California Condor
(*Gymnogyps californianus*)

5-Year Review:
Summary and Evaluation

U.S. Fish and Wildlife Service
Pacific Southwest Region

June 2013

Acknowledgement:

The Service gratefully acknowledges the commitment and efforts of the California Condor Recovery Program partners for their many on-going contributions towards condor recovery. Our partners were instrumental both in ensuring that we used the best available science to craft our analyses and recommendations in this 5-year review and in providing individual feedback that was used to refine this document.

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5-YEAR REVIEW

California condor (*Gymnogyps californianus*)

I. GENERAL INFORMATION

Purpose of 5-Year Reviews:

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act of 1973, as amended (Act) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the Lists of Endangered and Threatened Wildlife, changed in status from endangered to threatened, or changed in status from threatened to endangered. Our original listing as endangered or threatened is based on the species' status considering the five threat factors described in section 4(a)(1) of the Act. These same five factors are considered in any subsequent reclassification or delisting decisions. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rulemaking process, which includes public review and comment.

Species Overview:

The California condor (*Gymnogyps californianus*) is the only remaining member of its genus in the family *Cathartidae*, and is one of the rarest bird species in the world. California condors are obligate scavengers that primarily feed on large mammalian carcasses (e.g., deer (family *Cervidae*), elk (*Cervus canadensis ssp. nannodes*), feral pigs (*Sus scrofa*), livestock (domestic ungulates), horses (*Equus ferus caballus*), pinnipeds (family *Otariidae*); however, medium- to small-sized carrion (e.g., rabbit (Family *Leporidae*) and squirrel (family *Scuridae)*) also are utilized.

California condors were widely distributed in North America during the late Pleistocene era (approximately 50,000–10,000 years before present), with records from Oregon, California, Nevada, Arizona, New Mexico, Texas, Florida, New York, and Mexico (Steadman and Miller 1986, Emslie 1987). At the time of the arrival of Russian and Euro-American explorers, California condors occurred only in western North America from British Columbia, Canada, to Baja California, Mexico, and inland to the Cascade and Sierra Nevada mountain ranges, with occasional observations farther east (Figure 1) (Koford 1953, Wilbur 1973, Wilbur 1978, Snyder and Snyder 2005, D'Elia 2013). California condors were observed in the Pacific Northwest until the early 1900s, and in Baja California until the 1930s (Koford 1953, Wilbur 1973, Wilbur and Kiff 1980).

By about 1950, California condors were confined in California to a horse-shoe shaped area encompassing six counties just north of Los Angeles, California (Figure 1) (Koford 1953).

Though no definitive causes of the condors' decline during the early 1900s have been established, it was likely the result of high mortality rates due to direct persecution, collection of specimens, and secondary poisoning from varmint control efforts and 1,1,1-trichloro-2,2-bis(p-chloro-phenylethane (DDT) (Snyder and Snyder 2005, D'Elia 2013). Lead poisoning may have been a contributing factor, but was not recognized as such until after 1980. Speculation that human nest disturbance and food scarcity were factors in the decline has been largely discounted (Snyder and Snyder 2005).

Active conservation efforts began in the 1930s, largely focused on habitat preservation. Despite these efforts, the wild population of the California condor continued to decline. A captive breeding program began in 1982 using eggs and chicks removed from the wild and a single captured adult condor, leaving an estimated 21 individuals in the wild. No additional juvenile or adult condors were captured until 1986. In the winter of 1984–1985, a population crash claimed six condors (40 percent of the wild population at that time), leaving only a single breeding pair in the wild (Snyder and Snyder 2000). During 1986 and early 1987, after much controversy, all nine remaining adult and juvenile wild birds were captured in order to ensure their safety and preserve the species' genetic diversity. Along with the 13 wild eggs and four chicks from wild nests captured previously, plus Topa Topa (a California condor removed from the wild as a fledgling in 1967), a captive breeding stock consisting of 27 birds became the nucleus of the captive breeding program (Snyder and Snyder 2000, Grantham 2007).

California condors were absent from the wild until 1992 when the first eight captive-reared birds were released in southern California. The reintroduction of birds continued in Arizona in 1996, central coastal California in 1997, northern Baja California, Mexico, in 2002, and Pinnacles National Monument, California, in 2003. At the end of December 2012, there were 404 condors in the world; 235 of these were free-flying wild birds distributed among the five release sites. The remaining 169 birds are used for captive breeding, inappropriate for release, or undergoing medical treatment (Service 2012).

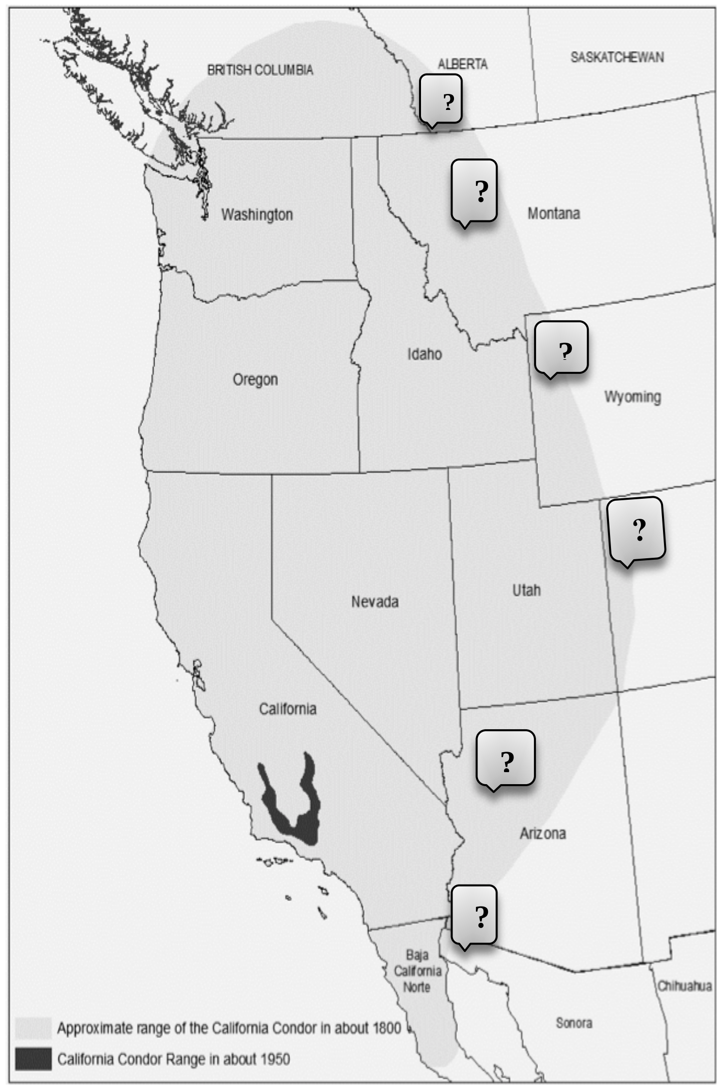

Figure 1. Range map of free-flying California condors in about 1800 (Snyder and Snyder 2005) and in about 1950 (Koford 1953)

Methodology Used to Complete This Review:

This review was prepared by the Hopper Mountain National Wildlife Refuge Complex (NWRC) and the Regional Office in Sacramento, California, and follows Service Region 8 guidance. In addition, a preliminary draft of this review was circulated among the California condor partners at their meeting in August 2012. All of the partners were invited to provide individual comments on the draft document, and those comments were incorporated, as appropriate, into the final review.

Our primary sources of information were the existing adopted Service recovery plans (Service 1975, 1979, 1984, 1996), scientific literature, written reports from the Service and partner organizations, data from the captive breeding and release programs, and records and personal communications from Service and other biologists who have been involved with the recovery of the California condor. We received no information from the public in response to our Federal Register notice initiating this 5-year review (74 FR 12878). This 5-year review contains updated information on the species' biology and threats, summarizes progress toward recovery, clarifies some listing-related issues, and includes a recommendation regarding status. Finally, the report recommends additional conservation actions to be completed or initiated within the next 5 years.

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Federal Register Notice Citation Announcing Initiation of This Review: A Federal Register notice initiating the 5-year review and opening a 60-day comment period was published on March 25, 2009 (74 FR 12878). During this period, the Service received no comment letters that provided information for use in this 5-year review.

Listing History:

Original Listing under Endangered Species Preservation Act of 1966:
FR Notice: 32 FR 4001; March 11, 1967
Entity Listed: California condor (*Gymnogyps californianus*)
Classification: Endangered
Portion of the Range where Threatened or Endangered: Entire

<u>Revised Listing under Endangered Species Act of 1973:</u>
CFR Notice: 50 CFR 17.11 (1975)
Entity Listed: California condor (*Gymnogyps californianus*)
Classification: Endangered
Portion of the Range where Threatened or Endangered: Entire
(see section "Application of the 1996 Distinct Population Segment (DPS) Policy" below for a discussion of inconsistencies in Code of Federal Regulations (CFR) language due to a textual error that began in 1987)

<u>Listing of Nonessential Experimental Population:</u>
FR Notice: 61 FR 201 54043
Entity Listed: California condor (*Gymnogyps californianus*)
Classification: Nonessential experimental population
Special Rule: 50 CFR Part 17.11 and 17.84
Portion of the Range where Threatened or Endangered: Specified portions of Arizona, Nevada, and Utah

<u>State Listing:</u>
The California condor was protected under California law in 1901 (Wilbur 1978), and specifically protected from take in California's Fish and Game Code (section 1179.5) in 1953. The condor was listed under the California Endangered Species Act as endangered on June 27, 1971, and is fully protected pursuant to California Fish and Game Code section 3511.

<u>Mexico Listing:</u>
The California condor is listed in Mexico under the NORMA Oficial Mexicana NOM-059-SEMARNAT-2010, Protección ambiental-Especies nativas de México de flora y fauna silvestres-Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio-Lista de especies en riesgo. The NOM-059 is Mexico's equivalent to the U.S. List of Endangered and Threatened Wildlife and Plants. It was revised and updated in 2010. The current version lists the California condor as "En Peligro de Extincion," which is the equivalent to "endangered status" in the United States.

Associated Rulemakings:

- **September 24, 1976** (41 FR 41914): Determination of Critical Habitat for American Crocodile, California Condor, Indiana Bat, and Florida Manatee (American crocodile, *Crocodylus acutus*; California condor, *Gymnogyps californianus*; Indiana bat, *Myotis sodalis*; Florida manatee, *Trichechus manatus*)

- **September 22, 1977** (42 FR 47840): Final Correction and Augmentation of Critical Habitat Reorganization

Review History:
No previous 5-year reviews or formal status reviews of this taxon have been conducted.

Species' Recovery Priority Number at Start of 5-Year Review: At the start of this review, the recovery priority number for the California condor was 4C. As defined in the Endangered and Threatened Species Listing and Recovery Priority Guidelines (Table 1), the recovery priority number is based on a 1 to 18 ranking system where 1 is the highest rank and 18 the lowest (48 FR 4309, as corrected in 48 FR 51985). The existing 4C designation indicates that the California condor is a monotypic genus that faces a high degree of threat and has a low potential for recovery. The "C" indicates conflict with construction, development projects, or other forms of economic activity. The designation shown in the Services' third revision to the Recovery Plan for the California Condor (Recovery Plan) in 1996 was 1C, which indicates a monotypic genus that faces a high degree of threat and has a stable or increasing population and a high potential for recovery. However, that designation was not reflected in subsequent listing documents maintained by the Service.

Degree of Threat	Recovery Potential	Taxonomy	Priority	Conflict
High	High	Monotypic Genus	1	1C
		Species	2	2C
		Subspecies/DPS	3	3C
	Low	*Monotypic Genus*	*4*	*4C*
		Species	5	5C
		Subspecies/DPS	6	6C
Moderate	High	Monotypic Genus	7	7C
		Species	8	8C
		Subspecies/DPS	9	9C
	Low	Monotypic Genus	10	10C
		Species	11	11C
		Subspecies/DPS	12	12C
Low	High	Monotypic Genus	13	13C
		Species	14	14C
		Subspecies/DPS	15	15C
	Low	Monotypic Genus	16	16C
		Species	17	17C
		Subspecies/DPS	18	18C

Table 1. Ranking system for determining recovery priority.
The above ranking system for determining Recovery Priority Numbers was established in a September 21, 1983 Federal Register notice (48 FR 43098, as corrected in 48 FR 51985).

Recovery Plan

Name of Plan: Recovery Plan for the California Condor, Third Revision
Date Approved: 25 April, 1996
Dates of Previous Revisions: Original Plan Approved: 1975; First Revision: 1979; Second Revision: 1984

II. REVIEW ANALYSIS

Application of the 1996 Distinct Population Segment (DPS) Policy

The Act defines "species" as including any subspecies of fish or wildlife or plants, and any DPS of any species of vertebrate wildlife. This definition limits listing as DPSs to species of vertebrate fish or wildlife. The 1996 Policy Regarding the Recognition of Distinct Vertebrate Population Segments under the Endangered Species Act (61 FR 4722; February 7, 1996) clarifies the interpretation of the phrase "distinct population segment" for the purposes of listing, delisting, and reclassifying species under the Act.

In the original 1967 pre-Act list (under the Endangered Species Preservation Act of 1966), California condor is listed as a native endangered species (32 FR 4001, see also 35 FR 16047). The first combined domestic and foreign list under the Endangered Species Act listed the California condor as endangered across its entire range (50 CFR 17.11) (1975). In the republished list in the 1980 CFR (reformulated like the current one) the historical range is shown as "U.S.A. (OR, CA), Mexico (Baja California)," and the "Vertebrate Population where Threatened or Endangered" shows the species as listed across its entire range.

In 1987, the range of the listed entity stated "USA only" for the first time (50 CFR 17.11) (1987). Though it has been republished in this manner since 1987, no narrative explanation of this change in either the Federal Register or any other documentation can be found. A brief survey of leaders in the California Condor Recovery Program from that era also revealed no known reason why the range would be limited to "USA only." Because the 1987 language in the CFR (which persists to the present day) is a textual error, the species remains listed across its entire range. This review recommends the publication of a Federal Register notice that explicitly states that the 1987 language does not accurately reflect the listed entity.

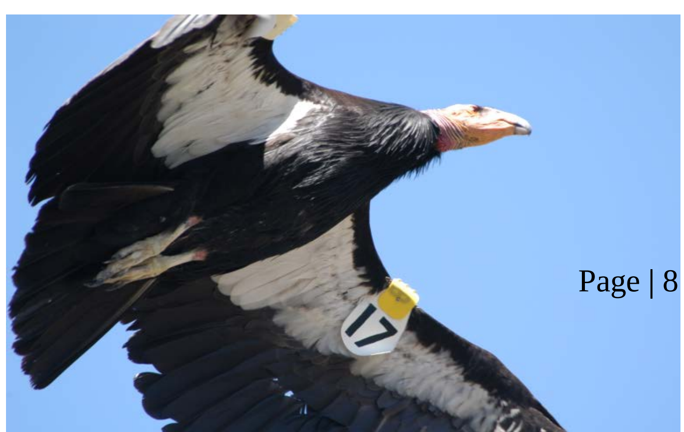
Information on the Species and its Status

Taxonomy

The California condor was originally classified in the same genus as its closest living relative, the Andean condor (*Vultur gryphus*), but due to the Andean condors slightly different markings, slightly longer wings, and tendency to kill small animals for food (Lint 1959, Gailey and Bolwig 1973), the California condor has now been placed in its own monotypic genus (Amadon 1977). The California condor is a member of the family *Cathartidae*, or New World vultures, a family of seven species, including the closely related Andean condor and the sympatric turkey vulture (*Cathartes aura*). This family has traditionally been placed in the Order *Falconiformes*, but more recently there has been a proposal to reassign it, along with other New World vultures, to order *Accipitriformes,* which includes hawks, eagles, ospreys (*Pandion haliaetus*), and the secretary bird (*Sagittarius serpentarius*) (Hackett et al. 2008). In the 1996 Recovery Plan, reference was made to a close relationship between New World vultures and storks (*Ciconiidae*) (Service 1996), but more recent studies have found no affinity to storks and support the newly proposed order (Hackett et al. 2008).

Species Biology and Life History

California condors are among the largest flying birds in the world, with wingspans measuring up to 9.5 feet (2.9 meters).



Adult condor males and females are identical in size and plumage, weigh between 17–24 pounds (7–11 kilograms), and are predominantly black with prominent white underwing linings. The head and neck are mostly naked, and the bare skin is gray, grading into various shades of red, yellow, and orange. The heads of juveniles (1–3 years) are grayish-black, and their wing linings are variously mottled or completely dark. During the third year, the head begins to develop yellow coloration and wing linings become gradually whiter. Adult plumage is attained between 5 and 6 years of age (Service 1996, Snyder and Snyder 2000).

California condor life history can be categorized into nesting, foraging, and roosting components (Service 1975). Courtship and nest site selection typically occur during winter (November–March), with a single egg clutch produced between late January and early April. Both parents are involved in incubation and hatching occurs after approximately 56 days. Both parents also feed and care for the offspring. Chicks fledge at 5.5 to 7 months of age, but may not become fully independent until the following year (Service 1996). Due to the long period of parental care, it was assumed successful condor pairs nested every other year (Koford 1953, Service 1979); however, this pattern seems to vary depending on the time of year the prior nestling fledges (Snyder and Hamber 1985). If a nestling fledges relatively early (in late summer or early fall), its parents may nest again the following year (Snyder and Hamber 1985).

While longevity has not been determined, Andean condors (*Vultur gryphus*), which are closely related to California condors, have been known to reach 60–70 years in captivity. Topa Topa, a California condor removed from the wild as a fledgling in 1967, is still an active breeder at the Los Angeles Zoo at 46 years of age. California condors are slow to mature and will typically begin to breed at 6 to 8 years of age, although a few birds have been known to breed at 5 years (Snyder and Snyder 2000, California Condor Studbook 2011). In captivity, both males and females typically begin breeding at 6 to 8 years (Kuehler et al. 1991).The historical (pre-1987) wild California condor population successfully fledged young from approximately 30–50 percent of eggs laid (Snyder 1983, Snyder and Snyder 1989), which is consistent with other solitary nesting New World and Old World vultures (Jackson 1983, Mundy et al. 1992, Meretsky et al. 2000).

California condors are primarily a cavity nesting species and typically nest in cavities located on steep rock formations or in the burned out hollows of old-growth conifers (coast redwood (*Sequoia sempervirens*) and giant sequoia trees (*Sequoiadendron giganteum*)) (Koford 1953, Snyder et al. 1986). Less typical nest sites include cliff ledges, cupped broken tops of old-growth conifers, and in several instances, nests of other species (Snyder et al. 1986, Service 1996).

California condors are obligate scavengers that feed only on carrion (Service 1996). It appears that they do not use smell, but instead locate food by sight or by following other scavenging birds (Snyder and Snyder 2000). Condors may feed individually or in large numbers at a carcass. Typical foraging behavior includes long-distance reconnaissance flights, lengthy circling over a carcass, and hours of waiting at a perch or on the ground near a carcass, possibly watching for predators (Service 1996). Condors maintain wide-ranging foraging patterns throughout the year, an important adaptation for a species with unpredictable food supplies (Meretsky and Snyder 1992). Condors at interior locations feed on mule deer (*Odocoileus hemionus*), tule elk, pronghorn antelope (*Antilocapra americana*), feral hogs, domestic ungulates, and smaller mammals, while the diet of birds on the coast includes whales (Order *Cetacea*), sea lions (*Zalophus californianus*), and other marine species (Koford 1953, Service 1984, Emslie 1987, Service, unpubl. data).

Currently, California condors predominately forage in open terrain of foothill grassland and oak savanna habitats, and at coastal sites in central California (birds released from Big Sur and Pinnacles National Park), but have also been observed feeding in more wooded areas, though this is less common (J. Grantham 2010 pers. comm.).

California condors have relatively heavy wing-loading (mass per wing area) and have a difficult time becoming and remaining airborne over flat terrain (Snyder and Snyder 2000). Over such terrain, condors are almost exclusively dependent on the uplift provided by thermal cells, a less consistent motive force than breezes blowing over hilly terrain (Snyder and Snyder 2000). During periods of inclement weather a condor may remain at a roosting location for an entire day or longer until better weather conditions occur (Snyder and Snyder 2000). However, in good weather it is common for birds to cover great distances over the course of a day. One California condor traveled 141 miles (mi) 225 kilometers (km) in a single day, from the northeast corner of Tulare County south through the Sierra Nevada mountain range and Tehachapi Mountains to a roost just north of the Santa Barbara nesting area (Snyder and Snyder 2000). Telemetry data and Global Positioning System (GPS) devices on some birds have documented other long-distance flights, including flights from southern Utah to Flaming Gorge, Wyoming (over 400 mi (643 km)) and from Sierra de San Pedro Martir in Baja California to Imperial County, California (approximately 155 mi (250 km) (Service, unpubl. GPS telemetry data).

California condors repeatedly use roosting sites on ridgelines, rocky outcrops, steep canyons, and in tall trees or snags near foraging grounds (Service 1984). While at a roost, condors devote considerable time to preening, sunning, and other maintenance activities. Similar to other vulture species, condor roosts also may serve in social interaction and as assembly points for group activities; it is common for two or more California condors to roost together and leave the roost at the same time (Service 1984, Buckley 1996). Cliffs and tall trees, including dead snags, are generally utilized by breeding pairs as roosting sites in nesting areas (Service 1996).

Spatial Distribution

Our knowledge of the prehistoric and historical range of the California condor comes from a variety of sources, such as fossil records, Native American feather regalia, and written records. Archaeological evidence suggests that during the Pleistocene era condors existed on both coasts of North America, but primarily occupied the west coast (Snyder and Snyder 2000, D'Elia 2013). Fossil evidence from New Mexico, Arizona, Utah, a single site in New York, sections of northern Mexico, and southern Canada support this hypothesis (Hansel-Kuehn 2003, Brasso and Emslie 2006).

By 1800, California condors were restricted to their west coast range, which stretched from British Columbia, Canada, to Baja California, Mexico, with small inland populations in regions such as the Grand Canyon (Snyder and Snyder 2000, D'Elia 2013). Condors were in the Pacific Northwest until the beginning of the 20th century and found in the southern segment (Baja California) until the 1930s (Koford 1953, Wilbur 1973). By the middle of the 20th century, condors were confined to a small horseshoe-shaped region in southern California (Figure 1). They occupied this area from the time of Federal listing in 1967 under the Endangered Species Preservation Act of 1966, until all California condors were removed from the wild in 1987 (Meretsky and Snyder 1992).

The captive breeding program begun by the Los Angeles Zoo and San Diego Wild Animal Park (now the San Diego Safari Park) had its first successful hatch of a wild-laid egg taken into captivity in 1983 and its first captive-laid egg in 1988. The captive breeding program allowed reintroduction of California condors back into the wild beginning in 1992. Subsequently, the World Center of Birds of Prey in Boise, Idaho (1993) and the Oregon Zoo in Portland, Oregon (2003) also developed and currently operate captive breeding facilities that support the reintroduction program.

Reintroduction projects started in 1992 in California, 1996 in Arizona, and 2002 in Baja California. These reintroductions brought free-flying birds back into portions of the species' historical range. Populations of California condors now exist in central and southern California, northern Arizona and southern Utah, as well as northern Baja California (Figure 2).

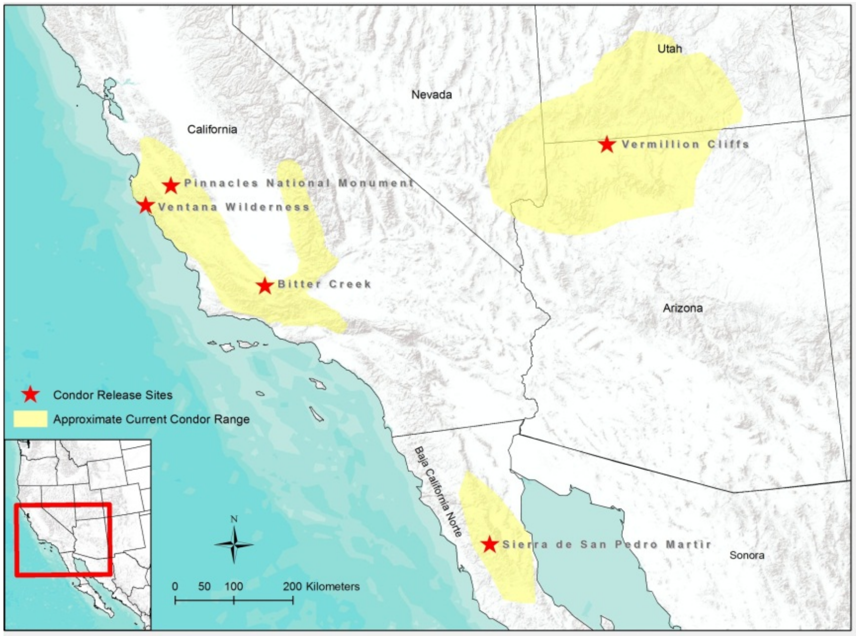


Figure 2. California condor range and active release sites 2012.

Very little is known about how California condors previously used the regions they currently inhabit in Arizona, Utah, and Baja California, but in southern California the reintroduced population has resumed its use of many historical areas. Most recently, the expanding population in southern California utilized the Tehachapi Mountains and resumed use of a number of traditional roosting sites (Johnson et al. 2010). The distribution of each of these populations continues to expand as release efforts persist and the current wild population matures and becomes more aware of the available food resources within their respective ranges. While some preliminary analysis regarding foraging habitat in southern California has been conducted as a part of the Tehachapi Multispecies Habitat Conservation Plan, additional research on conserved and available lands needs to be conducted. Telemetry and GPS records reveal condors currently exceed the boundaries of the occupied habitat that was known and defined at the time of the initial field reviews conducted by the Service in the late 1960s, and take advantage of food opportunities at increasingly farther distances from release or other management sites (Service, unpubl. data, 2009–2012). California condors do not make long-distance seasonal migrations. The available information indicates that they make use of various portions of their range at different times of the year, and seek out distinct habitats for each of their primary needs of foraging, nesting, and roosting (Meretsky and Snyder 1992, Hunt et al. 2006).

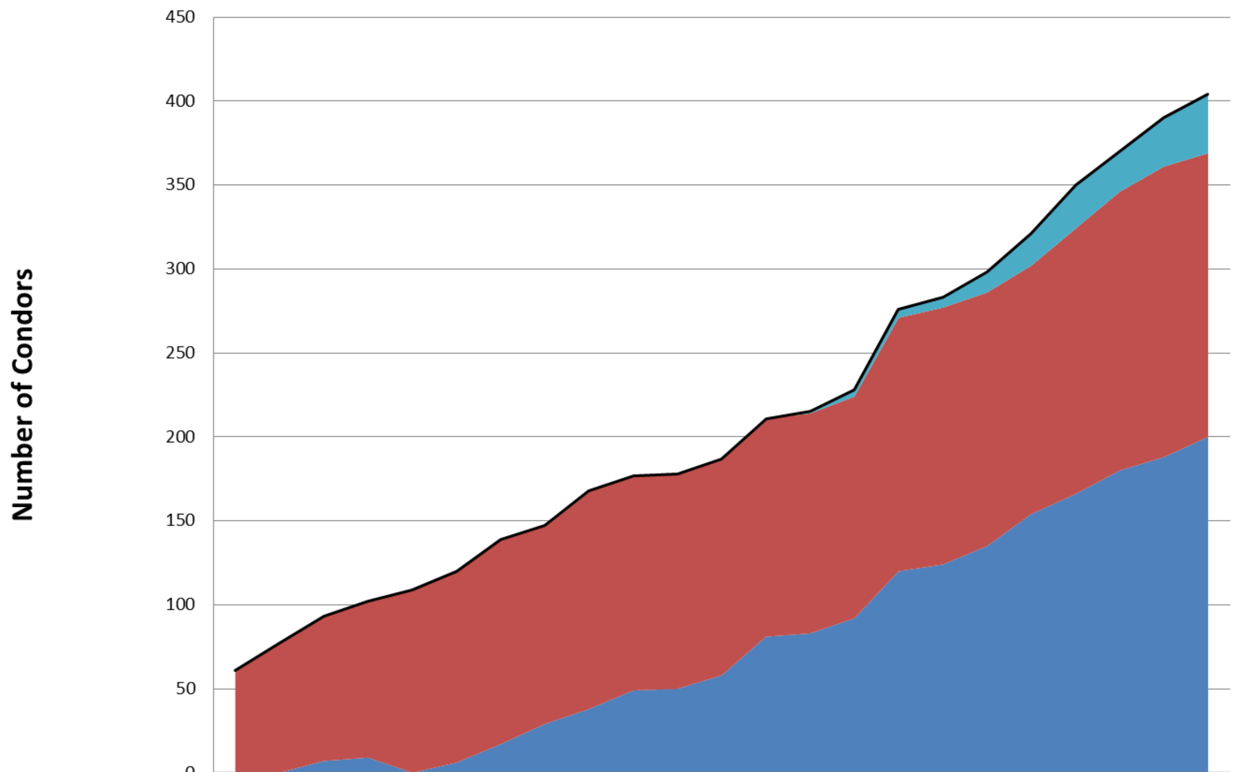
The need to trap and closely monitor California condor wild populations, test blood samples, and inoculate for West Nile Virus persists. To carry out these activities, carrion is supplied at release or trap sites throughout the year for all wild populations. Supplemental feeding can lead to a restricted range due to the restraint of their natural wide-ranging foraging (Snyder 2007). This constricted range may also result in underestimating the severity, intensity, and number of threats that would occur in a more widely distributed population (Meretsky et al. 2000, Mee et al. 2007a). Despite the ongoing presence of proffered food, condors are still expanding their range (Johnson, et al. 2010).

Abundance

California condor population size estimates suggest that there were 50–60 birds in 1968 and 25–35 birds in 1978, all confined to the horseshoe-shaped region shown in Figure 1 (Wilber 1980, Service 1984). The wild population continued to decline with an estimated 25–30 individuals in 1980, 21 in the fall of 1982, 19 in the summer of 1983, and 15 birds in 1984 (Snyder and Snyder 2000). A captive breeding program was authorized in 1980, successfully initiated in 1982, and by 1984 for the first time, the number of condors in captivity (16) exceeded the number in the wild (15) (Snyder and Snyder 2000). By 1985 only nine birds remained in the wild, and by April 1987 all of the remaining birds had been trapped and taken into captivity (Service 1996, Snyder and Snyder 2000).

Population growth has been steady over the last two decades, and in late 2008 the wild California condor population exceeded the captive population for the first time since 1983. As of December 31, 2012, the total California condor population was 404 individuals: 235 in the wild and 169 in captivity. Of the wild birds, 129 were in California, 78 in Arizona, and 28 in Baja California (Service 2012). These figures reflect the continued growth of the population shown in Figure 3. The end-of-year numbers were selected for comparison purposes.

The California condor wild-fledged population is growing (Figure 3). This trend is a result of subsequent breeding of captive-released birds in the wild. The first wild-fledged chick was produced in Arizona during the summer of 2003. Since then, the wild population has continued to produce additional offspring, numbering 35 survivors (14.8 percent of the wild population) at the end of December 2012.



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Wild Fledged														1	4	5	6	12	19	26	24	29	35
Captive Population	61	77	86	93	109	114	122	118	130	128	128	129	130	131	132	151	153	151	148	158	166	173	169
Captive Released	0	0	7	9	0	6	17	29	38	49	50	58	81	83	92	120	124	135	154	166	180	188	200
Total Population	61	77	93	102	109	120	139	147	168	177	178	187	211	215	228	276	283	298	321	350	370	390	404

Figure 3: Year-end population figures

The captive breeding program produces an average of 60 California condor eggs per year (2009, 2010, and 2011) with a 74 percent hatch rate, resulting in 45 new hatchlings on average each of the past three years. Managers at the five field release sites have indicated concern that they are not able to continue to release and manage a growing number of birds each year without changes in the management strategies utilized by the field teams. In some cases, this is because the number of person-hours required to track, feed, capture, treat, and release birds exceeds the capacity of the local field management teams. In every case, the cost of field management has grown significantly, and the various organizations engaged in condor recovery have not identified sufficient ongoing resources to continue to expand, or even maintain, what they have in field management capacity. This imbalance could be an indicator that additional planning effort to ensure the balance of the various program elements is necessary.

Habitat

Photo courtesy Gavin Emmons

Little is known about the specific range use of California condors prior to the 1980s, a period when the population was in steep decline (Snyder and Snyder 1989). As a large soaring scavenger that relies on sparsely distributed carrion for food, the condor was assumed to have a very large home range. Based on studies during that time, condors were believed capable of traveling 50–100 mi (30-60 km) in a single day, but little was actually known about condor range use or population distribution (Koford 1953, Wilbur 1978), especially when compared to the closely monitored reintroduced population. In 1980, the Condor Research Center (Center) was established by the Service and National Audubon Society to provide a more systematic approach to research on condor habitat use. The Center developed telemetry tracking and photographic censuses that allowed for a better understanding of how California condors utilized their range (Meretsky and Snyder 1992) as it was occupied at the time. It should be noted that while observations were possible in the southern California habitat, habitat types elsewhere in the known historical (pre-1987) range were unoccupied at the time due to the rapidly declining condor population. As a result, the Center's evaluation only allows a partial understanding of condor habitat use. A full understanding of habitats used by condors—which has included desert, conifer forest, temperate rainforest, coastal areas, and mid-elevation northwestern plains—was not possible. Although the condor population at that time was very small and on the verge of extinction, a number of insights into condor habitat use were made through intensive study of the remaining wild condors.

For example, the Center's work indicated that California condor nesting habitat was found in steep remote mountainous or canyon terrain on rock or cliff escarpments. These areas tended to be separate from foraging areas, which were typically open grasslands and oak savannas (Meretsky et al. 1992). Roosts, found in or near both foraging and nesting habitat areas consisted of large trees or snags with open lateral branches or cliff faces and rock spires with available perches. California condors have also been known to nest in the cavities of old-growth giant sequoias in the southern Sierra Nevada mountain range or coast redwoods along the central coast of California (Koford 1953). In all cases, condors do not build nests, but move sand, twigs, rock, and other materials around in nest sites to create the appropriately shaped substrate required for egg laying (Snyder and Snyder 2000). Nesting habitat is used year round by breeding pairs as they spend an 8-month period tending to their egg or chick in the nest (Snyder, 1983).

California condor nesting habitat is quite different from foraging habitat. Use of various foraging locations tends to be seasonal, with areas of high activity at different locations at different times of the year (Meretsky et al. 1992). Foraging habitat of California condors has been characterized as open foothill grasslands and oak savanna foothills that support populations of deer, elk, and cattle. Condors foraging along the coast in central California also feed on carrion from coastal environments, which include fish, marine mammals, and marine birds (Snyder and Snyder 2000, Chamberlain et al. 2005). California condors require great expanses of foraging habitat, as feeding opportunities are often widely distributed across their range. Adaptations to this include their highly efficient soaring ability, as well as the capacity to go many days between feedings. Condors will travel great distances to locate carrion. While foraging habitat is expansive, not all is usable at any given time due to inaccessible terrain and weather conditions that limit visibility or soaring. Condors may be restricted when the air currents necessary for soaring are absent or when fog inhibits visibility (Snyder and Snyder 2000).

Genetics

Although there were 27 individuals in captivity after all wild California condors were captured in 1987, the existing condor population is descended from only 14 individuals (Ralls and Ballou 2004). Some of these 14 founders were never brought into captivity, but were known to be the parents of individuals taken into captivity. DNA fingerprinting indicates that the captive condors fall into three basic groups or clans (Geyer et al. 1993).

The California condor population is covered under one of over 100 Species Survival Plans sponsored by the Association of Zoos and Aquariums. These captive populations are managed to preserve, as far as possible, the genetic diversity present in the founding individuals. The California condor population is being managed to retain 90 percent of its heterozygosity (one measure of genetic diversity) for 100 years, which is accomplished by minimizing mean kinship (the average relatedness of each individual to all individuals) within the population (Ballou and Lacy 1995, Ralls and Ballou 2004). Although preserving genetic diversity can reduce adaptation to the captive environment, in the long term it can minimize possible deleterious effects of inbreeding and facilitate a population’s ability to adapt to environmental changes in the wild after reintroduction (Ballou et al. 2010). Another objective of the genetic management program is to ensure that the full complement of genetic diversity is represented in each segment of the California condor population (captive, wild Arizona, wild California, and wild Baja) to guard against loss of overall diversity in the event of a catastrophic loss of any one of the population segments. Finally, genetic management aims to minimize the expression of chondrodystrophy, a lethal form of dwarfism, in the population (Ralls et al. 2000).

Records of each individual’s sire and dam, along with its birth and death dates, are recorded in the International California Condor Studbook, which provides the data for annual genetic and demographic analyses using both custom and standard software programs such as PMx (Lacy et al. 2012). The studbook contains data on both captive and wild-born individuals and is maintained by the studbook keeper, Dr. Michael Mace of San Diego Zoo Global. Annual genetic and demographic analyses are carried out by the population managers, Katherine Ralls and Jonathan Ballou of the Smithsonian Conservation Biology Institute. These analyses take the clan structure into account and result in annual recommendations to the Service regarding the best geographical placement for chicks hatched in captivity, new pairings, and which pairs to double-clutch if possible (Ralls and Ballou 2004).

It is likely that the wild California condor population lost genetic diversity during its long decline prior to being taken into captivity and molecular genetic studies of museum specimens have been initiated to examine this possibility (J. D'Elia, 2012 pers. comm.). Genetic management has successfully maintained genetic diversity in the population, measured as heterozygosity, since the birds were taken into captivity (Ralls and Ballou 2004). As of December 31, 2011, the population retained about 91 percent of its heterozygosity, the mean inbreeding level was about 3 percent, and genetic diversity was evenly distributed across the four segments of the population: captive, wild Arizona, wild California, and wild Baja (K. Ralls and J. Ballou, 2012 pers. comm.).

However, it is well known that population bottlenecks of short duration have a greater effect on the number of alleles (alternative forms of a gene) present than on heterozygosity (Allendorf 1986), so it is probable that the population has lost some rare alleles since the California condors were taken into captivity. Studies of mitochondrial DNA have documented the loss of several maternal lineages since the captive population was founded (Chemnick et al. 2000, Adams and Villablanca 2007). By the time all the remaining birds were taken into captivity, these maternal lineages were represented only by males, which do not pass their mitochondrial DNA to their descendants. Because genetic management minimizes mating between closely related individuals, expression of deleterious alleles has also been minimized. Thus, it is likely that chondrodystrophy is not the only deleterious allele segregating in the population and that others will be discovered. Nevertheless, the genetic situation in condors compares favorably to that in several other endangered species, such as black-footed ferrets (*Mustela nigripes*) and Guam rails (*Gallirallus owstoni*) (Ralls and Ballou 1992), and genetic problems do not appear to present a major impediment to the recovery of the species.

Current Species-specific Research and Grant Funded Activities

An extensive listing of current research efforts by several of the California condor partners is presented in Attachment I. Studies include genetic sequencing and mapping of all condor variations to enhance management of the range of genetic variations, and genetic analysis of preserved samples of condors from various times and places to assess the quality of the conserved population. The impact of contaminants on the population is a key area of research, including nutritional options for condors to counteract lead contamination from carcasses in the wild, the continuing impact of lead following California's ban on the use of lead ammunition in the condor's range, and the impact of 1,1-dichloro-2,2-bis(p-chlorophenyl)ethylene (DDE) exposure through marine mammals, including the impacts on condor eggshells. Outreach to hunters and tribal members are being conducted through various media and by various partners with a goal of reducing lead exposure in the condor population. A number of partners are looking at the potential impact of wind energy, including efforts to identify predictive models on condor space use and develop early warning systems for wind turbines. The goal of all this research is to improve condor survival and conservation by extending our understanding and knowledge of the species and educating the recovery program and others.

Five-Factor Analysis

The California condor was among the earliest species listed as endangered in the United States. At the time of its original listing, a five-factor analysis was not performed. Potential causes of California condor population decline were numerous and possibly varied through time (Wilber 1978, Snyder and Snyder 2000). Despite decades of research, it is not known with certainty which mortality factors have been dominant in the overall decline of the species. It is likely that a combination of factors had a compound effect on this species, which has a slow rate of maturity and naturally low reproductive rate. Aside from numerous individuals killed for collections or simply shot for target practice or no reason at all, relatively few dead California condors were found prior to the 1990s and definitive conclusions on the causes of death were made in only a small number of these cases (Miller et al. 1965, Wilbur 1978, Snyder and Snyder 1989).

Although the information regarding California condor mortality (outside of individuals killed for collections or through wanton shooting) is not based on necropsies, there is evidence to suggest that two anthropogenic factors, lead poisoning and shooting, contributed disproportionately to the decline of the species in the years just prior to its extirpation from the wild (Snyder and Snyder 2000, Snyder 2007). There is also considerable circumstantial evidence that condors may have experienced population declines due to secondary poisoning from predator elimination campaigns during the early settlement of the west coast of North America (Snyder and Snyder 2005). The effects of eggshell thinning are also thought to be a serious factor in the decline of the species during the 1950s–1960s (Wilber 1978b, Kiff et al. 1979, Wiemeyer et al. 1988). Other factors that contributed or may have contributed to the decline of the species prior to its extirpation from the wild were egg and specimen collecting and Native American ceremonial use. These activities are no longer considered threats to California condors.

Since reintroduction began in 1992, causes of California condor mortality have been closely documented. While not all have been identified, the great majority of deaths in the reintroduced population have been anthropogenic (Rideout et al. 2012). Figure 4 shows the various causes of death in the three reintroduced wild populations of condors from the time of reintroduction through 2012, as reflected in the records of the Service. (Note that the level of lead mortality is considerably understated due to the extraordinary management measures taken to ensure condor survival.) Some of these factors may have contributed to the species' decline prior to extirpation, but it is difficult to determine to what extent the current limitations on the population were a factor in the decline. These recent causes of mortality provide a better understanding of current limitations on the reintroduced populations and species recovery. However some factors, such as predation and starvation, are likely the result of the challenges of reintroducing captive-bred individuals into the wild (which has been a necessary step towards reestablishing wild populations), rather than factors that will have a large effect on a self-sustaining population.

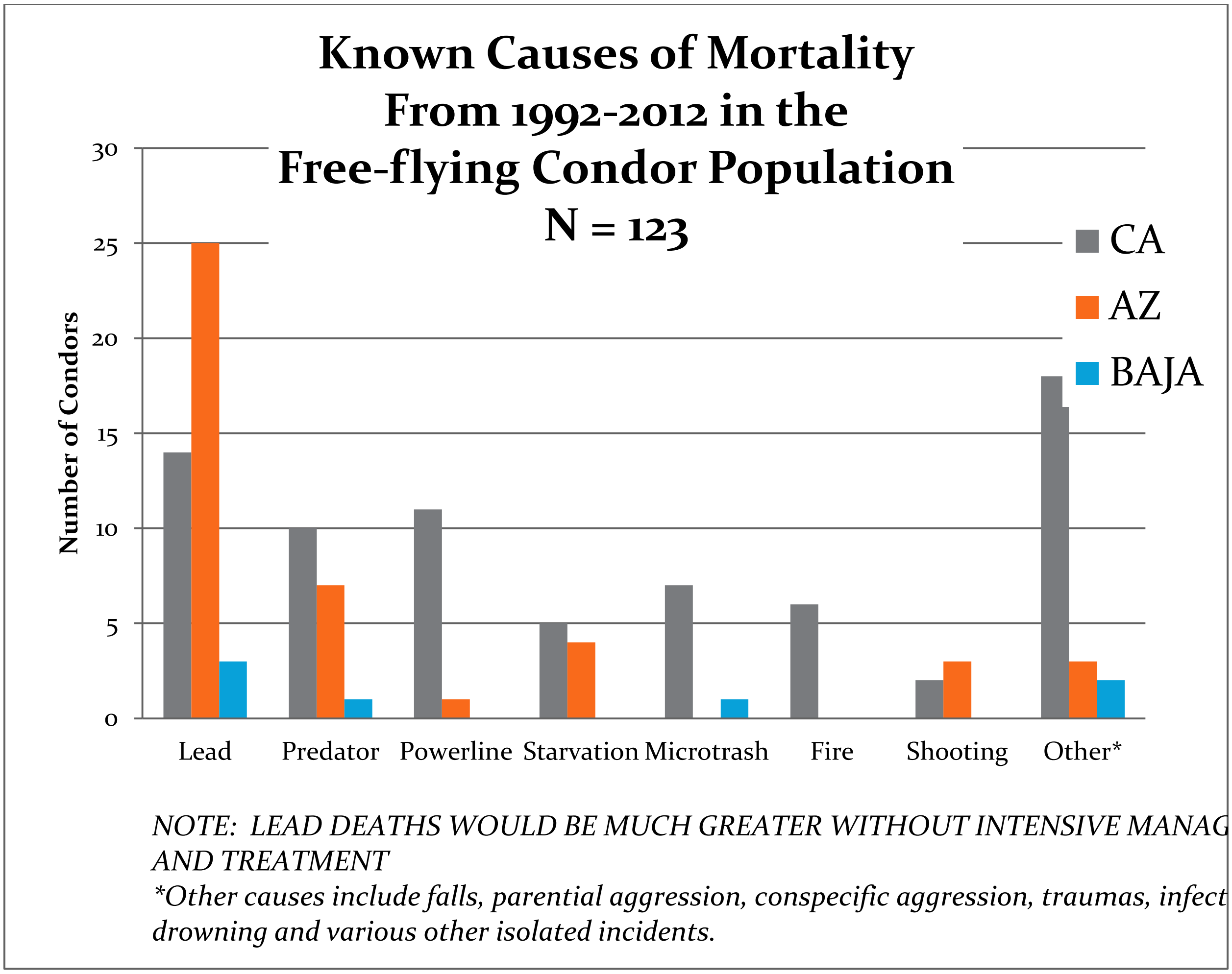


Figure 4. Known causes of mortality among free-flying flock since reintroduction into the wild in 1992 until 2009 (Rideout et al, 2012) and through 2012 (Service 2012).

The following five-factor analysis describes and evaluates threats to the current population attributable to one or more of the five listing factors outlined in section 4(a)(1) of the Act.

FACTOR A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

The loss and modification of California condor foraging, roosting, and nesting habitat has been identified as a threat to the continued recovery of the species. As noted in the 1979 Recovery Plan, adequate nesting sites, roosting sites, and foraging habitat with adequate food are the basic habitat needs of the condor. Human encroachment in the form of permanent development or disturbance may cause condors to avoid nesting in otherwise suitable sites, and may cause nest failure (Koford 1953), though there are no records of condors deserting a nest due to human encroachment (Snyder and Snyder 2005). Finally, retention of adequate carrion may become more difficult as rangelands, oak woodlands, and grasslands are developed, because developed sites support fewer mammals, which translate to fewer opportunities for condors to obtain carrion.

While hypotheses about condor decline during the 1960s included suppositions about food scarcity, no documentation of inadequate food sources has been identified in the California condor's range (Snyder and Snyder 2005). During the same period of population declines, there was no apparent lack of nesting and roosting sites, and significant conserved lands were available for condors (Snyder and Snyder 2000).

About 570,400 acres (ac) (230,842 hectares (ha)) have been designated as critical habitat by the Service (41 FR 41914). The Service, U.S. Forest Service, Bureau of Land Management, California Department of Fish and Wildlife, and others have set aside thousands of acres of habitat, largely within the designated critical habitat of California condors. As early as the 1930s, the U.S. Forest Service set aside the Sisquic Condor Sanctuary (1,198 ac (484 ha)). Following field studies, the Sespe Condor Sanctuary was established in 1947 and expanded in 1951 (53,000 ac (21,448 ha)). The Hopper Mountain National Wildlife Refuge (2,471 ac (100 ha)) in Ventura County was acquired in 1974. The Blue Ridge National Wildlife Refuge (897 ac (363 ha)) in Tulare County in 1982, and the Bitter Creek National Wildlife Refuge (14,097 ac (5,704 ha)) in Kern and adjacent counties in 1985 were established with the primary purpose of preserving habitat for California condors.

Tejon Ranch Company, with the technical assistance of the Service, has developed the Tehachapi Uplands Multispecies Conservation Plan (TU MSHCP) in support of a section 10(a)(1)(B) incidental take permit application under the Act. The take permit would allow for nonlethal take of up to four California condors associated with ongoing ranch activities and limited land development on a portion of Tejon Ranch for the life of the project. The TU MSHCP includes numerous measures intended to reduce and, if possible, eliminate potential threats to condors, such as those posed by powerlines, as well as measures to further the conservation of the species. The plan, if adopted, will conserve in perpetuity approximately 129,318 ac (52,333 ha) of open space, including important condor foraging and roosting habitat. Overall, the TU MSHCP, in combination with a separate Tejon Ranch Conservation and Land Use Agreement executed in 2008 by Tejon Ranch Company, Audubon California, the Endangered Habitats League, Natural Resources Defense Council, Planning and Conservation League, Sierra Club, and Tejon Ranch Conservancy, will result in the permanent conservation of approximately 240,000 ac (97,124 ha), or 90 percent of Tejon Ranch.

Protected lands are important for California condors in Mexico and a portion of the California condor range in Arizona, Utah, and California. Sierra de San Pedro Martir is a designated protected land similar to a national park in the United States, with the exception that full human communities thrive within the boundaries of the Mexican national park. In the United States, condors have utilized Zion and Grand Canyon National Parks, and a major release site is located in Pinnacles National Park in California.

Rangeland Conversion: Activities such as urban development, oil and gas extraction, farming, and wind energy development have transformed formerly suitable foraging habitat into areas that may not be compatible with California condor recovery. Domestic livestock carcasses currently provide an important source of food free from lead contamination. In some areas, the replacement of grazing land with more intensive uses has reduced the availability of domestic livestock to foraging condors, though improved market conditions for cattle operations have expanded cattle grazing in some portions of the range. When condors are recovered, continued population growth may at some point become limited by available forage, though no definitive scientific analysis of the carrying capacity of condor foraging habitat has been conducted. However, as noted above, nothing in the historical record indicates that condors currently lack adequate food or foraging opportunities. While agricultural conversion to more intensive uses and the corresponding increased human activity has caused speculation about the lack of adequate forage, no impact on the current population has been identified.

Further, the availability of appropriate habitat could be restricted by limitations in connectivity of suitable areas for California condor foraging, nesting, and roosting. Once again, no such limitations have been noted aside from natural landscape features, and condors have been observed utilizing areas with roads, housing, gas and oil fields, and similar human features.

Suitable conservation of significant California condor habitat is an important tool to ensure the long-term availability of roosting, nesting, and foraging habitat. While rangeland conversion is potentially a concern for the long-term expansion of a recovered condor population, it is not currently a substantial threat to the species or its roosting, nesting, or foraging habitat due to the extensive network of protected lands utilized by the species and the relatively small population of condors dependent, at least in part, on these lands.

Wind Energy: In March 2009, Secretarial Order 3285A1 created a national policy encouraging the production, development, and delivery of renewable energy as one of the Department of Interior's highest priorities. In April 2011, California increased its State renewable energy portfolio standard to 33 percent of all retail electricity sales by 2020 with the signing of Senate Bill 2X; wind power is an important component of California's renewable energy portfolio. As a result of these two policies, interest in wind energy development has greatly increased.

A number of proposed wind energy projects overlap with or are in close proximity to the occupied and historical range of the California condor including, but not limited to, the Tehachapi Mountains, Sierra Nevada mountain range, and Salinas River valley. Wind energy facilities pose a lethal threat to condors from collisions with wind turbine blades. This threat is magnified by the fact that the rotating turbines create a continuous potential for fatality events during standard facility operations. Explorations by individual birds often lead to range expansion or re-colonization. Therefore, the Service anticipates that if a single (or several) condor enters the risk zone (rotor swept area) within a wind energy facility, the same wind currents would promote similar movements by other individuals during the life of the project, resulting in ongoing fatality events. Furthermore, because of their communal feeding strategy, a single feeding event within a facility could kill many individuals. The increase in energy production will also prompt the construction of additional transmission lines, which could also pose a collision or electrocution threat to condors.

To date, several California condors have been documented flying over and near areas where wind energy facilities have been proposed, are operating, or are under construction (Service 2008, 2009, 2011, unpubl. data). In addition, there are records of condors on the ground within or near proposed project sites. It is anticipated that as condors continue to reoccupy their prior range and wind energy facilities encroach on the currently occupied range, an increasing number of condors could be exposed to the turbine strike hazard. The relative fatality risk to condors from any wind energy facility will be dependent on siting and specific avoidance measures proposed to prevent mortality. The Service is aware of the wind energy industries' efforts to develop techniques to successfully identify approaching condors and avoid potential collisions, though the viability of those techniques has not been proven.

To address this newly identified potential threat to California condors, the Service convened the California Condor Wind Energy Work Group, a subgroup of the California Condor Recovery Team. The goal of the work group is to assess the risks of wind energy development and provide the Service's Regional Director, Pacific Southwest Region, science-based recommendations of actions that can be taken to minimize those risks. Efforts from the work group include a U.S. Geological Survey analysis of condor locations, movement, and wind usage designed to evaluate potential areas of conflict. Recommendations to the Regional Director are anticipated during 2013. The development of wind energy facilities in or adjacent to the expanding range of condors is potentially a significant threat and will be addressed as the recommendations from the work group are received.

Powerlines: During the first several years of releases, four California condor deaths occurred (31 percent of released birds in the first 2 years) from blunt trauma from hitting powerlines or from electrocution from perching on powerlines or poles. Pre-release powerline aversion training of captive-reared birds began in 1995. The powerline aversion technique has proven successful in reducing a propensity for condors to associate with power poles. Seven additional deaths in the free-flying population occurred through 2007, or 4 percent (n=174) of released birds since the aversion training began. In many but not all cases, death occurred in close proximity to release sites and involved young birds, which led to the formation of a subcommittee of condor partner organizations to identify problem areas. Some remediation of potential problem areas was conducted and no powerline-associated deaths, from either trauma or electrocution, have occurred since 2007. Although the most recent death occurred in 2007, it was a 4-year-old bird and the third death in association with the Anderson Tap line, which stretched approximately 3 miles from Highway 1 to Anderson Peak in Big Sur, California. This and several other powerline-related condor mortalities in and around Big Sur, California, including the two others from the Anderson Tap line, were actually documented to have resulted from electrocution following mid-air collisions (San Diego Zoological Society 2001, 2002, 2003, 2006, 2007 (Cite - Necropsy reports SB#212, 230, 254, 301, 376)). Pacific Gas and Electric (PG&E) placed the Anderson Tap line underground in 2011. In 2012, a recently fledged condor nearly collided with another powerline that spans Partington Canyon in Big Sur, California (J. Burnett and S. Kirkland, 2012 pers. obs.). PG&E has committed to work with the Service and Ventana Wildlife Society to minimize the threat of collision and avoid the threat of electrocution from this powerline by replacing the existing line with insulated tree wire.

Other projects undertaken to eliminate powerline collisions include an undergrounding project in southern California by Southern California Edison, powerline retrofitting in Big Sur and Pinnacles National Park, and projects at various other locations where California condor use of power poles has been documented. Powerlines have had significant impacts on the population in the past, but aversion training has been successful in developing avoidance behaviors. Continued aversion training of the captive-reared population is important in order to ensure that released condors do not perch on power poles. As discussed above, the potential for electrocution or blunt trauma following collisions with powerlines remains a threat.

FACTOR B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Utilization for commercial, recreational, scientific, or educational purposes does not appear in the literature as a current risk factor for the California condor. There is considerable discussion of egg collecting in the late 19th and early 20th century being a factor in the decline of the species (Koford 1953, Service 1996). However, there are no known commercial uses of condors at this time (Service 1996). From the beginning of the release program in 1992 through 2011, four condors died as a result of gunshot and one from an arrow wound (Rideout et al. 2012, Service 2012). Several poachers have been prosecuted and convicted of killing condors; these are seen as isolated shooting incidents rather than systemic threats to the species.

FACTOR C: Predation and Disease

Both disease and predation are threats to the species and are described separately below.

Predation: Based on mortality data collected by the Service from January 1992 through December 2012, predation by terrestrial mammals (such as black bears (*Ursus americanus*) and coyotes (*Canis latrans*) and golden eagles (*Aquila chrysaetos*) accounted for or is suspected in 18 of 123 (14.6 percent) free-flying California condor deaths in the wild where a cause of death has been established (Rideout et al. 2012, Service, unpubl. data 2009–2012). Newly released condors are far more susceptible to predation, with 12 of the 18 predated condors having been in the wild less than a year. Older, more experienced condors are known to be more vigilant to predators than young naïve condors (West 2009). Further, overall increases in vigilance may be expected when many condors feed in a group due to the higher number of individuals alert to threat at any one time (West 2009).

In the winter of 2010, three mortalities were discovered at a roost site just off the Bitter Creek National Wildlife Refuge on Bureau of Land Management (BLM) property. These deaths were all attributed to mountain lion (*Puma concolor*) predation and occurred within 32 days of one another. The first mortality occurred in November 2010 and the third in December. After the remains of the second condor were discovered, a game camera was set at the site of the cached remains. This camera confirmed the presence of a mountain lion visiting the cache three days after the initial discovery of the remains. The first condor was cached about 50 meters away from the cache site where the other two condors were found. While mountain lions are considered a natural predator to condors and have preyed upon them in the past, the rate at which condors were taken in this particular case was unprecedented. These mortalities are considered a result of a lion exploiting a situation where novice condors are concentrated due to the ongoing release of captive reared condors on the Refuge. Field managers are developing standard protocols in the form of predation management plans to respond to instances of predation such as this example.

California condors in nests are also vulnerable to predation. Nests are sometimes situated in cavities accessible to mammals such as bobcats (*Lynx rufus*), mountain lions coyotes, and bears. The eggs and/or nestlings in these easily accessible nests are at risk of predation, particularly from ravens (*Corvus corax*). When condors are attending their eggs they are generally competent in defending the nest from ravens; however, occasionally the egg is left unattended and vulnerable to predation (Snyder et al. 1981).

Disease: Diseases of concern include West Nile Virus and Highly Pathogenic Avian Influenza (HP H5N1). West Nile Virus was first documented in the United States in 1999 and has caused deaths in both captive and wild California condor populations (Rideout et al. 2012). Two types of vaccines have been used since the threat was identified. The first was developed by the Centers for Disease Control and Prevention (CDC) specifically for condors (Chang et al. 2007). This vaccine is no longer being produced so the program has switched to RECOMBITEK® Equine West Nile Virus Vaccine. To ensure efficacy, an annual booster is required. To date, all captive and free-flying condors are vaccinated for West Nile Virus and provided with a booster annually or opportunistically. The efficacy of the vaccine is thought to be high, which is demonstrated by the low rate of infection in the population. There has been one death of a vaccinated flying bird; another appeared to be infected but recovered from the disease. Condor chicks are also susceptible to West Nile Virus. Although believed to be protected by maternal immunity, one wild chick died of West Nile Virus prior to being vaccinated. As a result, any chick that is handled in the nest is vaccinated. Chicks that are not handled are vaccinated the first time they are trapped.

HP H5N1 has yet to enter the country, but would be a serious threat to California condors. According to the CDC, HP H5N1 is highly contagious, particularly among birds, and often fatal. It has been found in wild bird populations in Asia, the Middle East, Europe, and Africa. The potential for mortality from this disease was significant enough to warrant some discussion in the American Ornithological Union evaluation of condors (Walters et al. 2010). Vaccines are available to immunize avian populations, especially to protect captive zoo collections and endangered species such as condors. To date, poultry and zoo birds have not been vaccinated in the United States and vaccinations are not planned unless HP H5N1 is discovered here (Walters et al. 2010).

Disease and predation are both threats to California condor survival. Predation continues to be a significant cause of mortality among juvenile condors. Mentoring of juvenile condors by older adults in the wild is a useful strategy to partially address this issue, and development of predator management plans to govern the actions of field managers will enhance the response to predation threats. Continuation of the inoculation protocols to prevent additional West Nile Virus occurrences, with the vaccine available for HPH5N1 outbreaks if they occur, is the current strategy for addressing disease. However, if the populations were not as aggressively managed by biannual trapping, testing, and inoculation/booster, alternative strategies would have to be developed. It should be pointed out that continuing the existing management practice of inoculation comes with associated risks. Namely, repeated human handling of condors increases the likelihood that habituation to humans. Habituation is discussed in more detail under Factor E below.

FACTOR D: Inadequacy of Existing Regulatory Mechanisms

Several State and Federal laws and regulations pertinent to federally listed species may contribute to the conservation of California condors. The Act is the primary Federal law that has provided protection since the species' listing as endangered in 1967. Additional Federal protections include the National Environmental Policy Act (NEPA), National Forest Management Act (NFMA), Federal Land Policy and Management Act of 1976 (FLPMA), Migratory Bird Treaty Act (MBTA), Lacey Act and National Wildlife Refuge System Improvement Act of 1997.

Protections for California condors in the State of California include the California Endangered Species Act (CESA), California Environmental Quality Act (CEQA), Natural Community Conservation Planning Act (NCCPA), and the California Coastal Act. The species is fully protected pursuant to Fish and Game Code Section 3511, which prohibits take of the species. Recently enacted legislation carves out an exception to section 3511, and allows take of condors authorized under an NCCPA permit. These laws, most of which were enacted in the past 30 to 40 years, have protected native species from being killed, taken, captured, or pursued and have attempted to protect and preserve habitat.

In 1996 the Service, in cooperation with the Arizona Game and Fish Department and the U.S. Bureau of Land Management, established a plan to reintroduce California condors into an anticipated range that included northern Arizona, southeastern Nevada, and southern Utah. These birds were designated as a nonessential experimental population under section 10(j) of the Act. The establishment of a second noncaptive population, spatially disjunct from the noncaptive population in southern California, is one criterion under the Recovery Plan. Nonessential experimental populations located outside National Wildlife Refuge System or National Park System lands are treated as if they are proposed for listing, but not listed. Thus, all Federal agencies are required to use their authorities to conserve listed species and section 7(a)(4) requires Federal agencies to informally confer with the Service on actions likely to jeopardize the continued existence of a proposed species.

In 2007, the California State Legislature passed the Ridley-Tree Condor Preservation Act (AB821), which prohibits the use of lead ammunition for big game hunting or varmint control in an area described as California condor habitat (See Figure 5). Effective July 1, 2008, this law declared the Legislature's intent to protect vulnerable wildlife species, including the California condor, from ongoing threats of lead poisoning. Education and enforcement are critical to successfully reduce (or eliminate) lead-related condor mortalities. Unfortunately, enforcement of lead-free hunting regulations is problematic due to budget constraints, the resulting lack of enforcement personnel to enforce the law, and the difficulty of determining if lead ammunition was used to harvest an animal (Walters et al. 2010).

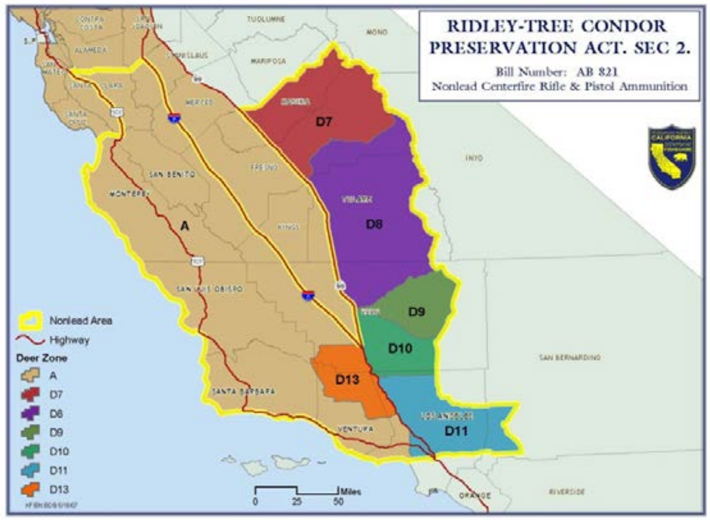


Figure 5. California condor range as described by the Ridley-Tree Condor Preservation Act (CA Dep't of Fish and Wildlife)

In adopting the associated regulations, the California Fish and Game Commission (Commission) developed a list of certified non-lead projectiles, which is now maintained by the California Department of Fish and Wildlife. Some other uses of lead projectiles in the California condors' range remain, including depredation (though strongly discouraged), farm and ranch management activities, and poaching. The Commission is reconsidering some of these regulatory issues as of August 2012, though no action has yet occurred. Within the pre-historical and historical range of the condor in California (statewide), but outside the designated range under State statute, no regulatory provisions for reducing or eliminating lead in big game, varmint, and depredation shooting are yet in place. In 2013, a California legislator introduced proposed legislation (AB711) which would, if adopted, eliminate the use of lead ammunition in any hunting activity in California, including varmint control and depredation. The lack of such protections could be a limiting factor for expansion of the condor population out of the currently identified designated range and for the identification of other appropriate release sites within their historical range. Similarly, very limited or no restrictions or limitations on the use of lead ammunition in other parts of the historical range, including Oregon, Washington, Nevada, and British Columbia, are in effect at this time.

FACTOR E: Other Natural or Manmade Factors Affecting Its Continued Existence

Lead: Lead poisoning in waterfowl has been well documented, as has lead poisoning in raptors, notably the bald eagle (*Haliaeetus leucocephalus*), feeding on waterfowl. The recognition of this problem led the Federal government to enact a ban on the use of lead shot for most waterfowl hunting in wetland areas in 1991. Further, there is substantial evidence in the scientific literature that the problem of lead poisoning extends to upland birds, particularly those that are partial or obligate scavengers. Tranel and Kimmel (2009) summarized available literature regarding ingestion of lead shot, bullets, and fragments by wildlife species and impacts of lead poisoning on wildlife, the environment, and humans from over 500 citations. In the literature, 24 percent of the bird species reported as affected by lead ammunition were raptors and scavengers.

Lead has detrimental effects on wildlife and humans (Tsuji et al. 2009). The impacts of ingested lead on wildlife include decreased survival, poor body condition, behavioral changes, and impaired reproduction (Finkelstein et al. 2012). Lead causes a decrease in the amount of hemoglobin in the red blood cells by obstructing heme synthesis, which causes critical anemia. Moreover, lead poisoning disrupts normal liver and kidney functioning and causes adverse impacts on the central and peripheral nervous systems.

Lead poisoning from ingestion of spent ammunition in carcasses and offal (gut piles) is the most severe impediment to California condor recovery (Church et al. 2006, Chesley et al. 2009, Hunt et al. 2009, Stroud and Hunt 2009, Finkelstein et al. 2012). There is strong evidence that increased mortality from lead poisoning was a serious factor that contributed to the California condor's precipitous decline at the time condors were brought into captivity (Meretsky et al. 2000, Snyder 2007).

All of the reintroduced California condor populations have been monitored for lead exposure over time. Each bird is trapped annually or semiannually so that a blood sample can be tested for lead. This requires supplemental feeding in order to attract and capture condors, which may affect the foraging behavior by constricting their range use (Snyder 2007). Repeated monitoring for signs of lead exposure, chelation, surgical removal of lead particles in the digestive system, and other emergency actions can reduce the harmful impacts of lead exposure on condors; however, frequent capture and exposure to humans may have detrimental effects on behavior (Cade 2007).

The results of the annual testing are an indication of the extent to which lead exposure occurs within the California condor population. In a study of the reintroduced population in Arizona from 1999 through 2004, annual blood tests showed 40 percent of the samples with higher than background lead levels (greater than 14 micrograms per deciliter (ug/dL)). During this period, more than half (28 of 50) of the birds in the population were treated for high lead exposure. In the same study, from 2002 to 2004, the majority of the population had above-background lead levels each year (Parish et al. 2007).

Similarly, in California condors are exposed to lead at levels that cause population effects. From 1997 through 2010, 150 condors were trapped and tested collecting 1,154 discreet blood samples, with an average 30 percent of the samples showing levels greater than 20 ug/dL, levels that are known to have physiological effects on condors (Finkelstein et al. 2012). Over the same period, 48 percent of the condor population in California had lead exposure greater than or equal to 45 ug/dL; all were treated or would have been treated under current protocols. Many birds have been treated multiple times across years. Condors would not survive in the wild if they were not regularly trapped, tested, and treated for lead exposure. Without treatment and the continued release of captive-reared birds into the California population, it is projected that the population would decline to 1984 levels (22 birds) in 11 to 61 years, depending on the blood lead level assumed for mortality (Finkelstein et al. 2012).

Even with the high level of monitoring and treatment, lead exposure remains the leading cause of death in wild California condor populations. Of the 135 condor deaths from 1992 to 2009, biologists were able to establish a definitive cause in 76 individuals. In juveniles and adults, lead caused 26 and 67 percent of the deaths, respectively (Rideout et al. 2012). Overall, from the first releases in 1992 until the end of 2012, 42 of the 123 condors deaths (34 percent) where a cause of death is known were as a result of lead poisoning, more than twice the next single highest cause of death, which is predation.

Sublethal lead exposure may also pose a barrier to condor recovery; lead is well known to damage multiple physiological systems in vertebrate species (Bellinger 2011). Recent evidence suggests that condors are as sensitive to sublethal lead exposure as other vertebrate species (Finkelstein et al. 2012), yet the impact of chronic lead exposure on condor reproduction or long-term survival is not known.

In California condors specifically, acute exposure to lead initially results in lethargy and reduced activity and, progressively, loss of appetite, loss of muscular coordination, neurological impairment, diarrhea and bile-stained feathers around the vent, wing droop, inability to stand and eventually death (Walters, et al. 2010). These symptoms may occur within a few days of exposure or may progress over several weeks.

Blood lead levels and mortality rates demonstrate only a portion of the impacts of lead on wild California condor populations. Lead persists in the blood of condors for only a short period of time, making it a poor measure of the overall exposure history. Even when blood is tested twice over the course of the year, only about 10 percent of the actual exposure for that year is ascertained (Finkelstein et al. 2012). Feathers provide a much wider window of detection, allowing a more accurate understanding of the duration and severity of lead exposure in condors (Finkelstein et al. 2010). Using feather samples collected from both living and dead birds, severity of exposure was found to be 1.4 to 14.4 times greater than that indicated by blood lead levels (because blood tests are rarely performed at the peak of exposure). Feathers also revealed that elevated blood lead levels are sustained for much longer periods of time than indicated by blood alone (Finkelstein et al. 2012).

When a California condor ingests lead it is slowly dissolved by stomach acid, enters the blood stream and is distributed to other tissues including liver, muscle, kidney, brain, bone, and growing feathers (Walters et al. 2010). The isotope ratio of the lead (Pb^{207}/Pb^{206}) in these tissues reflects the isotope pattern of the lead ingested in objects or food (Church et al. 2006, Chesley et al. 2009, Finkelstein et al. 2012). In order to identify sources of lead exposure in California condors, researchers have been characterizing the lead isotope patterns in blood and feather samples, and comparing them to ingested fragments of lead, commercial lead bullets, environmental lead background sources, and other known lead sources (Walters et al. 2010). In most cases, the lead isotope ratios in blood and/or feathers matched lead bullet fragments recovered from carcasses upon which the birds were feeding, and differed from background lead isotope ratios. Fragments recovered from the gastrointestinal tracts of exposed birds were also identified as ammunition through isotopic comparison (Church et al. 2006, Chesley et al. 2009, Finkelstein et al. 2010, Finkelstein et al. 2012).

Isotopic ratios were also used to successfully identify one other source of lead. An old fire tower in Pinnacles National Park covered with lead-based paint was found to be the source of lead poisoning in five condors. The lead paint had an isotopic signature that differed from ammunition and background lead and matched the blood of some birds observed to be perching in the vicinity of the tower (Finkelstein et al. 2012). Once identified as a source of contamination, the lead paint was remediated. This unique incident demonstrates how isotopic methodology can inform management actions to protect condor health.

The basic materials available to manufacture bullets include lead alloys, lead with external copper wash, lead core with a copper jacket, copper with zinc alloys, pure copper, and bismuth. Lead and bismuth bullets often fragment upon impact, whereas pure copper bullets typically remain intact (Stroud and Hunt 2009).

Bullet fragmentation (Figure 6) increases the degree of lead contamination in tissue ingested by scavengers feeding on hunter-killed animal remains (Stroud and Hunt 2009). Researchers investigating bullet fragmentation in deer remains found that all whole or eviscerated deer killed with lead-based bullets contained fragments; 74 percent contained more than 100 visible fragments (Hunt et al. 2009). In comparison, the study counted a total of only six fragments in four whole deer killed with copper expanding bullets (Hunt et al. 2009). The density and distribution of lead fragments within the carcasses suggest a high potential of exposure to scavengers (e.g., California condors, golden eagles, turkey vultures, ravens, coyotes) (Bloom et al. 1989, Craighead and Bedrosian 2008, Bedrosian et al. 2009, Hunt et al. 2009).

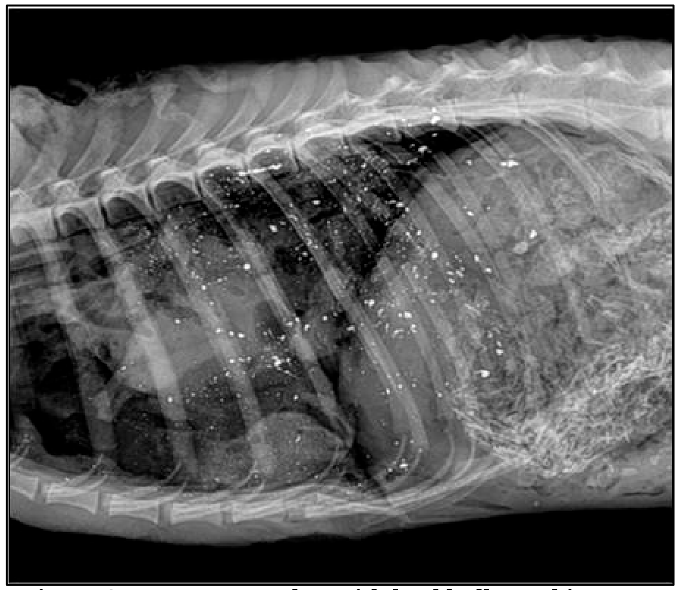


Figure 6. Deer carcass shot with lead bullet. White particles are lead fragments.

As noted under Factor D, in July, 2008 the Ridley-Tree Condor Preservation Act went into effect in the range of condor as defined by Commission action. Thus far there has been no discernible change in condor blood lead levels from a period prior to the regulation (2006–2007) to a period following its implementation (2009–2010) (Finkelstein et al. 2012). However, in the year following the ban a significant reduction in blood lead concentration was observed in turkey vultures and golden eagles, which have feeding strategies similar to, though not identical to condors (Kelly et al. 2011). Further study on the effects of this law is currently underway, and a report is due to the Commission in mid-2013.

There are a number of plausible explanations for why these restrictions have not yet had an effect on California condor blood lead levels. The law is limited in that it controls the use of lead ammunition only for big game and nongame hunting activity. Upland game hunting, nuisance animal depredation, dispatching domestic livestock, and poaching also have the potential for creating lead-contaminated carrion available to condors; these are not addressed by this law. Comprehensive bans that address these additional sources of lead poisoning on private lands, such as the ban on lead ammunition implemented by Tejon Ranch in January 2008, can assist in reducing this threat to condors. Animals that survived after being shot with lead ammunition prior to the change in the law also have the potential to expose condors once they die. Further studies may be warranted to determine the extent to which these animals persist in the environment. Enforcement and compliance are a concern in the State; game wardens must cover very large areas and face a diversity of wildlife issues.

In Arizona since 2003, and more recently in Utah (2012), voluntary efforts have been developed to reduce California condor exposure to lead-affected carrion. Activities include education and marketing outreach to hunters and free nontoxic high-performance ammunition for those hunting in condor range. While these efforts have been successful in changing the ammunition used by the majority of hunters, particularly in Arizona, the continued occurrence of lead poisoning in the condor population in those states continues to significantly impact the condor population. The most recent information on condor deaths indicates that nearly fifty percent of known deaths in that population resulted from lead toxicity. As a result, the Service has provided a grant to Utah to enhance their lead outreach efforts. The Section 10(j) rule and underlying agreements that established the experimental, nonessential population provide that no Federal regulatory action will be taken to restrict hunting or other shooting activities due to the presence of condors.

Lead ingestion by California condors and the subsequent behavioral and physiological effects of lead poisoning, including both mortality and morbidity events, is the single most significant threat to the species. Failing to adequately address this factor makes it difficult to progress towards sustainability.

Shooting: Shooting remains a potential additional threat to free-flying California condors. Since reintroduction, there have been four condor deaths attributed to shooting. Two of these were in California and two in Arizona (Rideout et al. 2012). In addition, one condor was shot and killed with an arrow. Other nonlethal shooting events have been documented in California. In southern California, an adult female condor (studbook #155) required capture and permanent detention after being shot. Additionally, two other birds radiographed during treatment for elevated lead levels were found to have shotgun pellets embedded in the soft wing tissue and other areas of the body. Several prosecutions have resulted from these incidents**.**

Microtrash Ingestion: Breeding California condors sometimes ingest small man-made materials (microtrash) and feed these items to their nestling (Grantham 2007, Mee et al. 2007b, Rideout et al. 2012). Trash items recorded include nuts, bolts, washers, copper wire, plastic, bottle caps, glass and spent ammunition cartridges (Figure 7) (Mee et al. 2007a, Walters et al. 2010). While nestlings are able to tolerate these items in small amounts, large quantities can result in digestive tract impaction, evisceration, internal lesions, and death (Grantham 2007, Snyder 2007, Rideout 2012). Of the known causes of death in wild nestlings, eight out of eighteen (44 percent) have been as a result of microtrash ingestion (Table 2).

Nestling Cause of Death	California Population	Arizona/Utah Population	Baja California Population	Total Population
Microtrash	7		1	8
Unknown/Missing	4	6	2	12
Fall	2			2
Infection	2			2
Parental Trauma	2			2
Handling	1		1	2
Pending	1			1
Predator	1			1

Table 2: Microtrash ingestion has predominantly impacted nestlings in California, where it is the leading cause of death in nestlings and has been the major cause of nest failure in the breeding population (Mee et al. 2007a, Rideout et al. 2012).

Mee et al. (2006) compared the number and mass of foreign trash items collected from pre-1987 nests to those from nests of reintroduced California condors and found that trash was significantly more prevalent and numerous in the latter. Trash items also tend to be more common in the California population, with the most impacted nests in the southern California region. Two documented deaths of adult condors in Arizona were caused by the ingestion of coins or washers, which led to zinc toxicosis (Rideout et al. 2012).

Trash ingestion appears to be common and problematic in some populations of Old and New World vulture species other than California condors (Mundy et al. 1992, Snyder and Snyder 2000, Mee et al. 2006, Grantham 2007), and in a variety of other avian species. The reason California condors ingest trash items is unknown; however, Snyder and Snyder (2000) suggest it might be related to a misdirected search for calcium and food sources needed for egg-laying and chick growth and development, as documented in other vultures. Other researchers propose that trash ingestion may fill a need for roughage that aids in digestion, a function found in other species (Wings 2007). Overall, the presence of trash is a reflection of increased human use and impact within condor range, particularly in southern California (Mee et al. 2006).

Figure 7: Objects surgically removed from chick.

The effects of microtrash are currently being mitigated through various methods. The first, known as nest guarding, involves periodically climbing into each California condor active nest, cleaning the nest floor of any microtrash, and assessing the nestling for consumption-related distress, including stunted growth. Cleaning trash from nests has been effective in preventing gastrointestinal impactions from forming. Chicks that are found to have impactions despite the nest cleaning can be treated by temporarily removing them from the nest to surgically remove the impaction. Nestlings can be absent from the nest for 24 hours and successfully returned. While the nestling is absent, a human presence is maintained to keep the parent from accessing the nest until the chick can be returned. Temporary nest evacuation is rarely required, but has been used successfully on three occasions, though it is not always successful (Service, unpubl. data).

The second method for reducing microtrash is to identify and clean locations where microtrash is collected by parent birds. Many of the actively breeding California condors have been fitted with GPS transmitters that broadcast hourly locations and speed during daylight hours. It is possible to identify potential sources of trash by investigating the locations where parent birds spend time on the ground. Microtrash sites tend to be roadside pullouts or overlooks where people discard bottles or other refuse that eventually break into coin-sized pieces, which are then ingested by condor parents and transported to the nest. There is some anecdotal evidence that cleanups have reduced the amount of trash collected by pairs with a propensity to use a particular site for collecting microtrash (J. Brandt and J. Burnett 2012, pers. comm.).

Another method used to mitigate the impact of microtrash on California condors has been to litter bait stations with bone chips. The practice of establishing boneyards has helped alleviate microtrash ingestion in Old World vulture species (Mundy and Ledger 1976, Menge et al. 2008). Breeding condors have been observed collecting these chips and bone is regularly found in the nests during cleaning.

While microtrash impaction has been a significant source of California condor mortality in the past, particularly in the southern California population, the aggressive program of nest guarding and cleanup has significantly ameliorated the problem. Nesting success in the southern California population has increased to approximately 65 percent with the nest guarding and cleanup programs, as compared to a 30–50 percent estimated nesting success rate in the natural population, based on both condors and other New World vulture populations (Snyder and Snyder 2000). As long as the extraordinary efforts of the staff involved with the program continue, this is no longer perceived as a significant current threat to the species. However, without continual management to prevent problems associated with microtrash, this could again become a significant threat.

Organochlorines: California condor eggshells collected in the late 1960s had severe thinning and structural abnormalities. These abnormalities were attributed to the effects of DDE, a breakdown metabolite of the pesticide DDT. DDT is thought to have contributed to the species' decline in the 1950s and 1960s (Kiff 1979). Significant eggshell thinning was also reported for the turkey vulture within the region of sympatry with the California condor (Wilbur 1978b, Kiff et al. 1979, Wiemeyer et al. 1988). These compounds (DDT/DDE) have been detected regionally in the reintroduced population. DDT was banned in the United States in 1972 (Kiff et al. 1979) and nearly all condor eggshell samples collected after 1975, prior to the population being extirpated from wild, were of normal thickness (Snyder and Meretsky 2003). However, two eggs laid in 1986 by the last female California condor (studbook #12) to breed in the wild were very thin (44 percent thinner than the historical mean thickness) and contained inexplicably high levels of DDE and DDT (Kiff 1989). Snyder and Meretsky (2003) conducted a reevaluation of DDE and condor eggshell thinning, and found that the available evidence did not indicate strong support for the hypothesis that DDE was causing significant eggshell thinning. However, current studies in Big Sur, California, suggest that thinning was induced by DDE contamination (K. Sorenson, 2012 pers. comm.). Recent low productivity of the central California portion of the California population has once again raised concern about DDT and DDE exposure in central California.

California condors, whose range includes the central California coastline, are known to regularly feed on marine carrion, particularly California sea lions (Sorenson and Burnett 2007). Despite DDT having been banned in 1970s, it continues to persist in California sea lions along the coast of California at very high levels as a result of past illegal disposal of a large amount of DDT in the ocean off southern California (LeBoeuf et al. 2002, Debier et al. 2005, Ylitalo et al. 2005). Due to the marine component of their diet, condors nesting in central California are susceptible to organochlorine exposure, DDT being of most concern. Investigators in central California reviewed the plausibility of DDE-induced thinning in the Big Sur population and found a correlation between eggshell thinning and weight loss rates, an absence of the outer crystalline layer of eggshells (characteristic of DDE contamination), and a significantly different eggshell thickness in condor eggs between southern California and central California birds (K. Sorenson, 2012 pers. comm.). Eggshell thinning and reproductive failure due to the consumption of organochlorine-contaminated marine animals has also been observed in reintroduced bald eagles on Santa Catalina Island, California (Garcelon et al. 1989).

The Service concluded that the effects of DDT/DDE exposure on California condors are a significant threat to the portion of the population that forages on marine mammals. Several ongoing research projects are evaluating the negative impacts on the population, as well as attempting to identify strategies to mitigate or address those effects.

Habituation: Each California condor release site has experienced unanticipated problems with condors landing on radio towers, telephone poles, houses, and other structures; being fed by humans; and approaching or allowing humans to approach them. These undesirable habituation behaviors were exhibited at a much higher frequency during the early years following the establishment of a release site and now persist to a lesser degree in each of the wild populations. These types of behaviors are also known in similar species. Wild populations of black vultures (*Coragyps atratus*) are known to exhibit similar behaviors, which caused the destruction of property and prompted control measures (Lowney 1999). Habituation increases the risk of injury to condors (or the people they approach) and the likelihood of associating food with humans, possibly resulting in reduced reliance on natural foraging behavior.

Cade et al. (2004) grouped undesirable behavior into three categories, increasing in level of severity:

- Type I behavior is characterized by birds landing no closer than 45 feet (15 meters) from people, by investigative fly-bys no closer than 45 feet (15 meters), occasional investigation of manmade objects, perching on manmade structures that resemble natural objects or provide safe vantage points, and not repeating undesirable behavior after being hazed once or twice.
- Type II behavior is an intermediate category that represents tolerable though not ideal behavior toward humans. It is characterized by birds landing or flying closer than 45 feet (15 meters) to humans, but maintaining an individual distance when approaching or being approached by humans and circumventing humans when investigating their

belongings, allowing close human approach only when a clear escape route is present, and fleeing when hazed.

- Type III behavior is dysgenic and consists of birds allowing close human approach when no escape route is present (no fear of being boxed in), seeking out and initiating contact with humans, allowing touching and handling (including capture), not responding to hazing, and showing no fear of humans.

Condors are extremely social animals. The presence of a single bird can attract others to the area; therefore, habituated birds within the population can put other individuals at risk. Condors are also very inquisitive animals and, like many other opportunistic species, will explore their environment as a means to discover potential food items, as well as keying in on the activities of other condors or other species to find food.

The age of the individual California condor can be a factor in terms of habituation. Younger birds tend to be more susceptible to the threat of habituation, especially when released from captive rearing programs without older birds to mentor them, as was the case early in the release effort. However, even young wild-fledged birds have been reported to be much more approachable than older individuals (J. Hamber 2012 pers. comm.).

Figure 8. Photo of condor (studbook #412) entangled and hanging from a communications tower. The injuries from this incident were so severe the bird was euthanized.

Prior to release, captive California condors are held for many weeks in remote isolated flight pens with a mentor bird. They are assessed and released only if they exhibit appropriate behaviors, including fear of humans. However, the social nature of condors makes all individuals at risk of habituation. While younger, naïve birds are more likely to exhibit Type I or II behaviors, that behavior may cause other individuals to exhibit the same behavior, regardless of age or breeding status.

Type I and II are considered normal exploratory and play activities that may be adaptations related to the foraging and social nature of California condors. However, these behaviors may lead to an increased potential for the development of Type III behaviors. In turn, case studies have shown that Type III behavior can be changed to Type I or II through the use of hazing or temporarily removing the offending bird from the population, though this is not effective in every situation (Cade et al. 2004).

Even Type I behaviors involve risks to California condors. While this category is not associated with approaching humans, it does include condors approaching or landing on human structures. In many cases these structures are inherently hazardous to condors, which can become entangled or entrapped on or in structures or ingest poisonous household or industrial items, leading to injury or death. The first death in the reintroduced population was after a condor (studbook #66) was exposed to ethylene glycol, a substance commonly used in hydraulic fluids and antifreeze; the source of this exposure is unknown (Rideout et al 2012). Another example occurred in 2010 when a wild-fledged condor in southern California became entangled in a line attached to a communication tower (Figure 8). This resulted in an injury so severe that the condor was euthanized. In yet another case, a condor approached a structure and became oiled after finding a bucket filled with motor oil. Fortunately, this bird was trapped and the oil cleaned from its head, feet, and feathers.

The field managers at each release site employ hazing as a means to manage Type I and II behaviors and prevent Type III behaviors or injury to California condors. The attitude toward hazing as an effective deterrent has changed over time (Grantham 2007). In some instances hazing in combination with removing any potential attractants has been effective at discontinuing condor activity at certain locations. In other instances condor activity has persisted for longer periods of time and only ceased when there was a change in foraging patterns (possibly seasonal in nature). In these cases, field staff found that hazing was only effective in temporarily keeping birds away from structures or people when it was done immediately and consistently. When placed properly, automated hazing devices, such as motion-activated sprinklers, are the most effective technique for persistent situations.

Climate Change: The warming climate and its effects or potential effects on wildlife has been well documented (Inkley et al. 2004, Hansen et al. 2006). According to the Intergovernmental Panel on Climate Change (IPCC) (2007, p. 1) “Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.” Average Northern Hemisphere temperatures during the second half of the 20th century were very likely higher than during any other 50-year period in the last 500 years and likely the highest in at least the last 1300 years (IPCC 2007). 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 more frequent (IPCC 2007). In addition, the frequency of heat waves and heavy precipitation events has increased over most land areas (IPCC 2007). The IPCC (2007) predicts that changes in the global climate system during the 21st century are very likely to be larger than those observed during the 20th century. Warming of about 0.4 degrees Fahrenheit (°F) per decade is projected for the next 2 decades (IPCC 2007).

Climate change may or may not affect the prevailing winds that California condors rely upon for soaring. Ungulates and ranching operations that condors rely upon for food may be impacted by a changing climate. The increased frequency of wildfires has the potential to destroy roosts and directly harm condors caught in the path of fast-moving fires. Finally, hotter summer temperatures and a smaller snowpack may reduce the availability of water sources that condors rely upon for drinking and bathing. However, condors have a very wide historical range, from the Pacific Northwest to the southwest desert, indicating an adaptability that may assist their survival in a changing climate.

A recent study by California Department of Fish and Wildlife and Point Reyes Bird Observatory (Gardali et al. 2012) of California's at-risk bird species determined that California condors were not one of the species most vulnerable to climate change, based on the sensitivity (intrinsic characteristics of an organism that make it vulnerable) and exposure (the magnitude of climate change expected) anticipated for each species. No specific observations about condors were made in the published study. Based on what we know about the species and the known and likely effects of climate change, we do not consider climate change as a significant threat to the species.

III. RECOVERY CRITERIA

Recovery plans provide guidance to the Service, States, and other partners and interested parties on ways to minimize threats to listed species and on criteria that may be used to determine when recovery goals are achieved. There are many paths to accomplishing the recovery of a species and recovery may be achieved without fully meeting all recovery plan criteria. For example, one or more criteria may have been exceeded while other criteria may not have been accomplished. In that instance we may determine that, overall, the threats have been minimized sufficiently and the species robust enough to downlist or delist. In other cases, new recovery approaches and/or opportunities unknown at the time the recovery plan was finalized may be more appropriate ways to achieve recovery. Likewise, new information may change the extent to which criteria need to be met for recognizing recovery of the species. Overall, recovery is a dynamic process requiring adaptive management and assessing a species' degree of recovery is an adaptive process that may or may not fully follow the guidance provided in a recovery plan. We focus our evaluation of species status in this 5-year review on progress that has been made toward recovery since the species was listed (or since the most recent 5-year review) in eliminating or reducing the threats discussed in the five-factor analysis. In that context, progress towards fulfilling recovery criteria serves to indicate the extent to which threat factors have been reduced or eliminated.

The Recovery Plan for the California Condor (Service 1996) did not specify criteria for removing the condor from the List of Endangered and Threatened Wildlife. At that time, there were too few condors in existence to anticipate all the actions that would be necessary to bring about full recovery. The Recovery Plan does outline one minimum criterion, along with five conditions that need to be achieved before reclassifying the species to threatened. The minimum criterion is the maintenance of at least two non-captive (wild) populations and one captive population. The five conditions that must be met, in addition to the minimum criterion, are that these populations:

(1) must each number at least 150 individuals;
(2) must each contain at least 15 breeding pairs;
(3) must be reproductively self-sustaining with a positive rate of population growth.

Furthermore, the non-captive (wild) populations

(4) must be spatially disjunct and noninteracting; and
(5) must contain individuals descended from each of the 14 founders.

One of the purposes of the 5-year review is to assess our achievements toward meeting the criteria as established in the Recovery Plan. The 1996 Recovery Plan anticipated that these criteria would be met by 2010, though this has not yet occurred. Each of the California condor populations continues to grow, though largely based on contributions from captive-bred birds.

The California condor population in California, with its 2012 population size of 129 condors and 12 active breeding pairs, will likely be the first to achieve the numerical Recovery Plan goals. Arizona had six active breeding pairs with a population of 78 free-flying condors in 2012. The Baja population was not considered at the time of the 1996 Recovery Plan and no goals have been established for that population.

None of the three free-flying (wild) populations are reproductively self-sustaining. Recovery of the California condor is constrained by the current anthropogenic causes of mortality, primarily lead contamination from prey shot with lead ammunition (Rideout et al. 2012). Further, reproductive success has been hampered by the presence of microtrash in the environment and the effects of DDT/DDE in coastal populations. Additionally, exposure to lead in breeding adults may cause nest failure. With natural reproductive rates already low in this long-lived and slow-to-mature species, the high rate of mortality and depressed reproduction have prevented growth in the wild population except through captive breeding.

The genetic representation of the 14 founders in the wild California condor populations has been managed by annually assessing each population's genetic makeup and selecting the most appropriate offspring from the captive flock for each release. All 14 founders are represented in the captive flock, which has a current population of 180 condors. About 60 breeding pairs are active each year. These pairs are periodically split and re-formed to maximize the genetic diversity of the captive offspring. Condors have been highly successful breeding in captivity and great care is taken in proper rearing techniques to allow for the successful release of captive-reared juveniles (Clark et al. 2007). A portion of the captive population must be retained as breeders to maintain the genetic diversity of the population, and space is required to hold these individuals until they mature and can reproduce. Exhibits serve the dual purpose of providing space for immature condors assigned to the captive breeding effort and promoting education and outreach.

IV. SYNTHESIS

At the time of Federal listing in 1967, one population of California condors, comprised of approximately 50–60 birds, was known in California. In 1982 it was decided to take eggs and nestlings produced by wild California condors into captivity to form a captive flock at the San Diego Wild Animal Park and Los Angeles Zoo. By 1985, due to the significant loss of wild birds, it was decided to capture all remaining wild birds in order to ensure the genetic viability of the species and enhance the chances of success in the captive breeding program. The first releases of captive-reared birds occurred in 1992 in southern California, but behavioral problems exhibited by these birds led to a decision to return them all to captivity in early 1995. Releases of captive-reared and formerly wild birds were reinitiated in southern California in 1995 and additional release sites were established in Arizona in 1996, central California in 1997 and Baja California in 2002. Currently, there are three condor populations (a blended population in central and southern California, and independent populations in Arizona and Baja California), however the California condor still remains absent from the northern portion of its historical range. The California Condor Recovery Program has achieved remarkable success with steadily increasing wild and captive populations. Condors raised in captivity are routinely released in California, Arizona, and Baja California to expand the wild populations. There are now chicks fledged from natural nests by breeding pairs that formed on their own after release. Despite these efforts, the status of the species remains endangered due to the continued high mortality rates that cannot be naturally offset due to the low numbers of individuals and naturally low reproductive rate of the species. At this time, the wild populations of California condors have yet to exhibit a positive rate of growth without captive releases and annual mortality has surpassed productivity in these populations. It is expected that releases and intensive management will be required to sustain and grow the populations into the future until the leading cause of mortality, lead contamination, is resolved in all three of the wild populations (Finkelstein et al. 2012).

Therefore, the California condor still meets the definition of endangered, and this review recommends no status change at this time.

V. RESULTS

Recommended Listing Action:

___Downlist to Threatened
___Uplist to Endangered
___Delist
_X_No Change

Recovery Priority Number and Brief Rationale: The existing 4C designation indicates that California condors are a monotypic genus that face a high degree of threat, have a stable or increasing population, and have a low potential for recovery. The "C" indicates conflict with construction, development projects, or other forms of economic activity, in this case largely hunting and the resulting exposure to lead. The conclusion of this assessment indicates a monotypic genus that faces a high degree of threat, has a stable or increasing population and continues to have a low potential for recovery. According to the Recovery Priority Guidelines, "priority will be given to those species and projects that offer the greatest potential for success" and recovery potential of a species will be determined by consideration of the following (Table 3):

Table 3: Recovery Potential Guidance

	High Recovery Potential	Low Recovery Potential
Biological and Ecological Limiting Factors	Well understood	Poorly understood
Threat to Species Existence	Well understood easily alleviated	Poorly understood or pervasive and difficult to alleviate
Management Needed	Intensive management not needed, or techniques well documented with high probability of success	Intensive management with uncertain probability of success, or techniques unknown or still experimental
From 48 FR 43098, as corrected in 48 FR 51985 (1983)		

The biological and ecological limiting factors for California condors, such as slow reproductive rate, long period until sexual maturity, and the impact of condor habituation are to be considered in designating the recovery potential. These factors are well understood and have been documented to various degrees through four recovery planning efforts and in this 5-year review. While additional scientific research would benefit the recovery of the species and is suggested with this report, these biological and ecological factors are considered in the recovery criteria established for the program and are not in themselves the cause of a low recovery potential.

The threats to the California condor's existence are also well understood, both in the scientific community and among policymakers. The primary threats, as documented in this report and demonstrated in many scientific references, is the ingestion of lead introduced into the environment, and, to a somewhat lesser degree, the presence of other contaminants such as DDT/DDE and microtrash. These and other threats to condor survival are the subject of active avoidance and minimization programs and statutory and regulatory changes, though they continue to be subject to ongoing scientific and policy debate. Lead is pervasive throughout all California condor ranges, and has proved very difficult to alleviate. Particularly because of the presence of lead in the environment, intensive management of California condors will continue in the foreseeable future. Also because of the mortality associated with lead and other mortality factors, continued operation of captive breeding facilities will be required. California condors have a low recovery potential because their limiting factors and threats, while well understood, are both difficult to alleviate and require continuing intensive management both of the wild and the essential captive population. Therefore, the Recovery Priority Number for the California condor should remain as 4C.

VI. RECOMMENDATIONS FOR ACTIONS OVER THE NEXT 5 YEARS

The California Condor Recovery Program involves a complex partnership of diverse organizations located over a large geographic area. The program's current structure makes each partner instrumental to future efforts and continued success will require proper coordination and communication. Previous management of the California condor has demonstrated that adaptive decision-making is often necessary due to unforeseen and changing circumstances. Therefore, although recommendations in this review are presently regarded as important over the next 5 years, future conditions may lead to updated management strategies that diverge from the current recommendations.

Audubon California and the American Ornithologists' Union (AOU) developed a report entitled Status of the California Condor and Efforts to Achieve its Recovery (Walters et al. 2010), which contained a number of organizational recommendations; some of these have been implemented and some considered in the context of the report. The Service has placed the Condor Recovery Coordinator, who reports to the Deputy Regional Director as suggested in the AOU Report, in the Regional Office (Region 8).

In 2010 the California Condor Recovery Team was disbanded; management of the flock continues to be performed by the Service and partner organizations. The last recovery plan revision, written in 1996, focused on captive propagation, appropriate sites for roosting, nesting and feeding, release techniques, subsequent individual bird management, and recordkeeping.

Over 90 partners in California condor recovery met together in August 2012 in Portland, Oregon, to review a draft of this 5-year review document, and to provide suggestions for improvements in the California Condor Recovery Program. Recommendations from partners have been incorporated, as appropriate, to add local perspectives to various issues identified in the review.

The four prior recovery plans, the AOU report, and this 5-year review provide an impressive body of information to use as a basis to update and improve recovery management. At the California condor recovery partners meeting in August 2012, many suggestions were made to develop focused, issue-specific work groups to engage the partnership that manages condor recovery, and to assist in resolving specific issues, such as contaminants, rather than to develop another large comprehensive plan. To the degree that the Service concurs with those recommendations, they have been incorporated into this document or will be considered in subsequent planning efforts.

Of particular importance is recognition that virtually all the recommended actions in this section are now dependent on private, non-Federal funding that cannot likely be sustained, and that the funding situation for the partners as a whole is now critical. In a separate communication with the Service, a number of partners indicated the current pressing need for approximately $3.5 million per year for the next 5 years in order to sustain the existing level of effort, and additional funds to address the lead issue identified as essential in this report.

Below, we present our specific management and research recommendations.

Priority Needs:

1. Develop a 5-year needs assessment to assess the need for resources to implement recommended organizational changes and for a State-based non-lead outreach and education effort.

2. Continue development of specific workgroups as part of a larger California Condor Recovery Team with narrowly drawn, time-limited responsibilities to address significant pending issues, including:

    a. Developing programmatic responses to contaminants in the environment, including lead, DDT/DDE, and microtrash;
    b. Planning for additional release sites if found feasible and desirable;
    c. Managing program growth and recordkeeping that results from the continued captive breeding, release, and management of condors in the wild;
    d. Developing consistent and structured health, veterinary and animal management protocols and standards.

3. Develop and publish a Federal Register notice that corrects the 1987 and subsequent listing of the non-experimental California condor population to reflect the actual listed range.

Captive Breeding Program

The California condor captive breeding program partners include the Zoological Society of San Diego/San Diego Zoo Global, Los Angeles Zoo, Oregon Zoo, and World Center for Birds of Prey. The anticipated participation of the Chapultepec Zoo as a captive breeding partner would include support by Mexican agencies, including the Instituto Nacional de Ecología, Comisión Nacional de Áreas Naturales Protegidas, Centro de Investigación Científica y de Educación Superior de Ensenada, and Dirección General de Zoológicos y Vida Silvestre, among others. A Memorandum of Understanding with Mexican authorities is under development as a near-term action to facilitate creation of a potential additional breeding program in Mexico in support of the existing release site in Baja California, and to ensure integration of the Mexican program into the overall recovery effort. Ongoing management of the captive breeding effort is managed by the partners pursuant to State and Federal recovery permits.

Field Restoration Activities

California condor field restoration activities include efforts by the Service, Ventana Wildlife Society, National Park Service, The Peregrine Fund, Zoological Society of San Diego, Los Angeles Zoo, and Santa Barbara Zoo. Mexican partners include the Instituto Nacional de Ecología, Comisión Nacional de Áreas Naturales Protegidas, Centro de Investigación Científica y de Educación Superior de Ensenada, Dirección General de Zoológicos y Vida Silvestre, and others. Contributions to field management efforts are also made by the U.S. Forest Service and Bureau of Land Management. Field research efforts are supported by academic institutions with expertise in ecotoxicology and population ecology. A primary area of concern of the field teams managing the populations is the continued population growth without a corresponding growth in resources available to manage those populations. Field team meetings provide opportunities to discuss management techniques, critical concerns, and data consistency across programs. A formal annual Service-developed meeting of representatives of each of the field sites is an essential component of the California Condor Recovery Program.

Data Analysis and Management

Data analysis and management efforts are conducted by all California condor captive breeding and field restoration partner organizations. The Condor Studbook is managed by the San Diego Zoo Global based on Association of Zoos and Aquariums standards. Appropriate ecological and toxicological investigations have and will be conducted by University of California (UC) Davis and UC Santa Cruz. Pursuant to a section 6 grant through the State of California, an online database project is in development to track post-ban lead exposure in the California population of condors. Efforts are underway to expand the database to provide a California Condor National Database to manage essential condor population information. The coordinated effort is a high priority for the program in the next several years.

Outreach and Education

Outreach and education efforts include all California condor captive breeding and field restoration partner organizations. Additional efforts have and will be conducted by Arizona Department of Game and Fish, Utah Department of Natural Resources, California Department of Fish and Wildlife, the Service, National Park Service, Yurok Tribe, and Institute for Wildlife Studies. These efforts include outreach to hunters, hunting and shooting organizations, landowners, and the general public, as well as development of other public information portals such as kiosks and display materials at museums and zoos featuring condor exhibits and online information. Increased penetration of the hunting and shooting sports communities is seen as the primary goals of these outreach activities.

Research Recommendations

Based on issues presented in this document and throughout the California Condor Recovery Program, the following research needs have been identified for the consideration of the partners. Proposals addressing these information and research needs will be evaluated through the recovery program as the scientific capacity, funding, and program priorities require.

The California Fish and Game Commission will receive a report from the California Department of Fish and Wildlife in summer 2013, developed to assess the effectiveness of the lead ban in California. The Service will assist in the development of the report, which provides an opportunity to compare the effectiveness of the lead ban in California with other State voluntary programs and outreach efforts. Additional proposals may result from that analysis, including development of other approaches to minimize the impacts of lead on the California condor population.

Several priority research projects are emerging from efforts currently underway relating to wind energy development, including recording and analysis of condor flight patterns on a fine scale, further development of alternatives to telemetry-based detection and avoidance systems in the California condor's range, and additional modeling of feeding behavior based on GPS telemetry information. Additional focus in these areas will assist in the evaluation of wind-energy permitting and siting proposals and help to ensure the long-range compatibility of wind-energy development with an expanded and expanding condor population.

Several proposals focused on the health protocols utilized in managing California condor populations have been discussed among the partners, including evaluating the efficacy of the current protocol for treating lead-exposed condors. Chelation therapy is the standard treatment for toxic levels of exposure, but there may be alternatives based on the timing of exposure and the level of chronic, as opposed to episodic, exposure. Further, greater understanding of the survivorship of untreated individuals may assist in evaluating specific incidents of exposure. Also in the health arena, an evaluation of the importance of West Nile Virus vaccine in maintaining the population compared with the survival rates under natural conditions of exposure to West Nile Virus will inform the program, leading towards a self-sufficient, unvaccinated population.

Also to facilitate independent self-sustaining populations, evaluations of the availability of sufficient carrion and other potential natural food sources will be valuable information. Field crews have looked at the use of food subsidies (proffered sources) to encourage range expansion, though additional research in this area has been suggested. Research on the efficacy of various hazing techniques would assist field crews in managing the various flocks, particularly as a mechanism to avoid habituation as the flocks expand their ranges. Better understanding of the behavioral motivations that promote the use of microtrash would assist in developing strategies to avoid this source of mortality.

In addition, a better understanding of habitat loss in the California condors' ranges and the development of models to evaluate habitat needs for a future self-sufficient population will be important to the long-range independence of the population. Integral to understanding the habitat needs will be a better, more thorough, species-specific evaluation of the potential impacts of climate change.

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Personal Communications

Jesse Grantham, California Condor Coordinator for the U.S. Fish and Wildlife Service (now retired) to Joseph Brandt, Supervising Biologist, U.S. Fish and Wildlife Service, 2010.

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Katherine Ralls, Senior Research Zoologist, Smithsonian Institution and Genetic Coordinator for the Condor Recovery Program, and Jonathan Ballou, Smithsonian Institution, via email to John McCamman, California Condor Coordinator on August 8, 2012.

Joseph Brandt, Supervising Biologist, Condor Recovery Program and Joe Burnett, Supervising Field Biologist, Ventana Wildlife Society, 2012.

Kelly Sorenson, Executive Director of the Ventana Wildlife Society, discussing with John McCamman, California Condor Coordinator, studies he has conducted which have been accepted for publication, 2012.

Kelly Sorenson, Executive Director of the Ventana Wildlife Society, discussing with John McCamman, California Condor Coordinator, studies he has conducted which have been accepted for publication, 2012.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW
California condor (*Gymnogyps californianus*)

Current Classification: Endangered

Recommendation Resulting from the 5-Year Review:

___Downlist to Threatened
___Uplist to Endangered
___Delist
_X_No change needed

Review Conducted By: Hopper Mountain National Wildlife Refuge Complex Office & John McCamman, California Condor Coordinator, Region 8

REGIONAL OFFICE APPROVAL:

Lead Regional Director, U.S. Fish and Wildlife Service, Pacific Southwest Region (Region 8)

Approve ____________________ Date 6 · 4 · 2013

COOPERATING REGIONAL OFFICE APPROVAL:

Cooperating Regional Director, Pacific Region (Region 1)

_____Concur _____ Do Not Concur

Signature____________________ Date_______

Cooperating Regional Director, Southwest Region (Region 2)

_____Concur _____ Do Not Concur

Signature____________________ Date_______

Cooperating Regional Director, Mountain-Prairie Region (Region 6)

_____Concur _____ Do Not Concur

Signature____________________ Date_______

U.S. FISH AND WILDLIFE SERVICE
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Review Conducted By: Hopper Mountain National Wildlife Refuge Complex Office & John McCamman, California Condor Coordinator, Region 8

REGIONAL OFFICE APPROVAL:

Lead Regional Director, U.S. Fish and Wildlife Service, Pacific Southwest Region (Region 8)

Approve ________________________ Date ________

COOPERATING REGIONAL OFFICE APPROVAL:

Cooperating Regional Director, Pacific Region (Region 1)

_✓_Concur _____ Do Not Concur

Signature Robyn Thorson Date MAY 28 2013

Cooperating Regional Director, Southwest Region (Region 2)

_____Concur _____ Do Not Concur

Signature________________________ Date_______

Cooperating Regional Director, Mountain-Prairie Region (Region 6)

_____Concur _____ Do Not Concur

Signature________________________ Date_______

U.S. FISH AND WILDLIFE SERVICE
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Review Conducted By: Hopper Mountain National Wildlife Refuge Complex Office & John McCamman, California Condor Coordinator, Region 8

REGIONAL OFFICE APPROVAL:

Lead Regional Director, U.S. Fish and Wildlife Service, Pacific Southwest Region (Region 8)

Approve ______________________________ Date _________

COOPERATING REGIONAL OFFICE APPROVAL:

Cooperating Regional Director, Pacific Region (Region 1)

_____Concur _____ Do Not Concur

Signature______________________________ Date_______

Cooperating Regional Director, Southwest Region (Region 2)

_✓_Concur _____ Do Not Concur

Signature J E Nicholopoulos Date 5/29/13

Cooperating Regional Director, Mountain-Prairie Region (Region 6)

_____Concur _____ Do Not Concur

U.S. FISH AND WILDLIFE SERVICE
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Review Conducted By: Hopper Mountain National Wildlife Refuge Complex Office & John McCamman, California Condor Coordinator, Region 8

REGIONAL OFFICE APPROVAL:

Lead Regional Director, U.S. Fish and Wildlife Service, Pacific Southwest Region (Region 8)

Approve ______________________________ Date _________

COOPERATING REGIONAL OFFICE APPROVAL:

Cooperating Regional Director, Pacific Region (Region 1)

_____Concur _____ Do Not Concur

Signature______________________________ Date_______

Cooperating Regional Director, Southwest Region (Region 2)

_____Concur _____ Do Not Concur

Signature______________________________ Date_______

Cooperating Regional Director, Mountain-Prairie Region (Region 6)

X Concur _____ Do Not Concur

Signature______________________________ Date 5/10/13
Acting ARD ES

Appendix I

Current Species Specific Research/Grant Funded Activities

Genetic map and whole genome sequences of California condors
Years: 2006–present
Study Objective: Utilize robust genetic and genomic approaches to construct a complete genome-based database of genetic variation in California condors, and make findings available for population management and recovery. Anticipated findings include detailed analysis of kinship among founder California condors, detailed characterization of variation at the single nucleotide polymorphism (SNP) level, assessment of retention of genetic variation in the species' pedigree, identification of the mutation causing chondrodystrophy, and identification of carriers of the chondrodystrophy allele.
Principal Researchers: Oliver A. Ryder, PI. Stephan C. Schuster, Webb Miller, Michael Romanov
Sponsors: California Condor Recovery Program, San Diego Zoo Global
Funding Sources: San Diego Zoo Global, Seaver Institute, John and Beverley Stauffer Foundation, other private foundations
Results to Date: A genetic map for California condors based on comparison to chicken and zebra finch genomes has been published. A microsatellite-based linkage map is in development. Sequencing of 30 California condor genomes, utilizing Illumina technology, has been proposed and funding is pending. This study would identify all extant genetic variation at the nucleotide level and affords the opportunity to identify the mutation associated with heritable chondrodystrophy.
Anticipated Completion: If current funding proposals are approved, the reference genome and initial descriptions of species variation would be completed within 1 year. More detailed analyses of demography and evolutionary population genetics would follow. Priority will be given to reporting recovery-relevant findings.

California condor West Nile Virus (WNV) vaccination study
Years: 2009–2012
Study Objective: Determine the range of serological responses in chicks to a commercial canary-pox vectored recombinant West Nile Virus vaccine.
Principal Researchers: Donald L. Janssen, Michael Mace
Sponsor: San Diego Zoo Global
Funding Sources: San Diego Zoo Global, Los Angeles Zoo, Oregon Zoo, Service Hopper Mountain NWRC
Results to Date: Three zoos (Oregon Zoo, Los Angeles Zoo, San Diego Zoo Safari Park) and one field site combined efforts in 2011 and 2012 to vaccinate 21 (2011) and 22 (2012) California condor chicks with a canary-pox vectored WNV vaccine. The Cornell University WNV

laboratory analyzed the serum samples from the 2011 and 2012 chick seasons. Statistical analysis performed on the 2011 cohort showed significant maternal antibodies that persisted for up to 75 days. Follow-up samples at about 5 months of age showed that up to 94 percent of birds were immune to WNV. No birds became sick or died from the disease during this study. In the 2012 season, post-vaccine titers were generally higher than in 2011, but statistical analysis is still pending.
Anticipated Completion: June 2012

Assessment of the biological impact of contaminants and management actions that influence the long-term persistence of the California condor
Years: 2011–2016
Study Objectives: Synthesize existing data and collect new data on the risks of contaminant exposure to California condors. Identify the suitability of existing and proposed future habitat with respect to changes in contaminant exposure, human demographics, and climate. Quantify baseline measures of individual California condor performance (e.g., survival, reproductive success) and how these rates are influenced by contaminants (e.g., lead, organochlorines, microtrash) and future habitat suitability from changes in human demographics and climate. Develop demographic modeling approaches that allow estimation of how contaminants, global climate change, future habitat suitability, and management efforts will impact recovery of each condor population in California.
Principal Researchers: Donald R. Smith, Daniel F. Doak, Myra Finkelstein, Vickie Bakker
Sponsors: Department of Environmental Toxicology University of California (UC) Santa Cruz; Hopper Mountain NWRC; Pinnacles National Monument, National Park Service; Forest and Rangeland Ecosystem Science Center, US Geological Survey; Water Pollution Control Laboratory, Service; Office of Spill Prevention and Response, CA Dept. of Fish and Game; University of Wyoming; Ventura Ecological Service Office, Service;
Funding Sources: Montrose Settlement Restoration Funds, Service Environmental Contaminants Program
Anticipated Completion: 2016

Examining the long-term transport of Montrose DDE via marine mammals: Evaluating risks to California condors
Years: 2011–2013
Study Objective: Examine the risk to scavenging California condors from DDE discharged from the Montrose site in the Southern California Bight and transported via marine mammals along the California coast.
Principal Researchers: Myra Finkelstein, Don Smith, Carolyn Kurle
Sponsors: UC Santa Cruz, Service California Condor Recovery Program, UC San Diego
Funding Source: Montrose Settlement Restoration Funds
Results to Date: Manuscript "Stable nitrogen and carbon isotope discrimination factors for blood and feathers from California condor (*Gymnogyps californianus*) chicks and juveniles" has been submitted to the journal Condor, and is currently in revision.
Anticipated Completion: 2013

California condor movement and space use relative across the annual cycle with relevance to wind energy potential

Years: 2009–2012
Study Objectives: Determine current California condor space use and movement patterns across the annual cycle, including home range size and habitat selection based on vegetation and atmospheric properties.
Principal Researcher: James Rivers
Sponsors: Service; US National Park Service, Pinnacles National Monument; US Geological Survey, Forest and Rangeland Ecosystem Science Center; Ventana Wildlife Society
Funding Sources: Service Hopper Mountain NWRC, Ventura Ecological Services Office
Results to Date: Development, maintenance, and distribution of condor movement .kmz files (Google Earth) for use by condor managers in California.
Anticipated Completion: 2012

History of California condors in the Pacific Northwest
Years: 2008–present
Study Objective: Document the history of California condor in the Pacific Northwest through a review of anthropological, archeological, paleobiological, and observational records, and assess plausible reasons for the decline and extirpation of the condor from the region.
Principle Researchers: Jesse D'Elia, Susan Haig
Sponsors: Service, U.S.G.S.
Funding Sources: Service, U.S.G.S.
Results to Date: Manuscript completed and accepted for publication.
Anticipated Completion: Published in June, 2013 Oregon State University Press, Corvallis, OR.

mtDNA variation in the California condor (*Gymnogyps californianus*) across space and through time
Years: 2008–present
Study Objective: Assess historical mtDNA variation in California condors (pre-1900) across space and through time, from the Columbia River to Baja California and from the early 1800s to the present using museum specimens.
Principle Researcher(s): Jesse D'Elia, Susan Haig, et al.
Sponsors: Service, U.S.G.S.
Funding Sources: Service, U.S.G.S.
Results to Date: Over 100 genetic samples collected from the early 1800s to 2000s and from the Columbia River to Baja California from museums around the world. Currently in the process of sequencing mtDNA.
Anticipated Completion: 2013

Ecological niche modeling for California condor (*Gymnogyps californianus*) reintroduction planning in the Pacific Northwest
Years: 2008–present
Study Objective: Develop and test spatially explicit niche models of California Condor nesting, roosting, and foraging habitat, and overlay these empirical models with threats and opportunities to identify areas in the Pacific Northwest that are likely to provide suitable reintroduction sites.
Principle Researchers: Jesse D'Elia, Susan Haig, et al.
Sponsor: Service, U.S.G.S.

Funding Source: Service, U.S.G.S.
Results to Date: Occurrence data and environmental predictor variables have been compiled and models are in development.
Anticipated Completion: 2013

Monitoring avian health and disease on the Pacific Coast in support of California condor reintroduction planning in the Pacific Northwest
Years: 2011–2015, pending funding
Study Objectives: Document lead and organochlorine (OC) contaminant concentrations in tissues of marine mammal carcasses and the avian scavenger community feeding in the same coastal marine environments, including bald eagles, turkey vultures, and common ravens. Use eagles, vultures, and ravens as surrogate species to estimate potential risks to California condors from exposure to lead and OC contaminants from consuming marine mammals. Screen for the presence of avian disease (viruses, bacteria and parasites) in avian scavengers feeding in the coastal marine environment, and determine whether there is a relationship between contaminant concentrations and disease agents in avian scavengers.
Principle Researchers: Dan Varland (Coastal Raptors and Hamer Environmental, L.P.), Scott Ford (Avian Veterinary Specialty Services), Tom Hamer (Hamer Environmental, L.P.), and Glenn Johnson (Hamer Environmental, L.P.)
Sponsor: None.
Funding Sources: Service, Migratory Birds Avian Health and Disease Program; Oregon Zoo; and American Association of Zookeepers, Puget Sound Chapter.
Results to Date: Captured and sampled tissue for contaminants and disease (10 turkey vultures, 6 bald eagles and 2 common ravens); tissue sampled for contaminants and disease (3 common ravens shot for the predator control program at snowy plover nest sites on the Oregon coast); tissue sampled for contaminants (3 harbor seals and 3 California sea lions). Report on first year of study filed by August 31, 2012.
Anticipated Completion: 2015

Assess the risk of non-lead environmental contaminant exposure to California condors
Years: 2012–2015
Study Objective: Provide critical information on contaminant threats to federally endangered California condors, determine the nutritional adequacy of condor food (wild found vs. proffered), and evaluate current management. Objectives are: 1) quantify condor exposure to toxic, bioaccumulative contaminants, 2) determine the relative contributions of condor diets derived from different sources, 3) determine the nutritional composition of wild and proffered foods eaten by condors, and 4) assess condor health and nutritional status. This project represents a major opportunity to integrate complementary efforts of multiple partners and implement a science-based management program.
Principal Researcher: Collin A. Eagles-Smith, Ph.D., Research Ecologist, U.S.G.S., Forest and Rangeland Ecosystem Science Center (FRESC), Corvallis, Oregon.
Sponsor: U.S.G.S. , National Park Service
Funding Source: U.S.G.S. in partnership with National Park Service
Results to Date: Just beginning
Anticipated Completion: 2015

Get the lead out: Gain support for non-lead hunting practices
Years: 2010–2013
Study Objective: Outreach will reduce lead (Pb) threats to wildlife of several Intermountain, Midwest, and Pacific West Region NPS units. The primary outcome will be heightened awareness among visitors and surrounding communities about their power to reduce unintended impacts. Workshops will transfer consistent messaging tools and elevate NPS staff understanding, thereby expanding agency capacity to confront this issue.
Principal Researchers: Scott Scherbinski, David Garcelon, Denise Louie
Sponsor: National Park Service, Institute for Wildlife Studies
Funding Source: National Park Service Natural Resource Preservation Program
Results to Date: Quarterly reports available; final report due September 2013. Completed non-lead ammunition education workshops at Grand Canyon NP and Zion NP; educational video and training materials with Theodore Roosevelt NP; conducted non-lead shooting demonstrations in Utah, southern California, central coast of California; set up informational booths at International Sportsmen Expositions in Las Vegas, Denver, and Sacramento; participated in numerous hunter education workshops in California; developed extensive educational materials and website clearinghouse www.huntingwithnonlead.org; provided non-lead information for NPS websites; gave numerous presentations to rancher education workshops, scientific symposia, and citizen groups.
Anticipated Completion: 2013

Monitoring post-ban lead exposure in the California condor
Years: 2010–2012
Study Objectives: Monitor lead exposure in California condors over a 3-year period during various hunting activities, and evaluate the effectiveness of the lead ammunition regulations by comparing historical lead exposure to lead exposure following the July 2008 ban on lead ammunition in the condors' range. Investigate sources of continued lead exposure in condors by 1) using satellite and radio telemetry to track condors and identify habitat use, foraging patterns, movements, and behaviors associated with lead exposure; 2) evaluating stable isotope composition of lead in condor samples; and 3) evaluating lead availability in hunted animal carcasses recovered in condor range and microtrash recovered from condor nests. Evaluate the health effects of ongoing lead exposure on condors by assessing individual animal clinical outcomes and survival. Develop an online data management system for the California Region of the Condor Recovery Program.
Principal Researcher: Christine Johnson
Sponsors: Wildlife Health Center, UC Davis; Department of Environmental Toxicology, UC Santa Cruz; US Geological Survey, Forest and Rangeland Ecosystem Science Center; Service Hopper Mountain NWRC; Pinnacles National Monument, California Department of Fish and Wildlife, Ventana Wildlife Society
Funding Source: Service Endangered Species Act (section 6) Grant-in-Aid Program
Results to Date: Pending
Anticipated Completion: 2013

Turbine early warning system for approaching California condors and other large birds
Years: 2012–2013
Study Objective: Development of Global System for Mobile Communications (GSM)/GPS

transmitter to communicate condor distances to wind turbine array managers to stop blades as a bird approaches to nearest turbines.
Principal Researchers: Mike Wallace, Paul Howey
Sponsor: Institute for Conservation Research, San Diego Zoo Global
Funding Sources: San Diego Zoo Global, SEMPRA Corp., Microwave Telemetry
Results to Date: Preliminary tests with the GSM component are positive. One prototype GSM/GPS transmitter deployed on a Baja California condor is functioning adequately, and an upgrade transmitter is currently being programmed.
Anticipated Completion: 2013

California condor nest guarding project
Years: 2007–2016
Study Objective: Analysis of nest success in southern California's reintroduced population of California condors. Assess the trends of breeding effort and nest success in response to changes in foraging, demographics, and management strategy.
Principal Researchers: Estelle Sandhaus, Joseph Brandt
Sponsors: Santa Barbara Zoo, US Fish & Wildlife Service Hopper Mountain NWRC, Los Angeles Zoo
Funding Sources: Hopper Mountain NWRC, Santa Barbara Zoo
Results to Date: 6 percent nesting success (2001–2006) increased to 60 percent nesting success (2006–2011); (Brandt et al. 2008 (presentation)), Brandt et al. 2010 (poster), Wynn and Stringfield 2011, Sandhaus et al. 2012)
Anticipated Completion: 2016

California condor movement and space use relative to wind energy potential
Years: 2009–2012
Study Objectives: Determine historical and current California condor space use and movement patterns. Develop a metapopulation model for condors throughout their historical range.
Principal Researcher: Jim Rivers
Sponsors: US Fish & Wildlife Service; US National Park Service, Pinnacles National Monument; US Geological Survey, Forest and Rangeland Ecosystem Science Center; Ventana Wildlife Society
Funding Sources: USFWS Hopper Mountain NWRC, Ventura Ecological Services Office
Results to Date: Development, maintenance, and distribution of condor movement .kmz files (Google Earth) for use by condor managers in California.
Anticipated Completion: 2012

Assessing reintroduction potential and planning for management of California condors in the Greater Yurok Ancestral Region
Years: 2011–2012
Study Objectives: Complete avian sampling to assess contaminant threats in proposed California condor release range within the Yurok Ancestral Region. Tribal member and public outreach and education on the progress of the condor reintroduction assessment, and the impacts of spent lead ammunition as a serious threat to wildlife and human health and to condor reintroduction efforts. Build and/or sustain partnerships related to condor reintroduction efforts. Participate in

onsite training at current condor release facilities to increase tribal capacity and expertise. Draft Yurok Tribe California Condor Management Plan
Principal Researcher: Chris West
Sponsors: Yurok Tribe Wildlife Program; National Parks Service, Redwood National Park; California State Parks; US Fish and Wildlife Service Hopper Mountain NWRC; Ventana Wildlife Society
Funding Sources: US Fish & Wildlife Service Tribal Wildlife Grant Program, The Peregrine Fund
Results to Date: Pending
Anticipated Completion: 2013

Hunters as stewards: Effecting positive change in the perception of non-lead ammunition for increased human, wildlife, and habitat health
Years: 2012–2013
Study Objectives: Conduct public and private shooting demonstrations. Exchange non-lead for lead ammunition. Increase program capacity via new employee hires and participation in hunter outreach trainings. Participate in hunter-oriented events and provide informational outreach to regional sporting goods stores.
Principal Researcher: Chris West
Sponsor: Yurok Tribe Wildlife Program
Funding Source: US Fish & Wildlife Service Tribal Wildlife Grant Program
Results to Date: Pending
Anticipated Completion: 2014

Analysis of California condor activity using satellite telemetry data
Years: 2005–2012
Study Objectives: Predict different types of behaviors in California condors through the analysis of GPS transmitter data.
Principal Researchers: Chris Cogan, Jesse D'Elia, Joseph Brandt, Ken Convery
Sponsors: California State University, Channel Islands (CSUCI)
Funding Sources: Service, CSUCI
Results to Date: Manuscript submitted for publication
Anticipated Completion: Published 2012

Eggshell thinning and depressed hatching success of California condors reintroduced to central California.
Years: 2006–2012
Study Objective: Compare condor hatching success and eggshell thickness of reintroduced populations of California condors in central and southern California. Evaluate the cause of egg failure in wild-laid eggs. Assess the potential sources of organochlorine contamination and determine its impact on the condor population in central California.
Principal Researchers: Joe Burnett, Kelly Sorenson, Joseph Brandt, Bob Risebrough
Sponsors: Ventana Wildlife Society, Service Hopper Mountain NWRC, The Bodega Bay Institute, Los Angeles Zoo and Botanical Gardens, Santa Barbara Zoo
Funding Sources: Ventana Wildlife Society, Service Hopper Mt NWRC

Results to Date: Burnett et al. 2009 (presentation); manuscript has been submitted to *Condor* and is currently in revision.
Anticipated Completion: 2012

Predictive models of California condor spatial behaviors and habitat use
Years: 2008–1013
Study Objectives: Calculate high-resolution, multidimensional predictive models of condor spatial behaviors and patterns of habitat use at landscape scales and determine how climate modifies condor movements. Create a conservation management toolbox to assist with the identification of important existing and future condor habitat, and to predict and mitigate the risk of wind energy development collision mortality.
Principal Researcher: James Sheppard, PhD, San Diego Zoo Global's Institute for Conservation Research
Sponsor: San Diego Zoo Global
Funding Sources: San Diego Zoo Global, Sempra Energy, Inc. Ellen Browning Scripps Foundation
Results to Date: Final design and calibration of novel 3D home-range estimator with manuscript and free software package ready for submission
Anticipated Completion: 2013