Recovery Outline[a] for the Jaguar (*Panthera onca*)

April 2012

PREPARED BY: The Technical Subgroup of the Jaguar Recovery Team in conjunction with the Implementation Subgroup of the Jaguar Recovery Team and the U.S. Fish and Wildlife Service

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This outline is meant to serve as an interim guidance document to direct recovery efforts, including recovery planning, for the jaguar until a full recovery plan is developed and approved. A preliminary strategy for recovery of the species is presented here, as are recommended high priority actions to stabilize and recover the species. The recovery outline is intended primarily for internal use by the U.S. Fish and Wildlife Service (USFWS) as a preplanning document. Formal public participation will be invited upon the release of the draft recovery plan for this species. However, any new information or comments that members of the public may wish to offer as a result of this recovery outline will be taken into consideration during the recovery planning process. Recovery planning began in January 2010, and the draft recovery plan is targeted for completion in winter 2012. The USFWS invites public participation in the planning process. Interested parties may contact the Arizona Ecological Services Office.

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I. INTRODUCTION

A. Species Name: Jaguar (*Panthera onca*)

B. Listing Status and Date: Prior to the current listing rule (62 FR 39147), the jaguar was listed as endangered from the United States (U.S.) and Mexico international border southward to include Mexico and Central and South America (37 FR 6476, March 30, 1972; 50 CFR 17.11, August 20, 1994). The species was originally listed as endangered under the Endangered Species Conservation Act (ESCA) of 1969. Under the ESCA, two separate lists of endangered wildlife were maintained, one for foreign species and one for the U.S. The jaguar appeared only on the "List of Endangered Foreign Wildlife". In 1973, the Endangered Species Act (ESA) replaced the ESCA. The foreign and native lists were replaced by a single ''List of Endangered and Threatened Wildlife,'' which was first published in the Federal Register on September 26, 1975 (40 FR 44412). On July 25, 1979, the U.S. Fish and Wildlife Service (USFWS) published a notice (44 FR 43705) stating that, although the jaguar was originally listed as endangered in accordance with the Endangered Species Conservation Act of 1969 (ESCA), when the 1973 Endangered Species Act superseded the ESCA, through an oversight the jaguar (and six other endangered species) remained listed on the List of Endangered Foreign Wildlife, but populations in the U.S. were not protected by the ESA. The notice asserted that it was always the intent of the USFWS that all populations of jaguars warranted listing as endangered, whether they occurred in the U.S. or in foreign countries; however, endangered status was not extended to the jaguar in the U.S. until July 22, 1997 (62 FR 39147) (see 62 FR 39147 for a complete listing history of the jaguar [http://www.fws.gov/southwest/es/arizona/Documents/SpeciesDocs/Jaguar/Jaguar_finalrule.pdf]). Historically, the jaguar inhabited 21 countries throughout the Americas, from the United States south into Argentina, but currently the jaguar is found in 19 of those countries (no longer in El Salvador and Uruguay).

Recovery Planning History

The jaguar was addressed in "Listed Cats of Texas and Arizona Recovery Plan (with Emphasis on the Ocelot)" (U.S. Fish and Wildlife Service 1990), but only general information and recommendations to assess jaguar status in the U.S. and Mexico, and protect and manage occupied and potential habitat in the U.S. were presented. No specific recovery recommendations or objectives for the jaguar were presented. In 2007, the USFWS made a 4(f)(1) determination that development of a formal recovery plan at this time would not promote the conservation of the

jaguar. The rationale for this determination was that for the purposes of formal recovery planning, the jaguar qualifies as an exclusively foreign species (see Memorandum for details at http://www.fws.gov/southwest/es/arizona/Documents/SpeciesDocs/Jaguar/Exclusion%20from%20Recovery%20Planning.pdf). The USFWS was subsequently litigated on this determination and the presiding judge remanded the decision regarding recovery planning back to the USFWS. Subsequently, in 2010, the USFWS made a new determination that development of a recovery plan would contribute to jaguar conservation and that, therefore the USFWS should prepare a recovery plan (http://www.fws.gov/southwest/es/arizona/Documents/SpeciesDocs/Jaguar/JaguarRPmemo1-12-10.pdf).

C. Lead Region, Field Office, and Contact Biologists: Region 2, the Southwest Region, of the USFWS is the lead for recovery of the jaguar. Arizona Ecological Services Office is the lead Field Office for the species. Lead biologists for the species are Marit Alanen of the Arizona Ecological Services Office (Tucson - 520/670-6150 x238) and Michelle Christman of the New Mexico Ecological Services Office (Albuquerque – 505/761-4715).

D. Level of available information and treatment of uncertainties: The Service convened the jaguar recovery team in 2010. By bringing together experts on the species, conservation biology, and other relevant topics on the recovery team, we hope to access the best information possible to develop a recovery plan. Open and free discussions and debate during team meetings will be needed to explore and sort all recovery options. However, we have much to learn about the conservation ecology of the jaguar, and recovery strategies and actions will need to be fine-tuned via research and adaptive management.

E. Purpose and Use of the Recovery Outline: This recovery outline has been prepared using the National Marine Fisheries Service's Interim Endangered and Threatened Species Recovery Planning Guidance Version 1.3, recently adopted by the USFWS (a copy may be obtained at http://www.nmfs.noaa.gov/pr/pdfs/recovery/guidance.pdf). As this guidance describes, recovery outlines are typically completed by the USFWS in consultation with other biologists, species experts, and stakeholders. This recovery outline, however, was prepared by the Jaguar Recovery Team (see section IV.F. below for more information on the Jaguar Recovery Team) with guidance and coordination by the USFWS. Based on the best currently available information, it provides a preliminary strategy for the jaguar that will guide recovery actions until a recovery plan is available. Although it includes interim recovery goals, objectives, and actions for the species, these will be further developed and presented in the draft recovery plan, which will undergo both public and peer review before the plan is finalized.

The USFWS is responsible for identifying and designating critical habitat for endangered species. For the jaguar this action is currently in review; the decision will be made in spring 2012. Documents developed by the Jaguar Recovery Team, including this recovery outline, and other relevant literature will be relied upon for the analysis. By law, if critical habitat is proposed, it can only be within the United States.

II. RECOVERY STATUS ASSESSMENT [b]

A. Biological Assessment:

Description

The jaguar is the largest felid in the New World (Seymour 1989). Rangewide, jaguars measure about 1.5 to 2.4 meters (m) (5 to 8 feet [ft]) from nose to tip of tail and weigh from 36 to 158 kilograms (kg) (80 to 348 pounds [lb]), although the 80 and 348 lb weights are exceptional (Nowak 1999, Seymour 1989). Males are typically larger than females, with reports of males being 10 to 25 percent larger than females (Emmons 1999, Wildlife Conservation Society 2007) and up to 20 to 30 percent larger (Sunquist and Sunquist 2007). In the southern part of the range, females tend toward 45 to 68 kg (100 to 150 lb) and males toward 77 to 100 kg (170 to 220 lb). In Central America and southern Mexico, both sexes trend slightly larger than they do to the north or south. Leopold (1959) listed a weight range in Mexico of 63 to 113 kg (140 to 250 lb) for males and 45 to 82 kg (100 to 180 lb) for females. Jaguars have a relatively robust head, compact but muscular body, short limbs and tail, and powerfully built chest and forelegs (Leopold 1959, Nowak 1999, Seymour 1989, Tewes and Schmidly 1987, Wildlife Conservation Society 2007). They have the strongest teeth and jaws of any American cat, and their skulls are more massive than those of mountain lions (Brown and López-González 2001). Their canines are well developed (Seymour 1989) and effectively deployed. The overall coat of a jaguar is typically pale yellow, tan, or reddish yellow above, and generally whitish on the throat, belly, insides of the limbs, and underside of the tail, with prominent dark rosettes or blotches throughout (Seymour 1989).

Subspecies

The jaguar was divided into a number of subspecies based on physical characteristics, like skull morphology (Mearns 1901, Nelson and Goldman 1933, Hall 1981, Seymour 1989, Wozencraft 2005). Pocock (1939) as cited by Larson (1997), described eight subspecies of jaguars, including five North American subspecies (Brown and López-González 2001): *Panthera onca arizonensis*, ranging from Arizona southward to southern Sonora; *P. o. hernandesii*, ranging from southern Sonoran southward to the state of Guerrero, Mexico; *P. o. centralis*, ranging from south of the Isthmus of Tehuantepec down through Central America and into Colombia; *P .o. goldmani*, ranging from the Yucatan Peninsula; and *P. o. veraecrucis*, ranged from southern Texas and eastern Tamaulipas southward to Tabasco. Yet, Larson's (1997) analysis of 11 skull characters (used historically to define subspecies) of jaguar specimens did not indicate distinct taxonomic groups, and found more variation within the previously-recognized subspecies than between them. More recently, molecular genetic analyses have revealed that subspecies recognition may not be warranted in jaguars (Eizirik et al. 2001). Ruiz-Garcia et al. (2006) reported that the genetic

[b] Passages throughout the assessment have been taken from and adapted, with the authors' permission, from Johnson et al. (2011).

heterogeneity between the two subspecies previously recognized by Pocock (1939) in Colombia (*Panthera onca centralis* and *P.o. onca*) and considered in their DNA microsatellite analysis was small, and therefore casts some doubt on the morphologically proposed subspecies separation. Johnson et al. (2002) found that mitochondrial DNA (mtDNA) analysis weakly supported two phylogeographic groups of jaguars, one north and one south of the Amazon River, South America, although there was evidence of continued gene flow between the two groups. Similarly, Eizirik et al. (2001) report that the Amazon River may represent a historical barrier to gene flow predominantly in females; though it appears to have been less of an impediment for male dispersal as inferred from microsatellite data.

The Larson and Eizirik studies had relatively small sample sizes, particularly in the northwestern-most portion of their range. Larson (1997) examined 170 skulls, but confined his study to data from 115 complete skulls; of these, four were from the *P. o. arizonensis* group. The Eizirik study included 44 jaguar samples, of which 42 were typed only for microsatellites and 37 for mtDNA. Of the 44 samples, none were from Sonora, Chihuahua, or the U.S.; one was from Sinaloa; and two were from Jalisco. Furthermore, it is unclear where specifically the Sinaloan sample and two of the Mexican zoos samples were from. Because these studies had limited sample sizes, further studies may be warranted to determine if real genetic differences among jaguar populations exist. Culver, of the Arizona Cooperative Fish and Wildlife Research Unit, U.S. Geological Survey, is currently working to assess the molecular taxonomy of northern jaguars (from Arizona and Sonora) compared to data from jaguars rangewide. The results from this analysis should be available in 2012.

Life History and Ecology

Reproduction and Lifespan

The life history of the jaguar has been summarized by Seymour (1989), among others. Jaguars may breed year-round rangewide; however, at the southern and northern ends of their range there is evidence for a breeding season (Seymour 1989). On average, gestation is 101 days with cubs being born in a sheltered place (Seymour 1989). Litters range from one to four although usually consists of two cubs (Seymour 1989). Cubs remain with their mother for 1.5 to 2 years (Seymour 1989). Sexual maturity ranges from 2 to just over 3 years for females and 3 to 4 years for males (Seymour 1989). According to Seymour (1989), in Belize, Rabinowitz (1986) found few wild jaguars over 11 years of age. A wild male jaguar in Arizona was documented to be at least 15 years of age (Johnson et al. 2011). In Jalisco, two wild females were documented to be at least 12 and 13 (Núñez-Pérez, August 2, 2011, email to FWS). Therefore, the lifespan of the jaguar in the wild is estimated to be approximately 10-15 years; however this estimation is based on limited information.

Diet

Cats are specialized ambush hunters with the stalk being the most important and least variable part of the prey capture sequence (Kitchener 1991, as cited by Cavalcanti 2008). Like other large cats, jaguars rely on a combination of cover, surprise, acceleration, and body weight to capture their

prey (Schaller 1972 and Hopcraft et al. 2005, as cited by Cavalcanti 2008). Jaguars usually catch and kill their prey by stalking or ambush and biting through the nape as do most Felidae (Seymour 1989). The list of prey taken by jaguars range-wide includes more than 85 species (Seymour 1989). Known prey include, but are not limited to, peccaries, capybaras, pacas, agoutis, deer, opossum, rabbits, armadillos, caimans, turtles, livestock, and various other reptiles, birds, and fish (Seymour 1989, Núñez et al. 2000, Rosas-Rosas 2006, Rosas-Rosas et al. 2008). Jaguars are considered opportunistic feeders, especially in rainforests, and their diet varies according to prey density and ease of prey capture (Seymour 1989). Jaguars equally use medium- and large-size prey, with a trend toward use of larger prey as distance increases from the equator (López-González and Miller 2002). In coastal Jalisco, Núñez et al. (2000) found that jaguars killed eight different prey species. In order of preference (via biomass consumed), the four main prey species of jaguars were white-tailed deer (54 percent of biomass consumed), collared peccary (14.96 percent), coati (14.85 percent), and armadillo (12.49 percent). Combined, these species contributed 89 percent of occurrence and 98 percent of the biomass consumed by jaguars. Other prey items included black iguana, birds, opossum, and rabbit (Núñez et al. 2000). In northeastern Sonora, where the northern most breeding population of jaguars occurs, Rosas-Rosas (2006) found that large prey (>10 kg) accounted for >80 percent of the total biomass consumed. Specifically, cattle accounted for more than half of the total biomass consumed (57 percent), followed by white-tailed deer (23 percent), and collared peccary (5.12 percent). Medium sized prey (1–10 kg), including lagomorphs and coatis, accounted for <20 percent of biomass. Small prey (<1 kg body weight) were not found in scats. It is thought that collared peccary and deer are mainstays in the diet of jaguars in the U.S.-Mexico borderlands (62 FR3 9147), though other available prey, including livestock and coatis, are likely taken as well. In other areas, however, different prey items become important in their diet such as reptiles (e.g., caimans and turtles) or large rodents (e.g., paca and capybara) (Da Silveira et al. 2010).

Genetic Fitness

According to Eizirik et al. (2008), information on genetic aspects of jaguar populations is still scarce. So far, two studies have analyzed the genetic structure of jaguars (Eizirik et al. 2001, Ruiz-Garcia et al. 2006), both of which reported evidence of historical connectivity across broad geographical areas, and only some inferred barriers to gene flow on a continental scale (e.g. the Amazon river, the Andean mountain chain, and an additional barrier affecting Central American populations) (Haag et al. 2010). Only two studies have examined the genetics of regional or local jaguar populations (Eizirik et al. 2008, Haag et al. 2010). Eizirik et al. (2008) surveyed the molecular diversity of two adjacent wild jaguar populations in the Brazilian Pantanal region. Their results indicate that moderate to high levels of variability are present in wild jaguar populations in the surveyed areas. Given that jaguars are believed to be more abundant in the southern Pantanal region than in many other parts of their distribution, Eizirik et al.'s preliminary data from this biome may serve as a baseline, which may be helpful when assessing current levels of diversity in small, fragmented jaguar populations.

Haag et al. (2010) investigated the genetic structure of four remnant jaguar populations in a recently fragmented Atlantic Forest region of South America to test whether loss of diversity and

differentiation among local populations are detectable and can be attributed to the recent effect of drift. They suggest that habitat fragmentation may disrupt original patterns of gene flow and lead to drift induced differentiation among local population units and that top predators, such as the jaguar, may be particularly susceptible to this effect, given their low population densities, leading to small effective sizes in local fragments. On the other hand, they report, the jaguar's high dispersal capabilities and relatively long generation time might counteract this process, slowing the effect of drift on local populations over the time frame of decades or centuries. Their results indicate that recent large-scale habitat removal and fragmentation of once contiguous habitat have caused the reduction of genetic diversity in jaguar populations in their study, as well as drift-induced differentiation among local fragments. The authors conclude that the jaguars' ability to effectively disperse across human-dominated landscapes that separate the fragments is currently very limited, and that each fragment contains a small, isolated population that is already suffering from the effects of genetic drift. They emphasize the importance of restoring gene flow among the study areas to avoid the negative demographic and genetic consequences of small population size, as well as to ensure the long-term viability of these groups. To accomplish this, they recommend the populations be managed as a metapopulation and that restoration of connectivity between the populations be a management priority.

To date, no studies have examined the genetics of jaguar populations in the northwestern most portion of their range. Boydston and López-González (2005) suggest, however, that range expansion to the north of eastern Sonora could help prevent genetic isolation and extinction of the northern jaguars and also increase chances for long-term survival of this species in the face of global anthropogenic changes. Citing Young and Clarke (2000), Grigione et al. (2009) suggest that conservation of peripheral populations, such as the jaguar in the northernmost portion of its range, plays a role in maintaining the total genetic heterozygosity of a species.

Disease and Epizootics

Furtado and Filoni (2008) report the most common virus in jaguars is canine distemper virus (CDV), which is known to cause high mortality in wild felids (e.g. 30 percent mortality in Serengeti lions) and has also caused epizootics in captive felids. CDV is usually associated with the presence of domestic dogs. Feline leukemia virus (FeLV), feline coronavirus (FCoV), and feline immunodeficiency virus (FIV), have also been detected in jaguars, all of which commonly affect domestic cats (Furtado and Filoni 2008). FIV may cause, although infrequently, feline infectious peritonitis (FIP), which results in systemic failure and ultimately death. Additionally, feline parvovirus (FPV) has been detected in jaguars (Furtado and Filoni 2008). Its presence can be asymptomatic or with specific symptoms, and in severe cases leads to gastroenteritis and a decrease in blood cells, which can be fatal. There are also reports of jaguars with Feline herpesvirus (FHV 1) (Furtado and Filoni 2008). The bacteria most frequently detected in jaguars are *Leptospira* sp., which does not cause major problems for jaguars; *Brucella* sp., commonly found in cattle; and *Bartonella henselae*, of which jaguars are reservoirs and potential transmitters to humans (Furtado and Filoni 2008). Some jaguars have also been shown seropositive to the anthrax bacterium (*Bacillus anthracis*) (Furtado and Filoni 2008). Infection by the fungus *Pythium insidiosum* has also been reported in jaguars (Furtado and Filoni 2008). Toxoplasmosis (*Toxoplasma gondii*) has been found in wild and

captive jaguars; however, jaguars with toxoplasmosis have not been found to exhibit any clinical symptoms (Furtado and Filoni 2008).

A wide variety of endoparasites has been found in wild jaguars, particularly the nematode *Dirofilaria immitis* (Furtado and Filoni 2008). Ectoparasite information is scarce and little information exists on the micro-parasites for which they are vectors (Furtado and Filoni 2008). Non-infectious diseases that have been reported include dental, gastrointestinal, musculoskeletal, and integumentary diseases as being the most common causes of morbidity (Furtado and Filoni 2008). Neoplasia, degenerative spinal disorders, and impairment of hearing have also been detected in captive jaguars (Furtado and Filoni 2008). Dental fractures (particularly of the canines) have been reported in wild jaguars (Furtado and Filoni 2008, Van Pelt, August 2, 2011, email to FWS).

In their northernmost range, jaguars have been reported to feed on domestic animals, including cattle and dogs, which could represent a threat to jaguars due to the potential for disease transmission (Rosas-Rosas, August 6, 2011, email to FWS). This may particularly be a problem in the Sierra Madre Oriental, where jaguars are known to feed on dogs (Rosas-Rosas, August 6, 2011, email to FWS). Furtado and Filoni (2008) explain that information on jaguar health is limited because animals in captivity are rarely subjected to clinical examinations. Furthermore they state that information on infectious and noninfectious diseases in jaguars is limited throughout is range, fragmented, based on small samples, and collected without an established methodology that allows comparisons among the case studies. They recommend that long-term studies in wild and captive jaguars are needed to understand the role and effect of diseases within populations.

Home Range and Movement

Like most large carnivores, jaguars have relatively large home ranges. According to Brown and López-González (2001), their home ranges are highly variable and depend on topography, available prey, and population dynamics. However, little information is available on this subject outside tropical America, where several studies of jaguar ecology have been conducted. Data compiled from studies in Brazil, Venezuela, and Belize found mean home range areas for males to vary from 12.8 to 140 square kilometers (km^2)(5 to 52 square miles [mi^2]) during the wet season and 28 to 165.8 km^2 (11 to 64 mi^2) during the dry season. For females, the ranges were smaller, with less variation between seasons (Rabinowitz and Nottingham 1986, Crawshaw and Quigley 1991, Brown and López-González 2001, Cavalcanti and Gese 2009). In the tropical deciduous forest of Jalisco, Mexico, mean home range size for two males was 100.3 +/- 15.0 km^2 (38.7 +/- 5.8 mi^2) and four females was 42.5 +/- 16 km^2 (16.4 +/- 6.2 mi^2) (Núñez-Pérez 2006). Only one limited home range study using standard radio-telemetry techniques has been conducted for jaguars in northwestern Mexico. Telemetry data from one adult female tracked for four months during the dry season in the municipality of Sahuaripa, Sonora, indicated a home range size of 100 km^2 (39 mi^2) (López-González 2011, pers. comm.). Additionally, camera trap data indicated that the average male home range in the municipality of Sahuaripa, Sonora, was 84 km^2 (32 mi^2) (López-González 2011, pers. comm.). Also using camera traps, in Nacori Chico, Sonora, Rosas-Rosas and Bender (in review) estimated the home range for one adult male jaguar encompasses about

200 km^2 (77 mi^2). No home range studies have been conducted for jaguars in southwestern U.S. using standard radio-telemetry techniques; though McCain and Childs (2008), based on the use of camera-traps, report one jaguar in southeastern Arizona as having a minimum observed "range" of 1359 km^2 (525 mi^2). Because female jaguar scat was used at some camera traps at various times throughout their research, it is unknown whether or how this could have influenced the observed range of the jaguar in this study.

In coastal Jalisco, jaguars moved up to 20 km (12.4 mi) in one night and one juvenile male dispersed about 70 km (43.5 mi) to the north (Núñez et al. 2002). The mean one-day movement of radio-collared jaguars in the Pantanal region of southwestern Brazil was 2.4 +/- 2.3 km (1.5 +/- 1.4 mi), with that of one male being significantly larger (3.3 +/- 1.8 km [2.0 +/- 1.1 mi]) than that displayed by females (1.8 +/- 2.5 km) (Crawshaw and Quigely 1991). Additionally, the mean distance travelled by all animals during one-day intervals in the dry season (2.7 +/- 2.5 km [1.7 +/- 1.5 mi]) was significantly greater than the mean one-day movement for all other months combined (1.6 +/- 2.1 km [1.0 +/- 1.3 mi) (Crawshaw and Quigley 1991). In Brazil, male jaguars have been documented to disperse up to 64 km (Rabinowitz and Zeller 2010).

Density

Jaguar density estimates vary throughout the jaguar's range, and are calculated using either camera trap or telemetry-based methods.

Camera trap methods

Camera trapping efforts have yielded jaguar population density estimates from 0.11-1.7 jaguars per 100 km^2 (39 mi^2) in the tropical rain forest of the Upper Parana in Argentina to 11.7 jaguars per 100 km^2 (39 mi^2) in the semi deciduous forest of the Pantanal in Brazil (see Table 2 in Núñez-Pérez 2011). In the northwestern portion of their range, a population density estimate of 5.4 jaguars per 100 km^2 (39 mi^2) (Núñez-Pérez 2011) with a sex ratio of 1 male to 1.6 females (Manriquez, 2011, pers. comm.) was reported in the tropical dry forest of the Chamela-Cuixmala Biosphere Reserve in coastal Jalisco. In 2010 in the tropical deciduous and pine forests of Cabocorrientes, Jalisco, a density was estimated of 2.8 jaguars per 100 km^2 (39 mi^2) with an equal proportion of males to females (Manriquez 2011, pers. comm.). In 2010 in the tropical deciduous and semi-evergreen forests Sierra de Vallejo, Nayarit, densities were estimated at 4.6 (null model) and 5.6 (heterogeneous model) jaguars per 100 km^2 (39 mi^2) with an equal proportion of males to females (Núñez-Pérez et al. 2010). In 2009 in the mangroves of Marismas Nacionales, Nayarit, a density was estimated of 6 jaguars per 100 km^2 (39 mi^2) with an equal proportion of males to females (Núñez-Pérez et al. 2010). Additionally, the presence of cubs was documented at all four of the aforementioned sites in Jalisco and Nayarit (Núñez-Pérez et al. 2010). In the Sinaloan thornscrub of Sonora, density estimates of 0.94 +/- 0.28 (Gutierrez-González et al. in press), 1 (Rosas-Rosas and Bender, In Review), and 1.4 jaguars (Gutierrez-González and López-González 2010) per 100 km^2 (39 mi^2) have been reported. In the state of San Luis Potosí in the Sierra Madre Oriental, a density was estimated of 4 jaguars per 100 km^2 (39 mi^2) (Ávila et al., In Review).

Telemetry based methods

In the Brazilian Pantanal, GPS-telemetry-based calculations produced a mean density of 6.6 and 6.7 jaguars/100 km^2 (39 mi^2) in 2003 and 2004, respectively (Soisalo and Cavalcanti 2006). Soisalo and Cavalcanti (2006) report that estimates using camera trapping techniques can over-estimate cat density (camera techniques yielded densities of 10.3 to 11.7 jaguars per 100 km^2 [39 mi^2]), likely due to repeated photographs of the same individuals. In the tropical dry forest of the Chamela-Cuixmala Biosphere Reserve in coastal Jalisco, telemetry-based calculations produced a population density estimate of 5 jaguars/100km^2 (39 mi^2), which was similar to that produced by camera technique (5.4 jaguars per 100 km^2) for the same population (Núñez-Pérez 2011).

Habitat Association

Jaguars are known from a variety of vegetation communities (Seymour 1989). Toward and at middle latitudes, they show a high affinity for lowland wet communities, including swampy savannas or tropical rain forests. Swank and Teer (1989) stated that jaguars prefer a warm, tropical climate, usually associated with water, and are rarely found in extensive arid areas. However, jaguars have been documented in arid areas, including thornscrub, desertscrub, lowland desert, mesquite grassland, Madrean oak woodland, and pine-oak woodland communities of northwestern Mexico and southwestern U.S. (Boydston and López-González 2005, McCain and Childs 2008, López-González and Brown 2002). The more open, dry habitat of southwestern U.S. has been characterized as marginal in terms of water, cover, and prey densities (Rabinowitz 1999). Brown and López-González (2001) report that the major habitat requirement appears to be a closed vegetative structure and that jaguars usually avoid open country like grassland or desertscrub. For this reason, jaguars rarely occur above 2,591 m (8,500 ft) (Brown and López-González 2001).

Several studies have examined habitat use of jaguars throughout their range, including, but not limited to, Crawshaw and Quigley (1991), Cavalcanti (2008), and Conde et al. (2010). In the Pantanal region of southwestern Brazil, Crashaw and Quigley (1991) found that the mean percentage composition of the four most common habitat types for all jaguars in their study was 44 percent open forest (35-57 percent), 29 percent grassland, 19 percent gallery forest, and 7 percent forest patches. Jaguars used habitat in different proportions than available in their home ranges (3^{rd} order habitat selection as described by Johnson 1980); gallery forest and forest patches were used more often than expected on the basis of their availability and open forest and grassland were used less than expected (Crawshaw and Quigley 1991). Additionally, the mean distance radio-collared jaguars were located from permanent water sources (0.5 km or 0.3 mi) was significantly smaller than the distance from water of randomly generated points within jaguar home ranges (1.7 km or 1.1 mi) (Crawshaw and Quigley 1991). Cavalcanti (2008) examined 2^{nd} and 3^{rd} order habitat selection (see Johnson 1980) of jaguars in the southern Pantanal in west-central Brazil. She found that, in general, jaguars used habitats disproportionately to their availability in the study area (2^{nd} order selection) in the wet and dry seasons. Forests and shrublands were selected by jaguars, while open field, open field with sparse trees, wetland vegetation, open water, and bare soil/agricultural land habitats were generally avoided by jaguars. However, herbaceous field and drainage vegetation habitats were only avoided during the wet season, but used according to their availability during the dry season. Additionally,

the mean distance radioed jaguars were located from permanent sources of water was significantly smaller than the distance from water of randomly generated points within the study area (Cavalcanti 2008). Jaguars differed in the use of different habitat types available within their individual home ranges (3rd order selection) (Cavalcanti 2008).

Conde et al. (2010) found significant differences in habitat use between male and female jaguars in the Mayan Forest of the Yucatan Peninsula by modeling occupancy as a function of land cover type, distance to roads, and sex. Although both male and female jaguars prefer tall forest, short forest was used by females but avoided by males. Whereas females significantly avoided roads, males did not and ventured into low-intensity cattle ranching and agriculture. Females' preference for intact forests and against roads led to a less extensive, more fragmented habitat distribution for females than for males. Conde et al. (2010) suggest that specifying sex differences increases the power of habitat models to predict landscape occupancy by large carnivores, and so greater attention should be paid to these differences in their modeling and conservation.

Other studies have also shown that jaguars selectively use large areas of relatively intact habitat away from certain forms of human influence. Zarza et al. (2007) report that towns and roads had an impact on the spatial distribution of jaguars (jaguars used more frequently than expected by chance areas located more than 6.5 km [4 mi] from human settlements and 4.5 km [2.8 mi] from roads) in the Yucatan peninsula. In the state of Mexico, Monroy-Vichis et al. (2007) report that one male jaguar occurred with greater frequency in areas relatively distant from roads and human populations. In some areas of western Mexico, however, jaguars (both sexes) have frequently been recorded near human settlements and roads (Núñez-Pérez, August 2, 2011, email to FWS.). In Marismas Nacionales, Nayarit, a jaguar den was recently located very close to an agricultural field, apparently 1 km (0.6 mi) from a small town (Núñez-Pérez, August 2, 2011, email to FWS). Jaguar presence is affected in different ways by various human activities; however, direct persecution likely has the most significant impact.

No formal habitat use studies have been conducted (with the exception of Núñez et al.'s [2002] examination of arroyo use) in the northwestern most portion of the jaguar's range. However, results of a study in the municipality of Nácori Chico, Sonora, showed that jaguar kill sites of wild prey (i.e., white-tailed deer and peccary) (Rosas-Rosas, August 6, 2011, email to FWS) and cattle were positively associated with oak forest and semi-tropical thornscrub vegetation types, whereas they were negatively associated with upland mesquite (Rosas-Rosas et al. 2010). Sites of cattle kills were also positively associated with proximity to permanent water sources and roads (Rosas-Rosas et al. 2010). General jaguar habitat associations have been described in this region by various authors. In western Mexico, including Nayarit and Jalisco, jaguars primarily occur in tropical deciduous forest, although other formerly important habitats are the mangrove forests and swamps of the Agua Bravo and Marismas Nacionales straddling the borders of Nayarit and Sinaloa (Brown and López-González 2001). In Jalisco, oak and pine forest are used by jaguars, some of them located between 2,700 and 2,800 m (8,858 ft and 9,186 ft) in elevation (Núñez-Pérez, August 2, 2011, email to FWS). Although jaguars are not primarily associated with these vegetation communities, it is

important to consider oak woodlands and pine forests as potential jaguar corridors (Núñez-Pérez, August 2, 2011, email to FWS).

In the tropical dry forest of coastal Jalisco, jaguars use arroyos in greater proportion to their availability (Núñez et al. 2002). Jaguars also occur in tropical deciduous forest in southern Sonora and Sinaloa (Rojero-Diaz, pers. comm. 2005, Navarro-Serment et al. 2005). Through interviews, Navarro-Serment et al. (2005) obtained 57 Class I records[c] of jaguars in Sinaloa; records were most abundant in the southern half of the state. Most occurrences were from the tropical deciduous forest, which originally grew across most of the lowlands in Sinaloa and still covers much of the Sierra (Navarro-Serment et al. 2005). According to Brown and López-González (2001), the most important biotic community for jaguars in the southwestern borderlands (Arizona, New Mexico, Sonora, Chihuahua) is Sinaloan thornscrub, which inhabits the lower bajadas and basins between 457 and 945 m (1,500 and 3,100 ft) in elevation. Based on records obtained through interviews, they report that nearly 80 percent of the jaguars killed in state of Sonora were documented in Sinaloan thornscrub. Madrean evergreen woodland is also important for borderlands jaguars; nearly 30 percent of jaguars killed in the borderlands region were documented in this biotic community (Brown and López-González 2001).

Several studies have helped refine a general understanding of habitats that have been or might be used by jaguars in Arizona and New Mexico, including studies by the Sierra Institute Field Studies Program (2000), Hatten et al. (2002 and 2005), Menke and Hayes (2003), Boydston and López-González (2005), Robinson et al. (2006), McCain and Childs (2008), and Grigione et al. (2009). As Johnson et al. (2011) explain, however, any conclusions about the conservation importance of the habitat types in which jaguars have occurred or might occur in Arizona and New Mexico are preliminary and can vary widely, depending on what assumptions are factored into the analyses, such as the number and reliability of jaguar occurrence records and the significance of single "point in time" occurrence observations as predictors of habitat use by jaguars.

Hatten et al. (2005) used Geographic Information System (GIS) to characterize potential jaguar habitat in Arizona by overlaying 25 historic jaguar sightings on landscape and habitat features believed important (e.g., vegetation biomes and series, elevation, terrain ruggedness, proximity to perennial or intermittent water sources, human density). The amount of Arizona land area identified as potential jaguar habitat ranged from 21 to 30 percent, depending on the input variables. One hundred percent of jaguar records were observed in four biomes. Of these, 56 percent were observed in scrub grasslands of southeastern Arizona, 20 percent in Madrean

[c] Class I records include those records with physical evidence for verification. Class I reports are considered "verified" or "highly probable" as evidence for a jaguar occurrence. Class II records have detailed information of the observation but do not include any physical evidence of a jaguar. Class II observations are considered "probable" or "possible" as evidence for a jaguar occurrence. This classification protocol was developed by adapting criteria published by Tewes and Everett (1986), based on work in Texas with jaguarundis and ocelots (*Leopardus pardalis*). The Arizona-New Mexico Jaguar Conservation Team reviewed and endorsed the protocol in 1998 for use in evaluating jaguar occurrence reports for Arizona and New Mexico.

evergreen forest, 12 percent in Rocky Mountain montane conifer forest, and 12 percent in Great Basin conifer woodland. At the vegetation series level, jaguars were observed 4.7 times more often in mixed grass-scrub than any other community. Related to water, when springs, rivers, and creeks were combined, 100 percent of the jaguar records were within 10 km (6.2 mi) of a water source. Sixty percent of jaguars were observed between 1,220 and 1,829 m (4,003 and 6,001 ft) in elevation, largely in the scrub grassland biome of southeastern Arizona. The remaining jaguar sightings were between 1,036 and 2,743 m (3,399 and 8,999 ft). With respect to topography, 92 percent of jaguar sightings occurred in intermediately rugged to extremely rugged terrain, with the remainder (8 percent) in nearly level terrain. Hatten et al. (2005) report that apparent preference of jaguars for scrub grasslands may actually reflect the use of travel corridors from the Sierra Madre Occidental of Mexico into southeastern Arizona rather than a preferred vegetation type, or perhaps jaguars were just more visible in open grasslands. They suggest that river valleys might provide travel corridors for jaguars, along with higher prey densities, cooler air, and denser vegetation than surrounding habitats. Furthermore, they suggest that perhaps the most important factor explaining jaguars' apparent preference for rugged terrain is the abundance of water in mountainous areas of southeastern Arizona. They identified a great deal of potential jaguar habitat along the Mogollon Plateau, but hypothesize that land use practices are limiting jaguar movement into central Arizona. They report that jaguar distribution patterns in the last 40 years suggest that southeastern Arizona is the most likely area for future jaguar occurrence in the U.S. and conservation efforts should focus on protecting potential jaguar habitat in Santa Cruz, Pima, Cochise, Pinal, and Graham counties.

Menke and Hayes (2003) conducted a spatial analysis of potential habitat for the jaguar in New Mexico. Because only seven jaguar reports and records from 1900 to 1996 have occurred in New Mexico, Menke and Hayes identified positive and negative potential habitat features for jaguars based on literature sources and evaluations from the Jaguar Habitat Subcommittee (JAGHAB) and Jaguar Scientific Advisory Group (JAGSAG) of the Arizona Game and Fish Department (AGFD) and New Mexico Department of Game and Fish (NMDGF)-led Jaguar Conservation Team. A GIS model was used to combine data layers for landscape features influencing suitability for jaguar habitat, and created a composite potential habitat map. Potential habitat variables modeled were human density, vegetation community, distance to water, prey abundance, and terrain ruggedness. Their final model predicted two areas with the highest probability of containing habitat variables that could support jaguars in New Mexico, including the Peloncillo and Animas mountains in far southwestern New Mexico, and the river canyon and adjacent areas of the Gila and San Francisco River drainages along the New Mexico-Arizona border and to the east. Although their relative suitability map for potential jaguar habitat in New Mexico does not predict the probability of jaguars occurring in any specific area, it can be used to evaluate potential corridors and routes of travel for jaguars in the U.S. They recommend that a complete evaluation of the prospects for long-term persistence of the jaguar in the U.S. must encompass information regarding not only the availability of potential habitat, but must also consider the potential linkages to habitats that currently sustain breeding populations of jaguars. Furthermore they suggest that additional jaguar habitat use data from the northern end of the jaguar's range is needed to test and improve the existing habitat models.

Robinson et al. (2006) conducted another analysis of potential habitat for jaguars in New Mexico. They mapped suitable habitat based on the JAGHAB's criteria used to identify jaguar habitat in the U.S. which included:

1) The area considered must be within 80 km (50 mi) of a documented jaguar occurrence. This would include an entire mountain range, if a portion of that range is within 80 km (50 mi) of the occurrence.
2) Based on Brown and Lowe (1994[map originally printed in 1980]) (as cited by Robinson et al. 2006) habitat associations, the area must be in the Semi-desert Grassland, Plains and Great Basin Grassland, Subalpine Grassland, Interior Montane Conifer Forest, Petran Subalpine Conifer Forest, Chihuahuan Desertscrub, Arizona Upland Sonoran Desertscrub, or Great Basin Desertscrub. Areas in the Lower Colorado River Sonoran Desertscrub, Mojave Desertscrub, and Alpine Tundra are not considered jaguar habitat.
3) The area must be within 16 km (10 mi) of surface water, at least seasonally.
4) Areas with continuous row crop agriculture over an area greater than one square mile and any agricultural crop areas immediately adjacent to those areas are not considered adequate habitat. Areas with human residential development in excess of 1 house per 4 hectares (ha) (10 acres [ac]) are not considered jaguar habitat. Areas developed for industrial purposes or a combination of industrial and residential development that create a footprint equal to or greater than 1 house per 4 ha (10 ac) are not suitable jaguar habitat.

To conduct their mapping exercise, Robinson et al. (2006) used 18 sightings (including three Class I sightings and 15 Class II sightings) from New Mexico and added 6 occurrences within 50 miles of New Mexico that are mapped in Hatten et al. (2005). Robinson et al.'s (2006) effort indicates that approximately one half of New Mexico is considered suitable habitat, and suggests the greatest threat to the integrity of jaguar habitat in the U.S. today is likely to be heavily-traveled, multiple-lane highways, such as interstates 25, 10, and 40 in New Mexico.

Boydston and López-González (2005) estimated the potential geographic distribution of jaguars in the southwestern U.S. and northwestern Mexico by modeling the jaguar ecological niche from occurrence records (100 male records from Arizona [42], New Mexico [6], Chihuahua [8], and Sonora [39] and 42 female records from Arizona [6] and Sonora [36]). They report that eastern Sonora appeared capable of supporting male and female jaguars with potential range expansion into southeastern Arizona, while New Mexico and Chihuahua contained environmental characteristics primarily limited to the male niche and thus may be areas into which males occasionally disperse. They found significant differences between land cover within the female distribution and the available landscape. The predicted distribution of female jaguars was mainly across areas of shrubland, deciduous broadleaf forest, and grassland, but deciduous broadleaf forest and mixed forest composed more of the female distribution than expected by chance when compared to the available land cover for the study area. Shrubland was a smaller proportion of the female distribution than expected, and grassland and needleleaf forest were present in proportion to their availability. Boydston and López-González's (2005) results indicated that the availability of areas meeting females' environmental requirements may be an important factor limiting the distribution of northern jaguars.

Grigione et al. (2009) conducted a study to construct a blueprint of priority conservation areas for jaguars, ocelots, and jaguarundis in the U.S. – Mexico border region. This was done by 1) compiling reliable (i.e., Class I) sightings for each species from the early 1900s to 2003, 2) conducting field surveys to ascertain species presence, and 3) conducting a GIS based habitat mapping workshop in which 29 scientists and conservationists provided information on the distribution and status of each species. Participants were asked to delineate and describe specific areas in the border region where historical and recent sightings of the three cats have occurred, resulting in a compilation of 84 Class I jaguar sightings from Arizona (20), New Mexico (8), and Sonora (56). They were then asked to identify important habitat areas, dispersal corridors, required or existing underpasses, and to characterize habitat areas and corridors. Finally, each participant was also asked to delineate Cat Conservation Units (units) and Cat Conservation Corridors (corridors) for their area of knowledge onto maps. Units were defined as habitat areas important to the long-term survival of a species, often where populations are currently located or areas likely to support relocated populations. Corridors were defined as strips of habitat connecting otherwise isolated units that had documented Class 1 sightings. Units and corridors were ranked into prioritization categories from very high to moderate conservation importance based on nine different factors. For the jaguar in the western bioregion of the study area (including Arizona, New Mexico, Sonora, Chihuahua, and Sinaloa), four units were identified (two very high priority, one high priority, and one low priority), including two in the U.S. and two in Mexico (totaling 102,530 km^2 [39,587mi^2]). Within these four units, currently 19.8 percent of the area has any form of protection (Grigione et al. 2009). A very high priority corridor was identified between the two Mexican units; otherwise the connections between the units are poorly understood and consequently two corridors needing further study were identified. Two underpasses were identified as being needed in northern Sonora, where jaguars are believed to be crossing roads as they disperse north. The authors conclude that the region to the south of Arizona and New Mexico is especially critical for the recovery of the jaguar in the southwestern U.S. because the source population is likely in central Sonora. Citing Brown and López-González (2001) and List (2007), Grigione et al. (2009) explain that to reach the U.S., jaguars need to travel through Sonora and Chihuahua, where there are many challenges to jaguar survival and movement, including the U.S. –Mexico border fence.

The USFWS (2011) sent a questionnaire to scientists with experience or expertise in jaguar ecology (primarily in the northwestern most portion of the jaguar range) or large cat ecology. The respondents included nine members of the Technical Subgroup of the Jaguar Recovery Team and two other jaguar experts. Among others questions, the survey asked "what features constitute high-quality habitat for jaguars in the northwestern portion (i.e., southwestern U.S. and northwestern Mexico) of their range?" High quality habitat was defined as habitat that can support a self-sustaining population of jaguars (i.e., breeding with population growth (a λ of 1.0 or greater) and a minimal risk of extinction). The respondents' compiled answers indicated the following features constitute high-quality habitat for jaguars in the northwestern portion of their range:

- High abundance of native prey, particularly large prey like deer and peccary, and adequate numbers of medium sized prey;
- Water available within 10 km (6.2 mi) year round;

- Dense vegetative cover (to stalk and ambush prey and for denning and resting), particularly including Sinaloan thornscrub;
- Rugged topography, including canyons and ridges, and some rocky hills good for denning and resting;
- Connectivity to allow normal demographic processes to occur and maintain genetic diversity;
- Expansive areas of adequate habitat (i.e., area large enough to support 50 to 100 jaguars) with low human density;
- Low human activity, development, and infrastructure, including high speed roads, mines, agriculture; and
- No to low jaguar persecution/poaching by humans.

Distribution and Abundance

Western Hemisphere

Jaguars historically ranged from southern U.S. to central Argentina: Argentina, Belize, Bolivia, Brazil, Colombia, Costa Rica, Ecuador, El Salvador, French Guiana, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Suriname, U.S. (AZ, NM, TX), Uruguay, Venezuela (Swank and Teer 1989, Caso et al. 2008). Currently, they range from the southwestern U.S. to northern Argentina, and are found in all countries except for El Salvador and Uruguay (Zeller 2007). Abundance and population trends for the jaguar are still not well known; however, populations throughout their range continue to be at risk. To better understand abundance and population trends for this species, research, inventories, and monitoring programs are being implemented in some parts of the jaguar range (Caso et al. 2008, Wildlife Conservation Society 2007, Chávez et al. 2007, Panthera 2011). During a symposium in November 2009 titled "The Jaguar in the XXI Century: The Continental Perspective", experts estimated that there are still probably more than 30,000 jaguars (Medellin 2009) and that Mexico has an estimated 4,100 jaguars (Zarza et al. 2010). Sanderson et al. (2002) found that the jaguar is known to be extant in about 8.75 million km^2 (3.4 million mi^2), which represents 46 percent of its historical global range. Jaguars are known to be extirpated in 37 percent of their historical range, and their status in another 18 percent is unknown (Sanderson et al. 2002). The probability of long-term survival of the jaguar is considered high in 70 percent of the currently occupied range (over 6 million km^2 or 2.3 million mi^2) (Sanderson et al. 2002).

Zeller (2007) updated Sanderson et al.'s (2002) work and found that the jaguar is known to be extant in about 11.7 million km^2, which represents 61% of its historical range, likely reflecting simply a greater representation of knowledge rather than actual range expansion. Within the currently occupied range, 90 Jaguar Conservation Units (JCUs) were identified representing a total area of 1.9 million km^2 (0.7 million mi^2) (Zeller 2007). JCUs were defined either as 1) areas with a stable prey community, currently known or believed to contain a population of resident jaguars large enough (at least 50 breeding individuals) to be potentially self-sustaining over the next 100 years, or 2) areas containing fewer jaguars but with adequate habitat and a stable, diverse prey base, such that jaguar populations in the area could increase if threats were alleviated (Sanderson

et al. 2002, Zeller 2007) (see further discussion of JCUs in the Conservation Assessment section below).

Rabinowitz and Zeller (2010) identified least-cost corridors connecting the 90 JCUs across the jaguar's global range. Their results indicate 78 percent of historical range, an area of approximately 14.9 million km^2 (5.7 million mi^2), still holds potential for jaguar movement and dispersal. They identified 182 potential corridors between populations, ranging from 3 to 1,607 km (1.9 to 998.5 mi) in length; 44 of these corridors are characterized as being of immediate concern due to their limited width (less than 10 km [6.2 mi] at any point along their length), and thus their high potential for being severed.

The two most northwestern JCUs (both considered highest Mexico priority JCUs) occur in the Sierra Madre Occidental of Sonora/Chihuahua and southern Sinaloa/Nayarit/Jalisco (figure 1c in Sanderson et al. 2002). One-hundred percent of the 13,613 km^2 (5,256 mi^2) Sonora JCU and 61 percent of the 29,409 km^2 (11,355 mi^2) southern Sinaloa/Nayarit/Jalisco JCU were identified as areas where probability of long-term survival is high (Zeller 2007). Factors important to the long-term survival of jaguars in Sonora received the following characterizations: 1) connectivity to other JCUs: infrequent dispersal; 2) habitat quality: medium; 3) hunting of jaguar: much; 4) hunting of prey: much; 5) population status: stable. Factors important to the long-term survival of jaguars in Jalisco received the following characterizations: 1) connectivity to other JCUs: frequent dispersal; 2) habitat quality: high; 3) hunting of jaguar: some; 4) hunting of prey: much; 5) population status: decreasing. Population estimates in the two JCUs were 50-100 in Sonora and >500 in Jalisco. The two most northeastern JCUs occur in the Sierra Madre Oriental and Tamaulipas (Sanderson et al. 2002, Zeller 2007, Rabinowitz and Zeller 2010). However, these JCUs and jaguars in northeastern Mexico will be further addressed in the recovery plan.

Rabinowitz and Zeller (2010) identified least-cost corridors connecting the 90 JCUs across the jaguar's range. Cost was assessed based on habitat structure and the species' response to the landscape in an effort to quantify the ease of movement by jaguars through the landscape matrix with the least chance of negative interactions with humans (Rabinowitz and Zeller 2010). Their results indicate 78 percent of the jaguar's historical range, an area of approximately 14.9 million km^2 (5.7 million mi^2), still holds potential for jaguar movement and dispersal. They identified 182 potential corridors between populations, ranging from 3 to 1,607 km (1.9 to 998.5 mi) in length; 44 of these corridors are characterized as being of immediate concern due to their limited width (less than 10 km [6.2 mi] at any point along their length), and thus their high potential for being severed. The authors highlight two corridors in the northernmost portion of the jaguar range, one between the southern Sinaloa/Nayarit/Jalisco JCU and the Sonora JCU and another connecting the Sierra Madre Occidental with the Sierra Madre Oriental. It seems unlikely, however, that jaguars would use the latter corridor as it passes through one of the most arid regions of the Mexican plateau dominated by Chihuahuan desert and there are several four-lane highways between the two sierras (Rosas-Rosas and López-González, pers. comm. 2011). Furthermore, there are no known jaguar records from Coahuila where the corridor terminates in the Sierra Madre Oriental (in the Sierra Madre Oriental, jaguars are known to occur in Chihuahua and there are recent

unconfirmed reports of jaguars in northern Nuevo Leon) (Rosas-Rosas, August 6, 2011, email to FWS). It has been recommended to initiate or support studies to locate potential corridors between the jaguar populations in the Sierra Madre Occidental and Oriental (Rosas-Rosas, August 6, 2011, email to FWS).

In northwestern and western Mexico, jaguars occur from the border of Colima and Jalisco north through Nayarit, Sinaloa, southwestern Chihuahua, and Sonora to the border with the U.S. Though Colima has not had any verified jaguar sightings for more than 50 years (López-González, pers. comm. 2011), there have been credible jaguar reports from the state in the last decade, mainly near the border with Jalisco (Núñez, pers. comm. 2011). Breeding populations currently occur in Jalisco, Nayarit, Sinaloa, and Sonora. The most northern recently documented breeding population of jaguars occurs in Sonora near the towns of Huasabas and Sahuaripa, about 210 km (130 mi) south of the U.S./Mexico international border (Valdez et al. 2002, Brown and López-González 2001). Since 2009, two jaguars have been documented at Rancho El Aribabi, Sonora, about 48 km (30 mi) southeast of Nogales, and one jaguar has been documented in the Sierra Los Ajos within the Reserva Forestal Nacional y Refugio de Fauna Silvestre Ajos-Bavispe, about 48 km (30 miles) south of the U.S. border near Naco, Mexico. As stated above, population estimates in the Sonora and Jalisco JCUs were 50-100 and >500, respectively (Zeller 2007). Results of the Mexican National Jaguar Census (Manriquez, July 15, 2011, email to FWS) indicate there are an estimated 271 jaguars in Sonora, 211 in Sinaloa, 92 in Nayarit, and 176 in Jalisco.

United States

Jaguars historically occurred in California, Arizona, New Mexico, Texas, and possibly Louisiana (62 FR 39147). The last jaguar sightings in California, Texas, and Louisiana were documented in the late 1800s into the early 1900s, with the last confirmed jaguar killed in Texas in 1948 (Nowak 1975). While jaguars have been documented as far north as the Grand Canyon, Arizona, occurrences in the U.S. since 1963 have been limited to south-central Arizona and extreme southwestern New Mexico. Three records of females with cubs have been documented in the U.S. (all in Arizona), the last in 1910 (Lange 1960, Nowak 1975, Brown 1989), and no females have been confirmed in the U.S. since 1963[d] (Brown and López-González 2000, Johnson et al. 2011). As a result, jaguars in the U.S. are thought to be part of a population, or populations, that occur largely in Mexico.

Recently (1996 through 2011), five, possibly six individual jaguars have been documented in the U.S. One adult male was observed and photographed on March 7, 1996, in the Peloncillo Mountains in New Mexico near the Arizona border (Glenn 1996, Brown and López-González 2001). The Peloncillo Mountains run north-south to the Mexican border, where they join the foothills of the Sierra San Luis and other mountain ranges connecting to the Sierra Madre Occidental. Another adult male was observed and photographed on August 31, 1996, in the Baboquivari Mountains of southern Arizona (Childs 1998, Brown and López-González 2001). In

[d] The validity of this record (a female jaguar killed in the White Mountains of Arizona) has been disputed. See Johnson et al. 2011 for further information.

February 2006, another adult male jaguar was observed and photographed in the Animas Mountains in Hidalgo County, New Mexico (McCain and Childs 2008). From 2001 to 2009, two jaguars, both adult males, referred to as "Macho A" and "Macho B", were photographed (one repeatedly) using infra-red camera traps in south-central Arizona, near the Mexico border, one of which, "Macho B", was the male observed and photographed in 1996 in the Baboquivari Mountains. More specifically, these two jaguars were documented in three different mountain range complexes in southeastern Arizona, over an area extending from the U.S./Mexico international border north 66 km (47 mi) and 63 km (39 mi) east to west (McCain and Childs 2008). Furthermore, they were found using areas from rugged mountains at 1,577 m (5,174 ft) to flat lowland desert floor at 877 m (2,877 ft) (McCain and Childs 2008). A fifth jaguar (adult male) was observed and photographed in November 2011 in the Whetstone Mountains. A possible sixth jaguar was photographed in 2004; however, it could not be determined if the animal was a unique individual or was "Macho A" (the photo was of the animal's right side and only photos of "Macho A's" left side were available for comparison).

There are differences of opinion regarding the characteristics and significance of jaguars in the U.S. For example, Rabinowitz (1999) reports that although the jaguar cannot simply be considered an accidental wanderer into the U.S., the southwestern U.S. has never been, at least in recent times, more than marginal habitat at the extreme northern limit of the jaguar's range. He reports that several points stand out: 1) confirmed or credible jaguar sightings are too few in number to indicate more than the possibility of small, short-lived jaguar populations north of the Mexican border over the last century; 2) the fact that 74 percent of the animals identified by their sex were male may be indicative of dispersal movements from south of the U.S./Mexico border; 3) the likelihood of jaguars traveling across the border from Mexico points to a strong possibility of jaguar populations in northern Mexico; 4) three sightings of females with young are indicative of jaguars possibly breeding in the U.S. in the early 1900s, but are not indicative of a long term resident population; and 5) the lack of substantial anecdotal evidence, mythology, religious beliefs, or folklore about jaguars in old books, by hunters, or recorded among Native American groups north of the Mexican border strongly suggests a lack of permanent presence even by relatively small numbers of jaguars within the last several hundred years. He further concludes that there is no indication that habitat in the southwest U.S. is critical for survival of the species. In contrast, both McCain and Childs (2008) and Grigione et al. (2007) report that the number of female jaguars with young historically recorded in Arizona suggests that there was once a breeding population in the state. Brown (1983) reported that when plotted at 10-year intervals, records of jaguars killed in Arizona and New Mexico between 1900 and 1980 show a decline characteristic of an over-exploited resident population. He further stated that if the jaguars killed during this period originated in Mexico, the numbers of killings should have always been irregular and erratic, without a declining pattern (Brown 1983).

As Johnson et al. (2011) note, Arizona and New Mexico are at the northern edge of the northernmost jaguar population. The importance of peripheral populations, such as jaguars in the northernmost portion of their range, has been discussed by a number of authors as summarized by Johnson et al. (2011). Miller et al. (1996) established the value of peripheral populations in

recovery of the black-footed ferret, as did Schaller (1993) for the giant panda. Ehrlich and Ehrlich (1992) and Garcia-Ramos and Kirkpatrick (1997) affirmed the conservation value of populations at the fringe of the range in a more general sense. Channell and Lomolino (2000), studying dynamic biogeography and conservation of endangered species, also assessed importance of populations at the edge of a species' range. They suggested populations undergoing dramatic range reductions persist longest at the extremes of their range; accordingly, they postulated such populations might deserve even greater conservation focus than "core" populations. Peterson (2001) discounted the conservation value of peripheral populations, asserting they often are not viable and can be sink populations (see: Brown and Kodric-Brown 1977, Pulliam 1988). Nielsen et al. (2001) contested Peterson's findings, claiming such populations are "vitally important to a species' past, present, and future existence."

Core, Secondary, and Peripheral Areas

Based on our examination of historical and recent evidence, and utilizing a format applied in other recovery outline documents, we categorized jaguar habitat and occurrence as: 1) core areas, 2) secondary areas, and 3) peripheral areas. These areas are categorized within larger units defined as "recovery units", and in one case, a "management unit". Recovery units are subunits of the listed species that are geographically or otherwise identifiable and essential to the recovery of the species. Management units are subunits that might require different management, be managed by different entities, or encompass different populations. However, each management unit is not necessarily essential to the conservation of the species. In this outline, the management unit falls entirely within the larger recovery unit. Recovery and management units are discussed in detail in Section 3.2.3, "Preliminary Recovery Strategy" of the Interim Endangered and Threatened Species Recovery Planning Guidance, Version 1.3 (NMFS 2010).

Within recovery units, the areas with the strongest long-term evidence of jaguar population persistence are defined as "core areas." Core areas have both persistent verified records of jaguar occurrence over time and recent evidence of reproduction. Two core areas occur within the Northwestern Recovery Unit (NRU) (see Figure 1 and description below); these areas have been identified by the Jaguar Recovery Team and are also supported by literature (i.e., Sanderson et al. 2002, Zeller 2007, Rabinowitz and Zeller 2010). Eighty-eight core areas occur in the Pan American Recovery Unit (PARU) (see Figure 2 and Sanderson et al. 2002, Rabinowitz and Zeller 2010, and Zeller and Rabinowitz 2011). Successful jaguar conservation efforts in these core areas and corridors will help ensure the continued persistence of jaguars by addressing fundamental principles of conservation biology, such as:

1) species representation, by conserving the breadth of ecological settings in which jaguar populations occur;
2) redundancy, by retaining a sufficient number of populations to provide a margin of safety to withstand catastrophic events; and
3) resiliency, by maintaining sufficient numbers of animals in subpopulations to withstand fluctuations due to randomly occurring events.

Areas classified as "secondary areas" are those that contain jaguar habitat with historical and/or recent records of jaguar presence with no recent record or very few records of reproduction. These secondary areas are of particular interest when they occur between core areas and can be used as transit areas through which dispersing individuals can move, reach adjacent core areas, and potentially breed. Dispersing individuals may also periodically establish residency in secondary areas and become breeders. Jaguars may occur in lower densities in secondary areas because of past control efforts and the area has not been recolonized by jaguars. If future surveys document reproduction in a secondary area, the area could be considered for elevation to core, particularly if the area of reproduction is contiguous with a core area (i.e., one isolated reproductive event in the middle of a secondary area would not necessarily elevate that area to a core); likewise, new information could reduce a secondary area to peripheral status. We hypothesize that secondary areas may contribute to jaguar persistence by providing habitat to support jaguars during dispersal movements, by providing small patches of habitat (perhaps in some cases with a few resident jaguars), and as areas for cyclic expansion and contraction of the core areas. In "peripheral areas" most historical jaguar records are sporadic and there is no or minimal evidence of long-term presence or reproduction that might indicate colonization or sustained use of these areas by jaguars.

I. Core Area Criteria - By Jaguar Recovery Team guidelines, a core area for jaguars is an area meeting the following conditions:

• Has reliable evidence of long-term historical and current presence of jaguar populations; jaguar occurrence within a core area has been persistent over time;

• Has recent (within the past 10 years) evidence of reproduction (although reproduction or recruitment into the population may not occur every year); and

• Contains habitat (i.e., suitable vegetation types, adequate prey and water availability, etc.) of the quality (i.e., low human density) and quantity (large tracts of contiguous habitat with connectivity to others areas of contiguous habitat) that are known to support jaguar populations, and of sufficient size to contain at least 50 adult jaguars. Jaguar habitat will be defined in greater detail in the recovery plan.

Northwestern Recovery Unit Core Areas (Figure 1):

1) Central Sonora, Southwestern Chihuahua, and Northeastern Sinaloa; and
2) Central Sinaloa, Nayarit, and the coast and coastal sierras of Jalisco.

Pan American Recovery Unit Core Areas (Figure 2):

The Jaguar Recovery Team accepts the areas known as "Jaguar Conservation Units" (JCUs) (Figure 2, Rabinowitz and Zeller 2010), excluding those in Sonora and Nayarit/Jalisco, as core areas in the PARU. A more detailed description of the 88 units will be provided in the recovery plan.

II. Secondary Area Criteria - By Jaguar Recovery Team guidelines, a secondary area for jaguars is an area meeting the following conditions:

• Compared to core areas, secondary areas are generally smaller, likely contain fewer jaguars, maintain jaguars at lower densities, and exhibit more sporadic current and historical records of jaguars; some of the secondary areas may not have not been surveyed through the use of defined survey protocols, thus resulting in the unknown current status of jaguars in some secondary areas;
• There is no or little evidence of recent reproduction (within 10 years); and
• Quality and quantity of jaguar habitat is lower compared to core areas. Jaguar habitat is likely less optimal due to one or more or a combination of these variables important for jaguar presence, including increased human impact, smaller amount of contiguous habitat, different vegetation types, lower prey populations.

Northwestern Recovery Unit Secondary Area (NRU) (Figure 1):

1) South-central and southeastern Arizona and southwestern New Mexico, U.S. and Northern Sonora (this area corresponds with the Northwestern Management Unit [NMU] - see Figure 1 and description below); and
2) Northeastern to central-eastern Sinaloa.

Pan American Recovery Unit (PARU) Secondary Areas (Figure 2):

In the PARU, there exists an extensive distribution of Secondary Areas. Although an accurate map of Secondary Areas may be available or possible to develop in small regions in jaguar range, it is not possible to provide such detail throughout the PARU. For the purposes of this outline, we suggest that Secondary Areas are generally defined by the corridor areas modeled and mapped in Figure 2 of Rabinowitz and Zeller (2010; see Figure 2), excluding the two corridors connecting western Mexico to northwestern and northeastern JCUs.

III. Peripheral Area Criteria - By Jaguar Recovery Team guidelines, a peripheral area for jaguars is an area meeting the following conditions:
• Areas that contain few verified historical or recent records of jaguar and records are sporadic;
• Quality and quantity of habitat are marginal for supporting adequate jaguar populations. Habitat may occur in small patches and is not well-connected to larger patches of high-quality habitat; and
• May sustain short-term survival of dispersing jaguars and temporary residents.

Peripheral Areas Outside but in the Vicinity of the NRU:

In the U.S., generally, California, Arizona (outside of the secondary areas listed above), New Mexico (outside of the secondary areas listed above), Texas, and possibly Louisiana. In Mexico, generally, parts of Chihuahua, Durango, Jalisco, and Zacatecas.

Peripheral Areas Within or Adjacent to the PARU:

Jaguar peripheral areas within or adjacent to the PARU are those areas included in general range maps, but that are inhospitable to jaguars, rarely having jaguar presence, and almost never supporting resident jaguars in recent times (last 100 years). Examples would be areas of extreme and consistent flooding, extremely dry climates, and high-elevations. Some high mountain passes in the Andes, for instance, may have historical records of jaguars, and dispersers may pass through the low passes periodically, but the presence of jaguars is very rare, and resident jaguars are non-existent. The same would be true of coastal areas of Ecuador and central and northern Argentina.

Land Ownership Pattern

Northwestern Recovery Unit

The NRU is approximately 222,197 km^2 (85,791 mi^2); with (32,081 km^2 [12,386 mi^2] in the U.S. and 190,116 km^2 [73,404 mi^2] in Mexico). The NMU lies within the NRU and is approximately 74,832 km^2 (28,893 mi^2); with (32,081 km^2 [12,386 mi^2] in the U.S. and 42,751 km^2 [16,506 mi^2] in Mexico). Within the U.S., jaguar habitat in the NRU primarily occurs on tribal (Tohono O'odham Nation) lands and federally and state owned lands, including those managed by the U.S. Forest Service (Coronado National Forest), Bureau of Land Management, National Park Service, USFWS, and Arizona State Land Department. The remaining non-state or federal land within the NRU is privately owned.

Within Mexico, jaguar habitat within the NRU primarily occurs on privately-owned, ejido (communal), and indigenous community (i.e., Yaqui) lands. Although there are natural protected areas (ANP) designated by the Comisión Nacional de Áreas Naturales Protegidas (CONANP [National Commission for Natural Protected Areas]) within the NRU, they overlap privately-owned and communal lands. The protected status of these ANPs does not change the land ownership status but instead imposes use restrictions on the lands. At this time, at least eight Federally recognized protected areas have been established within the NRU in Mexico that provide for jaguar protection (See Conservation Assessment below for more detailed information on protected areas).

Pan American Recovery Unit

The PARU is approximately 14.9 million km^2 (5.75 million mi^2) in 17 countries. It is difficult to characterize the land tenure in a finite manner for the entire PARU. However, some general statements do apply. Within this part of jaguar range, jaguars occur on all the potential land tenure classes, including state and federally managed lands and privately owned lands. Government-managed lands can vary in the level of protection they provide, providing high levels of protection in some areas; and, at times, and in other locations, providing little protection for jaguar habitat or jaguar prey. Private lands can also vary in their level of protection and value for jaguar conservation; however, in general, and in the long-term, government lands are considered a higher potential for jaguar conservation. This is tempered in some areas where very large tracts of

privately-owned land are hospitable to jaguars; here, the regional and local conservation potential is enhanced by these private lands and their management.

Biological Assessment Recovery Status Summary

The population trend of jaguars is decreasing (Caso et al. 2008), though the rate of decline is unknown and likely highly variable throughout the jaguar range. In addition to the numerous anthropogenic threats affecting jaguars, the species has a number of intrinsic biological factors that limit its recovery, including being a K-selected species and having large spatial requirements. Small and isolated jaguar populations do not appear to be highly persistent (Haag et al. 2010, Rabinowitz and Zeller 2010). However, persistence of relatively small populations appears to increase with connectivity to other populations and reduction of threats within a corridor (Rabinowitz and Zeller 2010). The prospects for the jaguar being self-sustaining in the wild are favorable; however conservation of key jaguar habitats and populations is critical to this sustainability.

Research Needs

Though recent studies have provided much new information on the basic biology and ecology of the species, more studies are needed to help better manage the species. In the NRU, among others, more information is needed on: 1) distribution and abundance; 2) habitat use; 3) gender- and age-specific estimates of dispersal rates and travel distances; 4) age-, gender-, and region-specific vital rates, including year to year variation; 5) the extent to which poaching and depredation loss are compensatory with other types of mortality; 6) the relationship of prey populations and jaguars; 7) how climate change may affect northern jaguar demography and ecology; 8) the impact of border security infrastructure and operations on jaguar movement; 9) the impact of roads upon jaguar movement and the effectiveness of under- and overpasses and other design measures to facilitate jaguar travel across these roads or highways; 10) interspecific competition between jaguars and pumas; and 11) how to most effectively protect jaguar habitat and reduce poaching of jaguars.

B. Threats Assessment:

The following is a brief summary of the most significant threats and their implications to the recovery of the species.

Reasons for Listing/Threats

Section 4(a)(1) of the ESA outlines five factors to consider when a species is a candidate for listing as threatened or endangered. The following analysis considers these factors in contributing to the endangered status of the jaguar (a more detailed analysis will be provided in the recovery plan). The 1997 final rule to extend endangered status for the jaguar in the U.S. (62 FR 39147) provided an analysis of the five factors; however, because the rule only applied to the U.S., the

analysis generally only addressed threats to the species in the U.S. The 1972 final listing rule (37 FR 6476) did not include a five factor analysis. Below, we address threats based on the five listing factors throughout the species range but focus on the NRU.

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

Range wide, habitat destruction and modification form one of the two most significant threats to the jaguar (Medellin 2009, Chávez and Ceballos 2006, Medellín et al. 2002, Núñez et al. 2002, Nowell and Jackson 1996). To recover jaguars, addressing this threat of habitat loss requires immediate response. The jaguar is classified as "Near Threatened" on the Red List of the International Union for the Conservation (IUCN) due to a number of factors, including habitat loss and fragmentation of populations across portions of the range (Caso et al. 2008). Various factors, particularly habitat loss, have caused a considerable reduction in the historical range of the jaguar (Sanderson et al. 2002, Zeller 2007, Rabinowitz and Zeller 2010). Most loss of occupied range has occurred in the southern U.S., northeastern Mexico, northern Brazil, and southern Argentina (Sanderson et al. 2002). Deforestation rates are high in Latin America and fragmentation of forest habitat isolates jaguar populations so that jaguars are more vulnerable to human persecution (Nowell and Jackson 1996). Medellin et al. (2002) report that loss, fragmentation, and modification of jaguar habitat have contributed to population declines throughout much of the species' range, including northern Mexico.

Chávez and Ceballos (2006) reported that deforestation was one of the two most important threats to jaguars in Mexico; 60 percent of the jaguar's historical range in Mexico had been lost; the nationwide population was fewer than 5,000 individuals; and a variety of threats suggested that, absent effective conservation efforts, jaguar imperilment in Mexico would only worsen. Rosas-Rosas and Valdez (2010) reported that jaguar habitats were degraded and conflicts between jaguars and human interests were common in Sonora. Furthermore, he reported that habitat fragmentation and illegal hunting of jaguars and their potential prey species are probably the main threats to long-term conservation of jaguars in their northernmost western range. Increased illegal activities and responsive law enforcement actions, including construction and maintenance of the border fence along the Mexico-U.S. international border, may be limiting jaguar movement across the border, but it is uncertain if and how much this is affecting that movement.

Human population growth has both direct and indirect impacts on jaguar survival and mortality. For example, human growth and development tend to fragment habitat and isolate populations of jaguars and other wildlife. For carnivores in general, the impacts of high road density have been well documented and thoroughly reviewed (e.g., Noss et al. 1996, Carroll et al. 2001, as cited by Menke and Hayes 2003). Roads may have direct impacts to carnivores and carnivore habitats, including mortality caused by vehicles, disturbance, habitat fragmentation, changes in prey numbers or distribution, and provision of increased access for legal or illegal harvest (Menke and Hayes 2003, Colchero et al. 2010).

Overall, the threat of human encroachment cannot be eliminated, but through conservation planning and implementation efforts, it can be reduced. Conservation of key habitat areas is critical to the recovery of jaguars and, as discussed below under the Conservation Assessment section, various efforts have been made to protect jaguar habitat. There are many opportunities and methods (i.e., creation of new reserves, incentive programs, etc.) to continue to conserve jaguar habitat; however, they will require significant international, national, and local cooperation, as well as financial support.

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

Illegal killing of jaguars is the other of the two most significant threats to the jaguar (Medellin 2009, Chávez and Ceballos 2006, Medellín et al. 2002, Núñez et al. 2002, Nowell and Jackson 1996) and, to recover jaguars, likely requires the most immediate response. Commercial hunting and trapping of jaguars for their pelts has declined drastically since the mid-1970s, when anti-fur campaigns and Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) controls progressively shut down international markets (Nowell and Jackson 1996). Although hunting (for pelts) has decreased, there is still demand for jaguar paws, teeth, and other products (Nowell and Jackson 1996). Additionally, illegal killing of jaguars due to conflicts with humans is a major threat to jaguars. Jaguars are known to kill cattle and are killed by ranchers as pest species (Nowell and Jackson 1996). People compete with jaguars for prey and jaguars are frequently shot on sight, despite protective legislation (Nowell and Jackson 1996). Continuing deforestation in Latin America and fragmentation of forest habitat isolates jaguar populations so that they are more vulnerable to human persecution (Nowell and Jackson 1996). Experts from throughout the jaguar range agree that one of the most severe causes of mortality is the direct hunting of jaguars, either because jaguars have caused some conflict by killing livestock or to sell the jaguar as a trophy or its skin or teeth (Medellin 2009). This illegal and indiscriminate killing eliminates hundreds or even thousands of jaguars each year in Latin America and must be controlled to reduce the risk of extinction (Medellin 2009).

In Mexico, officials have been working to assess and address retaliatory killing of jaguars by ranchers instigated by jaguar predation on livestock. In 2007, a study was conducted to develop a "National Strategy for the Diagnosis and Resolution of Conflicts with Big Cats due to Livestock Predation" which is sponsored by CONANP, through the Directorate of Priority Species, and implemented by civil society organizations, researchers, and government institutions. In 2007, an assessment of retaliatory killing in priority areas for jaguar conservation revealed that individual communities were killing up to five jaguars per year (Manriquez, July 15, 2011, email to FWS). It is estimated that 20 jaguars are killed each year in the state of Quintana Roo and at least 15 in Tamaulipas (Azuara et al. 2008). As part of a national compensation program for livestock depredation, from November 2009 to May 2011, ranchers throughout Mexico have been compensated, through the Livestock Insurance Fund, for 231 head of cattle attacked by jaguars and pumas. The number of reported attacks to livestock was greater than those actually compensated.

A model created from a population and habitat viability analysis for jaguars in Mexico indicated that poaching mortality significantly reduces population growth and increases the risk of extinction of small populations (Carrillo et al. 2007). This effect is stronger in females, as when take is over 3 percent of the female population, the population becomes non-viable over a period of 100 years (Carrillo et al. 2007). According to the model, population sizes of <100 individuals are not viable (Carrillo et al. 2007). The model, created specifically for jaguars in the Sonora region, indicates that without anthropogenic influences, the jaguar population will be reduced to less than 50 percent of its original size in 100 years (or about 65 individuals) and that with anthropogenic influences (illegal killing of jaguars, estimated at 3.35 percent of the population annually, was the only anthropogenic influence included in this model) jaguars will be reduced to about 20 individuals in 100 years (Carrillo et al. 2007). The model created for jaguars in the Jalisco/Nayarit regions indicates that without anthropogenic influences, the jaguar population will remain viable but be reduced from 140 to 110 individuals, and that with illegal killing, estimated at 10 percent of the population annually, jaguars will be extinct in 80 years (Carrillo et al. 2007).

In western Mexico, illegal killing is considered the main threat to jaguars (Núñez-Pérez, August 2, 2011, email to FWS). In northwestern Mexico, Rosas-Rosas and Valdez (2010) reported that illegal hunting of jaguars and their potential prey species and habitat fragmentation are probably the main threats to long-term conservation of jaguars in their northernmost western range. According to the 1997 listing rule (62 FR 39147), the primary threat to jaguars in the U.S. is illegal shooting (see listing rule for a detailed discussion). This, however, is no longer accurate and the most recent known shooting of a jaguar in Arizona was in 1986 (Brown and Lopez-González 2001).

It is unlikely that this threat will ever be completely eliminated; however, through education, outreach, financial incentive programs, and improved law enforcement, it can be reduced. Significantly reducing this threat is imperative to the recovery of jaguars.

Factor C. Disease or predation.

The 1997 listing rule stated that the USFWS is unaware of any known diseases or predators that threaten the jaguar at this time. Nonetheless, diseases are an increasing threat to wild felids due to habitat restriction and fragmentation and encroachment from domestic animals (Furtado and Filoni 2008, Brousset and Aguirre 2007). The potential role of diseases in wild felid and other carnivore populations, however, is still poorly understood, especially for the jaguar (Furtado and Filoni 2008, Brousset and Aguirre 2007) (see *Disease and Epizootics* section above for information on specific diseases affecting jaguars). Diseases should always be considered as an important factor in conservation biology, and surveillance and monitoring programs are required for an adequate understanding of disease dynamics in wild jaguar (Furtado and Filoni 2008). Brousset and Aguirre (2007) proposed to implement a standard protocol for the health evaluation of wild jaguar populations in Mexico to: 1) allow a comparison of results from different areas over time, 2) expand knowledge of the role of infectious diseases and other pathogens on the population dynamics of the species, 3) identify diseases that may represent a direct or indirect threat to jaguar

conservation, and 4) develop strategic recommendations to strengthen the understanding of the ecoepidemiology and conservation of jaguars in Mexico.

Factor D. The inadequacy of existing regulatory mechanisms.

On July 1, 1975, the jaguar was included in Appendix I of CITES. CITES is a treaty established to prevent international trade that may be detrimental to the survival of plants and animals. Generally, both import and export permits are required from the importing and exporting countries before an Appendix I species may be shipped, and Appendix I species may not be exported for primarily commercial purposes. CITES permits may not be issued if the export will be detrimental to the survival of the species or if the specimens were not legally acquired.

The jaguar is fully protected at the national level across most of its range, with hunting prohibited in Argentina, Brazil, Colombia, French Guiana, Honduras, Nicaragua, Panama, Paraguay, Suriname, United States, and Venezuela, and hunting restrictions in place in Brazil, Costa Rica, Guatemala, Mexico, and Peru (Nowell and Jackson 1996). The jaguar is listed as endangered under Mexican law (NOM-059- SEMARNAT-2010) in Mexico (SEMARNAT 2010) and as endangered throughout its range under the ESA. In Mexico, though jaguars are protected by federal law, poaching continues and legal action is rarely taken against hunters (Núñez-Pérez, August 2, 2011, email to FWS). Illegal hunting may be punished with a fine of up to about $500,000 (U.S.) or three years in prison, but this has never been enforced (Núñez, pers. comm. 2011). States like Nayarit and Jalisco are currently working on local enforcement ("vigilancia") programs for jaguar conservation (Núñez-Pérez, August 2, 2011, email to FWS).

Jaguars are also protected by state law in Arizona and New Mexico. As described in Johnson et al. (2011), the Arizona Game and Fish Commission protected the jaguar in 1969, prohibiting take by licensed hunters. Jaguars are now listed as nongame mammals under AGFD Commission Order 14, with no open season for legal take by hunting. Violation of this order is a Class 2 misdemeanor. On May 7, 1998, state legislation (Senate Bill 1106) was signed into law that provides, when the jaguar is delisted federally, for imposing a $2,500 criminal penalty (Class 2 Misdemeanor) and up to $72,500 in civil penalties for unlawful take of a jaguar. The civil fine is commensurate with the current federal fine under the ESA but the criminal penalty is considerably lower than the companion federal fine. The legislature's intent was to ensure that state penalties would not be additive to current federal penalties and could serve as an inducement to federal delisting. Also as described in Johnson et al. (2011), the State of New Mexico classifies the jaguar as a Restricted species (19.33.6.9 NMAC) because of its status as a CITES Appendix 1 species. In 1999, Senate Bill 252 was signed into law, establishing new regulations and penalties for illegally killing a jaguar. The penalties would take effect only if the jaguar was removed from the federal endangered species list. Although this law provided state penalties as high as those for any animal protected by New Mexico, the penalties are not as high as those under the ESA. In the 2006 New Mexico legislative session, House Bill 536 ("Unlawful Trophy Animal Disposition") was passed and signed into law. It allows the New Mexico Game Commission to establish regulations

authorizing higher civil damages than previously allowable for wildlife designated as trophy animals and establishes a minimum $2,000 in civil penalties (without requiring removal from ESA listing to take effect). Thus, higher penalties for illegal jaguar killing may be established through Commission action. As of December 2010, no such action had been initiated.

Despite the aforementioned protections, as described above under Factor B., illegal killing of jaguar continues to be a major threat to jaguars south of the U.S.-Mexico border. The U.S. has little authority to implement actions needed to recover species outside its borders, especially when recovery requires the employment of laws and regulations. As described above, in many of the foreign countries in the range of the jaguar, key threats include the killing of jaguars and destruction of their habitat. The powers that the USFWS can employ in this regard are limited to prohibiting unauthorized importation of listed species into the U.S., prohibiting persons subject to U.S. jurisdiction from engaging in commercial transportation or sale of listed species in foreign commerce, and assisting foreign entities with education, outreach, and other aspects of conservation through authorities in section 8 of the ESA. The "take" prohibitions of section 9 of the ESA only apply within the U.S., within the territorial seas of the U.S., and on the high seas. They do not apply in the foreign countries where the majority of jaguars are actually found. Section 7 of the ESA, which provides for all Federal agencies to utilize their authorities to carry out programs for the conservation of the species, and to ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of listed species or adversely modify its critical habitat, is the primary tool within the ESA to address conflict with development or construction. The USFWS has no section 7 authority outside the boundaries of the U.S. Within the U.S., section 7 authority has been waived in specific instances regarding threats to the jaguar and construction of the border fence and roads pursuant to the Real ID Act (P.L. 109-13; for more details see below in Factor E). To date, under section 7, incidental take of two jaguars has been authorized and no jeopardy opinions have been issued. Under section 10 of the ESA, which prescribes permits for scientific purposes or incidental take while carrying out lawful activities, the following has been authorized for specific approved activities: 1) incidental take of one jaguar in the form of mortality or harm, and 2) unlimited take in the form of harass. Additional incidental take through section 7 or 10 is not currently anticipated; however, this may change as new projects are proposed.

Factor E. Other natural or manmade factors affecting its continued existence.

Illegal and Legal Overhunting of Jaguar Prey

The jaguar is classified as "Near Threatened" on the Red List of the IUCN in part due to poaching of prey (Caso et al. 2008). According to experts across the jaguar range, hunting of the most important prey, such as peccaries and deer, is one of the primary factors negatively affecting the jaguar (Medellin 2009). An estimated 27 percent of jaguar range has a depleted wild prey base (WCS 2008 as cited by Caso *et al*. 2008). Illegal hunting of potential jaguar prey species is one of the main threats to long-term conservation of jaguars in northwestern Mexico (Rosas-Rosas 2006). Human population growth can put pressure on game populations that are used for human consumption. These same game populations are often prey for jaguars. Furthermore, overhunting

of natural prey may cause an increase in jaguar predation on livestock and consequently increase human-jaguar conflicts, including continued negative attitudes toward jaguars and illegal killing of jaguars.

It is unlikely that this threat will ever be completely eliminated; however, through education, outreach, improved law enforcement, and other programs, it can be reduced. Reducing this threat is imperative to the recovery of jaguars.

Border Issues

A number of actions along the U.S.-Mexico border may impact current and future jaguar recovery efforts. Continuing threats from construction and maintenance of border infrastructure (i.e., pedestrian and vehicle fences, towers, roads, etc.), as well as illegal activities and resultant law enforcement response (i.e., increased human presence, vehicles, lighting, etc.) may limit movement of jaguars at the U.S/Mexico border (U.S. Fish and Wildlife Service 2007, 2008).

In 2006, Congress passed the Secure Fence Act, mandating that 700 miles of physical fencing be installed along the U.S./Mexico border by the end of 2008. The Real ID Act of 2005 also gave the Secretary of the Department of Homeland Security the ability to waive any law or treaty to erect the fence, including environmental laws such as the National Environmental Policy Act, Clean Water and Clean Air Acts, Refuge Improvement Act, Migratory Bird Treaty Act, and ESA. On April 1, 2008, Department of Homeland Security Secretary Michael Chertoff invoked his ability to waive these laws and continued construction without compliance.

The border from the Tohono O'odham Nation, Arizona to southwestern New Mexico has a mix of pedestrian fence (not permeable to jaguars), vehicle fence (fence designed to prevent vehicle but not pedestrian entry; it is generally permeable enough to allow for the passage of jaguars), legacy (older) pedestrian and vehicle fence, and unfenced segments. Nearly the entire southern border of the Tohono O'odham Nation has vehicle fence. To the east, nearly the entire southern border of the Buenos Aires National Wildlife Refuge (BANWR) has pedestrian fence. From BANWR to Nogales, only a portion of the Coronado National Forest has vehicle fence, the rest is unfenced. Pedestrian fence exists from Nogales east to the boundary of the Coronado National Forest and from Douglas west through the Coronado National Memorial. Most of the Coronado National Forest, which lies between Nogales and Naco, is bordered by vehicle fence, but the steepest areas are unfenced. The San Rafael Valley is bordered by vehicle fence. Vehicle fence also exists from two miles west of the Arizona/New Mexico border west to the terminus of the pedestrian fence on the east side of Douglas. In southwestern New Mexico, the border fence is entirely vehicle fence.

Fences designed to prevent the passage of humans across the border also prevent passage of jaguars. Because jaguars in Arizona and New Mexico are believed to be part of a population centered in northern Mexico, impeding jaguar movement from the Mexico to the U.S. would likely adversely affect the presence and persistence of jaguars in the U.S. Additionally, fences may cause an increase in illegal traffic and subsequent law enforcement activities in areas where

no fence exists. This activity may limit jaguar movement across the border and result in general disturbance to jaguars and degradation of their habitat.

Predator Control Programs

Wildlife damage management programs may impact jaguars where these programs are implemented in the jaguar range. In the U.S., the U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection (APHIS) - Wildlife Services (WS) implements a nationwide animal damage control program that may impact jaguars in the southwestern U.S. Though jaguars are not a target of the program, according to the USFWS (1999), jaguars may be incidentally impacted by certain animal damage control methods used in the program (i.e., use of toxic chemicals, leghold traps, snares, dogs, etc.). However, incidental take of jaguars resulting from this program is authorized under section 7 of the ESA and WS implements reasonable and prudent measures to minimize any such take (USFWS 1999). To date, no incidental take has been documented resulting from WS' program. In Mexico, when authorized by SEMARNAT, under certain circumstances, "problem" jaguars may be controlled through translocation or capture and confinement in a zoo (Azuara et al. 2010). Additionally, such an effort would be conducted under the advice of a wildcat expert.

Genetics

Little is known about the genetic health of jaguars, however, it has been documented that large-scale habitat removal and fragmentation of once contiguous habitat have caused the reduction of genetic diversity in local jaguar populations, as well as drift-induced differentiation among local fragments. Citing a number of sources, Rabinowitz and Zeller (2010) explain that reduction or loss of genetic exchange leads to smaller effective population sizes, increased levels of genetic drift and inbreeding, and potential deleterious effects on sperm production, mating ability, female fecundity, and juvenile survival. Furthermore, they state that such effects eventually compromise adaptive potential, reduce fitness, and contribute to extinction risk for a population and, ultimately, for the species. To ensure genetic health and long-term viability of jaguars rangewide, it is critical to maintain gene flow among populations through maintaining and restoring connectivity. Corridors can provide one of the most basic requirements for species persistence–genetic exchange (Rabinowitz and Zeller 2010).

Climate Change

Based on the unequivocal evidence of warming of the earth's climate from observations of increases in average global air and ocean temperatures, widespread melting of glaciers and polar ice caps, and rising sea levels recorded in the Intergovernmental Panel on Climate Change Report (IPCC 2007), climate change is now a consideration for Federal agency analysis (GAO 2007). Average Northern Hemisphere temperatures during the second half of the 20th century were higher than during any other 50-year period in the last 500 years and likely the highest in at least the past 1,300 years (IPCC 2007). The earth's surface has warmed by an average of 0.74 º C (1.3 º F) during the 20th century and over the past 50 years, cold days, cold nights, and frosts have become less frequent over most land areas, and hot days and hot nights have become more frequent (IPCC 2007).

Changes in the global climate system during the 21st century are predicted to be larger than those observed during the 20th century. The IPCC projects there will be an increase in the frequency of extreme weather events that are temporally and spatially more variable as a result of a changing climate. For the next two decades, a warming of about 0.2°C (0.4°F) per decade is projected, with future temperature projections increasingly dependent on specific emission scenarios (IPCC 2007). Various emission scenarios suggest that by the end of the 21st century, average global temperatures are expected to increase 0.6°C to 4.0°C (1.1°F to 7.2°F) with the greatest warming expected over land (IPCC 2007). Localized projections suggest the southwestern U.S. may experience the greatest temperature increase of any area in the lower 48 states (IPCC 2007). There is also high confidence that many semi-arid areas like the western U.S. will suffer a decrease in water resources due to climate change (IPCC 2007). At present, Texas and parts of New Mexico and Arizona are recovering from exceptional drought conditions during 2011, and remain in severe drought into 2012 (U.S. Drought Index 2012). Mexico currently is experiencing its worst drought in 70 years, particularly in 19 northern states, which is expected to continue well into 2012 (USDA 2012).

We do not know whether the changes that have already occurred have affected jaguar populations or distribution, nor can we predict how the species will adapt to or be affected by the type and degree of climate changes forecast by a range of models. But, ongoing and future changes in climate have the potential to adversely affect the jaguar within the next 50 to 100 years. Stochastic events driven by climate, such as drought and wildfires in jaguar habitat, may affect this species. Monitoring of habitat and populations will be needed to address the potential threat of climate change. Maintaining the opportunity for range expansion of jaguars may be a prudent precaution to reduce the potential negative impact of climate change. Apart from monitoring and conserving the opportunity for range expansion, addressing the threat of climate change is generally beyond the scope of jaguar recovery planning and implementation.

C. Conservation Assessment:

Throughout its range, the jaguar has a very active conservation constituency and many conservation planning efforts and actions have been taken in numerous countries across its range to address the species' recovery needs. Below is a summary of just some of these efforts. A more comprehensive summary will be included in the recovery plan.

International

In March 1999, during a Wildlife Conservation Society sponsored, priority-setting and planning exercise for the jaguar across its range, from northern Mexico to northern Argentina, scientists determined the most important areas for jaguar conservation in each regional habitat type, based on factors important for long-term survival of jaguars (compiled within Sanderson et al. 2002). The authors determined that saving a species means, at least, saving populations of the species in all the significantly different ecological settings in which they occur to capture the array of ecological differences throughout the species' distributional range. They report, for example, that

the ecology of jaguars in tropical moist lowland forest is significantly different from that in xeric deserts because of differences in factors such as prey base and habitat use. Similarly, because of regional differences in species composition and geographic factors, the role of jaguars in the tropical moist lowland forests of Central America is substantively different from their role in the tropical moist lowland forests of the southeast Amazon.

As a result of this meeting, ecological differences were represented geographically through Jaguar Geographic Regions (JGRs) or geographic units defined by potential habitat and bioregion across the jaguar's historical range to provide a convenient, ecologically based unit for planning. Codes were assigned to JGRs or divisions of JGRs to reflect the status of jaguars in the areas as: "status unknown"; "no jaguars"; and for areas that were known and currently occupied by jaguars, one of the following three classes was assigned: 1) high, 2) medium, or 3) low probability of long-term survival. As described above under the Distribution and Abundance section, JCUs were defined either as 1) areas with a stable prey community, currently known or believed to contain a population of resident jaguars large enough (at least 50 breeding individuals) to be potentially self-sustaining over the next 100 years, or 2) areas containing fewer jaguars but with adequate habitat and a stable, diverse prey base, such that jaguar populations in the area could increase if threats were alleviated. Based on present jaguar population size, prey base, and habitat quality in specific areas, 51 areas were identified as being important to the long-term survival of jaguars. By definition, each JCU represents a core population of jaguars on which conservation might be based. In 2006, Sanderson et al.'s (2002) work was updated by Zeller (2007) to include 90 Jaguar Conservation Units.

In November 2009, another workshop titled "The Jaguar in the XXI Century: The Continental Perspective" was conducted to discuss the conservation status of the jaguar rangewide. The most urgent conservation strategies were defined. Experts concluded that the jaguar's extinction can be avoided only with the commitment of all the governments of the countries and regions where the species exists. They called on the entire population of Latin America to join efforts to conserve the jaguar through reporting and preventing the indiscriminate killing of jaguars and their prey and promoting the message of the importance of jaguars as a keystone species and symbol of strength, pride, and power of all the peoples of America (Medellin 2009).

Mexico

Mexico considers the jaguar an endangered species (SEMARNAT 2010) and a national priority species for conservation (Ramírez-Flores and Oropeza-Huerta 2007) and, as a result, has carried out many planning and conservation-related actions for jaguars on a national level.
Within the NRU in Mexico, there are at least eight federally recognized protected areas that provide for the conservation of the jaguar including: Reserva Forestal Nacional y Refugio de Fauna Silvestre Ajos-Bavispe, Northern Jaguar Reserve, Rancho El Aribabi, and Área de Protección de Flora y Fauna Sierra de Alamos-Rio Cuchujaqui in Sonora; Área de Protección de Flora y Fauna Meseta de Cacaxtla in Sinaloa; Reserva de la Biosfera Marismas Nacionales in Nayarit; and Reserva de la Biosfera Chamela-Cuixmala and Reserva de la Biosfera Sierra de

Manantlán in Jalisco. The Reserva Forestal Nacional y Refugio de Fauna Silvestre Ajos-Bavispe occurs within the NMU in Mexico.

In 1999, SEMARNAT (previously SEMARNAP) created a technical jaguar conservation group, similar to a technical group of a recovery team in the U.S., comprised of the experiences wildcat researchers in Mexico. The group recognized that conserving the jaguar throughout Mexico would require a sustained and large-scale effort of diverse governmental and non-governmental groups in Mexico.

In 2005, the Instituto de Ecología de la UNAM (Ecology Institute of the National Autonomous University of Mexico), with the support of the CONANP, sponsored its first national symposium on jaguar conservation, El Jaguar Mexicano en el Siglo XXI: Situación Actual y Manejo (Chávez and Ceballos 2006). The current status of the jaguar in Mexico was assessed; threats to jaguar existence and priority conservation actions at the local, regional, and national scale were determined. Subcommittees were established to work at the local level, including one for the northern jaguar population in Chihuahua and Sonora. At least eight high-priority (priority I) regions for the conservation of jaguar exist in Mexico; the three most northwestern of these regions are northeastern Sonora, Vallejo Mountains (Sierra de Vallejo) in Nayarit (in the 2009 PACE [see below for definition], this priority I area was renamed to the Corredor Region Occidente [Nayarit, Michoacan, Jalisco]), and the Chamela-Cuixmala Biosphere Reserve (Reserva de la Biosfera Chamela–Cuixmala) in Jalisco (Chávez and Ceballos 2006). All regions, with the exception of two (the ones in Nayarit and Jalisco) are generally large enough to maintain populations of 100 or more animals. Ten priority II areas were documented; the three most northwestern of these regions are Sinaloa, coastal Nayarit, and the Cabo Corrientes region of Jalisco (in the PACE, eight priority II areas were included; the three most northwestern areas, however, remained the same). Some of the priority II areas, like Sinaloa, are large enough to maintain to maintain populations of 100 or more animals. Various priority III areas were also identified (none were named in the northwestern/western Mexico). The need to conduct a population and habitat viability analysis for jaguars in Mexico at a national scale was recognized (Carrillo et al. 2007).

In 2006, a second national symposium was held, the Jaguar Mexicano en el Siglo XXI: Taller de Análisis de la Viabilidad de Poblaciones y del Hábitat (Population and Habitat Viability Workshop). The primary objective of the workshop was to develop an action plan that determines conservation strategies for the jaguar in Mexico (Carrillo et al. 2007). Extinction risk assessments were developed for the life history, population dynamics, ecology, and history of different jaguar populations (the outcome of the assessment for jaguars is described under Listing Factor B above). A third national symposium took place in Cuernavaca, Morelos, in November 2007 (Manriquez, July 15, 2011, email to FWS). Priority sites and the methodology used for the National Jaguar Census were selected. Preliminary results were presented of on five pilot projects focused on livestock-jaguar conflicts. National symposia have been conducted on annual basis with varying

themes in Mexico, producing various publications (Chávez and Ceballos 2006, Ceballos et al. 2007). For example, in 2010, results from the National Jaguar Census were presented.

In 2006, CONANP's National Technical Consultants Subcommittee for Conservation and Management of the Jaguar published a PREP (Proyectos de Recuperación de Especies Prioritarias – Recovery Projects for Priority Species) for jaguars in Mexico that outlines general conservation guidelines for the jaguar and its habitat (Ramírez-Flores and Oropeza-Huerta 2007). In 2009, CONANP published a PACE (Programa de Acción para la Conservación de Especies – Species Conservation Action Program) for the jaguar (CONANP 2009). PACEs are planning documents that establish the strategies, tools, and actions (i.e., protection, management, research, monitoring, evaluation, etc.) necessary to meet the conservation objectives of each priority species (Ramírez-Flores and Oropeza-Huerta 2007). Additionally, state-specific jaguar conservation strategies have been completed for Oaxaca, Michoacán, Chiapas, and San Luis Potosí (Ramírez-Flores and Oropeza-Huerta 2007) and drafted, though not finished, for Jalisco and Nayarit (Núñez-Pérez, August 2, 2011, email to FWS). None have been completed for Sonora, Chihuahua, or Sinaloa.

A National Jaguar Census (CENJAGUAR) in Mexico was started in 2008. The objective of the CENJAGUAR is to estimate the population status of the jaguar (abundance will be estimated using camera traps) and its prey in priority conservation areas in Mexico (Chavez et al. 2007). The results will serve to determine priority areas for jaguar conservation at the local, regional, and national level (Chavez et al. 2007).

Many other federally-supported conservation efforts for jaguars in Mexico have been made in the areas of public outreach. 2005 was nationally declared the "Year of the Jaguar." Habitat conservation has grown through the creation of new reserves, as well as incentive programs to conserve jaguar habitat within reserves. Protection has improved through increased vigilance and law enforcement efforts. In Jalisco, Nayarit, and Sinaloa, La Procuraduria Federal de Proteccion al Ambiente (Attorney General for Environmental Protection; PROFEPA) and CONANP together with a local non-governmental organization have formed groups of Community Jaguar Rangers with the goal of protecting jaguars and their prey from illegal activities.

International agreements have been developed. Mexico, Belize, and Guatemala signed the "Jaguars without Borders" initiative in 2006. As part of this initiative, a series of trilateral meetings and workshops have been conducted to review progress of direct and indirect conservation actions for the species, including research, environmental education, and habitat conservation in the three countries. As a result of these meetings, authorities now have a better understanding of the challenges to jaguar conservation in the region and a strategy has been developed to conserve jaguars and their habitat in the region. This initiative has been made possible through funding from CONANP and the Inter-American Development Bank (IDB), as well as the participation of NGOs; academia; federal, state and municipal governments; and representatives of communities located in the Mayan region of the three countries.

Local conservation efforts are also being undertaken. Mexican NGO, Naturalia, and U.S. NGO, Northern Jaguar Project (NJP), have worked together for years to conserve jaguars in Sonora. In 2004, Naturalia and the NJP purchased a 4,047-ha (10,000-ac) ranch, Rancho Los Pavos, in northern Sonora for the conservation of jaguars and other species. In 2008, they purchased Rancho Zetasora, a 14,164-ha (35,000-ac) ranch located adjacent to Rancho Los Pavos for the purpose of jaguar conservation (NJP 2008). These two ranches are now collectively referred to as the Northern Jaguar Reserve (NJR) and support part of the northernmost breeding population of jaguars. In 2007, Naturalia started a working group with diverse governmental and non-governmental partners, to address conservation concerns of carnivores, particularly felids, in Sonora. Naturalia and NJP developed and implement the Feline Photo Project. Under this project, when a rural landowner participating in the project produces a photograph of a jaguar on his ranch, the landowner will be paid a cash value equal to the long-standing bounty offered locally for dead jaguars. Ten ranch owners near the NJR are enrolled in the project and have signed agreements not to harm wildlife. Their land encompasses a total of 16,592 ha (41,000 ac), effectively increasing the protected area for jaguars.

During field surveys in 1999, scientists of the Wildlife Sciences Department at New Mexico State University found a resident jaguar population in the municipality of Nacori Chico in northeastern Sonora. Cattle ranchers in this area considered jaguars and pumas a threat to livestock and often killed them. However, through meetings with authorities and stakeholders in the area, a plan to conserve jaguars that also met the needs of cattle ranchers was developed. As a result, in January 2003, a 55,000 ha (135,908 ac) Wildlife Management Unit (UMA) encompassing 12 cattle ranches was created to compensate and mitigate for occasional jaguar predation on livestock and promote tolerance and conservation of the jaguar. The UMA's collective conservation efforts are designated as the "Programa de Conservacion del Jaguar en la Sierra Alta de Sonora" (Jaguar Conservation Program in the High Sierra of Sonora). The UMA raises compensation and other funds used to further jaguar conservation through managed white-tailed deer trophy hunts designated as "conservation hunts" (Rosas-Rosas and Valdez 2010).

In 2011, Rancho El Aribabi, a ranch owned by the Robles family, was declared a Natural Protected Area, under the category of Voluntary Land Conservation, by CONANP. This ranch, about 48 km (30 mi) southeast of Nogales, Arizona, supports jaguars as well as a host of other endangered and sensitive species. In southern Nayarit, another group, Alianza Jaguar (Jaguar Alliance), has been working to establish the Sierra de Vallejo reserve primarily for jaguar conservation.

United States

Federal endangered status was extended to jaguars in the U.S. in 1997. In 1997, AGFD and NMDGF entered into the Jaguar Conservation Agreement with other State, local, and Federal cooperators, with voluntary participation by many private individuals, and thereby formed the Jaguar Conservation Team, to contribute to conserving the jaguar in Arizona and New Mexico and

to encourage parallel efforts in Mexico. The Jaguar Conservation Agreement provides opportunities and incentives for interested parties to become involved with conservation activities including: collection of biological information (to provide a sound scientific basis for decisions); consideration of relevant cultural, economic, and political factors; design and implementation of a comprehensive approach to conservation (including public education); and monitoring, evaluation, and feedback.

In addition to an over-arching Memorandum of Agreement (MOA) among the signatories, the Conservation Agreement included a Conservation Assessment. The Conservation Assessment described the status of the jaguar in the U.S. and identified threats to the jaguar in Arizona and New Mexico, and a offered a Conservation Strategy, which focused on reducing or eliminating threats in Arizona and New Mexico that might prevent expansion of the current range and distribution of the jaguar, and thus contribute to recovery of the species (Van Pelt 2006). In 2007, the MOA was replaced with an updated conservation framework (finalized July 2007) and Memorandum of Understanding (MOU) (signed on March 22, 2007). The AGFD, NMDGF, and USFWS are the lead agency signatories on these documents, while other Federal and County governmental agencies in Arizona and New Mexico are Cooperator signatories. Additionally, the original Conservation Assessment and Strategy was replaced with a revised Jaguar Conservation Assessment for Jaguars in Arizona, New Mexico, and northwestern Mexico (finalized in January 2011).

The Jaguar Conservation Team has made several conservation-related accomplishments, including: 1) collaboration with Mexico on jaguar conservation; 2) a jaguar-based educational curriculum (in Spanish and English) that meets State and National standards and is in use in area schools; 3) enhanced public awareness of jaguar presence and conservation needs; 4) increased penalties under state law for unlawful killing of jaguars (in Arizona these increased penalties apply only if the jaguar is delisted federally); 5) a jaguar detection project (using still and video "camera traps"); 6) a system for evaluating and archiving sighting reports; 7) GIS-based evaluations of areas and habitats of historical and recent jaguar occurrence in Arizona and New Mexico for delineation of primary emphasis areas in both states for this conservation effort; 8) delineation of research recommendations intended to guide studies and provide the Jaguar Conservation Team with information requisite to science-based conservation efforts; 9) a rural outreach program (see Rinkevich and Bashum 2002 and Warshall and Bless 2003 as cited by Johnson et al. 2011); and 10) regular public forums in Arizona and New Mexico for discussion of jaguar-related issues (Johnson et al. 2011). The Jaguar Conservation Team remains a viable approach to borderlands conservation. Although activity has virtually ceased since February 2009, due to legal and other proceedings revolving around the death of a jaguar in south-central Arizona, the AGFD intends to reconvene the Jaguar Conservation Team.

Several formal consultations (pursuant to section 7 of the ESA) have been completed that analyzed the effects of various actions on jaguars. As a result of these consultations, a number of conservation measures have been identified, including support and funding of jaguar survey, monitoring, and recovery efforts; and closure and restoration of unauthorized road in jaguar

habitat. To implement one of these conservation measures, in 2011, U.S. Customs and Border Protection (CBP) provided funding to the USFWS to implement jaguar monitoring and recovery efforts in the U.S. to help offset effects of the border security activities on jaguar. A jaguar survey and monitoring program, funded by CBP, in the borderlands region of Arizona and New Mexico is planned to begin by 2012. To date, incidental take of two jaguars has been authorized under section 7 and no jeopardy opinions have been issued.

Under section 10 of the ESA, the following has been authorized for specific approved activities: 1) incidental take of one jaguar in the form of mortality or harm, and 2) unlimited take in the form of harass. In the U.S., regulatory mechanisms, in particular section 7, have been and will continue to be important in maintaining recovery options for jaguars in the U.S. Section 7 allows the USFWS to work with Federal agencies to 1) ensure that their actions do not jeopardize the continued existence of jaguars and 2) incorporate measures into projects that help minimize impacts to jaguars and contribute to their recovery. Because such a small portion of the jaguar's range occurs in the U.S., it is anticipated that recovery of the species will rely primarily on actions that occur outside of the U.S. Activities that may adversely or beneficially affect jaguars in the U.S. are less likely to affect recovery than activities in core areas of their range.

D. Summary Statement of Recovery Needs:

The jaguar, as a large carnivore, is more prone to extinction than many other land mammals. Loss of habitat, direct killing of jaguars, and depletion of prey are the primary factors contributing to its current status, considered to be stable or decreasing in numbers in most of its range. The legal protected status in Mexico and other range countries does not appear to have secured jaguars in their core or corridor areas, though it likely has aided in increased awareness and reduced direct killing in some areas. Ultimately, the long-term recovery needs for the jaguar throughout its range focus on the stabilization of core area populations, the expansion of the core areas, and the maintenance of secondary areas that provide connectivity between core areas and that could allow for range expansion and genetic exchange. Range expansion and natural movement of the jaguar may be of increased importance in the face of climate change and increased habitat fragmentation.

III. PRELIMINARY RECOVERY STRATEGY

A. Recovery Priority Number with Rationale: 5C.

This ranking, determined in accordance with the Recovery Priority Criteria at 48 FR 51985, is based on a high degree of threat due to habitat loss, a low potential for recovery, a taxonomic classification as a species, and the state of conflict between jaguars and humans. Degree of threat is considered high due to continuing habitat loss, ongoing poaching, and increased isolation of populations. Potential for recovery is considered low based on the specific needs of a very large home range, a viable prey base, proximity to water, avoidance of humans and development, and connectivity to other protected wild lands, along with natural history constraints of low population

densities, low reproductive rates, difficulty in controlling killing of jaguars by humans, and an increasing human population throughout the jaguar's range. Direct conflicts with humans remain, in the form of jaguar hunting to prevent damage to livestock, poaching, and human encroachment into jaguar habitat through expanding resource extraction and human development. Indirect conflicts of competing for the same prey and depending on shared water sources occur, and could be exacerbated by altered prey and water availability resulting from future changes in climate.

B. Recovery Vision Statement

1. Recovery Goal

The goal for this plan is to conserve and protect the jaguar and its habitat so that its long-term survival is secured and it can be considered for removal from the list of threatened and endangered species (delisted). As a species that is listed throughout its range (historically the species occurred in 21 countries; currently the species occurs in 19 countries, including the United States), the jaguar presents a significant challenge for recovery planning. Our knowledge regarding the status of the species in much of its range is limited, and the USFWS and its partners lack the resources and authority to coordinate large scale international research and recovery for the entire species. However, we can establish the framework to better understand the status and conservation needs of the jaguar for recovery throughout its range. We can cooperate with our partners in the northwestern and western states of Mexico (Sonora, Chihuahua, Durango, Sinaloa, Nayarit, and Jalisco) to focus efforts within our respective jurisdictions to conserve and recover jaguar populations in the northwestern limits of the species' range. We can establish specific criteria for recovery, and actions that, if implemented, will conserve viable jaguar populations in the northwestern portion of their range (i.e., from Arizona and New Mexico south to Colima – see description of the NRU below).

2. Preliminary Recovery Strategy

Our approach to the jaguar recovery plan will be as follows:

- To summarize what is known about the status of the jaguar throughout its range, and identify primary information gaps and broad actions necessary to address conservation of the species outside of the U.S. and northwestern/western Mexico (i.e., within the PARU).
- To address in significant detail the actions necessary to conserve jaguars in the northwestern portion of their range (i.e., within the NRU).

While we consider the jaguar throughout its range, we focus the details of this recovery plan on the NRU. We recognize the conservation needs and challenges facing the jaguar elsewhere in its range (i.e., throughout the PARU), but there are compelling circumstances that dictate this focus. The USFWS has little authority to implement actions needed to recover species outside the U.S. borders. The management and recovery of listed species outside of U.S. borders, including the jaguar, are primarily the responsibility of the countries in which the species occur, with the help, as appropriate, of available technical and monetary assistance from the U.S. Thus, it is appropriate to focus our efforts and resources on conservation of the jaguar in the northwestern

part of its range as our contribution toward an international effort to conserve and recover the jaguar rangewide.

Recovery units are subunits of the listed species that are geographically or otherwise identifiable and essential to the recovery of the species. Recovery units are individually necessary to conserve genetic robustness, demographic robustness, important life history stages, or some other feature necessary for long-term sustainability of the species. Each designated recovery unit is critical to recovering the jaguar throughout its entire current range. Establishing recovery units is a useful tool for species occurring across wide ranges with multiple populations, varying ecological pressures, or different threats in different parts of their range. Recovery units are primarily delineated on a biological basis; however, boundaries may be modified to reflect differing management regimes. Recovery units are not necessarily self-sustaining viable units on their own, but instead need to be collectively recovered to ensure recovery of the entire listed entity.

Management units are subunits that might require different management, be managed by different entities, or encompass different populations. However, each management unit may not necessarily be essential to the recovery of the species, yet may provide a function within the unit that benefits the overall recovery unit. In this outline, the management unit falls entirely within the larger recovery unit (i.e., the NMU is a subset of the NRU).

Northwestern Recovery Unit

The NRU extends from south-central Arizona and extreme southwestern New Mexico, U.S. south through Jalisco, Mexico, (Figure 1) and is approximately 222,197 km^2 (85,791 mi^2) in area: (32,081 km^2 [12,386 mi^2] in the U.S. and 190,116 km^2 [73,404 mi^2] in Mexico). It is a logical recovery unit because: 1) it encompasses the current known range of the putative subspecies, *Panthera onca arizonensis*, and a portion of *P. o. hernandesii* (Hall 1981); 2) it includes two core areas (see definition above) and two highest priority Jaguar Conservation Units (Rabinowitz and Zeller 2010); 3) it has distinct ecological conditions (i.e., xeric habitat) that occur nowhere else in the species' range (Sanderson et al., 2002); 4) peripheral populations such as these are important genetic resources; and 5) peripheral populations may be beneficial to the protection of evolutionary processes and the environmental systems that are likely to generate future evolutionary diversity (Lesica and Allendorf 1995). This may be particularly important considering the potential threats of global climate change.

As described in the Distribution and Abundance section above, in the NRU, jaguars currently occur from the border of Colima and Jalisco north through Nayarit, Sinaloa, southwestern Chihuahua, Sonora, and southeastern Arizona. There are breeding populations in Sonora, Sinaloa, Nayarit, and Jalisco. Just south of the southern boundary of the NRU, jaguars may occur in very low densities. Colima has not had any verified jaguar sightings for more than 50 years (López-González, pers. comm. 2011); however, there have been credible jaguar reports from the state, mainly near the border with Jalisco (Núñez-Pérez, August 2, 2011, email to FWS). No jaguars

have been documented in the northern part of the state of Michoacán for more than 50 years; however, jaguars have been confirmed in the last couple of years along the central coast of Michoacán. Although historically jaguars were present in the region, current habitat conditions in the Jalisco/Colima border area are likely not suitable to support jaguars or provide connectivity between the NRU and small extant populations in Guerrero, Oaxaca, and Chiapas. This poses a barrier for connectivity between the NRU and remaining jaguar populations along the pacific coast of Mexico into Central America. There is no verified connectivity between the Sierra Madre Occidental and the Sierra Madre Oriental. Zeller and Rabinowitz (2010) proposed a corridor between these mountain ranges but it seems unlikely that jaguars would use this corridor as it passes through one of the most arid regions of the Mexican plateau dominated by Chihuahuan desert.

In the U.S. portion of the NRU, including southeastern Arizona and extreme southwestern New Mexico, only male jaguars have been documented since 1950; the last female documented in this area was in 1949 (Brown and López-González 2001). No jaguars have been documented north of the NRU in the U.S. since 1963[e] (Brown and López-González 2001, Johnson et al. 2011). Hatten et al. (2005) hypothesize that current land use practices are limiting jaguar movement into central Arizona. In general, little is known about the current status of jaguars in Arizona and New Mexico; however, we anticipate that a three-year survey and monitoring effort, to be initiated soon in south-central and southeastern Arizona and extreme southwestern New Mexico, will provide more information. As more information is gathered on the distribution and status of jaguars within the NRU and adjacent areas, the boundaries of the NRU may need to be expanded or reconfigured.

In January and March 2011, the Conservation Breeding Specialist Group and the Jaguar Recovery Team conducted a population viability analysis (PVA), which can be a useful tool for investigating current and future demographic dynamics of jaguar populations in the northwestern portion of the species' range. *VORTEX*, a simulation software package written for PVA, was used as a vehicle to study the interaction of a number of jaguar life history and population parameters, and to test the effects of selected management scenarios. The results of the PVA suggest that jaguar populations in the central and southern portions of the NRU, namely those in Jalisco and southern/central Sonora, are of sufficient size to remain demographically viable as long as some level of dispersal acts to reduce the potentially deleterious effects that inbreeding depression may bring to a small and relatively isolated population. Moreover, this viability is critically dependent on at least minimal opportunities for population growth of key subpopulations in the absence of dispersal so that these areas can act as demographic source populations of dispersing individuals. The strength with which a source population can supply individuals for neighboring regions is critically dependent on its intrinsic capability for growth, itself a function of the threats imposed on it by local human activity.

[e] The validity of this record (a female jaguar killed in the White Mountains of Arizona) has been disputed. See Johnson et al. 2011 for further information.

Northwestern Management Unit

Within the NRU, the NMU extends from south-central Arizona and extreme southwestern New Mexico, U.S. south through northeastern Sonora, Mexico, (Figure 1) and is approximately 74,832 km^2 (28,893 mi^2); with (32,081 km^2 [12,386 mi^2] in the U.S. and 42,751 km^2 [16,506 mi^2] in Mexico). It is a logical management unit because it encompasses the secondary area north of the northwestern most core area (the Sonoran core area). Unlike other secondary areas, this secondary area does not connect two core areas; however, it may allow for expansion of the Sonoran core area.

Pan American Recovery Unit

The PARU extends from Mexico to Argentina and encompasses 88 core areas and all corridors connecting these areas (Figure 2). Although general maps of this large unit may include peripheral areas, more refined maps would not include such areas (i.e., Texas or high mountain passes in the Andes) due to the lack of persistent presence in these parts.

3. Preliminary Recovery Objectives

Recovery objectives collectively describe the specific conditions under which the goals for recovery of the jaguar will be met. These objectives apply to the recovery of the jaguar throughout its range and the five listing factors (see "Reasons for Listing/Threats" for a description of the five Listing Factors):

1) Assess, protect, and restore sufficient habitat to support viable populations of jaguars in the two recovery units (NRU and PARU) (Listing Factors A, E).
2) Mediate or mitigate the effects of human population growth and development on jaguar survival and mortality where possible (Listing Factors A, E).
3) Reduce direct human-caused (i.e., illegal and legal killing) mortality of jaguars (Listing Factor B).
4) Reduce illegal hunting of jaguar prey and improve regulation of legal hunting where appropriate (i.e., in cases where hunting is leading to significant reductions of jaguar prey) (Listing Factors B, E).
5) Maintain or improve genetic fitness, demographic conditions, and health of the jaguar (Listing Factors C, E).
6) Assure the long-term viability of jaguar conservation through partnerships, the development and application of incentives for landowners, application of existing regulations, and public education and outreach (Listing Factors A, B, D, E).
7) Practice adaptive management in which recovery is monitored and recovery tasks are revised by the USFWS in coordination with the Jaguar Recovery Team as new information becomes available. (Listing Factors A, B, C, D, E).
8) Support international efforts to ascertain the status and conservation needs of the jaguar in the two recovery units (NRU and PARU) (Listing Factors A, B, C, D, E).

4. Recovery Criteria

Recovery criteria are the objective, measurable criteria that if met, provide a basis for determining whether a species can be considered for reclassification (downlisting to threatened status, or removing it from the list of threatened and endangered species [delisted]). Because the same five statutory factors must be considered in delisting as in listing, 16 U.S.C. § 1533 (a), (b), (c), the USFWS, in designing objective, measurable criteria, must address each of the five statutory delisting factors and measure whether threats to the [species] have been ameliorated (see Fund for Animals v. Babbitt, 903 F. Supp. 96 [D.D.C. 1995]). Recovery criteria will be presented in the recovery plan.

Recovery Criteria for the Northwestern Recovery Unit – *To be developed.*

Recovery Criteria for the Pan American Recovery Unit – *To be developed.*

Though specific recovery criteria will be presented in the recovery plan, in general, to recover jaguars key jaguar habitat must be protected from loss and fragmentation and jaguar populations and their prey must be protected from illegal killing. These protections will need to be well-established and remain in place after delisting to ensure the long-term viability of the species. Due to past habitat loss, it is unlikely that jaguars will be fully self-sustaining throughout their historical range; however, conservation of key jaguar habitat (including core and secondary areas) and populations will be critical to the recovery of jaguars. Recovery may include restoration of some historical habitats which could facilitate expansion of the current jaguar range; however a substantial increase in the number of jaguar populations is not anticipated.

C. Brief action plan for working with this vision

Below are some preliminary recovery actions (not in order of priority) to help achieve the aforementioned goal and objectives. A more thorough list of prioritized actions will be developed for the recovery plan.

Preliminary Recovery Actions common to the NRU and PARU:

1) Document jaguar presence in a reliable fashion.
2) Assess the habitat quality of occupied areas through some type of objective and defensible method.
3) Conduct studies to better understand the impacts of highways on jaguar movement and the effectiveness of under and overpasses and other design measures to facilitate jaguar movement across these highways.
4) Maintain and improve, when necessary, connectivity for movement of jaguars throughout the landscape and between populations to increase the long-term survival of subpopulations. This should include developing and maintaining highway under or overpasses and other design measures to facilitate jaguar movement where needed.

5) Test and put in place conservation tools that 1) encourage the protection of jaguar habitat and corridors and 2) reduce illegal killing of jaguars. Although the tools will vary with the site, these are likely to include consideration of tax or other incentives (particularly economic incentives); enactment of new laws and enforcement of existing ones; research; and education programs to increase awareness of the value and current status of jaguars. Protection of jaguar habitat and corridors will not only help conserve jaguars, but will also improve ecosystem resiliency and the health of natural communities.
6) Reduce conflicts between jaguars and livestock through improvement of livestock management practices, which have been proven through field studies. Applying these practices may not eliminate jaguar killing of livestock, but it will reduce it and consequently the motivation for retaliatory killing of jaguars.
7) Reduce illegal and, where needed, legal hunting of jaguar prey through improved law enforcement programs and other programs aimed at developing alternative food sources for local communities.

<u>Preliminary Recovery Actions specific to the Northwestern Recovery Unit:</u>

Research and monitoring

8) Conduct surveys, using consistent methods in each area, for jaguars in (a) the northern Sonora secondary area, (b) northern Sinaloa secondary area, (c) southern Arizona, and (d) southwestern New Mexico. Surveys should last a minimum of three years to reflect year to year variation and be repeated in regular intervals.
9) Continue ongoing analyses and publication of habitat use by northern jaguars. Specifically, develop and implement rigorous, standardized methodologies to investigate and better understand habitat use (including use of corridors) of males and females across different regions of the NRU.
10) Obtain gender- and age-specific estimates of dispersal rates and travel distances.
11) Obtain accurate information on the drought cycle.
12) Obtain a better understanding of the extent to which poaching and depredation loss are compensatory with other types of mortality in order to conduct a more accurate PVA.
13) In conjunction with the aforementioned study, conduct a study of ungulate abundance and trends to better understand the relationship of prey populations and jaguars.
14) Characterize vegetation where jaguar and its prey occur to better understand water availability and vegetation structure necessary to support jaguars and their movements.
15) Obtain information on how climate change affects northern jaguar demography and ecology.
16) Conduct research to understand the impact of border security infrastructure and operations on jaguar movement.
17) Conduct research to understand the impact of subsistence hunting on jaguar prey species.
18) Conduct research to understand interspecific competition between jaguars and pumas, specifically focused on competition for prey.
19) Continue and expand studies to obtain more rigorous estimates of age-specific vital rates, including year to year variation.

20) Continue and expand studies to obtain more rigorous estimates of gender-specific vital rates, including year to year variation.
21) Continue and expand studies to obtain more rigorous estimates of region-specific vital rates, including year to year variation.

Partnerships
22) Maintain existing collaborative local efforts to conserve jaguars and establish and maintain new collaborative efforts where possible (e.g. JAGCT in the borderlands and other efforts in the NRU).

Education and outreach
23) Improve and increase landowner awareness of the importance of jaguars and their habitat.

Landowner Incentives
24) Support ecotourism or other conservation efforts that promote the conservation of jaguars within the NRU.
25) Improve incentive programs for landowners within jaguar habitat in the NRU that support jaguar persistence, and increase the number of landowners enrolled in such programs.
26) Support and increase the number of ranchers enrolled in photo incentive programs (i.e., payment for jaguar photos) in the NRU.

Regulation and Enforcement
27) Mitigate human activity, such as road and mine development, through improved regulation within jaguar habitat in the NRU.
28) Collaborate with Departments of Transportation, Regional Transportation Authorities, landowners, Department of Homeland Security, county planning offices, and others to voluntarily include jaguar conservation in their plans and activities.
29) Work with the Ministry of Communication and Transportation in Mexico to encourage the use of under or overpasses and other appropriate measures (i.e., guiding fences) that decrease the risk of mortality associated with roads and facilitate jaguar movement across roads in the NRU (i.e., Highway 2 in northern Sonora when it is expanded from two to four lanes [planned for 2013] and any other highways that impede or could impede jaguar movement).

<u>Preliminary Recovery Actions specific to the Pan American Recovery Unit</u> – *To be developed.*

Actions that contribute to the conservation of core and secondary habitats and reduce illegal killing of jaguar and their prey should begin immediately where they are not being conducted and continue to be conducted where they have already begun. The USFWS will play an active role in initiating recovery actions for the jaguar in the U.S. and for supporting recovery actions outside of the U.S. Using funds provided by the Department of Homeland Security, the USFWS recently contracted the University of Arizona to conduct a three-year jaguar survey and monitoring effort in south-central and southeastern Arizona and extreme southwestern New Mexico to begin to

address our research needs. Results of this study will be used to inform the implementation of future recovery actions in the U.S.

IV. PREPLANNING DECISIONS

A. Will a recovery plan be prepared? Yes

B. Scope of the recovery plan: Single species**,** focused on the Northwestern Recovery Unit for jaguar.

C. Recovery Plan Coordinator: Marit Alanen, USFWS's Jaguar Recovery Team Liaison.

D. Plan preparer(s): The recovery plan will primarily be authored by the Technical Subgroup of the Recovery Team working closely with the USFWS liaisons and the Implementation Subgroup of the Recovery Team. More specifically, the Recovery Team Technical Subgroup Co-leaders (one from the U.S. and one from Mexico) will have responsibility for writing portions of the plan and encouraging Technical and Implementation Subgroup authorship of other portions of the plan, as long as such input can be provided according to the schedule outlined above. The plan will reflect the input of both subgroups of the team. The Co-leaders, with the assistance of USFWS liaisons, will engage the Technical and Implementation Subgroups through regular teleconferences or meetings and reviews of draft plans.

E. Where will information sources and the administrative record be housed? Arizona Ecological Services Office, Tucson

F. Will a recovery team be appointed? Yes

Recovery Team Expertise

The JRT, a binational team with members from the U.S. and Mexico, is composed of two subgroups: a Technical Subgroup (TS) and an Implementation Subgroup (IS). Both subgroups have nearly equal representation from the U.S. and Mexico. The Team has two Co-leaders, one from the U.S. and one from Mexico; both are members of the TS, though they serve as Co-leaders for the entire JRT.

Technical Subgroup of the Recovery Team
The TS consists of feline ecologists, conservation biologists, and other experts, who will, among other tasks, advise the JRT and the USFWS on appropriate short- and long-term actions necessary to recover the jaguar.

Implementation Subgroup of the Recovery Team
The IS consists of members who will advise the TS, Co-leaders, and the USFWS on ways to achieve timely recovery with minimal social and economic impacts or costs. Specifically, the IS consists of landowners and land and wildlife managers, including, but not limited to, representatives of: Arizona Game and Fish Department; New Mexico Department of Game and Fish; U.S. Forest Service; Bureau of Land Management; USDA APHIS Wildlife Services; Customs and Border Protection; the Tohono O'odham Nation; the Malpai Borderlands Group; Altar Valley Conservation Alliance; Comisión Nacional de Áreas Naturales Protegidas; Comisión de Ecología y Desarrollo Sustentable del Estado de Sonora; Secretaría de Agricultura; Ganadería, Recursos Hidráulicos, Pesca y Acuacultura, Unión Ganadera Regional de Sonora, and Asociación para la Conservación del Jaguar en la Sierra Alta de Sonora, Sonora, Naturalia, Biodiversidad y Desarrollo Armónico, and private landowners in Arizona and Sonora.

If deemed appropriate, the IS will prepare a Participation Plan, which would become an Appendix to the Recovery Plan and would detail their recommendations on recovery action implementation. Arizona Game and Fish Department, New Mexico Department of Game and Fish, and the Tohono O'odham Nation will be full partners in developing the recovery plan pursuant to applicable regulations, policies, agreements, and memoranda of understanding.

G. Production schedule for planning documents: USFWS, Region 2, initiated the preparation of the recovery plan in fiscal year 2011. The USFWS policy establishes an 18-month time frame for preparation of a draft recovery plan with the final plan due within 2 ½ years of listing. No recovery plan was written for the species at the time of listing, and in 2007 the USFWS determined that a recovery plan would not promote the conservation of the species and therefore no plan was needed. Subsequently, the USFWS determined that a recovery plan would benefit the species. As a result, the USFWS aims to prepare a draft recovery plan by fall 2012 and a final plan by fall 2013.

As stated above, the USFWS is considering proposing critical habitat for the jaguar and will make that decision spring 2012. If critical habitat is proposed, by law, it can only be within the United States. Though designation of critical habitat is an internal USFWS task, documents developed by the Jaguar Recovery Team, including this recovery outline, and other relevant literature will be relied upon for the analysis.

H. Key stakeholders: In addition to the key stakeholders included in the subgroups, other stakeholders may also include agencies, organizations, institutions, and/or or individuals that take an interest in, contribute to, or are affected by recovery planning.

I. Plan for stakeholder involvement in the recovery planning and/or implementation process: As explained above, many stakeholders will be involved in the recovery planning process through their participation on the IS of the Jaguar Recovery Team. Locally-based implementation of recovery actions will be coordinated among the various partners and stakeholders that take an interest in, contribute to, or are affected by recovery planning.

Stakeholders will play a crucial role in plan development to ensure that recovery actions can be implemented effectively and in ways that minimize economic and social harm.

Approval:

Joy E. Nicholopoulos

Date 4/18/12

Acting

Benjamin Tuggle
Regional Director,
U.S. Fish and Wildlife Service, Region 2

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TABLES AND FIGURES

Figure 1. Northwestern Jaguar Recovery Unit.

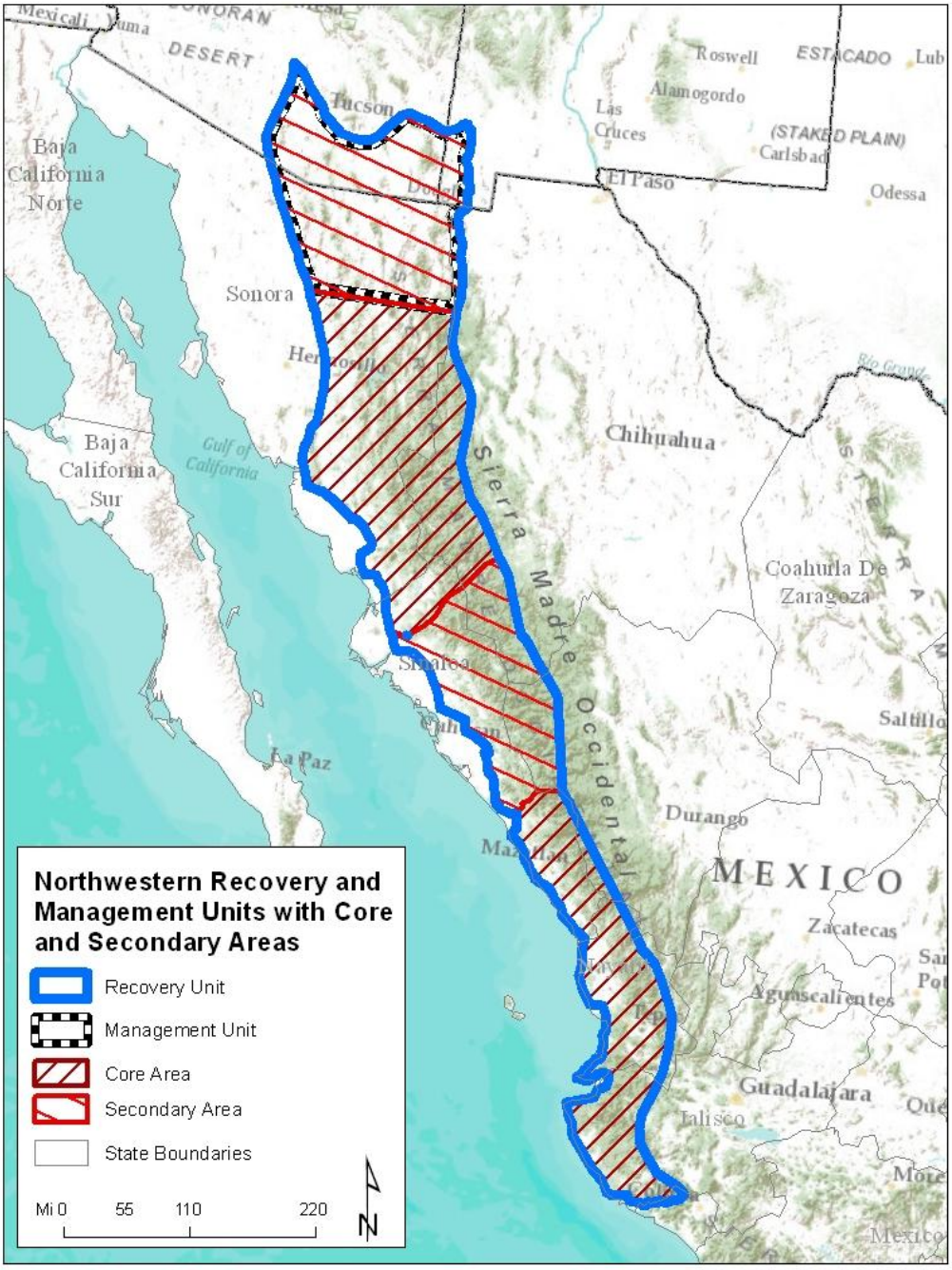

Figure 2. Pan American Jaguar Recovery Unit Core (Jaguar Conservation Units) and Secondary Areas (Corridors) (modified from Rabinowitz and Zeller 2010).