels located within TBPA habitat.
- 4.4. Promote the use of different legal tools such as ejido reserves, ecological easements, and usufructs to protect lands within occupied habitat with the goal of regulating and modifying land use practices.
- 4.5. Encourage the management of watersheds in such a way that generates financial resources through habitat conservation and payments for environmental services.
- 4.6. Collaborate with the Ministry of SAGARPA (Rural Development) to promote environmentally friendly projects among the communities located in the parrot's known distribution areas.
- 4.7. Promote payments for environmental services to landowners involved in management and conservation actions that contribute to maintaining TBPA populations.
- 4.8. Complete and implement a long-term thick-billed parrot habitat conservation plan (encompassing the current range of the species in Mexico), based on sound science, species expert knowledge, and predicted effects of climate change. The plan will provide goals for a) the location, size, and spatial distribution of thick-billed parrot habitat; b) forest composition, structure, and future forecasted changes due to climate change; and c) guidelines for forest management plans of the Sierra Madre Occidental.*
- 4.9. Develop (or revise) and implement site-specific forest management plans that incorporate habitat and foraging needs, including longer rotational cycles and maintenance of mature trees, fire management, and current and future states of forest health and vegetation distribution, including climate change scenarios of future potential.*

5. Develop monitoring and management guidelines that promote population increases in parrots.

- 5.1. Build, install, and monitor at least 40 artificial nest boxes in each thick-billed parrot nesting site.
 - 5.2. Develop guidelines for handling confiscated parrots.
 - 5.3. Develop handbooks for managing, rehabilitating, and reintroducing parrots held in captivity.
 - 5.4. Evaluate the impact to the species from ecotourism on TBPA protected areas.
- 6. Restore suitable habitat that has been degraded or eliminated within the historical distribution of species.**
- 6.1. Identify degraded areas in need of restoration that are considered important to the conservation of the species.
 - 6.2. Implement soils and forest restoration and conservation actions such as gabion construction, retention berms, cover crops, reforestation, fluvial terraces, brush piles, dead wood removal (to reduce fuel loads), living fences, and resting the land to decrease habitat loss in TBPA priority areas.
- 7. Prevent (minimize) destructive anthropogenic activities such as fires, erosion, and deforestation that result in habitat loss and degradation.**
- 7.1. Develop a forest fire danger map encompassing important TBPA nesting areas.
 - 7.2. Implement wildfire prevention measures (firebreaks, controlled burns, and community watch) within TBPA habitat.
 - 7.3. Implement reforestation programs within TBPA habitat, with a special emphasis in areas that harbor tree species used by the parrot.
 - 7.4. Monitor the effect of the main threats to TBPA populations and habitat and evaluate impacts on population trends.
- 8. Compile and verify information on the current distribution of the parrot, including areas used for nesting, feeding, migration, and wintering.**
- 8.1. Compile historical and current distribution information for the TBPA.
 - 8.2. Identify key sites (nesting, feeding, and migration areas) through species distribution models and interviews with local residents.
 - 8.3. Verify in the field the presence of the species and suitable habitat.
 - 8.4. Estimate species population sizes in priority areas.
 - 8.5. Estimate available habitat in priority areas.
 - 8.6. Promote joint actions in municipal and state land use planning processes focused on preventing land use changes in conservation priority areas.
- 9. Promote the development of research on the parrot and its habitat that leads to effective protection, management, and recovery actions.**
- 9.1. Use satellite telemetry (or geolocators, if site fidelity is high and the birds can be recaptured) to determine migration and dispersal patterns of adult and juvenile parrots.
 - 9.2. Implement field studies to quantify availability of nest sites.
 - 9.3. Determine level of pine cone production in nesting areas.
 - 9.4. Conduct studies to determine a suitable design for artificial nests.

- 9.5. Conduct research to better understand the physical, biological, and adaptability requirements of the species for potential reintroduction (translocation) efforts in Mexico.
- 9.6. Conduct an assessment of current diseases in TBPA wild populations.
- 9.7. Implement population genetic studies to evaluate genetic variability and understand the dynamics of the population.
- 9.8. Evaluate habitat composition and quality to identify potential areas for species reintroduction (translocation) efforts in Mexico using tools such as HEP (Habitat Evaluation Procedures) and HQI (Habitat Quality Index) models.
- 9.9. Conduct studies to determine the ecological requirements and forest attributes needed for nesting, roosting, drinking, and foraging areas; map and develop conservation strategies for these areas.
- 9.10. Identify home ranges and migration patterns of reproductive and non-reproductive thick-billed parrot groups during the breeding and non-breeding season and evaluate habitat use and availability.*
- 9.11. Develop predictive parrot occurrence models such as ecological niche modeling and verify, evaluate, and quantify occurrence sites.*
- 9.12. Develop energetic models for TBPA to determine and quantify habitat goals needed to achieve population goals.*
- 9.13. Characterize the habitat requirements of thick-billed parrots based on all aspects of the species' life history, and develop a habitat suitability model to understand, manage, and restore habitat areas and features for the parrot.*

10. Monitor parrots and habitat to assess population trends and habitat conditions.

- 10.1. Implement or continue existing monitoring studies of breeding populations.
- 10.2. Implement monitoring studies to estimate population size.
- 10.3. Develop a Geographical Information System (GIS) to determine land cover of habitat used, vegetation types, ecological features, wildfire impacts, and land use changes and trends.
- 10.4. Monitor habitat regeneration or deterioration as well as forest restoration at nesting sites.
- 10.5. Evaluate winter habitat to better understand other threats to the populations.
- 10.6. Develop a statistically sound and peer-reviewed parrot monitoring protocol to document population trends.*
- 10.7. Conduct a range-wide population survey during breeding season and winter for the species using standardized, peer-reviewed methodology.*
- 10.8. Determine the minimum viable population size, temporal and spatial distribution, and number of breeding colonies needed for recovery.*

11. Promote a culture of conservation for the parrot and its habitat through outreach efforts and active public participation.

- 11.1. Design an environmental education curriculum for schools in the local communities (especially those close to nesting sites), as well as urban and rural schools.
- 11.2. Prepare printed materials and audiovisual presentations to conduct outreach on TBPA biology, ecology, protection status, and threats, and conservation actions contributing to recovery.

- 11.3. Prepare a TBPA information handbook for environmental educators.
- 11.4. Organize community training workshops for school teachers, environmental education staff, and people interested in conducting outreach in communities near nesting areas to encourage conservation of the species and its forests.
- 11.5. Conduct outreach and education activities including workshops, field trips, field activities, contests, clean-up activities, and public meetings, in the communities adjacent to TBPA habitat.

12. Implement outreach campaigns that allow the public to understand the conservation status of the species and actions necessary to conserve it.

- 12.1. Design and distribute posters, fliers, comic strips, games, printed banners, and activity books to educate the public on the importance of the Thick-billed Parrot and its habitat.
- 12.2. Sign agreements with regional radio stations to broadcast informational spots.
- 12.3. Prepare and distribute informational videos on the TBPA and its habitat.
- 12.4. Inform the public (through printed materials) on conservation successes and actions taken to protect the species.
- 12.5. Share information on threats to the TBPA and its habitat with communities adjacent to occupied areas to involve these communities in conservation of the species.
- 12.6. Emphasize the importance of the general public actively participating in the protection, conservation, and recovery of the species and its habitat.

13. Seek collaborations with communities, associations, institutions, and other stakeholders to facilitate species and habitat conservation through training and capacity building.

- 13.1. Encourage activities with low environmental impact among the communities located within distribution areas of the parrot.
- 13.2. Develop community ecotourism projects jointly with tourism companies to limit access through fees, and to provide lodging and local guides in areas inhabited by TPBA.
- 13.3. Train local guides to develop ecotourism projects that are harmless to the species and to assist in monitoring their populations.
- 13.4. Train people (lodge owners, guides, etc.) living in communities close to TBPA priority areas to focus on a 'nature appreciation' theme in coordination with the Office of Tourism.
- 13.5. Include indigenous groups living in TBPA inhabited areas in the planning and implementation of ecotourism projects.
- 13.6. Encourage participation by students and graduates on species projects.
- 13.7. Train CONANP personnel on censusing populations and monitoring nesting success in TBPA sites falling within Natural Protected Areas.

Recovery Actions Developed for this Addendum for the U.S.

14. Assure the long-term viability of thick-billed parrot conservation by cooperating with partners in Mexico and providing any available technical or financial support for implementing recovery actions.

- 14.1. Develop partnerships with Mexican NGOs and agencies to support implementation of recovery actions.*

- 14.2. Support field work in Mexico to better understand the biology of the species including better defining the wintering ranges of the known breeding populations.*
- 14.3. Support effort to assess, protect, and restore sufficient habitat to sustain viable populations in Mexico.*
- 14.4. Support work by biologists in Mexico to more accurately assess population numbers and trends.*
- 14.5. Support work by biologists in Mexico to actively monitor and manage breeding populations.*
- 14.6. Encourage enforcement of psittacid (parrot family) regulations in Mexico to increase protection of TBPA.s.*

15. Preserve and enhance U.S. historical habitat and augment cross border connectivity of habitat.

- 15.1. Develop and implement strategies to preserve and enhance historical habitat in the mountains of southeastern Arizona and southwestern New Mexico.*
- 15.2. Collaborate with Mexico to identify specific strategies to preserve and enhance borderlands habitat (northwest Chihuahua, northeast Sonora) including the northern most breeding site of Mesa de las Guacamayas and potential habitat in Sierra de San Luis.*
- 15.3. Encourage U.S. based researchers and institutions to continue or enhance conservation efforts of Mexican parrot populations closest to the U.S.*

16. Evaluate feasibility, risks, and appropriateness of conducting translocations of individuals into historical and potential habitats as part of a comprehensive conservation strategy.

- 16.1. Conduct a review of U.S. historical habitat, current habitat management, and habitat connectivity with Mexico.*
- 16.2. Assess the feasibility, risks, and appropriateness of translocating parrots into historical and potential habitats into or near the U.S.; implement translocations if supported by Mexico and considered appropriate in the assessment *
- 16.3. Develop a health assessment protocol for TBPA.s to understand and mitigate disease patterns and risks.*

3.2. Narrative of Recovery Actions

A narrative for the recovery actions was not included in the PACE and was not developed for this addendum.

3.3. Research Needs

Range-wide surveys are needed to determine the baseline population size, temporal and spatial distribution, and number of breeding and wintering colonies. Survey methods should be standardized to allow for comparisons between years and between sites. Survey information is especially lacking in the species' southern breeding and wintering range (Monterrubio-Rico 2012). Survey of additional populations in Durango, as well as other parts of the range, will inform management for recovery. Information gathered will contribute toward a better

understanding of range-wide breeding and wintering areas and non-reproductive groups. Survey data and demographic modeling would provide information to calculate the minimum viable population size and number of breeding colonies, which is necessary to estimate the number of thick-billed parrots and time frame required for the species' recovery. Information about the size, productivity, and range-wide distribution of breeding and non-reproductive groups will offer a better understanding of the species' needs for managers.

More information is needed on habitat use (e.g. home range) of non-breeding, breeding, migrating, and wintering parrots. Additional effort should include collecting information on the persistence of breeding populations and nesting areas in the southern breeding range. Population movement of reproductive and non-reproductive groups within the breeding range needs to be better understood to evaluate the population structure and use of habitat.

Habitat loss is the major factor currently threatening the persistence of the thick-billed parrot. Data are needed to update, develop, and implement forest management plans in suitable habitat for thick-billed parrots. Forest management plans would need to be updated or designed to incorporate needs of thick-billed parrots, by addressing the threats of logging, grazing, and wildfire, providing a long-term vision for the species' recovery, and directing actions on the ground to control these factors. Managing forests to maintain existing habitat, restore logged habitat, and prevent high-intensity fire, insect and disease damage, and human-caused habitat loss is necessary to recover this species. Healthy forest conditions will be indicated by tree stocking levels and fuel load conditions such that fire can be allowed to burn naturally across the landscape without risking the loss thick-billed parrot habitat (including mature trees and snags).

An evaluation of U.S. habitat availability is needed to determine the potential for thick-billed parrots to colonize and survive in the Sky Islands of southeastern Arizona and southwestern New Mexico.

4.0. IMPLEMENTATION SCHEDULE

The following implementation schedule outlines priorities, potential or responsible parties, and estimated costs for the specific actions for recovering the thick-billed parrot. It is a guide to meeting the goals, objectives, and criteria from Section 2 RECOVERY of this recovery plan. The schedule: (a) lists the specific recovery actions, corresponding outline numbers, the action priorities, and the expected duration of actions; (b) recommends agencies or groups for carrying out these actions; and (c) estimates the financial costs for implementing the actions. These actions, when complete, should accomplish the goal of this plan – recovery of the thick-billed parrot.

4.1. Responsible Parties and Cost Estimates

The value of this plan depends on the extent to which it is implemented; the USFWS has neither the authority nor the resources to implement many of the proposed recovery actions. The recovery of the thick-billed parrot is dependent upon the voluntary cooperation of many other organizations and individuals who are willing to implement the recovery actions. The implementation schedule identifies agencies and other potential “responsible parties” (private

and public) to help implement the recovery of this species. This plan does not commit any “responsible party” to carry out a particular recovery action or to expend the estimated funds. It is only recognition that particular groups may possess the expertise, resources, and opportunity to assist in the implementation of recovery actions. Although collaboration with private landowners and others is called for in the recovery plan, no one is obligated by this plan to any recovery action or expenditure of funds. Likewise, this schedule is not intended to preclude or limit others from participating in this recovery program.

The cost estimates provided are not intended to be a specific budget but are provided solely to assist in planning. The total estimated cost of recovery, by priority, is provided in the Executive Summary. The schedule provides cost estimates for each action on an annual or biannual basis. Estimated funds for agencies included only project-specific contract, staff, or operations costs in excess of base budgets. They do not include ordinary operating costs (such as staff) for existing responsibilities.

4.2. Recovery Action Priorities and Abbreviations

Priorities in column 1 of the following Implementation Schedule are assigned as follows:

Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2 - An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to provide for full recovery of the species.

The assignment of these priorities does not imply that some recovery actions are of low importance, but instead implies that lower priority items may be deferred while higher priority items are being implemented.

The following abbreviations are used in the Implementation Schedule:

AGFD = Arizona Game and Fish Department

AZA = Association of Zoos and Aquariums

CBP = U.S. Customs and Border Protection

CESTAC = Consejo Ecoregional Sierra Tarahumara

CITES = Convention on International Trade in Endangered Species of Wild Fauna and Flora

CNA = Comisión Nacional del Agua

CONAFOR = Comisión Nacional Forestal

CONABIO = Comisión Nacional para el Conocimiento y uso de la Biodiversidad

CONANP = Comisión Nacional de Áreas Naturales Protegidas

DOW = Defenders of Wildlife

EJIDOS = Ejidos Ubicados dentro de las zonas de anidacion de la Cotorra Serrana Occidental

GOBIERNOS ESTATALES = Gobiernos Estatales de Chihuahua y Durango, México

INEGI = Instituto Nacional de Estadística y Geografía

ITESM = Instituto Tecnológico y de Estudios Superiores de Monterrey
 NAT = Naturalia
 NMDGF = New Mexico Department of Game and Fish
 NMSU = New Mexico State University
 PL = Private Landowners
 PROFEPA = Procuraduría Federal de Protección al Ambiente
 PRONATURA = Pronatura
 RAN = Registro Agrario Nacional
 SAGARPA = Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación
 SCT = Secretaría de Comunicaciones y Transportes
 SDZSP = San Diego Zoo and Safari Park
 SECTUR = Secretaría de Turismo
 SEMARNAT = Secretaría de Medio Ambiente y Recursos Naturales
 UACH = Universidad Autónoma de Chihuahua
 UANL = Universidad Autónoma de Nuevo León
 UA = University of Arizona
 UAAAN = Universidad Autónoma Agraria Antonio Narro
 UMAFOR = Unidad de Manejo Forestal
 UNAM = Universidad Nacional Autónoma de México (National Autonomous University of Mexico)
 USFWS = U.S. Fish and Wildlife Service



Sign at the entrance to the thick-billed parrot sanctuary on Ejido El Largo, Chihuahua, Mexico. The Madera Priority Conservation Region was established in November, 2002. Photo courtesy of Bill Howe.

4.3. Implementation Schedule

The actions presented in Spanish in this table are taken directly from the PACE (pages 41-52). For consistency, the original Spanish wording for each action has been left intact (actions in Spanish are described in the PACE as encompassing both the thick-billed parrot and the maroon-fronted parrot, as appropriate). However all the information (e.g., priority number, Recovery Criterion Number, etc.) presented in this table for each action only addresses the thick-billed parrot. Actions in this table that do not appear in the PACE are followed by asterisks. This table also excludes 4 actions that appear in the PACE under “Evaluation and Follow-up”, because they had an administrative focus. Actions 1.1 through 13.7 are included in the PACE and costs were estimated primarily by Mexican partners, with the exception of those followed by asterisks. Actions 14.1 through 16.3 were developed for U.S. based recovery tasks and were not translated into Spanish.

Las acciones presentadas en español en esta tabla son tomadas directamente del PACE (paginas 41-52). Para mantener consistencia, se ha tomado el texto original de cada acción según aparece en el PACE (las acciones descritas en el PACE abarcan ambas especies, la cotorra serrana occidental y la cotorra serrana oriental, según sea apropiado). Pero toda la información (nivel de prioridad, numero de criterio de recuperación, etcétera) presentada en esta tabla para cada acción, solo cubre a la cotorra serrana occidental. La acción denominada 1.9 en esta tabla no aparece en el PACE, fue agregada en consulta con biólogos de México. Esta tabla también excluye 4 acciones que aparecen en el PACE bajo “Componente de Evaluación y Seguimiento”, por ser mas de enfoque administrativo. Las acciones denominadas 1.1 a 13.7 están incluidas en el PACE y los costos fueron estimados por los socios en México. Las acciones denominadas 14.1 a 16.3 fueron desarrolladas por las tareas basadas en los EEUU y no fueron traducido al español.

Priority Number <i>Nivel de Prioridad</i>	Action Number <i>Número de la acción</i>	Action Description <i>Descripción de acciones para la Recuperación (vienen del PACE paginas 41-52)</i>	Recovery Criterion Number(s) <i>Numero(s) de Criterio de Recuperación</i>		Threats <i>Amenazas</i>	Action Duration (years) <i>Duración de actividad (en años)</i>	Responsible Parties <i>Socio(s) responsables</i>	Is USFWS Lead? <i>Actividad liderada por USFWS?</i>	Total Cost (\$1,000s) <i>Costo Total (en miles USD)</i>	Cost per Year (by \$1,000s) <i>Presupuesto estimado por año (en miles USD)</i>					Comments <i>Comentarios</i>
			Demo-graphic Criteria	Threats-based Criteria						2013	2014	2015	2016	2017	
			1	1.1						Have Madera and Las Pomas (Chihuahua) decreed federally protected. ----- Realizar las gestiones necesarias para decretar como Santuario Federal las zonas conocidas como Madera, Mesa de las Guacamayas, Tutuaca, Heredias y las Pomas (Chihuahua), y zonas en el rango invernal; Las bufas, California, y San Miguel de	1	1,2	A,D	<4	

		las Cruces (Durango).														propuestas para protección por los biólogos Mexicanos y no incluidas en las acciones del PACE (2009): Mesa de las Guacamayas, Tutuaca, Heredías (Chihuahua) y áreas en el rango invernal; Las bufas, California, y San Miguel de las Cruces (Durango).
1	1.2	Protect trees for nesting and feeding. ----- Identificar los hábitats críticos o prioritarios de las cotorras serranas para planear el aprovechamiento forestal, a través de las Unidades de Manejo Forestal con el fin de conservar el arbolado propicio para la anidación y alimentación de las cotorras serranas.	1	1,2,3	A,D	<5	ITESM, PRONATURA	No	25	15	10	-	-	-		
1	1.3	Protect habitat through conservation easements and on-the-ground actions. ----- Efectuar acciones de protección de tierras, las cuales incluyen la firma de acuerdos legales, cercado de predios, brechas cortafuegos, y señalamientos.	1	1,2	A,D	>4	PRONATURA, CONANP, CESTAC, CONAFOR, GOBIERNOS ESTATALES, EJIDOS, ITESM, NAT, PL, SAGARPA, SECTUR, SEMARNAT, UMAFOR	No	956	-	239	239	239	239		
2	1.4	Strengthen protection of private reserves. ----- Fortalecer el nivel de protección de las reservas privadas, a través de servidumbres ecológicas y certificados de	1	1,2,3	A,D	>5	PL, EJIDOS, PRONATURA, ITESM, CONANP	No	40	10	10	10	10	-		

		conservación, entre otros mecanismos.													
1	1.5	Identify and control access points to key nesting and perching areas. ----- Identificar y controlar los accesos a las principales áreas de anidación y dormideros de cotorras serranas.	1	1,2,3	A,D	>3	ITESM, CONANP	No	20	7	7	6	-	-	
2	1.6	Install educational and regulatory signage in nesting areas. ----- Instalar señalización informativa y restrictiva en las principales áreas de anidación de cotorras serranas.	1	1,2,3	A,D	<5	PRONATURA, CONANP	No	216	44	43	43	43	43	
1	1.7	Promote sound land use planning at key sites. ----- Promover la realización y ejecución de Programas de Ordenamiento Ecológico del Territorio en sitios de ocurrencia de ambas especies.	1	1,2	A,D E	>5	GOBIERNOS ESTATALES CONANP PRONATURA	No	50	-	25	-	25	-	
1	1.8	Establish Forest Fire Management programs. ----- Efectuar programas de manejo y control integrado del fuego en los bosques en colaboración con la Comisión Nacional Forestal (CONAFOR).	1	1,2	A,D E	<3	PRONATURA, CONANP, CONAFOR	No	120	40	40	40	-	-	
3	1.9	Evaluate forest health to identify and control pests and diseases of trees in parrot habitat * ----- Identificar, zonificar y controlar plagas y enfermedades de arbolado	1	1,2	A,C, E	<10	CONAFOR, UMAFOR, UAAAN	No	1280	128	128	128	128	128	Costs calculated for 10 years. Los costos se calculan para 10 años.

		en el hábitat de distribución de Cotorra Serrana Occidental*.													
1	1.10	Identify unprotected, occupied breeding and wintering priority areas; evaluate their potential for protection (in Mexico).* ----- Identificar áreas prioritarias no reproductoras que son ocupados y no son protegidos; evaluar su potencial para protección (en México).*	1	1,2,3	A,B, D,E	<4	PL, EJIDOS, PRONATURA, ITESM, CONANP	No	80	20	20	20	20		
2	2.1	Keep stakeholders informed on relevant TBPA legislation. ----- Difundir entre los diferentes sectores involucrados en la protección y conservación de las cotorras serranas y su hábitat, la legislación nacional e internacional vigente aplicable.	1	1,2,3	A,B, C,D, E	<3	PROFEPA, PRONATURA, CONANP, GOBIERNOS ESTATALES	No	30	10	10	10	-	-	Includes cost for Action 2.2. Los costos incluyen acción 2.2.
2	2.2	Continuously assess the legal framework for TBPA conservation. ----- Promover y difundir mecanismos de evaluación y en su caso modificación del Marco Jurídico vigente entre los sectores involucrados con la conservación, protección y manejo.(Costo incluido en el criterio anterior)	1	1,2,3	A,B, C,D, E	>5	PROFEPA, PRONATURA, CONANP, GOBIERNOS ESTATALES	No	-	-	-	-	-	-	Costs included in Action 2.1. Costos incluidos en acción 2.1.
1	2.3	Address habitat development through legal prevention and mitigation measures. ----- Diseñar medidas de prevención legal y	1	1,2,3	A,D	<5	PROFEPA, PRONATURA, CONANP, GOBIERNOS ESTATALES	No	30	6	6	6	6	6	

		mitigación de impactos que puedan ocurrir por la implementación de desarrollos o cambios de uso de suelo en áreas de distribución de las cotorras serranas.													
1	2.4	Share species technical information with government entities. ----- Proporcionar, a solicitud de las autoridades que así lo requieran, información técnica de la especie que ayude en la correcta toma de decisiones.	1	1,2,3	A,B, C,D, E	<5	USFWS, AGFD, ITESM, PRONATURA	No	10	-	10	-	-	-	
1	3.1	Request from PROFEPA law enforcement actions. ----- Solicitar operativos de inspección y vigilancia por parte de la PROFEPA en las áreas críticas identificadas para las cotorras serranas, entre otros sitios.	1	1,2,3	A,B, D	<5	PROFEPA, CONANP, GOBIERNOS ESTATALES	No	12	6	6	-	-	-	
1	3.2	Establish local community watch groups. ----- Promover la formación de comités de vigilancia participativa y la mejora de los ya existentes con la finalidad de identificar y controlar el aprovechamiento ilegal de cotorras serranas y la destrucción de su hábitat.	1	1,2,3	A,B, C,D, E	<5	PL, EJIDOS, PRONATURA, CONANP	No	30	10	-	10	-	10	Costs include Action 3.4. Los costos incluyen acción 3.4.
1	3.3	Encourage the general public to report habitat/species violations. ----- Promover entre la sociedad en general, la detección y denuncia pública de la captura y tráfico ilegal de estas aves así como de la alteración ilegal de su	1	1,2,3	A,B, C,D, E	>5	PRONATURA, CONANP, ITESM, PROFEPA, GOBIERNOS ESTATALES	No	25	5	5	5	5	5	Costs include Action 4.3. Los costos incluyen acción 4.3.

		hábitat.														
1	3.4	Reinforce law enforcement inspections and monitoring activities. ----- Reforzar las actividades de inspección y vigilancia en coordinación con los gobiernos estatales y municipales.	1	1,2,3	A,B, D	<5	PRONATURA, CONANP, CONAFOR, PROFEPA, GOBIERNOS ESTATALES	No	-	-	-	-	-	-	-	Costs included in Action 3.2. Costos incluidos en acción 3.2.
1	4.1	Confirm existing and identify new nesting and feeding areas. ----- Identificar las áreas con hábitat adecuado que registren uso actual y potencial (posibilidad de uso futuro) para la anidación y alimentación de cotorras serranas.	1	1,2,3	A,E	<3	ITESM, SEMARNAT	No	12	6	6	-	-	-	-	Costs include Actions 8.3, 8.5, and 9.2. Los costos incluyen acción 8.3, 8.5, y 9.2.
1	4.2	Exclude mature tree stands and snags from forest harvesting. ----- Proponer a la SEMARNAT, áreas de exclusión de autorizaciones de aprovechamientos maderables en aquellas áreas consideradas como hábitat actual y potencial para las cotorras serranas, incluyendo los arbolados con características requeridas por las cotorras para su anidación y alimentación.	1	1,2	A	<5	CONANP, PRONATURA	No	64	16	16	16	16			
1	4.3	Work with private landowners to conserve parrot habitat. ----- Fomentar entre los titulares de predios ubicados en áreas consideradas como hábitat de cotorras serranas, la protección y conservación de las mismas.	1	1,2,3	A,B, C,D, E	>5	PL, EJIDOS, PRONATURA, CONANP	No	-	-	-	-	-	-	-	Costs included in Action 3.3. Costos incluidos en acción 3.3.

1	4.4	Promote the use of different legal tools to protect habitat. ----- Promover la aplicación de diferentes herramientas de protección legal de tierras en donde habitan las cotorras tales como Reservas Ejidales, Servidumbres Ecológicas y Usufructos, con la finalidad de regular el aprovechamiento de estas áreas y de replanificar las actividades productivas.	1	1,2,3	A,B, D	<5	PRONATURA, CONANP, CONAFOR	No	306	62	61	61	61	61	61	Costs include Action 4.7. Los costos incluyen acción 4.7.
3	4.5	Encourage sustainable management of watersheds. ----- Fomentar el manejo de cuencas hidrológicas con el fin de generar recursos a través de la conservación del hábitat de las especies y la generación de pago por servicios ambientales.	1	1,2	A,E	>5	PRONATURA, CONANP, CNA, CONAFOR	No	60	12	12	12	12	12	12	Costs include Action 13.1. Los costos incluyen acción 13.1.
3	4.6	Promote environmentally friendly projects. ----- Efectuar proyectos productivos amigables al medio ambiente en las comunidades de las regiones donde se distribuyen las cotorras, en colaboración con la Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (SAGARPA).	1	1,2,3	A	>5	PRONATURA, ITESM, CONANP, SAGARPA	No	82	17	17	16	16	16		
2	4.7	Promote payments for environmental services to landowners. ----- Promover el pago de servicios ambientales para aquellos propietarios que realicen acciones de manejo y conservación encaminadas	1	1,2,3	A,B, D,E	>5	PRONATURA, CONANP, CONAFOR, SAGARPA	No	-	-	-	-	-	-	-	Some costs included in Action 4.4, but actual costs will depend on services needed. Costos incluidos en acción 4.4.

		al mantenimiento de poblaciones de cotorras serranas en México													
1	4.8	Complete and implement long-term thick-billed parrot habitat conservation plan.* ----- Completar e implementar un plan de conservación del hábitat de largo plazo para la cotorra serrana occidental.*	1	1,2,3	A,B, C,D, E	>5	PRONATURA, CONANP, CONAFOR USFWS	No	100	20	20	20	20	20	Plan implementation will be ongoing and costs will depend on actions needed.
2	4.9	Develop and implement forest management plans* ----- Desarrollar e implementar Planes de Manejo de los Bosques.*	1	1,2	A,D E	>10		No	100	20	20	20	20	20	Plan implementation will be ongoing and costs will depend on actions needed.
2	5.1	Build, install, and monitor artificial nest boxes. ----- Diseñar, instalar y monitorear al menos 40 nidos artificiales para la cotorra serrana occidental en cada sitio de anidación detectado.	1	1,2-	A,E	<5	ITESM, EJIDOS	No	19	4	4	4	4	3	Costs include Actions 9.4. Los costos incluyen acción 9.4.
1	5.2	Develop guidelines for handling confiscated parrots. ----- Desarrollar un protocolo para la canalización de ejemplares de cotorras serranas decomisados.	1	3	B,C	<5	USFWS, AGFD, CITES, PROFEPA, SEMARNAT, AZA	No	8	4	4	-	-	-	
2	5.3	Develop handbooks for dealing with parrots held in captivity, rehabilitation, and for releases. ----- Elaborar manuales para el manejo de ejemplares de cotorras serranas en cautiverio, así como para la rehabilitación y reintroducción de ejemplares.	1	-	B,C	<5	USFWS, AGFD, CITES, AZA, ITESM	No	10	3	7	-	-	-	
3	5.4	Evaluate ecotourism	1	1,2,3	A,B,	<5	SECTUR,	No	40	10	10	10	10	-	

		impacts to species. ----- Evaluar el impacto que generan en las cotorras serranas la instauración de programas de ecoturismo de áreas protegidas con ocurrencia de estas especies.			C,D, E		CONANP, ITESM								
3	6.1	Identify degraded areas for restoration. ----- Identificar áreas perturbadas que requieran acciones de restauración consideradas como prioritarias para la conservación de cotorras serranas.	1	1,2	A,E	4	ITESM, PRONATURA, UMAFOR, CONAFOR	No	20	10	10	-	-	-	
2	6.2	Implement soils and forest restoration and conservation actions. ----- Establecer acciones de restauración y conservación de suelos y áreas forestales tales como la instalación de presas de gavión, bordos, empalizadas, siembra de cultivos, reforestación, uso de terrazas, líneas con material vegetal muerto, remoción de madera muerta (material combustible), cercos vivos e inclusive promover el descanso del aprovechamiento, etc. que disminuyan los efectos de pérdida de hábitat en zonas prioritarias para la conservación de cotorras serranas.	1	1,2	A,E	5	PRONATURA, ITESM, CONANP, CONAFOR, UMAFOR	No	170	34	34	34	34	34	Costs include Action 7.3. Los costos incluyen acción 7.3.
1	7.1	Develop a forest fire danger map. ----- Elaborar un mapa de riesgo de incendios forestales que incluya la zonificación de los sitios de anidación más importantes para ambas especies	1	1,2	A,E	<4	PRONATURA, CONANP, CONAFOR, ITESM, UMAFOR	No	15	5	5	5	-	-	

1	7.2	Implement wildfire prevention measures. ----- Efectuar acciones de prevención de incendios (apertura de brechas cortafuego, quema controlada, vigilancia participativa) dentro de las áreas consideradas como hábitat de cotorras serranas.	1	1,2	A	<5	PRONATURA, CONANP, CONAFOR, ITESM, UMAFOR, USFS	No	192	39	39	38	38	38	
1	7.3	Implement reforestation programs. ----- Implementar programas de reforestación en áreas catalogadas como hábitat con especial énfasis en áreas con presencia de especies vegetales utilizadas por estas aves	1	1,2	A	>5	PRONATURA, ITESM, CONANP, CONAFOR, UMAFOR, USFS	-	-	-	-	-	-	-	Costs are included in Action 6.2. Costos incluidos en acción 6.2.
1	7.4	Monitor main threats to thick-billed parrot populations and habitat and assess their effects. ----- Monitorear el efecto de los principales factores de riesgo identificados para las poblaciones de las cotorras serranas y su hábitat y evaluar su impacto en las tendencias poblacionales de estas aves.	1	1,2,3	A,B, C,D, E	>5	PRONATURA, ITESM, CONANP, CONAFOR, UMAFOR	No	20	5	5	5	-	5	
1	8.1	Compile historical and current species distribution. ----- Compilar información histórica y actual de la distribución de las cotorras serranas.	1	1,2	A	>5	ITESM, UACH, USFWS	No	21	4	4	3	-	10	
1	8.2	Identify key sites (nesting, feeding, and migration areas). ----- Identificar áreas clave (áreas de anidación, alimentación o de migración) para las dos	1	1,2,3	A,E	4	ITESM, SEMARNAT	No	21	6	5	5	5	-	Costs include Action 8.3. Los costos incluyen acción 8.3.

		especies mediante algoritmos de predicción y entrevistas con gente local.														
1	8.3	Field-verify site occupancy and suitable habitat. ----- Corroborar en campo la presencia de las especies y la existencia del hábitat apropiado.	1	1,2	A,E	4	ITESM, SEMARNAT	No	-	-	-	-	-	-	-	Costs included in Action 4.1 and 8.2. Costos incluidos en acción 4.1 y 8.2.
1	8.4	Estimate population numbers in priority areas. ----- Estimar las poblaciones de cotorras serranas en áreas prioritarias.	1	1	A,E	<5	ITESM, PRONATURA, UACH	No	51	11	10	10	10	10		
1	8.5	Estimate available habitat in priority areas. ----- Estimar la disponibilidad de hábitat de las cotorras serranas en áreas prioritarias.	1	1	A,E	<5	PRONATURA, CONANP, ITESM	No	-	-	-	-	-	-	Costs included in Action 4.1 Costos incluidos en acción 4.1.	
3	8.6	Promote land use planning processes to benefit priority areas. ----- Promover acciones coordinadas para el ordenamiento territorial municipal y estatal, enfocadas a evitar cambios de uso de suelo en áreas prioritarias de conservación de las cotorras serranas.	1	1,2	A,E	>5	GOBIERNOS ESTATALES, PRONATURA, CONANP, ITESM	No	50	10	10	10	10	10		
1	9.1	Determine migration and dispersal patterns. ----- Aplicar técnicas de telemetría con transmisores satelitales para determinar los movimientos de migración y dispersión de ejemplares adultos y juveniles.	1	1	A	<5	ITESM, PRONATURA,	No	111	38	37	36	-	-		
1	9.2	Quantify availability of nest sites.	1	1,2	A,E	<5	ITESM, PRONATURA	No	-	-	-	-	-	-	Costs included in Action 4.1.	

		Implementar estudios en campo para cuantificar la disponibilidad de sitios de anidación.														Costos incluidos en acción 4.1
2	9.3	Determine level of pine cone production in nesting areas. Determinar la producción de conos de pino consumibles por las cotorras en las áreas de reproducción	1	1,2	A	<5	ITESM, PRONATURA, CONANP	No	14	4	4	3	3	-		
1	9.4	Determine a suitable design for artificial nests. Desarrollar estudios para obtener el diseño adecuado de nidos artificiales para la cotorra serrana occidental.	1	1,2	A,B	2	ITESM, PRONATURA	No	-	-	-	-	-	-		Costs included in Action 5.1. Costos incluidos en acción 5.1.
3	9.5	Research feasibility of reintroductions (translocations) in Mexico. Efectuar estudios que permitan conocer los requerimientos físicos, biológicos y de adaptabilidad de La especie con la finalidad de poder efectuar reintroducciones.	1	1	A,B, C,E	7	ITESM, PRONATURA	No	20	-	-	-	-	10		Calculated for 7 years. Calculado de 7 años.
2	9.6	Assess current diseases in TBPA wild populations. Realizar un análisis de las enfermedades existentes en las poblaciones silvestres de cotorras serranas.	1	1	A,C	4	ITESM, PRONATURA, AZA, NMSU, SDZSP	No	25	6.25	6.25	6.25	6.25	-		
2	9.7	Evaluate genetic variability population dynamics. Implementar estudios de genética poblacional para evaluar la variabilidad genética y conocer el funcionamiento poblacional de ambas especies.	1	1	A,E	5	NMSU, AZA, ITESM, UANL	No	50	10	10	10	10	10		
3	9.8	Evaluate habitat	1	1,2	A,E	<5	ITESM,	No	10	-	10	-	-	-		

		<p>composition and quality for potential reintroductions (translocations) in Mexico, using tools such as HEP (Habitat Evaluation Procedures) and HSI (Habitat Quality Index).</p> <p>-----</p> <p>Evaluar las características y la calidad del hábitat de las cotorras serranas con la finalidad de identificar áreas potenciales para su reintroducción, utilizando herramientas como los modelos HEP (Procedimientos de Evaluación del Hábitat, por sus siglas en inglés) e HSI (Índice de Calidad del Hábitat, por sus siglas en inglés).</p>					PRONATURA, INEGI, CNA, CONABIO,								
1	9.9	<p>Conduct studies to determine the forest attributes needed for nesting, roosting, drinking, and foraging areas; map and develop conservation strategies for these areas.</p> <p>-----</p> <p>Efectuar estudios que permitan conocer los requerimientos ecológicos de las cotorras para permitir la implementación de estrategias efectivas para su conservación y generar mapas con los atributos del bosque de utilidad para estas especies como sitios de anidación, refugio, fuentes de agua, alimento, dormideros, bancos de minerales y perchas.</p>	1	1,2,3	A,B, C,D, E	>5	ITESM, PRONATURA, INEGI, CNA, CONABIO	No	100	20	20	20	20	20	
2	9.10	<p>Identify home ranges and migration patterns; evaluate habitat use and availability.*</p> <p>-----</p> <p>Identificar rangos hogareños</p>	1	1,2	A	>5		No	500	100	100	100	100	100	Costs calculated for 5 yrs.

		y patrones de migración; evaluar el uso y disponibilidad del hábitat.*													
2	9.11	Develop predictive TBPA occurrence models.* ----- Desarrollar modelos predictivos de ocurrencia de la cotorra serrana occidental.*	1	1	A,E	>5	ITESM, PRONATURA, CONANP	No	100	-	-	-	-	100	
2	9.12	Develop energetic models for TBPA to determine and quantify habitat goals needed to achieve population goals.* -----													
2	9.13	Characterize habitat requirements of TBPA; develop hábitat suitability model to manage, restore hábitat.* ----- Caracterizar los requerimientos del hábitat de la cotorra serrana occidental; desarrollar un modelo de idoneidad del hábitat para manejar y restaurar el hábitat.*	1	1,2	A,E	>5	ITESM, PRONATURA, CONANP	No	150	-	-	-	-	-	To be completed after 9.9 and 9.10.
1	10.1	Monitor breeding populations. ----- Implementar o dar continuidad a los estudios de monitoreo de las poblaciones reproductivas de cotorras serranas.	1	1	A,E	>5	ITESM, PRONATURA	No	30	10	-	10	-	10	Calculated for 5 years, every other year. Calculado de 5 años, cada año Costs include Action 10.2. Los costos incluyen acción 10.2.
1	10.2	Estimate population size. ----- Implementar monitoreos para realizar estimaciones del tamaño poblacional de las dos especies de cotorra serrana.	1	1	A,E	>5	ITESM, PRONATURA, INEGI, CNA, CONABIO	No	-	-	-	-	-	-	Costs included in Action 10.1 and 11.5. Costos incluidos en acción 10.1 y 11.5.
1	10.3	Develop relevant	1	1,2,	A,B,	<5	CONAFOR,	No	33	23	10	-	-	-	

		Geographical Information System (GIS) layers. ----- Integrar un Sistema de Información Geográfica (SIG) con la finalidad de determinar la cobertura de hábitat utilizado y los tipos de vegetación disponible para las dos especies, las características ecológicas del mismo, el impacto de incendios y el cambio de uso de suelo, así como las tendencias de éste último, entre otros aspectos.			C,D, E		CONABIO, PRONATURA, ITESM, USFWS, AGFD, INEGI								
1	10.4	Monitor habitat changes at nesting sites. ----- Monitorear los procesos de regeneración o de deterioro del hábitat de estas especies así como la restauración forestal en los sitios de anidación.	1	1,2	A,,B E	>5	CONAFOR, UMAFOR, PRONATURA, ITESM, CONANP, USFWS	No	15	-	3	-	3	-	Calculated for 5 years, every other year. Calculado de 5 años, cada año.
1	10.5	Evaluate winter habitat. ----- Evaluar el hábitat invernal de las cotorras para conocer otros factores de riesgo de las poblaciones.	1	1,2	A,B	>5	ITESM, PRONATURA	No	15	3	3	-	3	-	
1	10.6	Develop standardized TBPA monitoring protocol.* ----- Desarrollar un protocolo estandarizado para el monitoreo de la cotorra serrana occidental.*	1	1,3	B,E	1	PRONATURA, ITESM, CONANP	No	20	20	-	-	-	-	
1	10.7	Conduct range-wide population survey for TBPA using standardized method.* ----- Realizar una encuesta poblacional por todo el rango de distribución de la cotorra serrana occidental.*	1	1,3	A,B, ,E	5	PRONATURA, ITESM, CONANP	No	150	-	50	50	50	-	
2	10.8	Determine minimum viable population size, distribution,	1	1	A,E	5	USFWS	No	80	-	-	-	-	80	

		number of breeding colonies for recovery.* ----- Determinar la población mínima viable, la distribución, y el número de colonias reproductoras para la recuperación.*													
1	11.1	Design school environmental education curriculum. ----- Diseñar un programa de educación ambiental que pueda ser incorporado en el programa escolar de las comunidades locales (principalmente en los sitios de anidación de las cotorras), tanto de escuelas urbanas como de escuelas rurales.	1	1,2,3	A,B	<5	PRONATURA, ITESM, DOW	No	88	22	22	22	22	-	Costs include Actions 11.2 and 11.4. Los costos incluyen acción 11.2 y 11.4.
1	11.2	Prepare outreach materials. ----- Desarrollar materiales impresos y audiovisuales que informen sobre las características biológicas de las dos especies, ecología, estado de riesgo, principales problemas que enfrenta y las acciones de conservación implementadas para su recuperación así como la importancia de estas últimas.	1	1,2,3	A,B	>5	PRONATURA, ITESM, CONANP, DOW	No	-	-	-	-	-	-	Costs included in Action 11.1. Costos incluidos en acción 11.1
1	11.3	Prepare information handbook for environmental educators. ----- Desarrollar un manual con información de las dos especies dirigido a educadores ambientales.	1	1,2,3	A,B	4	PRONATURA, ITESM, CONANP, DOW	No	30	10	10	10	-	-	Costs include Action 12.2. Los costos incluyen acción 12.2.
2	11.4	Organize community training workshops. ----- Implementar talleres de	1	1,2,3	A,B	<5	PRONATURA, ITESM, CONANP	No	-	-	-	-	-	-	Costs included in Action 11.1. Costos incluidos

		capacitación comunitaria dirigidos a profesores de escuela, educadores ambientales y personas interesadas en difundir información sobre estas especies para fomentar su conservación y la de los bosques en las comunidades aledañas a las áreas de anidación.														enacción 11.1.
1	11.5	Conduct outreach and education activities in local communities. ----- Efectuar actividades de educación y concientización social directamente con habitantes de las comunidades donde se localizan estas especies a través de talleres, excursiones, prácticas de campo, concursos, actividades de saneamiento, talleres de planeación participativa, etc.	1	1,2,3	A,B, C,D, E	<5	PRONATURA, ITESM, DOW	No	54	10	14	15	15	-		
2	12.1	Design and distribute outreach and educational materials. ----- Diseñar y distribuir carteles, trípticos, tiras cómicas, juegos, lonas, libros de actividades y otros materiales, con información sobre la importancia de ambas especies y su hábitat.	1	1,2,3	A,B, E	<5	PRONATURA, ITESM, CONANP, DOW	No	6	3	3	-	-	-		
3	12.2	Broadcast informational spots. ----- Establecer convenios con las estaciones de radio regionales para efectuar la transmisión de cápsulas informativas.	1	1,2,3	A,B, E	<5	PRONATURA, ITESM, CONANP	No	-	-	-	-	-	-	Costs included in Action 11.3. Costos incluidos en acción 11.3.	
3	12.3	Prepare and distribute informational videos.	1	1,2,3	A,B, E	<5	PRONATURA, ITESM,	No	25	-	-	-	-	-		

		Elaborar y difundir videos con información sobre las cotorras serranas y su hábitat.					CONANP								
1	12.4	Inform the public on conservation successes and actions. Publicar material de divulgación en el que se den a conocer las acciones de protección desarrolladas en favor de la conservación de las cotorras serranas, así como los logros alcanzados	1	1,2,3	A,B, C,D, E	<5	PRONATURA, ITESM, CONANP	No	26	-	-	12	14	-	
1	12.5	Inform and engage local communities to assist with TBPA conservation. Difundir en las comunidades cercanas a las áreas de distribución de cotorras serranas, la problemática de la especie y su hábitat en México, con la finalidad de que se colabore en la implementación de acciones de conservación de la especie en su comunidad.	1	1,2,3	A,B, C,D, E	4	PRONATURA, ITESM, CONANP	No	-	-	-	-	-	-	Costs included in Action 11.5. Costos incluidos en acción 11.5
3	12.6	Emphasize the importance of TBPA to the public. Difundir la importancia de la sociedad en general, en las tareas de protección, conservación y recuperación de las cotorras serranas y su hábitat.	1	1,2,3	A,B, C,D, E	4	PRONATURA, ITESM, CONANP	No	20	7	6.5	6.5	-	-	
3	13.1	Encourage low environmental impact activities. Fomentar actividades productivas de bajo impacto ambiental entre las comunidades inmersas en las áreas de distribución de	1	1,2,3	A,B, E	>5	PRONATURA, ITESM, CONANP, SAGARPA	No	-	-	-	-	-	-	Costs included in Action 4.6. Costos incluidos en acción 4.6.

		cotorras serranas.													
3	13.2	Develop sustainable community ecotourism projects. ----- Diseñar proyectos ecoturísticos comunitarios en convenio con empresas (control en el acceso a partir de cuotas, hospedaje, contratación de guías locales) en sitios con ocurrencia de cotorras.	1	1,2,3	A,B, C,D, E	7	PRONATURA, GOBIERNOS ESTATALES, SECTUR, CONANP, CONAFOR	No	77	11	11	11	11	11	Cost calculated for 7 years. Los costos se calculan para 7 años.
3	13.3	Train local guides on developing ecotourism projects. ----- Capacitar a los guías locales en el desarrollo de proyectos ecoturísticos inocuos a las cotorras y para que contribuyan con el monitoreo de las poblaciones.		1,2,3	A,B,	<5	PRONATURA, GOBIERNOS ESTATALES, SECTUR, CONANP, CONAFOR	No	15	5	5	5	-	-	
3	13.4	Train community members on 'nature appreciation' themed projects. ----- Capacitar a la gente de las comunidades cercanas a las áreas prioritarias (dueños de cabañas, guías, etc.) en el enfoque de "Apreciación de la Naturaleza" en coordinación con la Secretaría de Turismo.	1	1,2,3	A,B	<5	CONAFOR, CONANP, SECTUR	No	80	16	16	16	16	16	
3	13.5	Include indigenous groups in ecotourism planning and implementation of ecotourism. ----- Incluir a grupos étnicos establecidos en las áreas de distribución de cotorras serranas en el desarrollo e implementación de proyectos ecoturísticos.	1	1,2,3	A,B, E	>5	CONAFOR, GOBIERNOS ESTATALES, PRONATURA, CESTAC, RAN	No	15	-	-	-	15	-	
3	13.6	Encourage participation by	1	1,2,3	A,B,	>5	ITESM,	No	80	8	8	8	8	8	Costs calculated for 10

		academia. ----- Promover la participación de estudiantes y tesis en proyectos con estas especies.			C,D, E		PRONATURA, UAAAN, UACH, UANL, UNAM, NMSU, UA									years. Los costos se calculan para 10 años.
3	13.7	Train CONANP personnel on monitoring protocols. ----- Capacitar a personal de la CONANP para llevar a cabo censos de monitoreo de las cotorras serranas, además del seguimiento de su éxito de anidación, en las Áreas Naturales Protegidas donde ocurran las especies.	1	1,2,3	A,B, C,D, E	>5	PRONATURA, CONANP	No	18	6	6	6	-	-		
1	14.1	Develop partnerships with Mexican NGOs and agencies.* ----- Desarrollar alianzas con los ONGs y agencias gubernamentales de México.*	1	1,2,3	A,B, C,D, E	4	USFWS, AGFD, NMDGF,NAT, PRONATURA, SEMARNAT, SDZSP	Yes	5	2	1	1	1	-		
1	14.2	Support efforts in Mexico to improve knowledge of species ecology.* ----- Apoyar los esfuerzos en México para mejorar el conocimiento de la ecología de la especie.*	1	1,2,3	A,C, E	4	USFWS,AGFD	Yes	50	10	10	10	10	-		
1	14.3	Support effort in Mexico to conserve habitat.* ----- Apoyar los esfuerzos en México para conservar el hábitat.*	1	1,2	A,D E	>5	USFWS,AGFD	Yes	50	10	10	10	10	10		
1	14.4	Support work in Mexico to better assess population numbers and trends.* ----- Apoyar el trabajo en México para una mejor asesoría de los números y tendencias poblacionales.*	1	1,2	A,E	>5	USFWS,AGFD	Yes	50	10	10	10	10	10		
1	14.5	Support work by biologists	1	1,2,3	E	>5	USFWS,AGFD	Yes	50	10	10	10	10	10		

		in Mexico to actively monitor and manage breeding populations.* ----- Apoyar el trabajo de los biólogos en México para un activo monitoreo y manejo de las poblaciones reproductoras.*														
1	14.6	Encourage enforcement of parrot regulations in Mexico.* ----- Fomentar la aplicación de las leyes relacionadas a las coturras en México*.	1	3	B,D	5	AGFD, USFWS, CITES, CBP	Yes	5	1	1	1	1	1		
3	15.1	Implement strategies to preserve U.S. historical habitat.* ----- Implementar las estrategias para preservar el hábitat histórico en los EEUU.*	1	1	A	>5	USFS, USFWS	Yes	-	-	-	-	-	-	In progress with Arizona Firescape Program. En marcha programa de Firescape.	
2	15.2	Collaborate binationally to preserve borderlands habitat.* ----- Colaborar de manera binacional para preservar el hábitat fronterizo*.	1	1	A	4	AGFD, NMDFG, USFS, USFWS,	Yes	10	-	5	5	-	-		
2	15.3	Encourage U.S. based researchers and institutions to enhance conservation efforts of Mexican parrot populations closest to the U.S.* ----- Fomentar científicos e instituciones basados en los EEUU a mejorar los esfuerzos para conservar las poblaciones de coturras en México más cercanas a los EEUU.*	1	1,2,3	A, C,E	>5	AGFD, USFWS, UA, USFS, NMSU, SDZSP	Yes	50	10	10	10	10	10		
3	16.1	Conduct a review of U.S. historical habitat.* ----- Realizar una revisión del	-	1	A,E	2	USFWS, AGFD, USFS	Yes	5	5	-	-	-	-		

		hábitat histórico de los EEUU.*															
3	16.2	Assess the feasibility, risks, and appropriateness of translocating parrots into historical and potential habitats into or near the U.S.; if appropriate and supported by Mexico, implement translocations.* ----- Asesorar la factibilidad, riesgos, y idoneidad de translocación de cotorras hacia hábitat histórico y potencial en los EEUU ; si apropiado y apoyado por México, implementar las translocaciones.*	1	1	A,C, D,E	5	USFWS, AGFD, NMDGF, NAT, PRONATURA, SDZSP, AZA, CONANP, SEMARNAT, CITES	Yes	10	-	10	-	-	-	-	-	Potential costs of translocating parrots into or near the U.S are not included. Mexican law (General Wildlife Law Decree 60 Bis 2) currently bans the exportation of all parrot species (Gobierno Federal 2008).
3	16.3	Develop a health assessment protocol for TBPAs to understand and mitigate disease patterns and risks.* ----- Desarrollar un protocolo de asesoría de salud para la cotorra serrana occidental para entender y mitigar patrones y riesgos de enfermedades.*	1	1	C,E	>5	AZA, PRONATURA, SDZSP	Yes	250	50	50	50	50	50	50	50	Estimated costs include developing new disease testing for captive parrots and an ectoparasite protocol.
		Total Cost of Recovery								6,467*						*Annual costs do not add up to Total costs because some tasks continue beyond 2016. These additional costs are included in the Total.	

5.0. LITERATURE CITED

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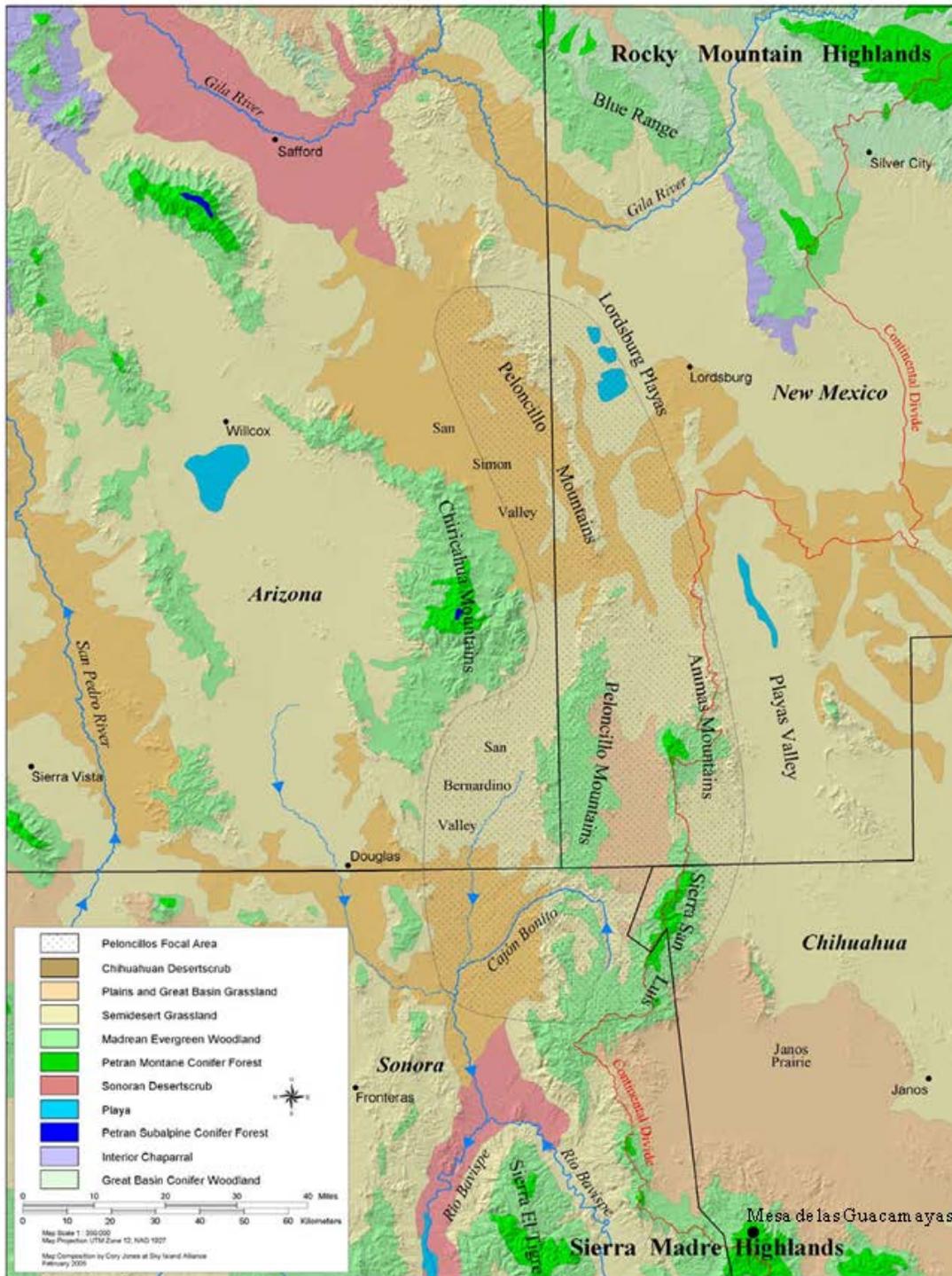
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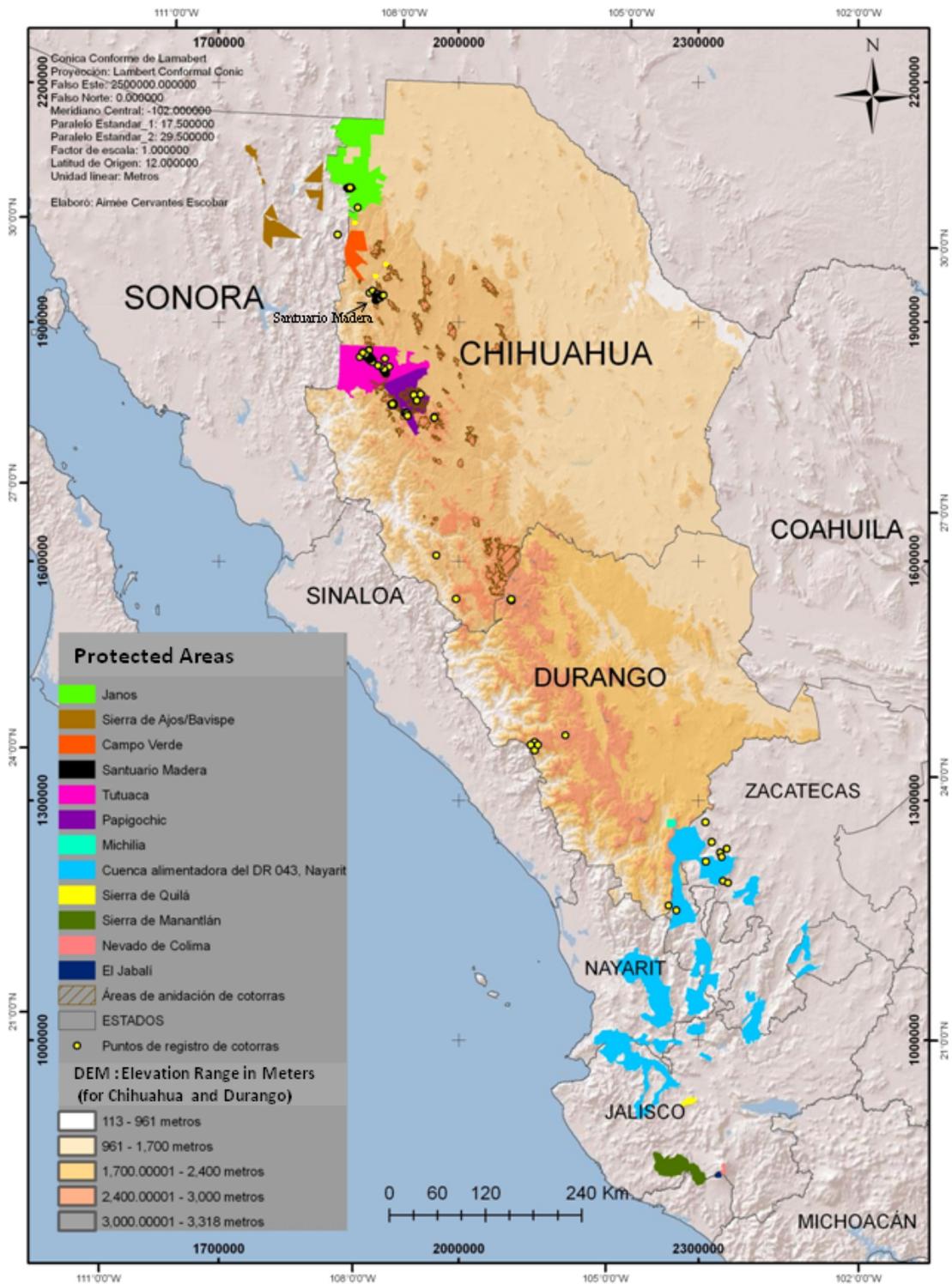
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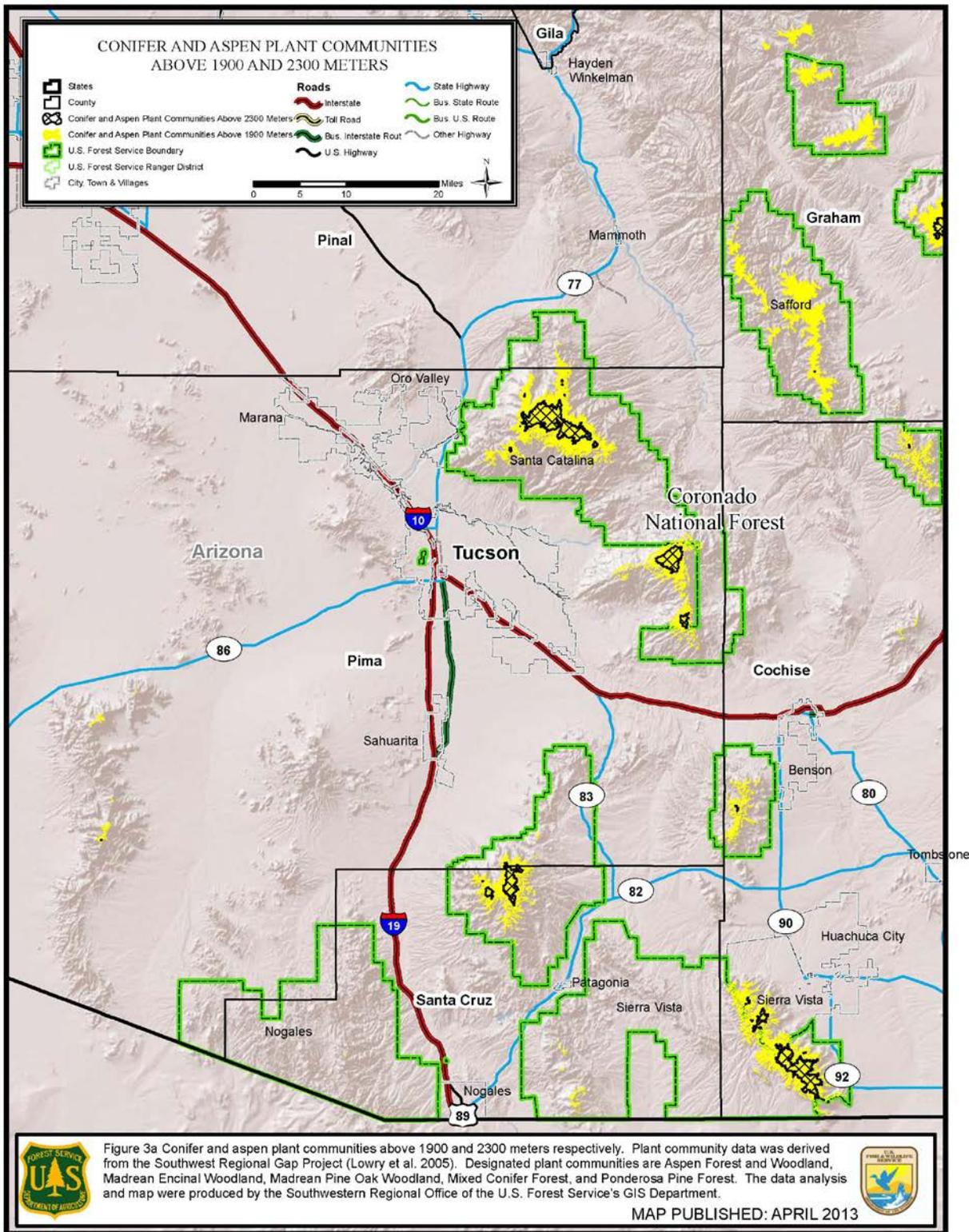
APPENDIX A. Figures Cited in Text



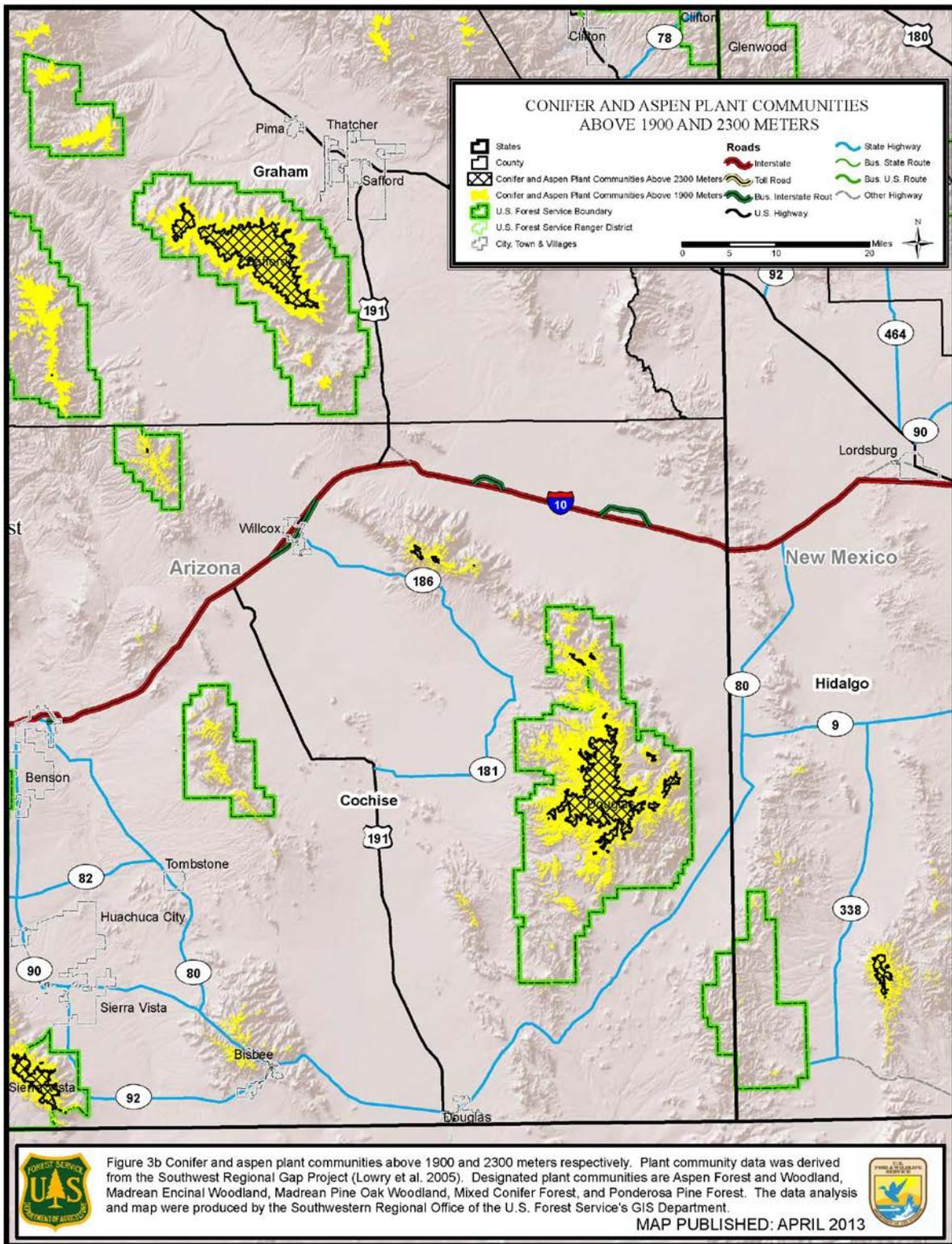
Map 1. Ecological context of portions of the Sky Islands area. Mesa de Las Guacamayas (part of the Janos Biosphere Reserve), the northernmost breeding area of the thick-billed parrot, is shown for reference. Biotic community characterizations are based on Brown and Lowe (1980). Map adopted from Bodner et al. (2005).



Map 2. Protected Areas (PAs) in Mexico with thick-billed parrot occurrence (current, historical, or anecdotal). PAs in southern Durango and further south fall within the winter range. Specific sites with verified (within the last 15 years) thick-billed parrot occurrence are shown with yellow points (although no points are shown falling within the Campo Verde PA proper, nearby points are considered part of its area of influence). Potential breeding areas (identified by hashed polygons) based on MaxEnt modeling work by Cruz-Maldonado (2011). List of PAs derived from CONANP (2009) table 1, with Cerro de Mohinora excluded (polygon not well defined). Map courtesy of Pronatura Noroeste and Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM).



Map 3a. Western half of conifer and aspen plant communities in U.S. above 1900 and 2300 meters, respectively.



Map 3b: Eastern half of conifer and aspen plant communities in the U.S. above 1900 and 2300 meters, respectively.

**APPENDIX B. Thick-billed Parrot Program of Action for the Conservation of the Species:
(*Rynchopsitta* spp.). English translation.**

ENDANGERED SPECIES RECOVERY PLAN

**Maroon-fronted and Thick-billed Parrot
(*Rynchopsitta terrisi* and *R. pachyrhyncha*)**

TABLE OF CONTENTS

TABLE OF CONTENTS

I. INTRODUCTION.....	73
II. BACKGROUND.....	75
III. BIOLOGY, ECOLOGY, AND THREATS.....	78
Species Description.....	78
Distribution.....	78
Thick-billed Parrot.....	78
Maroon-fronted Parrot.....	81
Migration.....	83
Reproduction.....	83
Food.....	84
Habitat.....	85
Population Dynamics.....	87
Main Threats.....	87
Habitat Destruction.....	87
Illegal Trade.....	89
Breeding Population.....	89
Feeding specialization.....	89
IV. OBJECTIVES.....	91
V. GENERAL GOALS.....	91
VI. GOALS (2012).....	91
VII. CONSERVATION STRATEGIES (SUBPROGRAMS).....	92
1. Protection.....	92
2. Management.....	94
3. Restoration.....	95
4. Research.....	96
5. Outreach and Education.....	98
6. Human and Financial Resources; Partnerships.....	100
VIII. INDICATORS OF SUCCESS.....	102
IX. TABLE OF PLANNED ACTIVITIES.....	104
LITERATURE CITED.....	116
APPENDIX 1.....	119
APPENDIX 2.....	120

I. INTRODUCTION

On February 24, 2007 at El Llano de las Papas in the of State of México, Felipe Calderón-Hinojosa, President of México, presented the strategic plan “Commitment to Conservation” to the Mexican people. This series of programs to control the deterioration of the Mexican ecosystems and biodiversity will be implemented through the Mexican National Commission of Protected Natural Areas (Comisión Nacional de Áreas Protegidas, CONANP). As part of this commitment, the Division of Species of Conservation Priority under CONANP implemented the Endangered Species Conservation Program (PROCER, in 2007). The program’s general objective is to design the framework, and coordinate, promote, and link Federal Government efforts with the various sectors of society to the recovery and conservation of 30 Mexican priority and endangered species.

More than 60 people from various public sectors participated in a comprehensive analysis to select the species to be included in the Federal Endangered Species Conservation Program. Both species of *Rhynchopsitta* were selected as warranting protection as part of the Endangered Species Recovery Plan [Programas de Acción para la Conservación de las Especies PACE].

Since the Maroon-fronted Parrot (*Rhynchopsitta terrisi*) and the Thick-billed Parrot (*R. pachyrhyncha*) share many physical and biological characteristics as well as similar threats and conservation needs, the Technical Consultative Subcommittee for the Protection, Conservation, and Recovery of Psittacids in

Mexico⁴ decided to include both species in a single Recovery Plan.

The Subcommittee was very involved in the preparation of The Endangered Species Recovery Plan for both *Rhynchopsitta* species along with other organizations, institutions, and people interested in the conservation of the species, and federal and state government organizations. Based on previous work by this group, it addressed the critical needs for both parrot species conservation. Concrete actions are scheduled to address these needs using six conservation strategies: 1) Protection, 2) Management, 3) Restoration, 4) Research, 5) Outreach and Education, and 6) Human and Financial Resources and Partnerships. This established a document to guide the management practices for both parrot species and their habitats. The Plan will incorporate the conservation efforts, create institutional and social synergies, optimize financial, material, and personnel resources to maintain these species in the wilds of Mexico far into the future.

⁴ The present document refers to the Technical Consultative Subcommittee for the Protection, Conservation, and Recovery of Psittacids in Mexico as the Psittacids specialist group after the Technical Consulting Committee for the Recovery of Endangered Species in Mexico (which gave legality to the Endangered Species Subcommittees) was repealed in the Diario Oficial de la Federación on March 17, 2009, until a new legal concept is created

Since the Endangered Species Conservation Program is a government program linked to the current Mexican presidential term, the Maroon-fronted and Thick-billed Parrot Endangered Species Recovery Plan presents goals for 2012, and requires that scheduled activities be synchronized with the biological factors necessary for the conservation and recovery of the species and their habitats. Likewise the general goals and objectives go beyond the mentioned time periods giving continuity to previous conservation efforts and scheduled actions in the short-, medium-, and long-term. For these purposes, we define short-term as one to two years, medium-term as three to four years, and long-term as more than five years.

The proposed actions by the experts group are necessary and feasible for the conservation of both species. But the challenges to both parrot species and

their habitats are not static and could require the modification of the strategies presented here. The Recovery Plan was planned as a dynamic document using an evaluation process to improve the course and strategies as needed to accomplish the established goals and objectives.

Finally it is worth mentioning that the Maroon-fronted and Thick-billed Parrot Recovery Plan includes actions to involve the local communities in research, protection, management, and conservation. The Plan also promotes the implementation of social programs to help the local residents gain access to financial resources from conservation projects. The intention of this is not only to improve both parrot species conditions but also the quality of life of people living in the area.

II. BACKGROUND

In the temperate forests of northern Mexico, there are two parrot species in the genus *Rhynchopsitta*, the Maroon-fronted Parrot (*R. terrisi*), and the Thick-billed Parrot (*R. pachyrhyncha*), known by the Spanish names guacamaya enana or guaca (Enkerlin et al., 1999). Today, both parrot species are legally protected in Mexico and worldwide.

Both species are listed as Endangered Species in the *Norma Oficial Mexicana NOM-059-SEMARNAT-2001a* (D.O.F., 2002, 2008a). Similarly they are included in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendix I. In the International Union for Conservation of Nature (IUCN) Red List of Threatened Species, the Maroon-fronted Parrot is listed as a Vulnerable Species, while the Thick-billed Parrot is listed as an Endangered Species (IUCN, 2007). It is worth mentioning that recent evaluations of the former species recommended increasing the protection status to Endangered Species, which is in process and waiting for resolution. In addition, the Maroon-fronted Parrot is one of the priority species to be monitored by the Conservation Assessment and Monitoring, Information System (SIMEC) of the Comisión Nacional de Áreas Naturales Protegidas (CONANP-UANL, 2008).

Extensive forests areas used by both species are included in the National Protected Areas System (SINAP) as part of their conservation efforts. Such is the

case of the Áreas de Protección de Flora y Fauna de Tutuaca y Papigochic in Chihuahua, which contains one of the largest breeding populations of the Thick-billed Parrot. Likewise a decree to create a Sanctuary for this species near Madera, Chihuahua, another important breeding area, is currently in process. Other sites have been located in the Región Prioritaria para la Conservación Sierra Tarahumara such as the Cerro Romurachi, close to the Cusarare waterfall in the Municipio de Bocoyna, and the Cerro Mohinora in the Municipio de Guadalupe y Calvo. The latter is the southernmost area in Chihuahua with Thick-billed Parrot (Enrique Correón, pers. comm.). Other protected areas for the species are mentioned later.

Similarly the Cumbres de Monterrey National Park in the Sierra Madre Oriental protects more than 150,000 forest hectares (370,658 acres), including almost half of the breeding colonies known for the Maroon-fronted Parrot. It is worth mentioning that this is an important protected area providing various environmental services to about five million people living in the city of Monterrey and its metropolitan area (CONANP-UANL, 2008). In addition there are other federal protected areas like El Potosí National Park in San Luis Potosí, and El Cielo Biosphere Reserve in Tamaulipas, which partially cover the remaining known breeding colonies and part of the wintering sites.

Finally there are the private protected areas, such as the El Taray Sanctuary in Coahuila. This Sanctuary was created in 1996, specifically to protect the Maroon-fronted Parrot. This is an area with about 350 hectares (864 acres) of conifer forest critical to the species because it includes the largest known breeding colony, and close to 40% of the known breeding pairs (Enkerlin et al. 1998). El Taray is a private reserve managed by the Mexican Bird Museum in Saltillo, Coahuila. The Mexican National Commission for Knowledge and Use of Biodiversity (CONABIO) and donations by domestic and foreign organizations such as the Zoological Society of San Diego and the U.S. Fish and Wildlife Service funded the reserve (Enkerlin et al., 1998). But severe wildfires in February and March of 2006 destroyed 1,685 hectares (4,163 acres) of forest in the region (CONAFOR 2006a, b), including more than 90% of this protected area. It is worth mentioning that today the Sanctuary has a management program (CONANP-Pronatura Noreste, 2008).

In the case of the Thick-billed Parrot different legal protection tools have been used in private properties. They are ejido reserves, ecological easements (voluntary legal agreements to limit the use of private land to protect a specific habitat in exchange for monetary compensation from the organization that obtains the legal rights to the land), and usufructs (the legal right to use and benefit from it without full ownership, as long as the property is not damaged) were created to control logging and other forest uses such as cattle and agricultural activities, hunting, and fishing (CONANP-Pronatura Sur, 2008) to develop activities compatible with the protection of the species. Today, 3,500

hectares (8,648 acres) in the Tutuaca and Conoachi ejidos in Chihuahua are protected as ejido reserves (op. cit.). Although these areas are small, they play important roles in maintaining high levels of local biodiversity (Sánchez-Mateo et al, 2007), making them very valuable ecoregion reserves. In addition, the protected breeding areas for both parrot species are also important ecosystems for other species such as the Eared Quetzal (*Euptilotis neoxenus*, Monterrubio-Rico and Enkerlin, 2004b).

Related to the information available on these parrot species, the first distribution, breeding, and population studies were done in the late 1970's and early 1980's (Lanning and Shiflett 1981, 1983; Lawson and Lanning 1981; Ridgely, 1981). Starting in 1995, the Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM) began various studies of population stability, monitoring, and assessment for both species. These studies have helped to establish a point of reference for the conservation of both parrot species (Enkerlin-Hoeflich et al., 1997, 1998, 1999; Macías-Caballero 1998; Ortiz-Maciel, 2000). In 1999 Enkerlin and collaborators continued their study on the status, distribution, ecology, and conservation of both parrot species. In addition researchers from the Universidad Autónoma de Nuevo León (UANL) worked in 2008 on a project in the Cumbres de Monterrey National Park to characterize the breeding habitat and associated landscape for the Maroon-fronted Parrot (CONANP-UANL, 2008). These studies allowed ITESM and Pronatura to determine population size, trends, and threats with high precision, and began to define conservation strategies for big areas (CONANP-Pronatura Sur, 2008).

Education and outreach have also been included in the conservation of both parrot species and their habitats. In late 2008, Pronatura Noreste, with support of CONANP and within the Endangered Species Conservation Program (PROCER), developed casual and formal environmental education activities on the Maroon-fronted Parrot in seven localities in the Cumbres de Monterrey National Park (PNCM). These localities were Canoas, El Terrero, La Jacinta, La Peñita, San Antonio de la Osamenta, San José de las Boquillas, and Santa Cruz (CONANP-Pronatura Noreste, 2008). It is worth mentioning that in these workshops, Pronatura designed teaching aids such as workbooks, posters, printed banners, and board games.

In addition it was found that land values in the Sierra Madre Oriental are very high. Pronatura Noreste did a survey in the Maroon-fronted Parrot distribution area communities and found that the cost varies from 50,000 to 2 million pesos per hectare. Land values have increased because of the construction of luxurious country houses with potential for tourism activities (CONANP-Pronatura Noreste, 2008).

Within the Mexican legal framework, a recent development is the modification of the General Wildlife Law to prohibit the exploitation of any Mexican native psittacids for food or profit (DOF 2008b). Also, today the Federal Government is protecting at various levels more than 700,000 hectares (1,729,737 acres) of forest in the Sierra Madre Occidental through the Protected Areas System (CONANP-Pronatura Sur, 2008).

Given the conservation status of both parrot species in Mexico, the Technical Consultative Subcommittee for the Protection, Conservation, and Recovery of Psittacids in Mexico developed a project in 2000 on the Conservation, Management and Sustainable Use of Psittacids in Mexico (PREP) where both species of *Rhynchopsitta* were considered priority species for conservation (SEMARNAP-INE 2000). The Psittacids Subcommittee had a Workshop on Selection of Priority Species of Psittacids to be included in the Endangered Species Recovery Plan (PACE) on June 30, 2008, which resulted in the present document.

III. BIOLOGY, ECOLOGY, AND THREATS

Class: Aves

Order: Psittaciformes

Family: Psittacidae

Species: *Rhynchopsitta terrisi*

Spanish common names:

Cotorra serrana Oriental,
guaca, guacamaya enana

Class: Aves

Order: Psittaciformes

Family: Psittacidae

Species: *Rhynchopsitta pachyrhyncha*

Spanish common names:

Cotorra serrana occidental,
guaca, guacamaya enana

Species Description

They are attractively colored like most psittacids. The body is mainly dark green with red or maroon markings on the forehead and the thighs, a superciliary stripe, and a shoulder patch. Their eyes are amber, with yellow eye-rings, and the beak is black (Howell and Webb, 1995). There are a few differences between the species. The Maroon-fronted Parrot (*Rhynchopsitta terrisi*) with maroon-brown forehead markings is between 40 cm (16 in) and 45 cm (18 in) in length (Forshaw 1989). While the Thick-billed Parrot (*Rhynchopsitta pachyrhyncha*) with red forehead is about 38 cm (15 in) in length with yellow feathers underneath the wings (Forshaw 1989). Neither of the species shows sexual dimorphism.

Distribution

Thick-billed Parrot

The Thick-billed Parrot was historically found from the northernmost regions of the Sierra Madre Occidental in Mexico into the United States in the Chiricahua Mountains in southeastern Arizona and the Animas Mountains in southwestern New Mexico until the 20th century (Forshaw 1989). The last official report for the species in the United States was in 1938. Later it was declared extirpated from the country caused by such human pressures such as hunting and habitat destruction (Snyder et al., 1994). Their distribution in Mexico was from northern Chihuahua and Sonora through Michoacán and Jalisco (Forshaw 1989; Howell and Webb, 1995) with the southernmost distribution in Veracruz and the State of Mexico (CONANP-Pronatura Sur, 2008).

In 1995, the species distribution was from northern Chihuahua and Sonora to Michoacán and Jalisco (Howell and Webb, 1995). Today, the breeding range of the Thick-billed Parrot in the Sierra Madre Occidental is from La Mesa de las Guacamayas in Chihuahua south through Camellones in central Durango (CONANP-Pronatura Sur, 2008). In Chihuahua the following breeding areas stand out: Madera, Cebadillas de Yahuirachi, Vallecillo, and San Juanito (Monterrubio-Rico and Enkerlin 2004). Similarly, Monterrubio-Rico and Enkerlin, (2004) reported the current breeding range of the Thick-billed Parrot to be between 30°39'N in Chihuahua and 25°57'N in Durango, and estimated that the nesting areas for this species are concentrated in about 2,112 hectares (5,219 acres). The diurnal movements between the perching and feeding sites of this species can be as much as 40 km (24.9 miles; SEMARNAP-INE, 2000). The Thick-billed Parrot has a larger population than the Maroon-fronted Parrot, but individuals are more

widely dispersed (Enkerlin et al., 1997).

In winter, this species' distribution area is from Sinaloa and the southern part of Durango through Nayarit and Jalisco. In the pine forests of the Colima Volcano in southern Jalisco flocks of more than 100 individual Thick-billed Parrot were observed in January (Schnell et al., 1974). The distribution area of this species drastically declined in the last few decades (Snyder et al. 1999), with an estimate of less than 1% of the original distribution remaining in 1995 (Lammertink et al., 1997). It is worth mentioning that the localities of Mohinora, Vacas, Camellones, and Nevado that were identified as breeding sites in Durango in the 1980's are today highly disturbed without signs of breeding activity. In turn, sites such as Cebadillas de Bisaloachi and Madera with smaller trees than the ones that existed in the previous four localities, but with well-preserved habitats are currently the most important breeding sites for the species (Monterrubio-Rico and Enkerlin, 2004).

Table 1. Protected Natural Areas with Thick-billed Parrot.

Name	Type	Area	Location
Área de Protección de Flora y Fauna Sierra de Ajos Bavispe	Federal	180,048	Sonora
Reserva de la Biosfera de Janos ² (Mesa de Guacamayas)	Federal	19,000	Chihuahua
Área de Protección de Flora y Fauna Campo Verde	Federal	108,067	Chihuahua y Sonora
Santuario Madera ²	Federal	2,800	Chihuahua
Área de Protección de Flora y Fauna Tutuaca	Federal	363,440	Chihuahua y Sonora
Área de Protección de Flora y Fauna Papigochic	Federal	243,639	Chihuahua
Área de Protección de Flora y Fauna Cerro de Mohinora ²	State	9,126	Chihuahua
Reserva de la Biosfera La Michilía ¹	Federal	9,421	Durango
Cuenca Alimentadora del Distrito de Riego 043 Estado de Nayarit ¹	Federal	1,553,438	Aguascalientes, Jalisco, Durango, Nayarit y Zacatecas
Área de Protección de Flora y Fauna Sierra de Quila ¹	Federal	14,168	Jalisco
Reserva de la Biosfera Sierra de Manantlán ¹	Federal	139,577	Jalisco y Colima
Parque Nacional Nevado de Colima ¹	Federal	6,525	Jalisco y Colima
Área de Protección de Flora y Fauna El Jabalí ¹	Federal	5,065	Colima
Parque Nacional Pico de Tancítaro ¹	Federal	23,448	Michoacán
Parque Nacional Barranca del Cupatitzio ¹	Federal	427	Michoacán

¹ Winter distribution

² In process to become officially declared protected area

Maroon-fronted Parrot

The Maroon-fronted Parrot is a Mexican endemic species (Forshaw 1989), with one of the most restricted distribution range for a bird (Enkerlin et al., 1997). The distribution area for this species was estimated in 18,000 km² (6,950 mi²) in the 1970's, although habitat used within the area was thought to be only between 3,500 and 7,000 km² (1,351 and 2,703 mi²; Collar et al., 1992).

Today, the breeding range for the Maroon-fronted Parrot from April to November is limited to a small region in the Sierra Madre Oriental from the Sierra de Zapalinamé, Coahuila (CONACYT, 2006) to the El Cielo Biosphere Reserve in Tamaulipas (Enkerlin et al., 1998; ITESM-Pronatura, 2002) passing through the Cumbres de Monterrey National Park and part of the Municipio de Rayones in Nuevo León. This band is ca. 300 km long and ca. 60 km wide (186 mi long, 37 mi wide, Juniper and Parr 1998).

Recently isolated colonies were reported on the Tamaulipas-San Luis Potosí border, and in the Sierra Gorda Biosphere Reserve in Querétaro. This area is ca. 150 km south of the previous known distribution range cited in the literature (CONANP-Pronatura Noreste, 2008). The Maroon-fronted Parrot movement range is 23.7 km (14 mi) per day within an area of 18,252 hectares (45,101 acres; Ortiz-Maciel, 2000).

Between 40% and 45% of the breeding pairs are concentrated in El Taray, Coahuila (Enkerlin et al., 1998). The El Taray pairs together with other pairs from the Condominios, Santa Cruz, and San Antonio de la Osamenta colonies in the Cumbres de Monterrey National Park represent 80-84% of the breeding pairs for this species. Enkerlin et al (1999) reported 21 breeding colonies of Maroon-fronted Parrot including eight new records after 1994. One to a hundred pairs have been observed in these breeding sites.

In addition, the Universidad Autónoma de Nuevo León (UANL) researchers in the Cumbres de Monterrey National Park (PNCM) found that the biggest concentrations of birds are on the highest peaks (CONANP-UANL, 2008). The Condominios cliff within the PNCM is the best-protected Maroon-fronted Parrot site (Enkerlin et al., 1999).

The winter (December to March) range of this species is mainly in southeastern Nuevo León and southwestern Tamaulipas with

occasional sightings, including 100 individuals in the Sierra Gorda, Querétaro (Pedraza, 1998 *in* Enkerlin et al., 1999). Breeding sites have been reported from El Tarillal, La Tosca, and Aguajito in the Municipio de Arteaga, Coahuila, and La Huasteca in the Municipio de Santa Catarina, and Puerto La Manteca in the Municipio de Santiago, Nuevo León (González-Iglesias et al., no year).

Table 2. Protected Natural Areas with Maroon-fronted Parrot.

Name	Type	Area	Location
Monumento Natural Cerro de la Silla	Federal	6,039	Nuevo León
Parque Nacional Cumbres de Monterrey	Federal	177,396	Nuevo León
Reserva de la Biosfera El Cielo	Estatal	144,530	Tamaulipas
Santuario El Taray	Privada	350	Coahuila
Área de Protección de Flora y Fauna Sierra de Álvarez	Federal	16,900	San Luis Potosí
Parque Nacional El Potosí	Federal	2,000	San Luis Potosí
Reserva de la Biosfera Sierra Gorda de Guanajuato	Federal	236,882	Guanajuato
Reserva de la Biosfera Sierra Gorda	Federal	383,567	Querétaro
Sierra de Arteaga*	Federal		Coahuila

Migration

The season when the parrots form large migratory flocks starts in late October and early November. The Thick-billed Parrot has been reported from the mountains of Jalisco and Colima from January and February, but no records between May and October, indicating that this species has latitudinal migratory movements (Forshaw, 1989). Although the exact number of wintering sites in the Sierra Madre Occidental today is unknown, it is thought that during this season they do not stay in a single site but move constantly looking for forest areas with good food resources (op. cit.). In contrast, it is considered that the Maroon-fronted Parrot has altitudinal migratory movements (Forshaw 1989), but precise information is not available.

Reproduction

Both species of *Rhynchopsitta* have a tendency to nest in the same places each year (Lanning and Shiflett 1983, Macías-Caballero 1999), Monterrubio-Rico et al., 2006). In the case of Maroon-fronted Parrot, the pairs nest in crevices in high limestone cliffs (Lawson and Lanning 1981, Macías-Caballero 1999). In contrast, the Thick-billed Parrot mainly nests in tree cavities in dead standing trees (Lanning and Shiflett 1983, Monterrubio-Rico and Enkerlin-Hoeflich 2004a, Monterrubio-Rico et al. 2006) in *Pseudotsuga*, and in the Madera Sanctuary especially in *Populus*. Both species nest in colonies once a year from July to November (Macías-Caballero, 1999). Their fall breeding period coincides with the peaks in pine seed production, their main food.

Both parrot species breed in nesting colonies and have an average of two chicks per nest (Macías-Caballero 1999, Monterrubio-Rico et al., 2002), although in bad years their reproduction can decrease drastically. A pair of Thick-billed Parrot on average laid 2.7 eggs per nest, producing an average of 1.6 young parrots per nest (Monterrubio-Rico and Enkerlin, 2004). The chicks are raised when the pine seeds are mature from late summer through fall (Juniper and Parr, 1998). Maroon-fronted Parrot in the Cumbres de Monterrey National Park averaged 1.09, 1.31, 1.9, 1.8, and 1.3 chicks per nest in 2003, 2004, 2005, 2006, and 2007 respectively (CONANP 2006, Ortiz-Maciel and Valdez-Peña 2007). Similarly, Valdez-Juárez (2006) recorded that 86% of the nests in a colony in the same park produced at least one chick. Crevices in poor or wet conditions have reduced productivity because chicks died of cold (CONANP-Pronatura Sur, 2008) or drowned.

Parrot breeding pairs rest in nesting cavities during their breeding season. In well-protected areas, nest concentration is higher than disturbed areas (Monterrubio-Rico

and Enkerlin, 2004). In Maroon-fronted Parrot, Enkerlin et al., (1998) documented San Antonio de la Osamenta, El Taray, Condominios, and Santa Cruz as the most important breeding sites for the species. Both parrot species are gregarious and are usually found in flocks, sometimes of more than 100 pairs.

Food

Rynchopsitta are considered “specialist” species with restricted diets. They eat mainly seeds from various pines such as *Pinus arizonica*, *P. greggii*, *P. teocote*, *P. montezumae*, and *P. cembroides* (Lawson and Lanning 1981, Forshaw 1989) *P. durangensis*, *P. engelmannii* (Perry 1991, Cruz-Nieto 1998, Snyder et al., 1999), and *P. strobiformis* (pers. comm.). Occasionally they also eat fir (*Abies* spp.) seeds, acorns (*Quercus* spp.), conifers shoots, and occasionally agave flower nectar (Forshaw, 1989). Pine and oak seed production varies by region and the parrots disperse to high production areas, resulting in a considerable variability in their geographic distribution (Lawson and Lanning 1981).

Enkerlin et al. (1998) observed that Maroon-fronted Parrots eat earth (geophagia) from clay banks such as the ones in El Taray. These authors found two clay banks where the birds arrived every day to eat earth, one just at the base of Santa Cruz Canyon and the other in the southern limit of their breeding range near the town of Santa Rosa.

Habitat

Both parrot species live in forests with *Pinus*, *Abies*, *Pseudotsuga* and *Quercus* with various geomorphic settings at elevations between 2000 and 3000 meters (6561 and 9842 ft). There are also exceptional records between 1300 and 3700 meters (4265 and 12,139 ft; Forshaw 1989). They also have been reported in habitats with trees such as *Arbutus*, *Fraxinus*, *Juniperus*, *Populus*, *Prunus*, and *Pseudotsuga* (Monterrubio-Rico and Enkerlin, 2004). The Maroon-fronted Parrot appears to be very habitat selective, restricted to the conifer forests; it has never been recorded in scrub, grassland, agricultural areas, orchards, or bare areas (Ortiz-Maciel, 2000). Optimal habitat conditions for Thick-billed Parrot with cavities for breeding are found in old-growth forests,⁵ where the presence of damaged or dead trees is higher than in younger forests (Enkerlin et al., 1998).

In the Cumbres de Monterrey National Park, Maroon-fronted Parrots nest in the tallest (ca. 20 m or 65 ft) pine and oak forests (CONANP-UANL, 2008)

which are most likely to yield good seed crops. In this area, parrots are associated with plants of the genus *Abies*, *Ageratina*, *Baccharis*, *Dalea*, *Decatropis*, *Dodonaea*, *Fraxinus*, *Galactia*, *Garrya*, *Hechtia*, *Helietta*, *Mortonia*, *Pinus*, *Prunus*, *Quercus*, *Taxus*, *Tecoma*, etc. (op. cit.).

⁵ The established average age for trees in mature forests is 326 years (CONANP-Pronatura Sur, 2008).

It is worth mentioning, especially for the Cumbres de Monterrey National Park, that Oyamel Fir (*Abies religiosa*) forests, pine forests, and oak woodlands dominate the sites with the best habitat. The same is true in the Municipio de Arteaga, Coahuila, and La Huasteca in Santa Catarina, and Puerto La Manteca in Santiago, Nuevo León (CONANP-UANL, 2008). Thick-billed Parrots share the habitat with species such as the Black Bear (*Ursus americanus*), Jaguar (*Panthera onca*), Mountain Lion (*Felis concolor*), Golden Eagle (*Aquila chrysaetos*), Solitary Eagle (*Harpyhaliaetus solitarius*), Wild Turkey (*Meleagris gallopavo*; CONANP-Pronatura Sur, 2008), White-Tailed Deer (*Odocoileus virginianus*), Coati (*Nasua narica*), Red-Tailed Hawk (*Buteo jamaicensis*; Sánchez-Mateo et al., 2007) among others, whose populations have decreased by different causes related to habitat

destruction. The Maroon-fronted Parrot shares habitat with species facing similar challenges such as the Northern Goshawk (*Accipiter gentiles*), Red-Tailed Hawk (*Buteo jamaicensis*), Peregrine Falcon (*Falco peregrinus*), Coati (*Nasua narica*; Enkerlin et al., 1997), the Black Bear (*Ursus americanus*), Collared Peccary (*Pecari tajacu*), Ocelot (*Leopardus pardalis*), Jaguar (*Panthera onca*), Raccoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), and many more.

Temperatures were recorded by UANL researchers (CONANP-UANL, 2008) in the Maroon-fronted Parrot nesting sites or “walls” in the Cumbres de Monterrey National Park. Mean annual temperatures were 18 to 20 °C (64 to 68 °F) at Banco de Abajo, Canoas, and El Pajonal, and 16 to 18 °C (61 to 64 °F) at Condominios, El Hondable, and San Antonio de la Osamenta.

These authors suggested that the species nest within 23.7 km (14.7 mi) of water sources (rivers), equal to or less than the average daily traveling distance reported by Ortiz-Maciel (2000).

Population Dynamics

The population of Thick-billed Parrot was estimated to be no more than 5,000 individuals in 1992 (Enkerlin, 2000 in BirdLife International, 2007). In contrast, Lammertink et al., (1995, in BirdLife International, 2007) estimated between 1000 to 4,000 birds. In three breeding sites (Madera, Mesa de las Guacamayas, and Tutuaca) Pronatura Sur personnel counted close to 3,500 individuals in 2008 (CONANP – Pronatura Sur, 2008). The species experts reach the conclusion that the numbers of individuals in the populations have decreased drastically the last century, mainly due to timber harvest (Collar et al., 1992).

For the Maroon-fronted Parrot, Lawson and Lanning (1981) estimated a population size between 2,000 to 3,000 individuals. Enkerlin et al., in 1997 showed that in El Taray were close to 100 pairs of these birds, representing nearly a quarter of the total known pairs

at that time, and the breeding center for the species. The second biggest colony was found in Los Condominios, ca. 16 km (9 mi) from El Taray, hosting close to 60 pairs (Enkerlin et al., 1997). Two years later the bird counts in nesting sites estimated a minimum population of 2,500 birds, possibly as high as 3,000 individuals (Enkerlin et al., 1998, 1999). In addition Valdés-Peña and collaborators in 1998 estimated a population size of about 3,500 individuals after watching large flocks in their wintering range.

Main Threats

Habitat Destruction

Habitat modification or destruction is the main issue affecting the decrease of Thick-billed Parrot (CONANP – Pronatura Sur, 2008) and Maroon-fronted Parrot (Enkerlin et al., 1998). In the case of the Thick-billed Parrot in the Sierra Madre Occidental it is estimated that only 1% of the old-growth forests with the old trees critical for nesting and feeding are left today.

The Maroon-fronted Parrot nesting activities are not affected by this problem since they use crevices on the cliffs, although wildfires (CONANP – Pronatura Sur, 2008) and land use changes in the forest, usually for agriculture and cattle raising (Ridgely, 1981 cited by Enkerlin et al., 1998 and 1999) and logging for timber production and the cellulose industry, have affected their feeding areas. Most of the areas cleared in the Sierra Madre Oriental were to plant orchards, mainly apples, even though the potential to expand them is limited (Enkerlin et al., 1997).

Wildfires are part of the natural dynamics and succession in forests. However, catastrophic wildfires result in the loss of nesting sites and feeding resources for both parrot species. Wildfires in 2006 destroyed nearly 2,000 hectares (4,942 acres) of pine forest in the Sierra Madre Oriental, which supply feeding resources for the Maroon-fronted Parrot, directly impacting on the nesting success of the species. Unlike pine forests in other regions, the forests in the Maroon-fronted Parrot area have very poor regeneration after wildfire. This is probably caused by very thin rocky soils and relatively scant rains in the region (Enkerlin et al., 1997). Similarly, wildfires in the Sierra Madre Occidental have devastated forest habitats crucial to the Thick-billed Parrot, destroying 3,947 hectares (9,753 acres) from 2004 to 2008 (CONANP-Pronatura Sur, 2008).

In addition forestry practices with logging of pines over 40 cm DBH (Diameter Breast Height) including clear cutting and the removal of standing dead trees, reduce nesting site availability for the Thick-billed Parrot. Large areas of old-growth forest are not found today in the Sierra Madre Occidental (Monterrubio-Rico and Enkerlin-Hoeflich, 2004a, Monterrubio-Rico et al., 2006). In addition when the average ages of trees and conifer forests decrease, seed production reduces by natural stochastic effects and the frequency of sterile cones increases, with considerable effects on the birds that feed on them (Benkman, 1993; Enkerlin et al., 2004; Monterrubio-Rico and Enkerlin-Hoeflich 2004b). In the Sierra Madre Occidental, some areas have been converted by timber harvest to homogeneous young forests with ages of 120 years or less. For successful nesting the Thick-billed Parrot needs forests with average ages of 326 years for *Pinus strobiformis* (= *P. ayacahuite*) and *Pinus durangensis* (CONANP – Pronatura Sur, 2008). A ban implemented by the Environment, Natural Resources, and Fisheries Ministry (SEMARNAP-Secretaría de Medio Ambiente, Recursos Naturales y Pesca) on harvesting trees such as *Pinus strobiformis*, *Abies concolor*, *Pseudotsuga menziesii*, and *Populus tremuloides* has helped to maintain these species in their historical ranges and in disturbed breeding sites.

Illegal Trade

The demand for both parrot species as pets has caused additional population stresses. It is estimated that from 1984 to 1994 more than a thousand Thick-billed Parrots were captured as adults or chicks poached from nests and illegally smuggled into the United States for the pet market (Snyder et al., 1994; SEMARNAP-INE, 2000). This species is frequently found in the pet market in Mexico, even though their exploitation is prohibited (CONANP –Pronatura Sur, 2008). Especially disturbing are reports of cutting down trees in mature forests to access the nests; e.g., in San Juanito in the Sierra Madre Occidental (CONANP – Pronatura Sur, 2008)

Breeding Population

Data on breeding success by Enkerlin and collaborators (1998) showed that in the genus *Rhynchopsitta*, the percentages of birds trying to nest and producing eggs is low. The cause of failure in the breeding process varies from low food availability to immaturity of the breeding pairs. For the Maroon-fronted Parrot, it is estimated that less than 25% of the active pairs in the population try to breed. A similar situation occurs with the Thick-billed Parrot where a small fraction of the birds in the flocks in the breeding areas try to nest.

It is worth mentioning that both parrot species, like the macaws on the genus *Ara* (Munn 1991) to which *Rhynchopsitta* is closely related, show a low percentage of breeding pairs (Enkerlin et al., 1998).

Other problems for this species are the low rate of recruitment and small population sizes (SEMARNAP-INE, 2000). Dying or poached birds are not easily replaced, further increasing the difficulty of replenishing small populations. Small populations are vulnerable to catastrophic events such as wildfires that could suddenly kill the entire group.

Feeding specialization

Wildfires and pine forest logging limit food supplies, resulting in serious impacts on both parrot species because of their strong food specialization. Therefore, their distributions restricted to food areas, especially for the Thick-billed Parrot, are also risks factor to add to the challenges faced by these birds. It is worth mentioning that both parrots can be considered indicator species of the quality of their ecosystems because both species are dependent on mature trees for food, and the Thick-billed Parrot for nesting sites (Enkerlin et al., 1997).

IV. OBJECTIVES

General:

Recovery and protection of the wild populations of the two parrot species (*Rhynchopsitta terrisi* and *R. pachyrhyncha*) and their habitat.

Specific:

Control, stop, and revert the process of habitat loss of both parrot species.

Reach viable population sizes to ensure their long-term survival in the wild.

Promote the protection of wild populations of *Rhynchopsitta* spp. and their habitats through the vigilance of community groups close to breeding and wintering sites.

Generate information on the biology and ecology of both parrot species that results in the protection, management, recovery, and conservation of the species and their habitats.

Encourage the active participation of the various sectors of Mexican society in protection, management, recovery, and conservation of *Rhynchopsitta* spp. and their habitats through education and activities such as workshops, field work, cultural events, etc.

V. GENERAL GOALS

Generate technical and scientific information about the current state of both parrot species populations and plan and apply actions for their protection and recovery.

Restore, protect, and conserve areas considered both parrot species habitat.

Have long-term viable populations of both the Thick-billed and Maroon-fronted Parrot.

Establish effective and lasting protection actions for both parrot species and their habitat.

Increase the involvement of the various sectors of society in the implementation of the actions in the Recovery Plan.

Establish a continuous operating budget to develop the different activities needed to accomplish the actions of the Recovery Plan.

VI. GOALS (2012)

To get new Natural Protected Areas dedicated as Sanctuaries for the protection of both parrot species.

In collaboration with the Mexican Environmental Protection Agency (PROFEPA) establish vigilance committees in communities located in both parrot species sighting areas.

With PROFEPA reduce poaching and illegal trade of *Rhynchopsitta* spp. –alive, dead, and related products.

Establish conservation actions jointly with organizations of the three levels of government, academic institutions, and other sectors of society.

Conduct a national diagnostic study of potential habitats to be restored to reintroduce both parrot species, including priorities and management guidelines.

Sign agreements with institutions responsible to carry out urgent actions in both parrot species critical conservation areas.

Produce educational and outreach materials on the species, including a Web Page with current information on the Recovery Plan projects.

VII. CONSERVATION STRATEGIES (SUBPROGRAMS)

1. Protection

1.1 Habitat Protection Elements

OBJECTIVES

General:

Strengthen or implement efficient new mechanisms to protect both parrot species habitats.

Specific:

Strengthen or implement protection measures in both parrot species nesting and dispersal sites.

Establish new areas with potential to be used for protection of both parrot species and their habitats.

ACTIVITIES

Do all the steps necessary to get the areas of El Taray (Coahuila), Los Condominios (Nuevo León), Madera and Las Pomas (Chihuahua) decreed as Federal Sanctuaries

Do a Technical Justification Study for El Taray's decree as a Federal Sanctuary.

Designation of critical habitat for both parrot species to enable forest planning use through Forest Management Units to protect trees for nesting and feeding.

Protection of land, including signing legal agreements, fencing properties, fire barriers, and signs.

Strengthen protection in private reserves through the implementation of ecological easements, conservation certifications, and other programs.

Locate and control access to both parrot species primary nesting and perching areas.

Put up signs with information and restrictions in both parrot species primary nesting areas.

Promote sound land use planning and its application in areas where both parrot species are present.

Establish Integrated Forest Fire Management in collaboration with the Mexican National Forestry Commission (CONAFOR).

1.2 Legal Framework Elements

OBJECTIVE

Promote the application of laws to protect both parrot species among the different government entities and the people.

ACTIVITIES

Disperse current national and international legislation on the protection of both parrot species to all interested parties.

Promote evaluation methods to the legal framework related to the protection and management of both parrot species, and suggest modifications when needed.

Establish legal prevention and mitigation measures to control development or land-use changes in both parrot species distribution areas.

Share species technical information to help government officials in decision-making.

1.3 Vigilance and Inspection Elements

OBJECTIVE

To prevent and detect illegal activities such as poaching, trade, and other uses of both parrot species and illegal modification of their habitat.

ACTIVITIES

Ask PROFEPA to have inspection and vigilance personnel in critical habitat areas for both parrot species.

Promote local vigilance committees to improve control of habitat destruction and illegal trade in both parrot species.

Ask the general public to denounce capture and illegal trade of these birds and disturbance of their habitats.

Reinforce inspection and vigilance activities jointly with the state and municipal governments.

2. Management

2.1. Habitat Management Elements

OBJECTIVES

General:

Develop and implement actions and activities to protect the habitat necessary to maintain viable populations of both parrot species in their distribution areas.

Specific:

Secure the permanence of mature trees important in the forest structure and with nesting and feeding characteristics for both parrot species.

ACTIVITIES

Locate good habitat currently used or potentially used for nesting and feeding of both parrot species.

Ask SEMARNAT to exclude current and potential habitat for both parrot species from forestry resources, including forest trees used by the birds for nesting and feeding.

Promote protection of both parrot species among private landowners in their habitat areas.

Promote different ways to protect land in both parrot species habitat to regulate land use, e.g. ejido reserves, ecological easements, and usufructs.

Encourage watershed management to get financial resources through habitat conservation and payments for environmental services.

With the Ministry of SAGARPA (Rural Development) promote environmental friendly projects among the communities located in both parrot species distribution area.

Promote payment for environmental services to landowners involved in management and conservation of both parrot species populations.

2.2 Species Management Elements

OBJECTIVE

Develop monitoring and management guidelines that promote population increases of the species.

ACTIVITIES

Build, install, and monitor at least 40 artificial nests in each Thick-billed Parrot nesting site.

Develop guidelines to deal with confiscated parrot species.

Prepare handbooks for management, rehabilitation, and reintroduction of captive parrot species.

Evaluate the impact of ecotourism on both parrot species in protected areas.

3. Restoration

3.1 Habitat and Ecosystem Restoration Elements

OBJECTIVE

Restore suitable habitats in the historical distribution of both parrot species that have been disturbed or eliminated.

ACTIVITIES

Locate disturbed areas in need of urgent restoration for the protection of both parrot species.

Establish programs to restore and protect soils and forest such as building gabions, retention berms, growing crops, reforestation, fluvial terraces, brush piles, removal of dead wood (fuel material), living fences, and resting the land to decrease the loss of habitat in critical habitat for both parrot species.

3.2 Mitigation and Prevention of Impacts

OBJECTIVE

Prevent damage and habitat loss caused by anthropogenic activities such as fires, erosion, and deforestation in both parrot species areas.

ACTIVITIES

Mapping potential wildfires in important nesting areas of both parrot species.

Prevent wildfires in both parrot species habitat areas through firebreaks, controlled burns, and community vigilance.

Implement reforestation programs in both parrot species habitats, especially forested areas presently used by these birds.

Monitor the effect of the main threats to both parrot species populations and habitats and evaluate their impacts on population trends.

4. Research

4.1 Critical Areas Elements

OBJECTIVE

Generate information on the current distribution of both parrot species and areas critical to their biological cycle.

ACTIVITIES

Compile historical and current distribution information for both parrot species.

Through point-occurrence data, inferential algorithms, and interviews with local residents determine critical areas (nesting, feeding, migration) for both species.

Verify in the field the presence of the species and suitable habitat.

Estimate both parrot species populations in critical areas.

Estimate habitat available for both parrot species in critical areas.

Promote joint actions in municipal and state land use planning processes to prevent land use changes in both parrot species protected areas.

4.2 Scientific Research Elements

OBJECTIVE

Promote research to increase the knowledge of both parrot species and their habitats to generate effective protection, management, and recovery actions to achieve the objectives of the Recovery Plan.

ACTIVITIES

Use telemetry with satellite transmitters to follow the migrations of adult and juvenile birds.

Implement field studies to count nesting sites available.

Determine pine cone production available to both parrot species in their reproductive areas.

Develop a study for a suitable design for artificial nests for the Thick-billed Parrot.

For both species develop physical, biological, and adaptation studies to understand their requirements with the goal of reintroduction.

Study current health problems in the wild populations of both parrot species.

Implement population genetic studies to evaluate genetic variability and learn about population trends for both species.

Evaluate both parrot species habitat composition and quality using tools like the HEP (Habitat Evaluation Procedures) and HQI (Habitat Quality Index) models to locate potential areas for the species reintroduction.

Study parrots ecological requirements to implement effective conservation strategies and map forest elements useful to the species such as nesting and shelter sites, water sources, food, perches, and mineral banks.

4.3 Biological Monitoring Elements

OBJECTIVE

Learn about parrot population trends and fluctuations through habitat monitoring for both species.

ACTIVITIES

Implement or continue existing monitoring studies of both parrot species reproductive populations.

Implement monitoring studies to estimate population size of both parrot species.

Develop a Geographical Information System (GIS) to determine coverage of habitat used, vegetation types, ecological features, wildfire impacts, land use changes, and trends for both parrot species.

Monitor habitat changes such as regeneration or deterioration, and habitat restoration in nesting sites for both species.

Evaluate winter habitat for both species to learn about other threats to the populations.

5. Outreach and Education

5.1 Environmental Education Elements

OBJECTIVES

General:

Promote a culture of conservation of both parrot species and their habitat through the spread of information to the general public.

Specific:

Include the participation of all sectors of society in both parrot species conservation activities

ACTIVITIES

Prepare environmental education curricula for the school programs in the local communities especially close to the species nesting sites.

Prepare printed materials and audiovisual presentations to educate about biology, ecology, protection status, threats, and conservation actions for the recovery of both parrot species.

Prepare an information handbook on both parrot species for environmental education teachers.

Organize community-training workshops for school teachers, environmental education staff, and people interested in educating citizens in the communities near nesting areas to encourage conservation of these species and their forests.

Promote outreach and awareness activities like workshops, field trips, field activities, contests, habitat improvement, and public meetings in the communities close to the species habitat.

5.2 Public Communication Elements

OBJECTIVE

Implement advertising campaigns that allow the public to understand the situations of both parrot species and other psittacids, as well the conservation actions necessary to protect them.

ACTIVITIES

Design and distribute posters, fliers, comic strips, games, printed banners, and activity books to educate the public on the importance of both species and their habitats.

Sign agreements with the regional radio stations to broadcast informational segments.

Prepare and give out information videos on both parrot species and their habitats.

Through printed materials inform the public on the actions taken to protect both parrot species and conservation achievements.

Disperse information on habitats and threats to the species in the communities close to their distribution areas to get them involved in their conservation.

Emphasize the participation of the general public in the activities of protection, conservation, and recovery of both parrot species and their habitats.

5.3 Community Involvement Elements

OBJECTIVE

Through personnel training and education manage the collaboration of communities, associations, institutions, and other stakeholders in the protection of both parrot species populations and their habitats.

ACTIVITIES

Encourage activities with low environmental impact among the communities in the distribution areas of both parrot species.

In both parrot species sites, plan community ecotourism projects jointly with tourism companies to limit access through fees, and to provide lodging and local guides.

Train local guides to develop ecotourism projects harmless to both parrot species and to assist in monitoring populations.

Train cabin owners, guides, etc. living in communities close to critical areas to work on 'nature appreciation' jointly with the Office of Tourism.

Include indigenous groups in both parrot species areas in the planning and implementation of ecotourism projects.

Encourage student participation through thesis and other projects with these species.

Train CONANP personnel to survey both parrot species, count individuals and assess nest success in Natural Protected Areas.

6. Human and Financial Resources; Partnerships

6.1 Stakeholders Elements

OBJECTIVES

General:

Establish the best organizational, administrative, law enforcement, and financial structure to achieve the Recovery Plan objectives.

Specific:

Identify the various groups working on research, management, protection, conservation, and recovery of both parrot species.

Management of the financial, material, and logistic resources necessary to implement the Recovery Plan.

ACTIVITIES

Determine Recovery Plan operation funding needs.

Acquisition of funds for the Recovery Plan from the government, private sector, and general public through agreements, contracts, and technical support, money, and in-kind donations.

Create a directory of people and organizations involved in the protection of both parrot species to know what is being done and where.

Coordinate activities in the Recovery Plan with the Technical Consultative Subcommittee for the Protection, Conservation, and Recovery of Psittacids in Mexico.

Increase municipal and state government participation in the development of the Recovery Plan.

6.2 Schedule Elements

OBJECTIVE

Establish a time chart for the activities and projects to accomplish in the Recovery Plan.

ACTIVITIES

Determine and prioritize activities in the Recovery Plan.

Develop schedules for short-, medium-, and long-term activities for the Recovery Plan.

Establish the steps necessary to achieve the goals and objectives in the Recovery Plan and prioritize the activities in each step.

Look for opportunities to have simultaneous activities to use resources more efficiently and generate synergy among the different conservation efforts.

Name people and organizations responsible to develop each activity related to the Recovery Plan.

6.3 Evaluation and Follow up Elements

OBJECTIVE

Accomplish the goals and objectives of the Recovery Plan on the scheduled times through the set up and analysis of success indicators.

ACTIVITIES

Schedule meetings to evaluate short-, medium-, and long-term achievements in the Recovery Plan.

Evaluate achieved results, goals, and objectives through the indicators of success identified in the Recovery Plan. Suggest adjustments and modifications to the Recovery Plan according to the evaluations to improve results.

Share the results of the Recovery Plan with everyone involved and the general public.

VIII. INDICATORS OF SUCCESS

Conservation Strategy	No.	Indicators of Success	Short-Term	Medium-Term	Long-Term
	1	Decreased illegal logging in Thick-billed Parrot nesting areas.		✓✓	
Protection	2	Increased number of people and concerned groups involved in vigilance and conservation programs for both species and their habitats.	✓✓✓		
	3	Increased area of protected key habitats for the conservation of both parrot species.	✓✓✓		
Management	4	Increased number of both parrot species nesting sites in Mexico.		✓✓	
	5	Increased number of individuals in both parrot species wild populations in Mexico.		✓✓	
	6	Increased number of projects with alternative uses for natural resources in both parrot species habitat.	✓✓✓		
	7	Increased number of hectares, either restored or in the restoration process, considered to be crucial habitats for the protection of both parrot species.	✓✓✓		
Restoration	8	Number of prevention and mitigation projects in critical habitat to the recovery of both parrot species.	✓✓✓		

Conservation Strategy	No.	Indicators of Success	Short-Term	Medium-Term	Long-Term
Research	9	Number of scientific projects developed according to the Recovery Plan guidelines.	✓	✓	✓
Outreach and Education	10	Increased awareness of both parrot species information through printed and electronic media.	✓	✓	✓
	11	Increased number of training, outreach and environmental education workshops.	✓	✓	✓
Human and Financial Resources; Partnerships	12	Increased financial and human resources for both parrot species protection programs and actions.	✓	✓	✓
	13	Number of actions taken to protect both parrot species jointly with individuals, associations, institutions, and other stakeholders.	✓	✓	✓
	14	Increased number of visitors assisted.	✓	✓	
	15	Number of policy and framework proposals to protect both parrot species habitat.	✓	✓	
	16	Number of goals reached through the implementation of the actions described in the Recovery Plan.	✓	✓	
	17	Number of objectives achieved in the Recovery Plan.			✓

IX. TABLE OF PLANNED ACTIVITIES

On this table we define Short-Term as one to two years, Medium-Term three to four years, and Long-Term as more than five years.

Activity	Indicators of Success	Short-Term	Medium-Term	Long-Term
1.1 Habitat Protection Elements				
Do all the steps necessary to get the areas of El Taray (Coahuila), Los Condominios (Nuevo León), Madera y Las Pomas (Chihuahua) decreed as Federal Sanctuaries	3,7,13,15			✓✓
Do a Technical Justification Study for El Taray's decree as a Federal Sanctuary	3, 13, 15			✓✓
Designation of critical habitat for both parrot species to enable forest planning use through Forest Management Units to protect trees for nesting and feeding.	1,9,6,15			✓✓
Protection of land, including signing legal agreements, fencing properties, fire barriers, and signs.	3,8,13			✓✓
Strengthen protection in private reserves through the implementation of ecological easements, conservation certifications, and other programs.	13, 12			✓✓✓
Locate and control access to both parrot species primary nesting and perching areas.	8, 13			✓✓
Put up signs with information and restrictions in both parrot species primary nesting areas.	10			✓✓

Activity	Indicators of Success	Short-Term	Medium-Term	Long-Term
Promote sound land use planning and its application in areas where both parrot species are present.	13,15,16			✓✓
Establish Integrated Forest Fire Management in collaboration with CONAFOR.	8,13		✓✓✓	
1.2 Legal Elements				
Disperse current national and international legislation on the protection of both parrot species to all stakeholders.	10, 11		✓✓✓	
Promote evaluation methods to the legal framework related to the protection and management of both parrot species, and suggest modifications when needed.	13, 15			✓✓
Establish legal prevention and mitigation measures to control development or land-use changes in the both parrot species distribution areas.	7, 15			✓✓
Share species technical information to help government officials in decision-making.	13, 15			✓✓✓

Activity	Indicators of Success	Short-Term	Medium-Term	Long-Term
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1.3 Vigilance and Inspection Elements

Ask PROFEPA to have inspection and vigilance personnel in critical habitat areas for both parrot species.	2, 12			✓✓
Promote local vigilance committees to improve control of habitat destruction and illegal trade in both parrot species.	2, 12, 13			✓✓
Ask the general public to denounce capture and illegal trade of these birds and disturbance of their habitats.	10, 12			✓✓✓
Reinforce inspection and vigilance activities jointly with the state and municipal governments.	2, 12, 13			✓✓✓

1.1 Habitat Management Elements

Locate good habitat currently used or potentially used for nesting and feeding of both parrot species.	9, 4, 5			✓✓
Ask SEMARNAT to exclude current and potential habitat for both parrot species from forestry resources, including forest trees used by the birds for nesting and feeding.	7, 15			✓✓
Promote protection of both parrot species among private landowners in their habitat areas.	2, 12			✓✓✓

Activity	Indicators of Success	Short-Term	Medium-Term	Long-Term
Promote different ways to protect land in both parrot species habitat to regulate land use, e.g. ejido reserves, ecological easements, and usufructs.	3, 15		✓✓	
Encourage watershed management to get financial resources through habitat conservation and payments for environmental services.	3, 6, 13, 15		✓✓✓	
With the Ministry of SAGARPA (Rural Development) promote environmental friendly projects among the communities located in both parrot species distribution area.	6, 12, 13		✓✓	
Promote payment for environmental services to landowners involved in management and conservation of both parrot species populations.	3, 6		✓✓	

2.2. Species Management Elements

Build, install, and monitor at least 40 artificial nests in each Thick-billed Parrot nesting site.	4, 5, 9		✓✓✓	
Develop guidelines to deal with confiscated parrot species.	5, 9, 13		✓✓	
Prepare handbooks for management, rehabilitation, and reintroduction of captive parrot species.	5, 10		✓✓	

Activity	Indicators of Success	Short-Term	Medium-Term	Long-Term
Evaluate the impact of ecotourism on both parrot species in protected areas.	9		✓✓	

3.1 Habitat and Ecosystem Restoration Elements

Locate disturbed areas in need of urgent restoration for the protection of both parrot species.	7, 9		✓✓	
Establish programs to restore and protect soils and forest such as building gabions, retention berms, growing crops, reforestation, fluvial terraces, brush piles, removal of dead wood, living fences, and resting the land to decrease the loss of habitat in critical habitat for both parrot species.	7, 8		✓✓✓	

3.2 Mitigation and Prevention of Impacts

Mapping potential wildfires in important nesting areas for both species.	8, 9, 13		✓✓	
Prevent wildfires in both parrot species habitat areas through firebreaks, controlled burns, and community vigilance.	8		✓✓✓	
Implement reforestation programs in both parrot species habitats, especially forested areas presently used by these birds.	7, 8		✓✓✓	

Activity	Indicators of Success	Short-Term	Medium-Term	Long-Term
Monitor the effect of the main threats to both parrot species populations and their habitats and evaluate impacts on population trends.	9		✓✓✓	

4.1 Critical Areas Elements

Compile historical and current distribution information for both parrot species.	9		✓✓✓	
Through point-occurrence data, inferential algorithms, and interviews with local residents determine critical areas (nesting, feeding, migration) for both species.	9		✓✓	
Verify in the field the presence of the species and suitable habitat.	9		✓✓	
Estimate both parrot species populations in critical areas.	2, 9		✓✓✓	
Estimate habitat available for both parrot species in critical areas.	9		✓✓✓	
Promote joint actions in municipal and state land use planning processes to prevent land use changes in both parrot species protected areas.	2, 13, 15		✓✓	

4.2 Scientific Research Elements

Use telemetry with satellite transmitters to follow the migrations of adult and juvenile birds.	9		✓✓✓	
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Activity	Indicators of Success	Short-Term	Medium-Term	Long-Term
Implement field studies to count nesting sites available.	4, 9		✓✓✓	
Determine pine cone production available to both parrot species in their reproductive areas.	9		✓✓✓	
Develop a study for a suitable design for artificial nests for the Thick-Billed Parrot.	4, 9		✓	
For both species develop physical, biological, and adaptation studies to understand their requirements with the goal of reintroduction.	4, 5, 9		✓✓	
Study current health problems in the wild populations of both parrot species.	9		✓✓	
Implement population genetic studies to evaluate genetic variability and learn about population trends for both species.	9		✓✓✓	
Evaluate both parrot species habitat composition and quality using tools like the HEP (Habitat Evaluation Procedures) and HQI (Habitat Quality Index) models to locate potential areas for the species reintroduction.	9, 15		✓✓✓	
Study both parrot species ecological requirements to implement effective conservation strategies and map forest elements useful to the species such as nesting and shelter sites, water sources, food, perches, and mineral banks.	9		✓✓	

Activity	Indicators of Success	Short-Term	Medium-Term	Long-Term
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4.3 Biological Monitoring Elements

Implement or continue existing monitoring studies of both parrot species reproductive populations.	9		✓✓✓	
Implement monitoring studies to estimate population size of both species of parrots.	9		✓✓✓	
Develop a Geographical Information System (GIS) to determine coverage of habitat used, vegetation types, ecological features, wildfire impacts, land use changes, and trends for both parrots species.	9		✓✓	
Monitor habitat changes such as regeneration or deterioration, and habitat restoration in nesting sites for both species.	7, 9		✓✓	
Evaluate winter habitat for both species to learn about other threats to the populations.	9		✓✓✓	

5.1 Environmental Education Elements

Prepare an environmental education curricula for the school programs in the local communities, especially close to the species nesting sites.	10, 11, 12		✓✓✓	
Prepare printed materials and audiovisual presentations to educate about biology, ecology, protection status, threats, and conservation actions for the recovery of both parrot species.	10, 12		✓✓✓	

Activity	Indicators of Success	Short-Term	Medium-Term	Long-Term
Prepare an information handbook on both parrot species for environmental education teachers.	10, 12		✓✓	
Organize community training workshops for school teachers, environmental education staff, and people interested in educating citizens in the communities near nesting areas to encourage conservation of these species and their forests	10, 11, 12		✓✓✓	
Promote outreach and awareness activities like workshops, field trips, field activities, contests, habitat improvement, and public meetings, in the communities close to the species habitat.	10, 11, 12		✓✓✓	

5.1 Public Communication Elements

Design and distribute posters, fliers, comic strips, games, printed banners, and activity books to educate the public on the importance of both species and their habitats.	10, 11, 12		✓✓✓	
Sign agreements with the regional radio stations to broadcast informational segments.	10, 11, 12, 13		✓✓✓	
Prepare and give out informational videos on both parrot species and their habitats.	10, 11, 12		✓✓✓	
Through printed materials inform the public on the actions taken to protect both parrot species and conservation achievements.	10, 11, 12		✓✓✓	

Activity	Indicators of Success	Short-Term	Medium-Term	Long-Term
Disperse information on habitats and threats to the species in the communities close to their distribution areas to get them involved in their conservation.	2, 10, 11, 12		✓✓	
Emphasize the participation of the general public in the activities of protection, conservation, and recovery of both parrot species and their habitats.	10, 11, 13		✓✓	

5.2 Community Involvement Elements

Encourage activities with low environmental impact among the communities in the distribution area of both parrot species.	3, 6		✓✓✓	
In both parrot species sites, plan community ecotourism projects jointly with tourism companies to limit access through fees, and to provide lodging and local guides.	6, 13, 14		✓✓	
Train local guides to develop ecotourism projects harmless to both parrot species and to assist in monitoring populations.	2, 6, 14		✓✓	
Train cabin owners, guides, etc. living in communities close to critical areas to work on ‘nature appreciation’ jointly with the Office of Tourism.	6, 13, 14		✓✓	
Include indigenous groups in both parrot species areas in the planning and implementation of ecotourism projects.	6, 13, 14		✓✓	
Encourage student participation through thesis and other projects with these species.	2, 12		✓✓✓	

Activity	Indicators of Success	Short-Term	Medium-Term	Long-Term
Train CONANP personnel to survey both parrot species, count individuals and asses nest success in Natural Protected Areas.	2, 12, 13		✓✓✓	
6.1 Stakeholders Elements				
Determine Recovery Plan operation funding needs.	12, 16, 17		✓✓	
Acquisition of funds for the Recovery Plan from the government, private sector, and general public through agreements, contracts, and technical support, money, and in-kind donations.	12, 13, 16, 17		✓✓	
Create a directory of people and organizations involved in the protection of both parrot species to know what is being done and where.	12, 13		✓	
Coordinate activities in the Recovery Plan with the Technical Consultative Subcommittee for the Protection, Conservation, and Recovery of Psittacids in Mexico.	12, 13		✓✓✓	
Increase municipal and state government participation in the development of the Recovery Plan.	2, 12, 13		✓✓✓	

Activity	Indicators of Success	Short-Term	Medium-Term	Long-Term
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6.2 Schedule Elements

Determine and prioritize activities in the Recovery Plan.	16, 17		✓	
Develop schedules for short-, medium-, and long-term activities for the Recovery Plan.	16, 17		✓✓	
Establish the steps necessary to achieve the goals and objectives in the Recovery Plan and prioritize the activities in each step.	16, 17		✓✓	
Look for opportunities to have simultaneous activities to use resources more efficiently and generate synergy among the different conservation efforts.	12, 13, 16, 17		✓✓	
Name people and organizations responsible to develop each activity related to the Recovery Plan.	12, 13		✓	

6.3 Evaluation and Follow up Elements

Schedule meetings to evaluate short-, medium-, and long-term achievements in the Recovery Plan.	16, 17		✓✓✓	
Evaluate achieved results, goals, and objectives through the indicators of success identified in the Recovery Plan.	16, 17		✓✓✓	
Suggest adjustments and modifications to the Recovery Plan according to the evaluations to improve results.	16, 17		✓✓	
Share the results of the Recovery Plan with everyone involved and the general public.	10, 11, 13, 16, 17		✓✓	

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APPENDIX 1

ACRONYMS

- CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora
- CONABIO: The Mexican National Commission for Knowledge and Use of Biodiversity (Comisión Nacional para el Conocimiento y Uso de la Biodiversidad)
- CONAFOR: Mexican National Forestry Commission (Comisión Nacional Forestal)
- CONANP: The Mexican National Commission of Protected Natural Areas (Comisión Nacional de Áreas Naturales Protegidas)
- DAP: Diameter Breast Height – DBH (Forestry measurement)
- HEP: Habitat Evaluation Procedures
- HQI: Habitat Quality Index
- INE: Mexican National Institute of Ecology (Instituto Nacional de Ecología)
- ITESM: The Monterrey Institute of Technology and Higher Education (Instituto Tecnológico y de Estudios Superiores de Monterrey)
- IUCN: International Union for Conservation of Nature
- PACE: Endangered Species Recovery Plan (Programa de Acción para la Conservación de Especies)
- PNCM: Cumbres de Monterrey National Park
- PREP: Listed Species Recovery and Conservation Programs (Proyectos de Conservación y Recuperación de Especies Prioritarias)
- PROCER: Endangered Species Conservation Program (Programa de Conservación de Especies en Riesgo)
- PROFEPA: Mexican Environmental Protection Agency (Procuraduría Federal de Protección al Ambiente)
- SAGARPA: Agriculture, Cattle, Rural Development, Fisheries, and Food Ministry (Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación)
- SEMARNAP: Environment, Natural Resources, and Fisheries Ministry (Secretaría de Medio Ambiente, Recursos Naturales y Pesca)
- SEMARNAT: Environment and Natural Resources Ministry (Secretaría del Medio Ambiente y Recursos Naturales)
- SIG: Geographic Information System
- SIMEC: Conservation Assessment and Monitoring, Information System
- SINAP: National Protected Natural Areas System (Sistema Nacional de Áreas Naturales Protegidas)
- UANL: Universidad Autónoma de Nuevo León

APPENDIX 2

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Y RECURSOS NATURALES**

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