Northern Aplomado Falcon
(Falco femoralis septentrionalis)

5-Year Review:
Summary and Evaluation

Northern Aplomado Falcon on Yucca in Luna County, New Mexico
Photograph by Ray Meyer 2013

U.S. Fish and Wildlife Service
New Mexico Ecological Services Field office
Albuquerque, New Mexico
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5-YEAR REVIEW
Northern Aplomado Falcon /*Falco femoralis septentrionalis*

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional Office: Southwest Regional Office, Region 2
Susan Jacobsen, Chief, Division of Classification and Restoration, 505-248-6641
Julie McIntyre, Acting Branch Chief, Restoration and Recovery, 505-248-6507
Sarah Rinkevich, Senior Recovery Biologist, 520-670-6144, ext. 237

Lead Field Office: New Mexico Ecological Services Field Office, Albuquerque
Eric Hein, Terrestrial Branch Chief, 505-761-4735
Patricia Zenone, Senior Fish and Wildlife Biologist, 505-761-4718

Cooperating Field Offices: Texas Coast Ecological Services Field Office, Corpus Christi
Robyn Cobb, Fish and Wildlife Biologist, 361-994-9005, ext. 241
Beau Hardegree, Fish and Wildlife Biologist, 361-994-9005
Laguna Atascosa National Wildlife Refuge
Jonathan Moczygemba, Wildlife Biologist, 956-748-3607, ext. 105
Lower Rio Grande Valley National Wildlife Refuge
Chris Perez, Wildlife Biologist, 956-784-7553
Arizona Ecological Services Field Office, Tucson
Mark Crites, Fish and Wildlife Biologist, 520-670-6150

1.2 Purpose of 5-Year Reviews:

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act (Act) to conduct a status review of each listed species once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing as endangered or threatened is based on the species' status considering the five threat factors described in section 4(a)(1) of the Act. These same five factors are considered in any subsequent reclassification or delisting decisions. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process including public review and comment.

1.3 Methodology used to complete the review: update with new methodology in additional paragraph below original if still using

This review was conducted through public review notification and a comprehensive review of all documents regarding the northern aplomado falcon (aplomado falcon) that were available to the Service's New Mexico Ecological Services Field Office (NMESFO). The Federal Register (FR) notice (75 FR 15454) announcing this review was published on March 29, 2010, and solicited new information about species biology, habitat conditions, conservation measures implemented, threats, trends, and significant portion of the range, from other agencies, both Federal and State, non-governmental organizations, academia, and the general public. No new information was received from this solicitation. The primary sources of information used in this analysis were the final listing rule (51 FR 6686; February 25, 1986); the final rule designating the nonessential experimental population of the northern aplomado falcon in New Mexico and Arizona (71 FR 42298; July 26, 2006); the Northern Aplomado Falcon Recovery Plan, June 8, 1990; and published and unpublished reports from The Peregrine Fund and other cooperating agencies. Service Offices cooperating in this review included the Texas Ecological Services Field Office in Corpus Christi, Laguna Atascosa National Wildlife Refuge, the Lower Rio Grande Valley National Wildlife Refuge, and the Arizona Ecological Services Field Office in Tucson. A final review and recommended classification were prepared by the NMESFO.

1.4 Background

1.4.1 FR Notice citation announcing initiation of this review:

75 FR 15454; March 29, 2010

1.4.2 Listing history

Original Listing
FR notice: 51 FR 6686
Date listed: February 25, 1986
Entity listed: Subspecies, *Falco femoralis septentrionalis*
Classification: Endangered, without critical habitat

Revised Listing: None.

1.4.3 Associated rulemakings:

A nonessential experimental population (NEP) of the northern aplomado falcon was established in New Mexico and Arizona on July 26, 2006 (71 FR 42298). NEP designation lessens land-use restrictions associated with the Act, which made re-establishment of aplomado falcons in New Mexico and Arizona less controversial to land managers and increased the number of reintroduction sites. The NEP designation was considered to be potentially the fastest method to re-establish aplomado falcons in New Mexico and Arizona. Authorities and directives for maintaining and restoring aplomado falcon habitat remain part of all Federal agencies' regulations and policies under their section 7(a)(1) responsibilities, which require all Federal agencies to use their authorities to further the purposes of the Act. In addition, due to the paucity of aplomado falcons in

the NEP area, section 7(a)(2) of the Act was not providing significant conservation protection to this subspecies.

1.4.4 Review History:

A 5-year review was initiated on November 6, 1991, (56 FR 56882) for all species listed before 1991, but no document was prepared for this species.

1.4.5 Species' Recovery Priority Number at start of 5-year review: 3

The recovery priority number is 3, meaning a high degree of threat, a high recovery potential, and the listed entity is a subspecies (U.S. Fish and Wildlife Service 2012).

1.4.6 Recovery Plan or Outline

Name of plan or outline: Northern Aplomado Falcon Recovery Plan
Date issued: June 8, 1990
Dates of previous revisions, if applicable: None.

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

The DPS policy is not applicable to the northern aplomado falcon as it is not listed as a DPS.

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan? Yes.

2.2.1.1 Does the recovery plan contain objective, measurable criteria? Yes, the recovery plan contains objective, measurable downlisting criteria; delisting criteria have not been developed.

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat? Yes.

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)? Yes.

Background. The northern aplomado falcon is one of three subspecies of the aplomado falcon and is the only subspecies recorded in the United States. This subspecies was listed by the Service as an endangered species on February 25, 1986 (51 FR 6686). In Mexico, the northern aplomado falcon is listed as nationally threatened. It once extended from Trans-Pecos Texas, southern New

Mexico and southeastern Arizona, to Chiapas and the northern Yucatan along the Gulf of Mexico, and along the Pacific slope of Central America north of Nicaragua (U.S. Fish and Wildlife Service 1990) (Figure 1). Aplomado falcon numbers declined through the early 1900s, and by the 1930s, the subspecies was uncommon (Ligon 1961, Hector 1987, Meyer and Williams 2005). By mid-century, the aplomado falcon was absent from most of its range in the United States with very few sightings reported (Hector 1987, Meyer and Williams 2005). The last documented nesting in Texas occurred in southern Brooks County in 1941 (Hector 1981). In New Mexico, the range of the aplomado falcon apparently receded westward in the early 1900s, with birds being reported primarily from the southwestern counties (Bailey 1928, Ligon 1961). The last documented nesting of aplomado falcons in the United States was reported from Luna County, New Mexico, in 1952 (Ligon 1961). The subspecies is listed as endangered by the States of Arizona, New Mexico, and Texas (Global Raptor Information Network 2014). The aplomado falcon is classified as Least Concern on the IUCN Red List (IUCN 2009) and listed on Appendix II of CITES (CITES 2009).

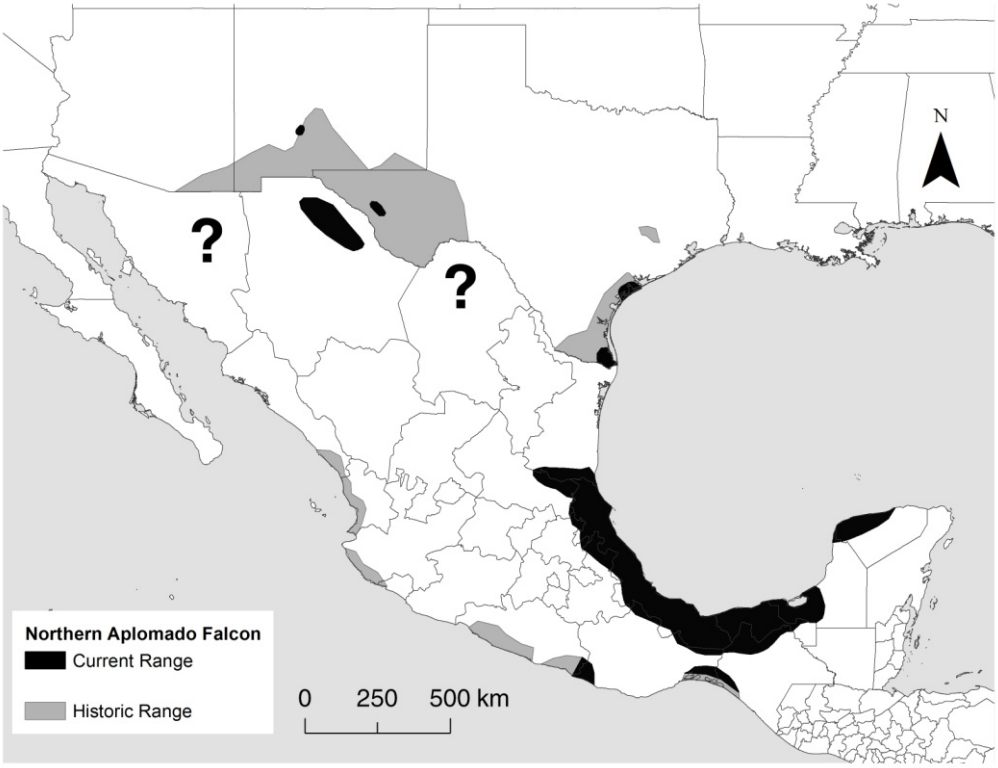


Figure 1. Current and historical range of the northern aplomado falcon in the United States and Mexico (Hunt et al. 2013).

Mexico. In Mexico, the aplomado falcon is described as an uncommon to fairly common resident from sea level to 100 meters (m) (32.81 feet [ft]) on the Atlantic slope, from southeastern San Luis Potosi and Veracruz to western Campeche, locally in Chihuahua, and on the Pacific slope in Oaxaca. The aplomado falcon is

classified as threatened nationally, and is also considered it to be threatened in the Los Tuxtlas region of Veracruz. It was formerly more widespread and resident in northern Sinaloa, south along the Pacific coast, and throughout the eastern lowlands. Following a major decline in numbers and range from the 1950s to 1980s, probably due to the eggshell-thinning effects of DDT (dichloro-diphenyl-trichloroethane), the range of this species has increased in Mexico. This is attributed both to the ban on most uses of DDT and in response to deforestation in many coastal areas.

Aplomado falcons studied in Chihuahua, Mexico, (Montoya et al, 1997, Macías-Duarte et al. 2004) are the only known population of wild, desert-breeding aplomado falcons north of the equator (Hunt et al. 2013). The 35 pairs present in the 1990s declined to 25 by 2002 (Macías-Duarte et al 2004), and only six could be found in 2011 (Hunt et al. 2013). Factors associated with the decline have been continuing drought and the sudden conversion of parts of the study area to irrigated croplands beginning in the mid-2000s (Macias-Duarte et al. 2007). Aplomado falcons are now nesting again in Tamaulipas, and probably Coahuila, Nuevo Leon, and Durango (Global Raptor Information Network 2014).

Life Cycle. The subspecies appears to be mainly non-migratory throughout its range in the United States. Harsh weather conditions and prey availability during the winter may possibly influence occupancy of territories in the northern extremes of the range (Gulf South Research Corporation and La Tierra Environmental Consulting 2013). Nesting chronology is somewhat variable, with egg-laying recorded from January to September, although eggs are usually laid during the months of March to May. Aplomado falcons do not build their own nests, but use nest sites constructed by large raptors or corvids. Thus, aplomado falcons are dependent on nesting activities of other stick nest-building birds and their habitat requirements. Nest sites are found in structures such as large multi-stemmed yuccas and mesquite trees, as well as other trees.

Prey. Aplomado falcons feed on a variety of prey, including birds, insects, rodents, small snakes, and lizards. Ligon (1961) suggested that the food habits of aplomado falcons "consisted almost wholly of small reptiles, lizards, mice, other rodents, grasshoppers, and various other kinds of insects, rarely small birds except in winter when other food is lacking." In winter, factors affecting habitat suitability for migratory bird species may also affect the suitability of the habitat for aplomado falcons, which in turn can affect the potential for survival of aplomado falcons (U.S. Fish and Wildlife Service 2002). In eastern Mexico, small birds accounted for 97 percent of total prey biomass, but insects represented 65 percent of prey individuals (Hector 1985). In one study, 82 bird species were found in prey remains. Of these, the most common were medium-sized songbirds (U.S. Fish and Wildlife Service 2002). Documented invertebrate prey includes grasshoppers, beetles, dragonflies, cicadas, crickets, butterflies, moths, wasps, and bees (U.S. Fish and Wildlife Service 1990). Differences in prey abundance and nest site availability can cause significant differences in home range size. Based

on several studies, the Service estimates aplomado falcon home range size to be approximately 34 square kilometers (km^2) (8,401 acres or 13.1 sections) (U.S. Fish and Wildlife Service 1990, 2002). For management purposes, this can be described by a circle with a radius of 3.22 km (2 miles [mi]) around a particular habitat feature, such as a nest site.

Historical Causes for Decline. The causes for decline of the northern aplomado falcon included widespread shrub encroachment that resulted from control of range fires and intense overgrazing (U.S. Fish and Wildlife Service 1986; Burnham et al. 2002) and agricultural development in grassland habitats used by the aplomado falcon (Hector 1987; Keddy-Hector 2000). Pesticide exposure was likely a significant cause of the subspecies' continued decline and eventual disappearance from the United States with the initiation of widespread use of the bio-acculumative, toxic pollutants DDT and dieldrin after World War II (51 FR 6686, February 25, 1986; Hector 1987). Aplomado falcons in Mexico in the 1950s were heavily contaminated with DDT residue, and these levels caused a 25 percent decrease in eggshell thickness (Kiff et al. 1980). Such high residue levels can often result in reproductive failure from egg breakage (U.S. Fish and Wildlife Service 1990). Collecting aplomado falcons and eggs may have also been detrimental to the subspecies in some locations (U.S. Fish and Wildlife Service 1990).

Current Causes for Decline. Currently, long-term drought, shrub encroachment in areas of Chihuahuan grasslands, and the increased presence of the great-horned owl (*Bubo virginianus*), which preys upon aplomado falcons, may be limiting recovery of this subspecies (Hunt et al. 2013). Perhaps more significant are the effects of degraded grasslands and drying climatic conditions on avian prey populations (Hector 1987, Gulf South Research Corporation and La Tierra Environmental Consulting 2013). Overgrazing and periods of drought have eliminated cover and food availability for grassland birds, and have likely reduced insect prey abundance. At the same time, large-scale conversion of North American grassland habitats to agriculture has greatly diminished populations of migratory birds (Chadde 1992, Smith 1992, Samson and Knopf 1994, Noss et al. 1995, Ricketts et al. 1999, Pool et al. 2012, Gulf South Research Corporation and La Tierra Environmental Consulting 2013). Habitat loss and degradation on both the breeding and wintering grounds of migratory birds negatively impact important avian prey species for aplomado falcons, such as meadowlarks (*Sturnella* spp.) and mourning doves (*Zenaida macroura*) (DeSante and George 1994, Gulf South Research Corporation and La Tierra Environmental Consulting 2013). In recent years, between 140,000 and 328,000 (mean = 234,000) birds are killed annually by collisions with monopole turbines used for wind power generation in the contiguous United States (Loss et al. 2013).

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information

The recovery criteria were developed to address threats to the aplomado falcon; thus, each criterion describes what is needed to overcome specific threats. The current endangered status of the northern aplomado falcon should be changed to threatened when:

Recovery Criterion 1. A minimum self-sustaining population of 60 breeding pairs has been established in the United States (this goal may be modified after we learn more about suitable habitat within the United States). This criterion addresses Factor E, small population size and its associated issues of demography and genetic variation.

Recovery Criterion 2. Patches of coastal prairie and desert grassland must be maintained in (or restored to) a condition providing optimal habitat for northern aplomado falcons through application of grazing, prescribed fire, and brush control. This criterion addresses the following factors: 1) The present or threatened destruction, modification, or curtailment of its habitat or range (Factor A), 2) disease or predation (Factor C), and 3) other natural or manmade factors affecting its continued existence (Factor E).

Recovery Criterion 3. Use of pesticides such as DDT and dieldrin must be permanently eliminated within areas inhabited by northern aplomado falcons and their prey. This criterion addresses the present or threatened destruction, modification, or curtailment of its habitat or range (Factor A).

Recovery Criterion 4. Aplomado falcons should be reestablished in suitable parts of the southwestern United States. This criterion addresses Factors A, C, and E, with E representing small, dispersed population size and impacts from climate change, primarily in the form of long-term drought and its associated prey availability.

Listing factors not relevant to this subspecies at present are: 1) overutilization for commercial, recreational, scientific, or educational purposes; and 2) inadequacy of existing regulatory mechanisms:

Progress on Recovery Criterion 1. A minimum self-sustaining population of 60 breeding pairs has been established in the United States (this goal may be modified after we learn more about suitable habitat within the United States).

A Recovery Plan for the northern aplomado falcon was finalized by the Service in 1990 (U.S. Fish and Wildlife Service 1990). The objective of the Aplomado Falcon Recovery Plan is to ensure that the northern aplomado falcon is no longer threatened by habitat loss, pesticide contamination, or human persecution. Implementation of the steps outlined in the Recovery Plan could lead to downlisting the northern aplomado falcon from endangered to threatened by 2010 to 2030. The criterion to reclassify the northern aplomado falcon to threatened status was tentatively identified to be a minimum self-sustaining population of 60 pairs in the United States, and this status could be achieved by implementing the following actions:

1. Evaluate, monitor, and minimize all threats, including pesticides and other contaminants, to extant populations of northern aplomado falcons.
2. Identify, maintain, and improve northern aplomado falcon habitat.
3. Re-establish the northern aplomado falcon in the United States and Mexico.
4. Conduct studies of habitat requirements, physiological ecology, and behavior of wild northern aplomado falcons.
5. Enhance public support for this recovery effort through educational programs.
6. Encourage national and international cooperation in carrying out these objectives.

From 1950 through the 1980s, occasional sightings of aplomado falcons were reported from the southwestern United States (Oberholser 1974, Keddy-Hector 1990 and 2000, Williams 1997). Because aplomado falcons were considered extirpated from the Chihuahuan Desert, with the nearest known extant population located in Veracruz, Mexico, sightings of birds in the southwestern United States were unexpected (Hector 1986, Keddy-Hector 1990, Cade et al. 1991, Williams and Hubbard 1991). In 1992, aplomado falcon populations were documented in north-central Chihuahua (Montoya et al. 1997).

Reintroduction Program – Texas. With the goal of restoring aplomado falcons to their historical range in the United States, a reintroduction program was initiated in 1978 to release captive-bred young into the historical range in south Texas (U.S. Fish and Wildlife Service 1990, Cade et al. 1991). A total of 927 young were reintroduced in south Texas from 1978 to 2013 (Table 1). Established pairs first bred in the wild and produced young in 1995 (Jenny et al. 2004). In recent years, there have been approximately 28 to 29 known pairs in south Texas (Hunt et al 2013; Mutch 2013, 2014). Almost all of these pairs use human-constructed nests in artificial nest towers that offer protection from predators. In addition, available corvid nests have been limited due to West Nile virus (Perez 2014).

Brownsville population. The aplomado falcon population near Brownsville, Texas, currently includes about 19 pairs and extends approximately 55 km (34.18 mi) north from the Mexican border past Laguna Atascosa National Wildlife Refuge (Hunt et al. 2013). All territories lie within a band 5- to 12-km (3.1- to 7.46-mi) wide of prairie and prairie brushland within 20 km (12.43 mi) of the Laguna Madre (Figure 2). Some pairs nest on the Refuge, some on municipal property at the Port of Brownsville, and some on private ranches. Aplomado falcons have successfully nested on the larger expanses of seasonally inundated salt prairie, and vegetated by gulf cordgrass (*Spartina spartinae*), sea ox-eye daisy (*Borrichia frutescens*), and glasswart (*Salicornia* sp.). Woody vegetation on salt prairie is sparse, except where honey mesquite (*Prosopis glandulosa*) and huisache (*Acacia farnesiana*) occur more frequently at slightly higher elevations, and occasional small hills (lomas) unless controlled by periodic fire. Brushy areas are of concern because they harbor great-horned owls and other potential predators (Hunt et al. 2013).

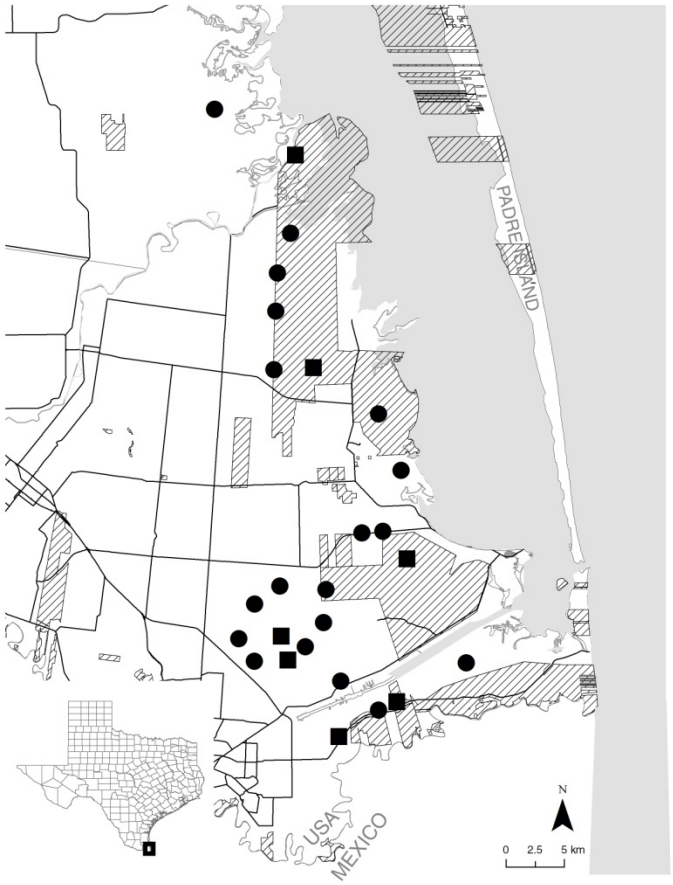


Figure 2. Distribution of the Brownsville subpopulation of aplomado falcon breeding territories. Circles depict sites regularly occupied by adult pairs, while squares indicate sites of intermittent occupancy (from Hunt et al. 2013).

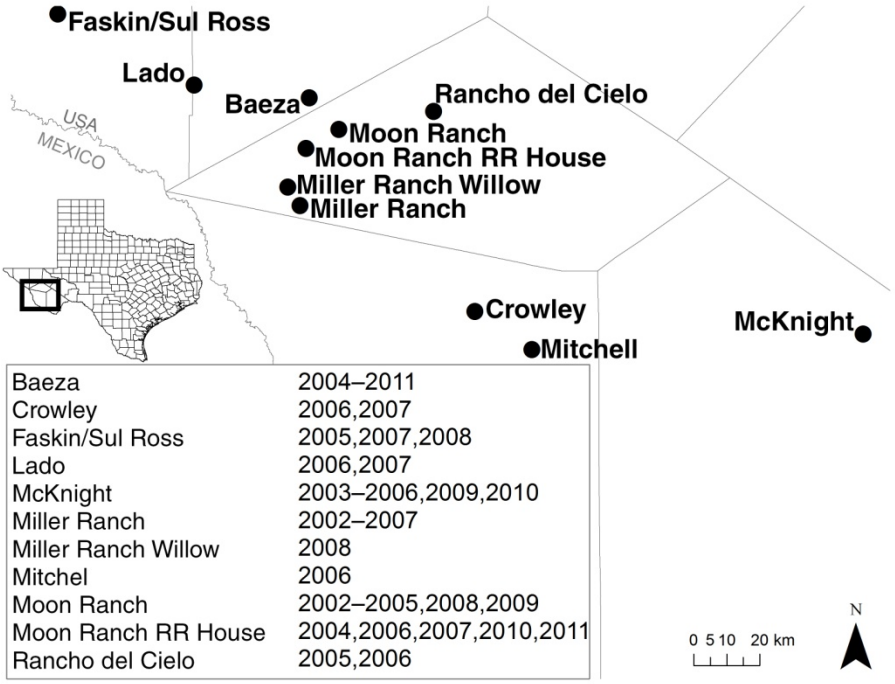
Rockport population. The aplomado falcon population near Rockport, Texas, includes approximately 12 territorial pairs distributed along the length of Matagorda Island (Figure 3) and two additional pairs on adjacent San Jose Island (Hunt et al. 2013). Matagorda Island is part of the Aransas National Wildlife Refuge, with a small area on the northern end administered by the Texas Parks and Wildlife Department. These agencies are actively maintaining the open character of the grassland with periodic burning as the primary method to benefit aplomado falcons. Both islands are dominated by gulf cordgrass (*Spartina spartinae*), marshhay cordgrass (*S. patens*), gulf dune paspalum (*Paspalum monostachyum*), and gulf bluestem (*Schizachyrium maritimum*). Woody plants comprise a small percentage of overall vegetation and consequently, very few great-horned owls are present on the islands, except on the northernmost ends where trees are present. Matagorda Island was not historically associated with aplomado falcons (Oberholser 1974). This population was established to improve survival success for aplomado falcon releases since the island was devoid of great-horned owls (Perez 2014). Potential avian predators of aplomado falcons that are known to occur on the islands include resident white-tailed hawks and crested caracaras, as well as migrating and wintering peregrine falcons (Hunt et al. 2013).

Figure 3. Aplomado falcon nesting territories on Matagorda Island near Rockport, Texas. Circles depict sites regularly occupied by adult pairs, while squares indicate sites of intermittent occupancy. Hatching shows Aransas National Wildlife Refuge boundaries (From Hunt et al. 2013).

Intervening ranchland. The occurrence of sizeable breeding populations of aplomado falcons in south Texas was primarily in the salt prairie habitat between Brownsville and Port Isabel (Oberholser 1974, Hector 1987). Available habitat of this type is very limited and is currently threatened by urbanization, industrial development, and proposed wind farms (Hunt et al. 2013, Perez 2014). Currently, the coastal region between the Rockport and Brownsville populations appears to be devoid of nesting aplomado falcons (Hunt et al. 2013). There are occasional reports of single birds on the Padre Island National Seashore, but none on the vast mainland ranches south of Corpus Christi, Texas, even though releases were conducted there and artificial nesting towers are present. Surveys on the King and Kenedy ranches detected frequent occurrences of great-horned owls in association with even small aggregations of live oaks (*Quercus virginianus*).

Chihuahuan Desert. In 2002, the reintroduction effort began transitioning to the Chihuahuan Desert (Table 2). Under Safe Harbor Agreements, 36 captively bred birds were reintroduced at sites near Valentine, Texas (Figure 4). By 2005, more than 100 captive-reared birds were reintroduced annually in west Texas. Pair formation and breeding by reintroduced birds was observed in west Texas during the 2006 breeding season. The number of monitored pairs increased to as many as 10 in 2009. However, in conjunction with severe drought in 2010, only two pairs were found in west Texas, and none were located the following year. Beginning in 2012, west Texas reintroductions were suspended because of extreme drought conditions (Hunt et al. 2013).

New Mexico and Arizona. Reports of solitary aplomado falcons in New Mexico and Arizona increased slightly in the 1990s (U.S. Fish and Wildlife Service 2006). In 2000, a territory occupied by a pair of aplomado falcons was discovered in Luna County, New Mexico (Meyer and Williams 2005). The pair occupying this territory nested unsuccessfully in 2001, and fledged three young in 2002. The territory was occupied intermittently in subsequent years, and a pair nesting there in 2014 successfully fledged young.



Baeza	2004–2011
Crowley	2006,2007
Faskin/Sul Ross	2005,2007,2008
Lado	2006,2007
McKnight	2003–2006,2009,2010
Miller Ranch	2002–2007
Miller Ranch Willow	2008
Mitchel	2006
Moon Ranch	2002–2005,2008,2009
Moon Ranch RR House	2004,2006,2007,2010,2011
Rancho del Cielo	2005,2006

Figure 4. Aplomado falcon release sites in west Texas, 2002 to 2011 (From Hunt et al. 2013).

Nonessential Experimental Population. To facilitate the re-establishment of the aplomado falcon in New Mexico and Arizona, the Service designated the aplomado falcon in these two States a Nonessential Experimental Population (NEP) under section 10(j) of the Act (U.S. Fish and Wildlife Service 2006). In 2006, the first New Mexico reintroductions were conducted on the privately owned Armendaris Ranch. Between 2006 and 2011, a total of 337 aplomado falcons were reintroduced at sites in southern New Mexico, including several sites on the Armendaris Ranch, on nearby lands managed by the Bureau of Land Management Las Cruces District (BLM LCDO), the State of New Mexico, and White Sands Missile Range (Figure 5).

In New Mexico, three breeding attempts have been observed on the Armendaris Ranch, with the first occurring during the 2007 breeding season (Sweikert and Phillips 2011). During years while reintroductions were occurring, aplomado falcons were reported fairly frequently at sites with suitable habitat in southern New Mexico, including Bosque del Apache National Wildlife Refuge, the Lake Valley area, and near Hermanas in southwestern New Mexico (Gulf South Research Corporation and La Tierra Environmental Consulting 2013). Five nesting attempts have been detected in New

Mexico since reintroductions began. In order to better ascertain the fates of reintroduced aplomado falcons, a radio and satellite telemetry monitoring program was implemented to track birds in 2011 and 2012. By January 2013, all tagged birds were either confirmed or presumed deceased (Hunt et al. 2013).

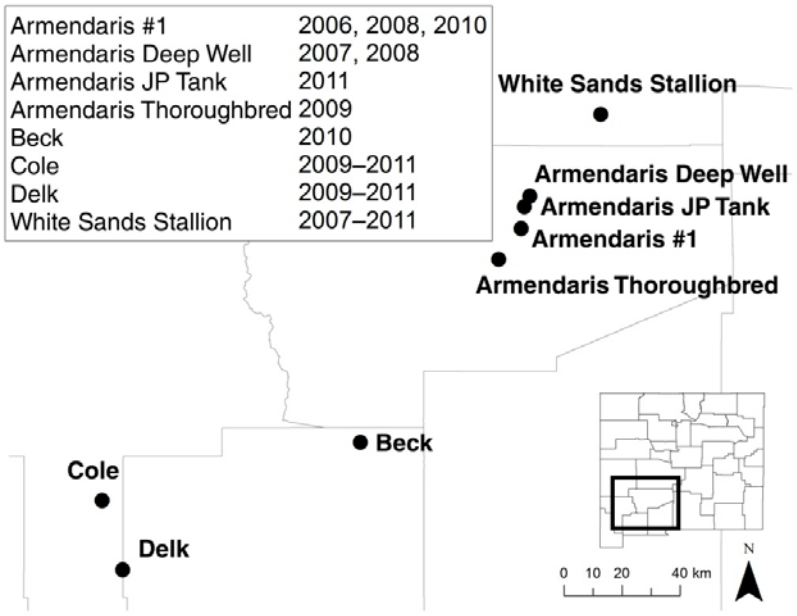


Figure 5. Aplomado falcon release sites in New Mexico, 2006 to 2011 (From Hunt et al. 2013).

In summary, during the 5 years from 2010 to 2014, the known number of breeding pairs of aplomado falcons in the United States has varied between 28 and 36 pairs, almost all of which are using artificial nesting towers in southern coastal Texas. In 2013 and 2014, intensive surveys conducted throughout the subspecies' historical range in the United States resulted in the observation of 29 pairs in south coastal Texas and 1 pair in New Mexico. Therefore, at present, there is approximately one-half the number of pairs recommended for reclassification of the subspecies to threatened status. This, or a slightly higher number of pairs has remained consistent since 2000, and future monitoring will indicate whether this number of pairs remains self-sustaining without additional reintroductions.

Progress on Recovery Criterion 2. Patches of coastal prairie and desert grassland must be maintained in (or restored to) a condition providing optimal habitat for northern aplomado falcons through application of grazing, prescribed fire, and brush control.

Aplomado falcon habitat is variable throughout its range and includes palm and oak savannahs, various desert and coastal grassland associations, and open pine woodlands. Within these variations, the essential habitat elements appear to be open terrain with scattered trees, relatively low ground cover, an abundance of insects and small to medium-sized birds, and a supply of nest sites (U.S. Fish and Wildlife Service 1990). In Mexico, reported habitat includes palm and oak savannas, open tropical deciduous

woodlands, wooded fringes of extensive marshes, various desert grassland associations, and upland pine parklands (U.S. Fish and Wildlife Service 1990).

Aplomado falcons generally occur in relatively flat, open habitats, including grasslands, savannahs, cleared pastureland, and cultivated fields (Blake 1977, Hector 1981, Keddy-Hector 1990). In the United States, the aplomado falcon historically inhabited ecologically varied regions in south Texas and the xeric grasslands from Trans-Pecos Texas through southeastern Arizona. In south Texas, the aplomado falcon was found in honey mesquite (*Prosopis glandulosa*) and yucca (*Yucca* spp.) grasslands, grassland with scattered oak (*Quercus* spp.) mottes, and coastal prairie with interspersed yucca-covered dunes (Merrill 1878, Smith 1910, Johnston 1963, Hector 1981). In the western region, the aplomado falcon inhabited yucca and honey mesquite grasslands and riparian woodlands adjacent to grasslands (Ligon 1961, Keddy-Hector 1990, Montoya 1995, Gulf South Research Corporation and La Tierra Environmental Consulting 2013).

Chihuahuan Desert Grassland Habitat. In the Chihuahuan Desert, aplomado falcons are primarily associated with open grasslands that include scattered mesquite or yuccas (*Yucca torreyi* and *Y. elata*), and secondarily, may also include small patches of scrub and woodlands (U.S. Fish and Wildlife Service 2006). Data suggest that the ecological status of Chihuahuan Desert grasslands occupied by aplomado falcons is high seral to potential natural community, or a climax community with significant basal cover of grass species (Montoya et al. 1997). Occupied nesting habitat in northern Mexico contains basal ground cover ranging from 29 to 70 percent, with a mean of 46 percent. Woody plant density ranged from 5 to 56 plants/acre, with a mean of 31 plants/acre. Dominant woody plant species, comprising 74 percent of this community, included Mormon tea (*Ephedra* spp.), soaptree yucca, mesquite, groundsel (*senecio* spp.), creosotebush (*Larrea tridentate*), and seep willow (*baccharis* spp.).

Suitable Habitat Characteristics. Figure 6 depicts a preliminary assessment of Chihuahuan Desert habitat suitability for northern aplomado falcons in New Mexico, Trans-Pecos Texas, and a portion of northern Mexico (Young et al. 2005). Potential habitat for the northern aplomado falcon in the Chihuahuan Desert region has been defined as patches of any of the following desert grasslands mapping units of Standard Habitat Sites:

Grass Flat NM011
Grass RUP NM012
Salt Flat NM022
BLM Veg Type: Short Grass 1001
Mid Grass 1002
Tall Grass 1003
GAP Veg Type: Short Grass Steppe 5121
Great Basin Foothill Piedmont Grassland 5212
Chihuahuan Desert Grassland 5220
Chihuahuan Desert Foothill Piedmont Desert Grassland 5221
Chihuahuan Desert Lowland Swale Desert Grassland 5222

In addition, the model suggested that suitable habitat must be greater than 320 acres in size, below 6,500 foot in elevation, and have adequate nesting substrates, such as multi-stemmed yuccas and large mesquites or other trees, and abandoned nests of large raptors or ravens. As described below, home range sizes for pairs of aplomado falcons in the Chihuahuan Desert have been shown to be much larger than this model of suitable habitat suggests.

This model utilized remote-sensing techniques, including satellite imagery and aerial photography, to delineate land cover classes, and it classified areas as having high, moderate, low, or no habitat suitability (Young et al. 2005). Site-specific habitat assessments are necessary to determine whether a location occurs within suitable habitat for aplomado falcons. Habitat assessments should employ visual estimation of site characteristics and quantitative measurements for evaluations. Agreement on the degree of habitat suitability between the model and field assessments has been reported as low in some areas due to inconsistencies with soils, vegetation communities, and ecological types (Gulf South Research Corporation and La Tierra Environmental Consulting 2013). This finding emphasizes the importance of site-specific habitat assessments to refine the results of the model for specific sites.

Vegetative Community. Chihuahuan grasslands show the greatest basal density on plateaus, rolling hills, and basin floors where the soils are relatively deep. Grama grasses (*Bouteloua* spp.), are the dominant species in uplands, and wetter areas have tobosa grass (*Pleuraphis mutica*) predominantly. Chihuahuan Desert scrub habitats in New Mexico and Arizona are dominated by creosotebush, with agave (*Agave lechuguilla*), sotol (*Dasylirion* spp.), yucca, mimosa (*Mimosa* spp.), acacia (*Acacia* spp.), mesquite, mariola (*Parthenium incanum*), fourwing saltbush (*Atriplex canescens*), tarbush (*Flourensia cernua*), and javelinabush (*Microrhamnus ericoides*) also present. Riparian woodlands and arroyo habitats, containing such trees as cottonwoods (*Populus* spp.), willows (*Salix* spp.), salt cedar (*Tamarix* spp.), and sycamores (*Platanus* spp.) provide important woody tree and brush species for aplomado falcon nesting.

Young et al. (2002) described aplomado falcon habitat in Chihuahua, Mexico, as having vegetative basal cover ranging from 43 and 48 percent (nesting and detection areas, respectively), with tobosa and blue grama grasses being the dominant grass species. Grass height was 8.4 inches (21.3 centimeters (cm)) in nesting areas and 7.8 inches (19.8 cm) in perching areas. Shrub density was 105 and 253 shrubs/ac in nesting and detection habitat, respectively. Dominant shrubs were longleaf ephedra (*Ephedra trifurca*), acacia, tarbush, honey mesquite (*Prosopsis glandulosa*), soaptree yucca, and creosote bush. Biomass, measured after nest-site selection, was 744 and 862 pounds/acre in nesting and detection areas, respectively.

Predators. Predators of aplomado falcons include great-horned owls (*Bubo virginianus*), crows, ravens and jays (family Corvidae), coyote (*Canis latrans*), and bobcats (*Lynx rufus*) (Montoya et al. 1997). Prairie falcons (*Falco mexicanus*) and Swainson's hawks (*Buteo swainsoni*) have also been observed to predate young aplomado falcons and compete for food and territories (Hunt et al. 2013).

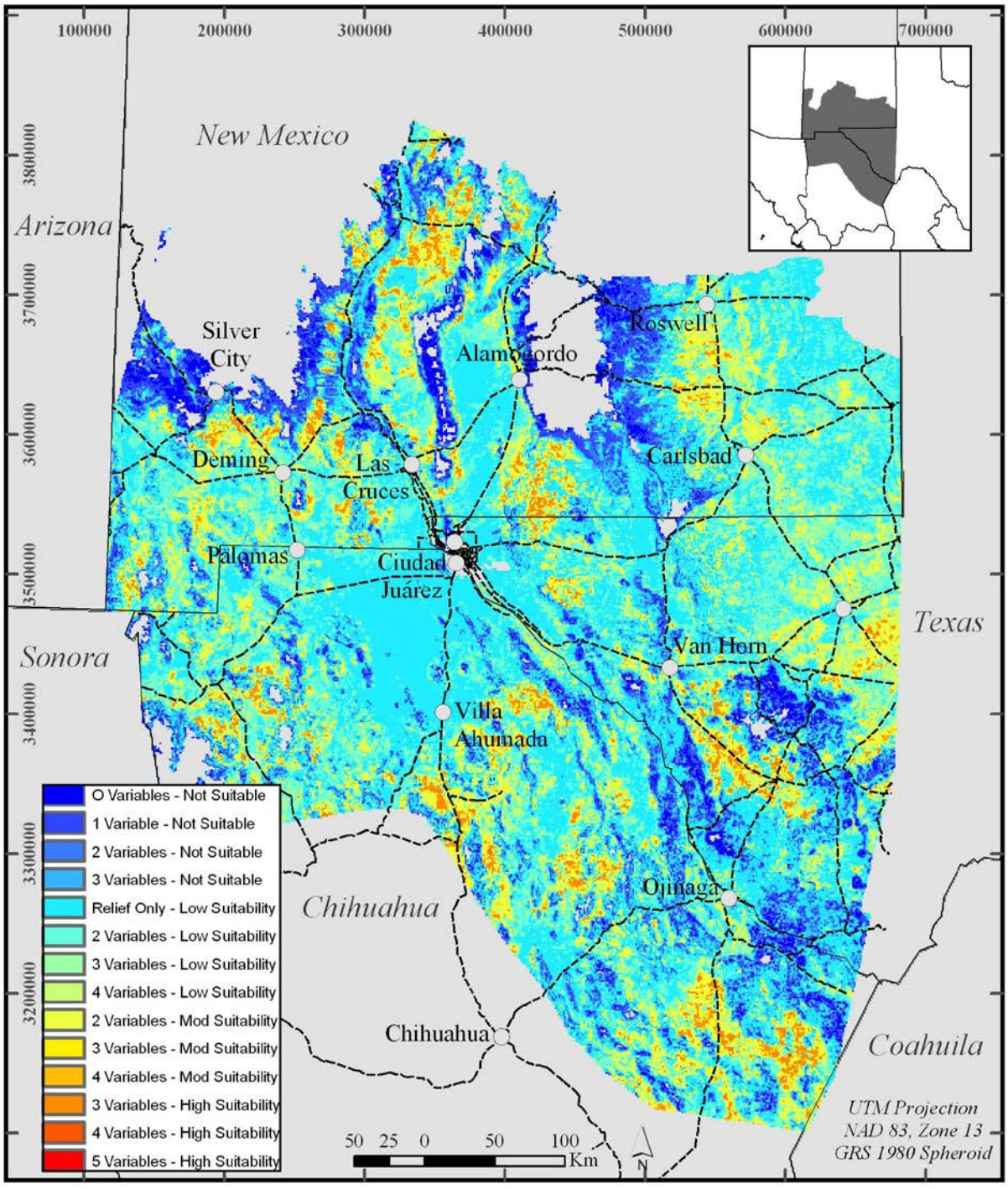


Figure 6 (must be viewed or printed in color). Aplomado falcon habitat suitability in southern New Mexico, west Texas, and northern Mexico (from Young et al. 2005).

Home Range. In eastern Mexico, the size of aplomado falcon home ranges varied from 2.6 to 9.0 square kilometers (km^2), or 11 to 39 pairs/100 km^2 (Hector 1988). Single breeding season home ranges of radio-tagged birds in northern Chihuahua ranged from 3.3 to 21.4 km^2 (1.3 to 8.3 mi^2) (Montoya et al. 1997). Montoya et al. (1997) estimated

that 10 monitored pairs in northern Chihuahua occupied 400 km^2, or 40 km^2 per pair, which is intermediate between territory sizes measured in southern New Mexico (Gulf South Research Corporation and La Tierra Environmental Consulting 2013).

In the Chihuahuan Desert, aplomado falcons prefer broad, open basins and valleys with optimum visibility of the surroundings and relatively few, scattered, tall woody plants providing perch and nest sites (Hector 1981, Montoya et al. 1997, Young et al. 2004). Such settings offer maximum detectability of potential prey and protection against predators. The aplomado falcon does not typically occupy hilly or highly irregular terrain. In habitat analysis, Young et al. (2002) conservatively used a 10 percent slope as a ceiling for potential habitat. Yucca grassland was by far the most common habitat for nesting aplomado falcons in Chihuahua (Young et al. 2004).

Territories. Territories are often centered on tobosa swales. Dominant grass species at nest and detection sites in Chihuahua were tobosa and blue grama (*Bouteloua gracilis*). The importance of these grasslands relates to their ability to support important avian prey of the aplomado falcon, including doves, meadowlarks, and birds in the Family Emberizidae (sparrows, juncos, towhees). Basal grass cover measured at nest sites in Chihuahua was comparatively high for desert grasslands (Montoya et al. 1997, Young et al. 2002).

As woody plant cover increases, the probability of aplomado falcon presence decreases (Young et al. 2002). At nest sites in Chihuahua, Mexico, woody plant densities typically ranged from 17 to 444 plants/hectare (ha) (Montoya et al. 1997, Young et al. 2002). Some nest sites were located at the interface of grasslands and shrublands, possibly because taller shrubs and yuccas tend to occur in those situations. In the Chihuahuan Desert, mosaics of open grasslands and areas with greater shrub/succulent densities provide structural diversity that may increase avian community diversity and overall avian prey abundances (Lloyd et al. 1998, Igl and Ballard 1999, Macías-Duarte et al. 2004, Gulf South Research Corporation and La Tierra Environmental Consulting 2013). Macías-Duarte et al. (2004) suggested that this may be a reason for aplomado falcons nesting in the grassland interface. The presence of both open grassland and more structurally diverse habitat may provide optimum habitat.

Nesting. Aplomado falcons are mainly secondary nesters, using abandoned nests constructed by other raptors and ravens. Natural platforms such as arboreal bromeliads or the crotches of multi-branched yuccas where dead leaves and other debris have collected may be used. In rare cases, aplomado falcons have nested in low bushes and even on the ground (Gulf South Research Corporation and La Tierra Environmental Consulting 2013). Aplomado falcons have also used man-made structures, including powerline poles and artificial nest sites (Jenny et al. 2004, T. Waddell, Armendaris Ranch, pers. comm., Mutch 2013). In eastern Mexico, nest sites were abundant (Hector 1981). Not only were nests of raptors and ravens available, but natural platforms, such as arboreal bromeliads, were also available. In Chihuahua, nests selected for use were primarily constructed by Chihuahuan ravens (*C. cryptoleucus*) and Swainson's hawks in yuccas (Montoya et al. 1997). Nest site availability may be a limiting factor in some

areas of the aplomado falcon's historic range in the Southwest. This may be more likely in open grasslands and areas with shallow soils that are incapable of supporting tall shrubs and succulents (Gulf South Research Corporation and La Tierra Environmental Consulting 2013).

Prey Availability

Prey Species. Montoya (1995) found the most important aplomado falcon prey species to include meadowlarks (*Sturnella* spp.), common nighthawks (*Chordeiles minor*), northern mockingbirds (*Mimus polyglottos*), western kingbirds (*Tyrannus verticalis*), brown-headed cowbirds (*Molothrus ater*), Scott's orioles (*Icterus parisorum*) and mourning doves ((*Zenaida macroura*). In an evaluation of potential aplomado falcon habitat in Arizona, the Arizona Department of Game and Fish identified the following species as potential prey: Scaled quail (*Callipepla squamata*), Gambel's quail (*Callipepla gambelii*), white-winged dove (*Zenaida asiatica*), mourning dove, common ground-dove (*Columbina passerina*), yellow-billed cuckoo (*Coccyzus americanus*), Gila woodpecker (*Melanerpes uropygialis*), ladder-backed woodpecker (*Picoides scalaris*), northern flicker (*Colaptes auratus*), ash-throated flycatcher (*Myiarchus cinerascens*), Cassin's and western kingbird (*Tyrannus vociferans* and *verticalis*), horned lark (*Eremophila alpestris*), Botteri's sparrow (*Peucaea botterii*), Cassin's sparrow (*Peucaea cassinii*), rufous-crowned sparrow (*Aimophila ruficeps*), lark sparrow (*Chondestes grammacus*), lark bunting (*Calamospiza melanocorys*), chestnut-collared longspur (*Calcarius ornatus*), eastern and western meadowlark (*Sturnella magna* and *S. neglecta*), brown-headed cowbird, and orioles (*Icterus* spp.) (Corman 1992). In addition, loggerhead shrike (*Lanius ludovicianus*), swallows (family Hirundinidae), Inca dove (*Columbina inca*), nighthawks, wrens (family Troglodytidae), thrushes (family Turdidae) , mockingbirds and thrashers (family Mimidae), pipits (*Anthus* sp.), warblers (family Parulidae), tanagers (*Piranga* spp.), sparrows (family Emberizidae), cardinals (family Cardinalidae), blackbirds (family Icteridae), and finches (family Fringillidae) are also potential aplomado falcon prey species (Montoya 1995).

Prey Availability. In the northern portion of the Chihuahuan Desert, the aplomado falcon is most dependent on avian prey during the winter and early spring when other prey is unavailable. In xeric grasslands such as the Chihuahuan Desert, avian prey abundance can be highly variable both spatially and temporally and provides a relatively unstable food source, particularly during the winter and early spring (Méndez-González 2000, Gulf South Research Corporation and La Tierra Environmental Consulting 2013). Not only is prey abundance low in dry seasons, but wintering birds tend to be smaller and more difficult to capture, further decreasing prey availability (Gulf South Research Corporation and La Tierra Environmental Consulting 2013). In northern Chihuahua, aplomado falcon productivity and reproductive timing were both associated with avian prey abundances early in the breeding season (Macías-Duarte et al. 2004). Reproductive failure and territory abandonment may occur because of extended periods of low avian prey levels. From late spring through fall, the amount of available avian prey for the aplomado falcon is more consistent and consists of larger, insectivorous birds that replace wintering species. Alternative prey types, including arthropods, lizards, and small

mammals, are also more abundant from late spring through fall (Gulf South Research Corporation and La Tierra Environmental Consulting 2013).

Macías-Duarte et al. (2004, 2009) found large seasonal and yearly variation in grassland bird abundance in two Chihuahua study areas, Tinaja Verde and Sueco, related to annual differences in precipitation. Aplomado reproduction was sensitive to this variation, with productivity ranging from 1.6 fledglings per occupied territory in wet years to 0.7 during drought (Macías-Duarte et al. 2004). Drought has been prevalent in Chihuahua, New Mexico, and west Texas since the mid-1990s, with periodic spikes of higher precipitation (Hunt et al. 2013).

Threats

Chihuahuan Desert Habitat Changes. The overall carrying capacity for aplomado falcons has decreased markedly in the Chihuahuan Desert since the late 1800s (Hunt et al. 2013). The extent of open savanna has diminished as a result of livestock grazing and agriculture, and the abundance of wintering grassland birds important to nesting aplomado falcons has declined similarly (Macías-Duarte et al. 2004, Pool et al. 2012, 2014). Grassland birds are thought to have declined more steeply than any other avian guild in North America (Knopf 1994). A primary source of migrants to the Chihuahuan Desert is the northern prairie grassland, extending northward and westward from South Dakota to Saskatchewan and eastern Alberta. This is a region that has undergone extensive agricultural development with consequent reductions in grassland bird abundance. This may have resulted in fewer migrant birds, thereby reducing aplomado falcon carrying capacity and productivity, even in areas where habitat conditions appear to be otherwise suitable (Hunt et al. 2013). In addition, the relatively recent potential threat posed by wind power operation may also reduce the availability of avian prey for the aplomado falcon by causing mortality from collision with moving blades (Hunt et al. 2013). Between 140,000 and 328,000 (mean = 234,000) birds are killed annually by collisions with monopole turbines in the contiguous United States (Loss et al. 2013).

Drought/Water Depletion. The Peregrine Fund began releasing captive-bred aplomado falcons in the Chihuahuan desert grasslands of western Texas in spring 2002. Reintroduction sites were chosen according to the suitable habitat criteria described by Young et al. (2004), primarily in yucca savanna similar to occupied habitat in nearby Chihuahua, Mexico (Montoya et al, 1997, Macías-Duarte et al. 2004) (see Figure 6 above). The Chihuahua population is the only known representative of wild, desert-breeding aplomado falcons north of the equator. The 35 pairs present when Montoya began his investigations had dwindled to 25 by 2002 (Macías-Duarte et al 2004), and only 6 could be found in 2011 (Hunt at al. 2013). Factors associated with this decline have been both continuing severe drought conditions and the nearly complete conversion of parts of the study area to irrigated croplands beginning in the mid-2000s (Macias-Duarte et al. 2007).

Climate Change. Changing climatic conditions are projected to create more extreme and generally drier conditions in the southwestern United States (Gulf South Research

Corporation and La Tierra Environmental Consulting 2013). The associated fauna are expected to experience lower productivity, greater stress, and reduced food resources (Parry et al. 2007, Albright et al. 2010, North American Bird Conservation Initiative 2010). This could directly impact aplomado falcons by diminishing the availability of their prey (as discussed below). Increased aridity of grasslands will make them more susceptible to negative impacts from livestock grazing (Gulf South Research Corporation and La Tierra Environmental Consulting 2013).

Prey Declines. Prey availability is a crucial component of grassland habitat suitability for aplomado falcons, and this may explain some recent distribution findings for the subspecies (Gulf South Research Corporation and La Tierra Environmental Consulting 2013, Hunt et al. 2013). In northern Chihuahua, aplomado falcon productivity and reproductive timing were both associated with avian prey abundances early in the breeding season (Macías-Duarte et al. 2004). Reproductive failure and territory abandonment may occur because of extended periods of low avian prey levels. Avian prey and aplomado falcon productivity in north-central Chihuahua were significantly greater than in an occupied area further east (Macías-Duarte et al. 2004). Researchers suggested that the former site may have been a more important migratory route for birds (Méndez-González 2000, Macías-Duarte et al. 2004).

Peripheral Ranges. In the outer limits of species' ranges, densities often are lower and more variable (Brown et al 1995, Pulliam 1988). Birds may have stronger tendencies to continue southward if conditions are not suitable in the northern extremes of the winter range (Newton 2008, Jonzén et al. 2011, Gulf South Research Corporation and La Tierra Environmental Consulting 2013). The southwestern New Mexico and Sueco, Chihuahua, areas occupied by aplomado falcons are located in broad valleys with deep, productive soils. The associated grasslands offer greater food quality and abundance for wintering birds (Gulf South Research Corporation and La Tierra Environmental Consulting 2013). These features also likely influence the migratory pathways used by grassland birds (Méndez-González 2000, Macías-Duarte et al. 2004).

Summary of Northern Aplomado Falcon Needs. The aplomado falcon is dependent on expansive, open grasslands and associated avian communities for prey. The continued conversion of grasslands to agricultural uses and potential impacts from climate change may further reduce bird populations that aplomado falcons rely on for prey and for nests (Samson and Knopf 1994, Bahre 1995, Dinerstein et al. 2000, Macías-Duarte et al. 2007, Ceballos et al. 2010). Because highly suitable potential habitat and availability of grassland birds for prey are limiting factors, an ecosystem management approach that protects and improves existing grasslands is recommended to benefit aplomado falcons and other grassland species. Maintaining the areal extent and suitability of existing aplomado falcon habitat is of primary importance (Gulf South Research Corporation and La Tierra Environmental Consulting 2013). Additionally, encouraging the development of healthy native grassland communities by limiting disturbance and shrub encroachment, as well as through proper management of fire, invasive species, and grazing, can improve habitat suitability for aplomado falcons and other birds. A healthy grassland ecosystem will likely develop a sufficient avian prey base, yuccas and other shrubs that form nest

substrates, and will support ravens and other raptors that build nests that aplomado falcons can use (Gulf South Research Corporation and La Tierra Environmental Consulting 2013).

Progress on Aplomado Falcon Habitat Restoration

Chihuahuan Desert Grasslands. A large effort to restore, maintain, improve, and protect grassland as suitable habitat for the aplomado falcon has been undertaken during the last decade in New Mexico and Texas. Responses to the intense overgrazing that resulted in shrub encroachment in Chihuahuan Desert grasslands have moderated, and improved range management techniques, including decreased stocking rates, stock rotation, prescribed burning, and other brush control methods are being implemented (Archer 1994; Heady 1994; Burnham et al. 2002).

The BLM LCDO has been successfully implementing grassland restoration projects within southwestern New Mexico since the early 1980s. An expansive interagency partnership began in 2006, with implementation of the Restore New Mexico Initiative. Through years of collaborative research and monitoring, the BLM LCDO has utilized adaptive management techniques to promote restoration success. Using information acquired from post-treatment monitoring over 161,874 ha (400,000 ac) of vegetation treatments, the BLM LCDO relies on an interdisciplinary team approach when evaluating proposed landscape treatments. The core team consists of a Rangeland Management Specialist, Wildlife Biologist, Hydrologist, and Soil Scientist. If an additional subject expert is needed, he or she is incorporated into the team for site evaluation and throughout the planning process. The merits of each project are evaluated to assess the site's ability to respond to treatment. These characteristics include sufficient soil structure and fertility, native seed source, and site variables consistent with prior successful treatments. Each project proposal is also reviewed for consistency with overall watershed objectives, post- treatment management, and adaptive management considerations, such as data from other treatments on similar sites, new ecological State mapping information, and current and predicted climate factors. The BLM LCDO has implemented a long-term monitoring strategy for all of their vegetation treatments.

To date, in occupied aplomado falcon habitat in southwestern New Mexico, approximately 11,170 ha (27,601 ac) have been treated for future grassland restoration. Similar grassland restoration to benefit aplomado falcons is also occurring in south-central and southeastern New Mexico by BLM offices in Roswell, Carlsbad, and Socorro. At present, a detailed analysis of the percentage of potentially suitable aplomado falcon habitat restored is not available. This will depend on the results of long-term monitoring to determine the degree of successful restoration attained, which is highly dependent on adequate precipitation.

South Texas Coastal Prairie. Mechanical removal of invasive mesquite and huisache trees in the south Texas coastal prairie is helping to restore aplomado falcon habitat that has suffered from fire exclusion. In fall and winter, the prairie is burned and herbicides are applied to manage invasive brush. The mechanical treatment re-created open prairie in a matter of months. Chemical treatments and fire appear to be maintaining the open prairie by achieving a high level of mortality in the invasive brush. Recent brush removal projects at Bahia Grande of approximately 231 ha; (570 ac) have opened and restored

1,102 to 1,093 ha (2,500 to 2,700 ac) of coastal prairie habitat. The goal is to continue restoration over the next few years and accomplish an additional 1,000 to 1,500 acres in the Bahia Grande area. Many other areas of coastal Texas would also benefit from these treatments to restore open prairie habitat for the aplomado falcon and other species.

In addition, artificial nest towers developed by The Peregrine Fund are used extensively in south Texas to protect nesting aplomado falcons from predation (Figure 7). Nearly all of the aplomado falcons in south Texas currently choose artificial towers for nesting.

Figure 7. Aplomado falcon young in nest tower in south Texas coastal prairie on Laguna Atascosa National Wildlife Refuge. Photograph by Christina Straway 2014.

In summary, expansive efforts are underway in both New Mexico and coastal Texas to restore native grasslands to their historical open character from current shrub-encroached conditions. These projects are still too new to assess their ultimate success. The high degree of shrub encroachment has caused native bird species, including the aplomado falcon, to decline. Whether these grassland restoration techniques will achieve historical habitat quality for aplomado falcon recovery remains to be assessed. In the Chihuahuan Desert, restoration efforts have been impeded by long-term drought conditions.

Progress on Recovery Criterion 3. Use of pesticides such as DDT and dieldrin must be permanently eliminated within areas inhabited by northern aplomado falcons and their prey.

The Service (1986) cited contamination with organochlorine pesticides (e.g., DDT, dieldrin) as a primary threat facing the aplomado falcon. Severe eggshell thinning and pesticide contamination were detected in eggs collected in eastern Mexico between 1957 and 1977 (Kiff et al. 1980). The use of DDT was banned in the United States in 1972, and in Mexico in 2000. Dieldrin has been banned in the United States since 1987, and in Mexico for more than a decade (Greene and Pohanish 2005). In 1995 and 1996, the potential impact of these organochlorine environmental contaminants on the recovery of aplomado falcons in southern Texas was studied by assaying the following: 1) Plasma from eight free-ranging aplomado falcons; 2) addled eggs from two nests; and 3) tissues from representative prey, including mourning doves, eastern meadowlarks, dragonflies (Odonata), and cicadas (Homoptera). Organochlorines, including DDE and dieldrin, were below detection limits in the plasma and were at insignificant levels in the eggs (1.4 to 1.8 ppm wet weight) and prey (0.02 to 0.25 ppm). Shells from the 2 addled eggs were as thick as pre-DDT eggshells from the same region and 1.26 to 1.34 times thicker than eggs collected in eastern coastal Mexico in 1977 (Kiff et al. 1980, Mora et al. 1997, Jenny et al. 2004).

Eggs collected between 2004 and 2007 from aplomado falcons nesting in Chihuahua and Veracruz, Mexico, were analyzed for organochlorine pesticides and polychlorinated biphenyl (PCB). DDE was the only organochlorine found in all eggs at concentrations ranging from 0.13 to 7.85 µg/g wet weight. PCBs ranged from 0.04 to 2.80 µg/g wet weight. DDE concentrations in eggs were not significantly different among regions; however, PCBs were significantly greater ($P = 0.015$) in Tinaja Verde, Chihuahua, than in the other three regions. DDE concentrations in eggs were much lower than those associated with eggshell thinning. PCBs were lower than those reported in raptors from industrialized countries. Overall, the observed contaminant concentrations indicate no likely impact on hatching success. Eggshell thickness was 20% thicker than the reported in eggshells from the 1970s. Aplomado falcons in Mexico are currently not affected by DDE, dieldrin, or PCBs (Mora et al. 2011).

Summary of Current Pesticide Impacts. The impacts of DDE and dieldrin on aplomado falcons have shown such significant decline in the United States and Mexico that they no longer constitute a threat to the subspecies. It is possible that other chemicals could affect the recovery of aplomado falcons in the United States. For example, elevated mercury (Hg) levels in meadowlark livers from three sites in south Texas (0.2 to 1.0 ppm dry weight) and in aplomado falcon eggs (1.5 to 4.1 ppm) suggested significant Hg exposure in tests conducted in 1995 and 1996 (Wiemeyer et al. 1984, Newton and Haas 1988). At this time, for the pesticides mentioned specifically at the time of listing and of writing the recovery plan, we conclude that this recovery criterion has been met. We will continue to monitor potential impacts from other contaminants.

Progress on Recovery Criterion 4. Aplomado falcons should be re-established in suitable parts of the southwestern United States.

Northern Aplomado Falcon Reintroductions. To address re-establishment of northern aplomado falcons in the United States, reintroduction of nestling northern aplomado falcons was identified in the Recovery Plan as a recommended recovery action. A captive-breeding population of aplomado falcons has been managed by The Peregrine Fund to maintain and maximize genetic diversity (Burnham et al. 2002). This population was derived from nestlings collected from robust populations in Chiapas, Tabasco, and Veracruz, Mexico. Genetic testing was conducted to insure that progeny from aplomado falcons collected in southeastern Mexico would be suitable for release in northern Mexico and the United States, where the subspecies had been extirpated. Results from both mitochondrial DNA and microsatellite variation were analyzed, and revealed no genetic divergence between samples that would indicate any problems from reintroducing this lineage into the Chihuahuan grasslands of the United States (Kiff, in litt., 1995; Mindell, in litt., 1997; Burnham et al. 2002). This finding is consistent with the known dispersal tendencies of aplomado falcons and the fact that these populations are recognized as the same subspecies of northern aplomado falcon (*Falco femoralis septentrionalis*).

To further aid re-establishment, reintroduction sites were carefully selected to optimize habitat suitability. Aplomado falcon reintroductions were conducted between 1985 and 2013 in south and west Texas on National Wildlife Refuges and on private land under Safe Harbor Agreements. More than 849,840 ha (2.1 million ac) are now enrolled in the Aplomado Falcon Safe Harbor Agreement in both south and west Texas (Mutch 2013). Although the percentage has not been assessed, much of this area is not highly suitable habitat for the aplomado falcon.

Southern Texas Reintroductions. The number of aplomado falcons reintroduced along the southern coast of Texas increased beginning in 1993 (Table 1) (Jenny et al. 2004). By 1995, the first wild-breeding pair appeared; and by 2002, there were 37 known pairs, with at least 87 young fledging from wild nests during the 7-year period. By 2005, reintroductions had resulted in at least 44 pairs of northern aplomado falcons in southern Texas and adjacent Tamaulipas, Mexico, where no pairs had been recorded since 1942 (Jenny et al. 2004). By 2005, the Texas pairs had successfully fledged more than 244 young (Juergens and Heinrich 2005). In all, The Peregrine Fund released 839 birds from 22 locations before temporarily suspending the coastal Texas release program in 2004, when the population appeared to stop increasing. Aplomado falcon pairs became established on Matagorda Island near Rockport and just north of Brownsville. Aplomado falcon pairs did not become established near mainland hack sites on the mid-coast, including the Tatton Unit on Aransas National Wildlife Refuge, the Welder Wildlife Refuge, and the Laureles Division of the King Ranch. Nor did pairs appear on the Kenedy Ranch or King Ranch further south. In general, aplomado falcons settled primarily in open savanna and did not persist in areas of mesquite brush or in ranchland containing scattered oak mottes (Hunt et al. 2013). Trees and brush support great-horned owls, a principal predator of aplomado falcons on the Texas coast that accounts for the

majority of recorded deaths among both newly-released aplomado falcons and free-ranging birds (Jenny et al. 2004).

In May 2014, productivity data was collected on all of the territorial pairs in the Brownsville and Matagorda areas. The productivity rate was 2.0 young/pair for the coastal Texas population (1.9 Brownsville, 2.0 Matagorda). The total number of nestlings observed was 55 (27 Brownsville, 28 Matagorda). This high productivity rate indicates the effectiveness of nesting structures in ensuring that aplomado falcons are able to successfully nest in this population (Hunt et al. 2013).

West Texas Reintroductions. From 2002 to 2011, The Peregrine Fund reintroduced 637 aplomado falcon fledglings (19 to 138 per year) in west Texas at 11 reintroduction sites (Table 2.). The first two pairs were observed in 2007; and by 2009, 10 pairs were located near the town of Valentine, producing at least three wild young that year. In the next year, a sharp decline began in the number of pairs, from two pairs in 2010, to one pair in 2011, and none known thereafter.

Reasons for the abrupt loss of pairs during fall 2009 and winter 2009-2010 could not be immediately ascertained (Hunt et al. 2013). The area experienced severe drought by the middle of 2009, resulting from the virtual absence of late-summer and fall thunderstorms and winter rain (Hunt et al. 2013). This condition can cause a sharp reduction in seeds and insect abundance essential to the bird populations on which aplomado falcons depend (Macías-Duarte 2004). It is unknown whether the aplomado falcons starved, died from other causes, or survived by relocating to wetter areas (Hunt et al. 2013).

Table 1. Aplomado Falcon Reintroduction Summary for South Texas (Mutch 2013)

Year	Captive Pairs	Captive Young Produced	Young Retained	Released	Survival	Established Pairs
1978-1990	17	37	13	24	17	0
1991	21	12	12	0	-	0
1992	30	19	19	0	-	0
1993	28	26	0	26	20	0
1994	28	12	0	12	7	0
1995	31	49	10	39	29	1
1996	33	42	13	29	24	4
1997	36	115	7	108	68	4
1998	36	117	4	113	77	≥4
1999	41	126	11	115	86	≥19
2000	42	115	3	112	73	≥30
2001	41	129	5	124	64	≥33
2002	46	120**	10	75	46	≥37
2003	46	90**	10	32	28	≥39
2004	46	117**	5	31	24	≥39
2005	---	---	---	---	---	≥44
2006	---	---	---	---	---	≥43
2007	---	---	---	---	---	* ≥39
2008	---	---	---	---	---	≥31
2009	---	---	---	---	---	≥32
2010	---	---	---	---	---	≥32
2011	---	---	---	---	---	≥34
2012	31	73**	1	35	27	≥28
2013	26	55	3	52	46	≥28
TOTAL	26	1,254	126	927	636	≥28

* Estimate

** A percentage of captive production during these years went to release sites in west Texas or New Mexico.

Table 2. Aplomado Falcon Reintroduction Summary for West Texas and New Mexico (Mutch 2013).

Year	Captive Pairs	Captive Young Produced	Young Retained	Released	Survival	Established Pairs
2002	46	120*	10	35	25	1
2003	46	90*	10	48	36	0
2004	46	117*	5	81	60	0
2005	46	140	2	138	116	0
2006**	46	132	6	126	68	>2
2007	45	131	6	125	89	>6
2008	45	159	6	149	88	>10
2009	45	116	0	116	74	>13
2010	45	119	11	107	75	>3
2011	45	68	2	66	19	>2
2012	31	73*	1	32	22	0
2013	26	55*	3	0	n/a	1
TOTAL	26	1265	62	1023	653	1

* A percentage of captive production during these years went to release sites in south Texas.
** Aplomado falcon releases begin in New Mexico; west Texas reintroductions continue.

New Mexico reintroductions. In New Mexico, reintroductions were conducted under a Nonessential Experimental Population (NEP) designation under section 10(j) of the Act (U.S. Fish and Wildlife Service 2006). Young aplomado falcons were bred in captivity by The Peregrine Fund and reintroduced by the method of "hacking" from an artificial tower (Jenny et al. 2004). Typically, 6 to 8 banded fledglings about 36 days of age were placed in a large predator-proof "hack" box fixed to the top of a platform approximately 3 meters (m) (9.84 feet [ft]) in height. Attendants regularly provided freshly thawed Japanese quail (*Coturnix japonica*), taking care to prevent the aplomado falcons from associating food with humans. The boxes were opened after 7 to 10 days of acclimation, after which attendants continued monitoring and discretely feeding the aplomado falcons for 6 weeks following release. During this period, surviving birds begin to catch prey and venture from the release site for increasing periods (Jenny et al. 2004, Mutch et al. 2001).

The Peregrine Fund released 305 captive-bred fledglings from eight hack sites in New Mexico during the 6-year period from 2006 to 2011 (Table 2). Five nesting attempts have been observed in New Mexico since reintroductions began, three on the Armendaris Ranch and two near Deming (Sweikert and Phillips 2011, Gulf South Research

Corporation and La Tierra Environmental Consulting 2013). Two of the pairs on the Armendaris Ranch nested in artificial nesting towers even though nearby natural nest substrate was abundant (Sweikert and Phillips 2011). Six young fledged from pairs on the Armendaris Ranch and two young fledged from the Deming sites.

Survival of Reintroduced Northern Aplomado Falcons.

Bird Banding Reports – Coastal Texas. Using bird-banding reports of aplomado falcons reintroduced in coastal Texas, Brown et al. (2006) estimated that 17 percent of hacked, and 34 percent of wild-fledged aplomado falcons survived their first year. The higher survival rate of wild-fledged birds likely indicates the benefits of parental care. Although similar estimates are not available for aplomado falcons reintroduced in west Texas and New Mexico, the current lack of a breeding population and overall rarity of sightings in those regions is suggestive of a higher rate of mortality (Hunt et al. 2013). In coastal Texas, two breeding populations formed rapidly and have persisted, in conjunction with the installation of protective nest towers where natural nest trees were absent (Hunt et al. 2013). Currently, there are approximately 28 pairs of aplomado falcons nesting in coastal Texas, which is nearly one-half of the number required for down-listing to threatened status under the Act.

Radio-tracking Data – West Texas and New Mexico. Monitoring the survival of Chihuahuan Desert aplomado falcons after they left hack sites required implementation of radio-tracking. The Peregrine Fund fitted 66 captive-bred fledglings with radio transmitters in 2011, and hacked the birds using standard techniques. The sample included 19 individuals released from two sites near Valentine, Texas (Baeza and Moon RR) and 47 from four sites in New Mexico (Delk, Cole, Armendaris JP, and White Sands). Transmitters, all less than 3 percent of body weight and attached by Teflon ribbons in backpack configuration, included 56 conventional VHF instruments and ten satellite-reporting PTTs (Hunt et al. 2013).

Results from radio-tracking aplomado falcons in west Texas and New Mexico showed high rates of mortality at all of the hack sites, mainly due to avian predators (Table 3). At least 49 aplomado falcons (74 percent) died among the 66 released birds, and none was known to survive longer than 146 days after release. Other raptor species accounted for at least 26 (53 percent) of the 38 recovered mortalities. Radio signals of the 17 birds that may have survived (Table 3) were eventually lost, with the last mobile signal on November 21, 2011. It is unknown whether the loss of signals resulted from transmitter failure, or mortality events that inverted the solar panels. In all, seven aplomado falcons were last detected at distances of >10 km (6.21 mi) from their release sites. Two of these were recovered as mortalities, one of which died of predation and the other struck a barbed wire fence (Hunt et al. 2013).

Documented mortality was higher in west Texas than New Mexico. Thirteen fatalities were recovered among the 19 aplomado falcons released, and an additional four were missing within 21 days of release and were presumed dead (Hunt et al. 2013). One individual survived about 100 days and moved to the aplomado falcon nesting area in

Chihuahua, Mexico, where its satellite-reporting transmitter became stationary by early November 2011. In summary, one (5 percent) of 19 aplomado falcons released in west Texas may have survived. This bird was located 37 days after release, approximately 16 km (9.94 mi) from the release site. It returned to the release site and was thereafter missing with an inoperable transmitter (Hunt et al. 2013).

Mortality in west Texas was apparently higher in 2011 than in any previous year, as evidenced by the proportion of aplomado falcons lost within 21 days of release (Hunt et al. 2013). Eighty-four percent were missing within 21 days in 2011, compared with an average of 34 percent during 2002-2010. Survival was highest in 2005, following an unusually wet year (twice the 74-year average), and lowest in 2011 following a very dry year (<50 percent of average) (Hunt et al. 2013).

Mortality among the aplomado falcons reintroduced in New Mexico varied among sites. The highest survival rate was at the Armendaris Ranch, where grain and water stations enhanced prey bird numbers (Table 3) (Hunt et al. 2013). A minimum of 31 birds (66 percent) died within 21 days among the 47 aplomado falcons reintroduced at four sites in New Mexico, including 24 discovered carcasses and seven birds that disappeared during that interval. As in west Texas, the highest rate of attrition, 50 percent during the first 21 days, occurred in 2011, as compared with an average of 23 percent in the previous 5 years (Hunt et al. 2013).

Reasons for the high attrition in 2011 may have involved the impact of drought upon predator activity (Hunt et al. 2013). Prior to 2011, survival of hacked falcons in the Chihuahuan Desert was comparable to that reported from studies in south coastal Texas hack sites. During 1996-2004, 490 of 738 aplomado falcons survived 21 days from release in south coastal Texas (66.4 percent) compared with 667 of 999 (66.8 percent) in west Texas and New Mexico.

In summary, reintroduction of aplomado falcons in south coastal Texas has resulted in a potentially self-sustaining population of approximately 28 pairs with a high productivity level when nesting in artificial towers. These birds constitute approximately one-half the number of pairs needed for reclassification to threatened status under the Act. In the Chihuahuan Desert, the number of pairs of aplomado falcons has remained extremely low after reintroduction efforts. Only one pair has shown persistence in southwestern New Mexico. Reintroduced birds in this region may benefit from using artificial nest towers to protect adults and especially young birds from predators. In addition, efforts to restore native grassland habitat may contribute to improved survival of reintroduced aplomado falcons in the future.

Table 3. Causes of mortality for 66 radio-tagged aplomado falcons reintroduced at four hacks sites in New Mexico (Armendaris, White Sands, Delk, and Cole) and two in west Texas (Baeza and Moon) in summer 2011. Aplomado falcons missing within 21 days of release were presumed dead (from Hunt et al. 2013).

	Armendaris	**White Sands**	**Delk**	**Cole**	**Baeza**	**Moon**	**Totals**
Number of Reintroduced Aplomado Falcons	10	12	18	7	9	10	66
Swainson's Hawk			5				5
Great Horned Owl		2		1		3	6
Red-tailed Hawk					1		1
Large Falcon					1		1
Unidentified raptor	2		6			5	13
Bobcat				1			1
Unknown mammal				1	1		2
Wire strike				1			1
Lightning strike		2					2
Starvation					1		1
Unknown agent		2	1		1	1	5
Missing within 21 days	2	2	3		3	1	11
Total dead	4	8	15	4	8	10	49
Missing at 22 to 42 days	2	1		1	1		5
Known surviving >42 days	4	3	3	2			12
Potential survivors	6	4	3	3	1	0	17

2.3.1 Biology and Habitat

Updates concerning biology and habitat have been discussed above in relation to the accomplishment of recovery criteria. Genetics work has not indicated a need for any changes in taxonomy. Population trends, spatial distribution, and habitat conditions are addressed in section 2.2.3 above.

2.3.2 Five-Factor Analysis

Three threats under the five-factor analysis are relevant to the aplomado falcon and have been discussed above in relation to the accomplishment of recovery criteria. These include: 1. Present or threatened destruction, modification or curtailment of its habitat or range; 3. disease or predation; and; 5. other natural or manmade factors affecting its continued existence. Two of the threats are not relevant to the aplomado falcon. These are: 2. Overutilization for commercial, recreational, scientific, or educational purposes; and 4. the inadequacy of existing regulatory mechanisms.

Emerging Threats

Factor number 5, other natural or manmade factors affecting its continued existence, may include the relatively new potential threat posed by wind power operation and impacts from climate change.

Wind Turbines. Wind power operations may reduce avian prey available to the aplomado falcon by causing mortality from collision with turbines (Hunt et al. 2013, Perez 2014). Between 140,000 and 328,000 (mean = 234,000) birds are killed annually by collisions with monopole turbines in the contiguous United States (Loss et al. 2013). Increased tower height and blade length have both been correlated with increased bird fatalities (Smallwood 2013, Loss et al. 2013). In Section 4.0 below, Recommendations for Future Actions, it is suggested that the effects of wind power infrastructure and operation in aplomado falcon habitat be evaluated and addressed.

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, p. 78). 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, p. 78).

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, p. 30; IPCC 2013, and Solomon *et al*. 2007, pp. 35–54, 82–85). 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, pp. 5-6 and figures SPM.3 and SPM.4; Solomon *et al*. 2007, pp. 21–35). Further confirmation of the role of GHGs comes from analyses by Huber and Knutti (2011, p. 4), who concluded 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, entire; Ganguly *et al*. 2009, pp. 11555, 15558; Prinn *et al*. 2011, pp. 527, 529). 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 based on 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, pp. 44–45; Meehl *et al*. 2007, pp. 760–764 and 797–811; Ganguly *et al*. 2009, pp. 15555–15558; Prinn *et al*. 2011, pp. 527, 529). (See IPCC 2007b, p. 8, 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(entire) 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, pp. 8–14, 18–19). 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, p. 89; see also Glick *et al.* 2011, pp. 19–22). There is no single method for conducting such analyses that applies to all situations (Glick *et al.* 2011, p. 3). 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.

2.4 Synthesis

Reintroductions of 839 captive-bred aplomado falcons from 22 sites along the coastal plain of southern Texas from 1993 to 2004 have resulted, at present, in two potentially stable nesting populations, including 19 pairs near Brownsville and 15 pairs on two islands near Rockport. Continued monitoring in the absence of further reintroductions will help ascertain the persistence of these pairs. Suitable habitat for aplomado falcon survival and reproduction in south Texas is comprised of extensive open savanna. Currently, the region is almost entirely dominated by

farmland and brushland, which often harbors great-horned owls, a primary predator of the aplomado falcon. Conserving and expanding aplomado falcon populations on the Texas coastal plain will require protection and management of existing breeding territories and the creation and management of much larger areas of brush-free savanna than currently exist (Hunt et al. 2013). In addition, one emerging potential threat is the proposal of wind farms in southern coastal Texas in close proximity to nesting aplomado falcons.

Reintroductions of 637 aplomado falcons in the Chihuahuan Desert of western Texas (2002 to 2011) and 305 in southern New Mexico (2006 to 2011) have thus far been unsuccessful in establishing a wild population in either region (Hunt et al. 2013). One pair in west Texas in 2011 remained out of 10 present in 2009, and none were found in 2012, the apparent consequence of severe drought. A single pair known in New Mexico in 2011 was associated with supplemental feeding. In 2013 and 2014, a pair of aplomado falcons nested near Deming, New Mexico. In 2014, the pair successfully fledged young, one of which was monitored until July 2014, and was observed attempting to hunt birds. Persistent, severe drought that reduced prey populations and high rates of mortality from raptor predation has thus far precluded the re-establishment of aplomado falcons in west Texas or New Mexico.

In Mexico, following a major decline in numbers and range from the 1950s to 1980s, probably due to the eggshell-thinning effects of DDT (dichloro-diphenyl-trichloroethane), the range of this species has increased. This is attributed both to the ban on most uses of DDT and in response to deforestation in many coastal areas. Aplomado falcons are now nesting again in Tamaulipas, and probably Coahuila, Nuevo Leon, and Durango (Global Raptor Information Network 2014). However, the only known wild-nesting Chihuahuan Desert population in Mexico has declined sharply in recent years, most likely due to severe drought and land conversion to agriculture.

The aplomado falcon is dependent on expansive, open grasslands and associated avian communities for prey. The continued conversion of grasslands to agricultural uses and potential impacts from climate change may further reduce bird populations upon which aplomado falcons depend for prey and nests (Samson and Knopf 1994, Bahre 1995, Dinerstein et al. 2000, Macías-Duarte et al. 2007, Ceballos et al. 2010, Pool et al. 2012, Gulf South Research Corporation and La Tierra Environmental Consulting 2013, Pool et al. 2014). Because highly suitable potential habitat and the availability of grassland birds for prey are limiting factors, an ecosystem management approach that protects and improves existing grasslands has been recommended to benefit aplomado falcons and other grassland species (Gulf South Research Corporation and La Tierra Environmental Consulting 2013). This approach recommends maintaining the extent and suitability of existing aplomado falcon habitat as of primary importance. In addition, encouraging the development of healthy native grassland communities by limiting disturbance and shrub encroachment, as well as through proper management of fire, invasive species, and grazing, can improve habitat suitability for aplomado falcons and other birds (Gulf South Research Corporation and La Tierra Environmental Consulting 2013). A healthy grassland ecosystem will likely develop a sufficient avian prey base, yuccas, and other shrubs that form nest substrates, and will support ravens and other raptors that build nests that aplomado falcons can use (Gulf South Research Corporation and La Tierra Environmental Consulting 2013). It will also reduce the availability of woody cover, habitat favored by great-horned owl predators.

Changing climatic conditions are projected to create more extreme and generally drier conditions in the southwestern United States across the entire range of the aplomado falcon, thus increasing the level of threat to the subspecies (Gulf South Research Corporation and La Tierra Environmental Consulting 2013). Wildlife species subjected to these conditions are expected to experience lower productivity, greater stress, and reduced food resources (Parry et al. 2007, Albright et al. 2010, North American Bird Conservation Initiative 2010, Gulf South Research Corporation and La Tierra Environmental Consulting 2013). Increased aridity of grasslands will reduce the quantity and quality of vegetation and habitat that support prey for the aplomado falcon, and will make grasslands more susceptible to negative impacts from livestock grazing (Gulf South Research Corporation and La Tierra Environmental Consulting 2013). These conditions appear to have impacted aplomado falcons in the Chihuahuan Desert in the United States and Mexico, reducing survivorship of young and precluding establishment of, or reducing populations in these areas.

With low population numbers in the United States and without accelerated and improved management actions that address the threats and needs of the aplomado falcon, this subspecies is likely to remain in endangered status and in danger of extinction within the foreseeable future throughout all or a significant portion of its range.

3.0 RESULTS

3.1 Recommended Classification:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist (*Indicate reasons for delisting per 50 CFR 424.11):*
____ *Extinction*
____ *Recovery*
____ *Original data for classification in error*
__X_ No change is needed

3.2 New Recovery Priority Number: No change; remain as 3.

Brief Rationale: A Recovery Priority Number of 3 describes a subspecies with a high degree of threat and high potential for recovery. The degree of threat remains high due to the aplomado falcon's currently small population sizes, high mortality from predation, and low prey availability in west Texas and New Mexico. Although the recovery of the aplomado falcon in west Texas and New Mexico has not yet shown steady success, the establishment of two viable and continuing populations in coastal Texas indicates that this subspecies can exhibit a high recovery potential if the habitat conditions for predator protection, abundant bird and insect prey, and available nest sites can be met within expanses of native open grasslands.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

The following recommendations should be considered as potential future recovery actions for the aplomado falcon:

The Aplomado Falcon Recovery Plan should be amended to include the development of delisting criteria. Currently, the recovery plan contains only down-listing criteria. Down-listing criteria should also be re-assessed in light of recent research findings. Both criteria should include recommendations for spatial distribution of aplomado falcon pairs within the historic range.

Additional aplomado falcon reintroductions should be considered near Deming, New Mexico, in areas used successfully by nesting aplomado falcons over the past 15 years, and in south coastal Texas, in areas where habitat has recently been restored to suitability for aplomado falcons.

The feasibility of supplemental feeding stations should be investigated and considered in areas of limited prey availability for reintroduced aplomado falcons.

Artificial nest towers should be installed and maintained in coordination with New Mexico landowners and land managers at sites near Deming, and on the Armendaris Ranch, Bosque del Apache National Wildlife Refuge, Otero Mesa, and Lake Valley.

Conservation organizations and agencies should continue to work with similar entities in Mexico to address the sharp decline of the aplomado falcon population in Chihuahua. They should consider acquisition of land or perpetual conservation easements to protect, improve, and maintain suitable aplomado falcon habitat for the Chihuahuan population. In addition, research is needed to further understand the status of aplomado falcons in coastal Mexico.

The effects of wind power infrastructure and operation in aplomado falcon habitat should be evaluated and addressed. Also, the potential effects of noise on the aplomado falcon's use of land near the proposed SpaceX project in Texas should be evaluated and addressed.

Research should be conducted to evaluate whether great-horned owls are becoming more abundant and widely dispersed across the aplomado falcon's range and to assess methods to address this potential predation threat.

The potential threat from mercury in south Texas should continue to be monitored and addressed, if needed.

The potential effects of sea-level rise on the aplomado falcon population on Matagorda Island should be evaluated and addressed. Currently, the aplomado falcons on the central Texas coast are restricted to barrier islands. Sea-level rise could reduce the barrier island habitat used by aplomado falcons. It may be unlikely that enough coastal prairie habitat would remain or could be restored to support a population, if the territorial requirements observed to date on Matagorda Island of 2,000 acres/pair are needed.

The fate of young aplomado falcons fledged in coastal Texas should be studied by satellite tracking hatch-year birds.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Northern Aplomado Falcon*

Current Classification: Endangered and Non-essential Experimental Population, without critical habitat

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
__X__ No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: 3

Review Conducted By: Patricia Zenone, Senior Fish and Wildlife Biologist, New Mexico Ecological Services Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, U.S. Fish and Wildlife Service, New Mexico Ecological Services Field Office

Approve _____ Date 8/26/14

REGIONAL OFFICE APPROVAL:

Assistant Regional Director, Ecological Services, U.S. Fish and Wildlife Service, Region 2

Approve _____ Date 8/26/14