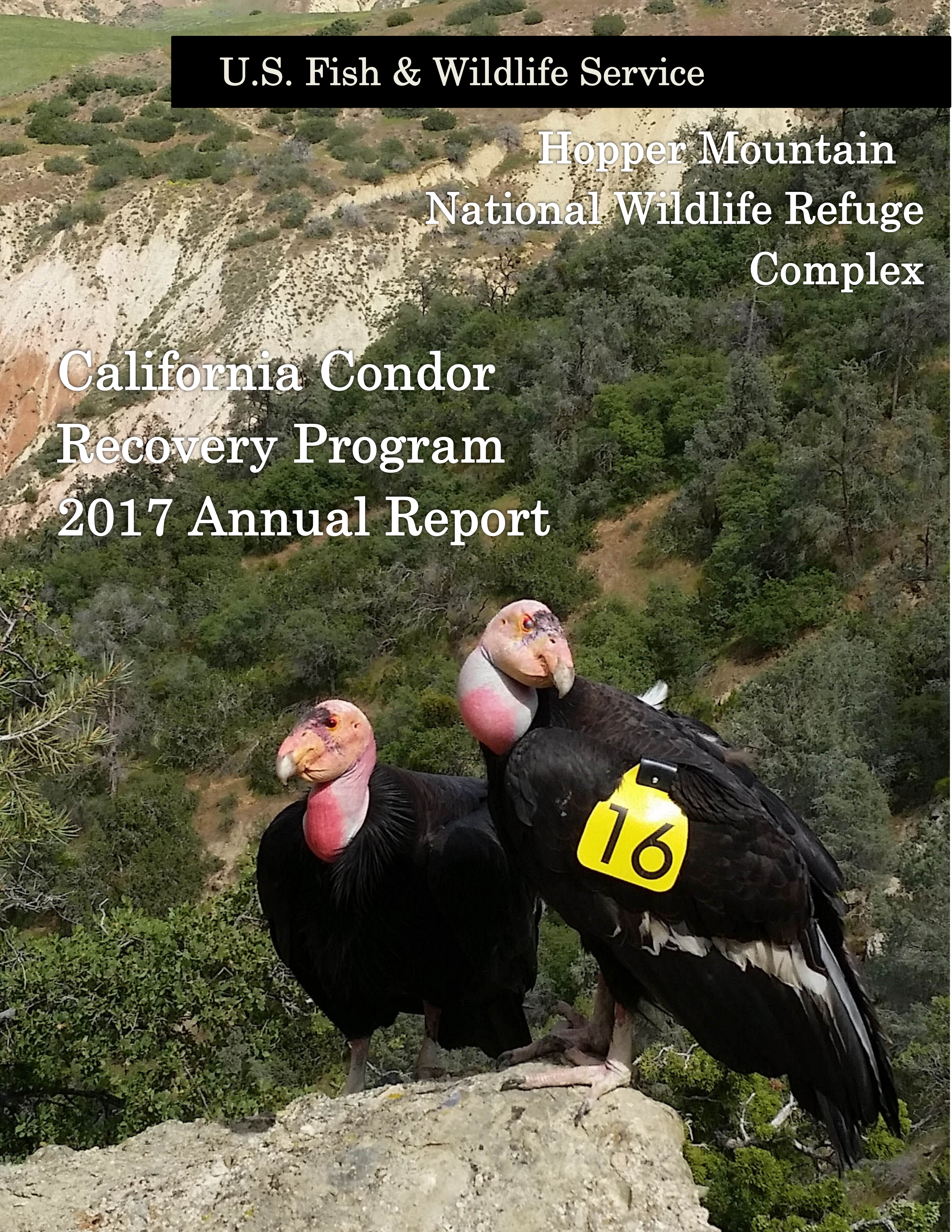
U.S. Fish & Wildlife Service

Hopper Mountain National Wildlife Refuge Complex

California Condor Recovery Program 2017 Annual Report



On the Cover: California condors #328 and #216 at the perched near their nest at Bitter Creek National Wildlife Refuge, Kern County, California.
Photo Credit: Steve Kirkland, USFWS

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We would also like to acknowledge hunters and ranchers using non-lead ammunition for their help keeping condors and other wildlife safe from the perils of lead poisoning.

Disclaimer

All products or brands mentioned in this reports are to inform readers of the methods and equipment used and are not an endorsement of these products of brands.

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Executive Summary

The Hopper Mountain National Wildlife Refuge Complex (Complex) manages a reintroduced California condor population in Southern California. The Bitter Creek and Hopper Mountain National Wildlife Refuges are used as the primary management locations for the release, monitoring, and recapture of condors in this region. Blue Ridge National Wildlife Refuge is a third refuge in the complex that provided roosting habitat for condors but no field activities occur on this refuge at this time.

As of December 31, 2017, the California condor population managed directly by the Complex consisted of 82 free flying condors. The population produced three wild chicks fledged from seven nests in 2017. Two of these nests were remotely monitored using nest cameras. Nine captive-reared condors were released at Bitter Creek National Wildlife Refuge in 2017. As a result of the successful wild nests and captive releases, the population increased by 2.5%.

The condor population in Southern California continues to recolonize its former range, exemplified by new nest territories established in the Tehachapi and Santa Barbara backcountry and increased activity in the southern Sierra Nevada foothills including Blue Ridge National Wildlife Refuge. Condors continued to inhabit the northern Tehachapi Mountains where they interact with humans and associated attractions in the residential mountain communities of Bear Valley Springs, Stallion Springs, and Alpine Forest Park. Condor activity within the footprint of wind energy facilities near the Tehachapi Mountains also increased in 2017.

The field team attempted to trap the condors twice during the year to replace radio transmitters and monitor for lead exposure which occurs when condors ingest carrion or gut piles that have been shot with lead ammunition. Trapping has become more difficult as the population's range has expanded and individuals have become more reliant on non-proffered food sources. In 2017, ten condors (12% of the population) evaded trapping. Lead exposures continue to occur in the population, with 51% of the lead tests performed resulting in blood lead levels greater than 30 µg/dL. Field methods for detecting condor lead exposure in the Southern California population changed in 2017 resulting in fewer condors removed from the wild to be treated.

A total of 10 condors were declared dead in 2017. Six of those condors went missing in the wild and were therefore declared dead, while the carcasses of four free-flying condors were recovered. Three of the recovered dead condors were determined to have died of lead poisoning. The remaining carcasses' cause of death is currently undetermined as results of a necropsy is still pending.

The Complex used partnerships to increase the level of condor education and outreach. The Complex, in partnership with the Santa Barbara Zoo, continued showcasing condor nesting behavior and management on the Condor Cave Facebook page. The Condor Cave has increased its following by 22% with a total of 13,930 followers as of December 31, 2017. A condor nest camera was again streamed live on the internet through a partnership with the Cornell Lab of Ornithology, Santa Barbara Zoo, and Western Foundation of Vertebrate Zoology. While streaming, it was viewed about one million times, from over 150 countries, for a total of 19 million minutes (36 years). The CondorKids program also continued in 2017 at the Fillmore Unified School District with all 12 third grade classes, 300 students, participating. The Institute for Wildlife Studies non-lead outreach coordinator conducted 11 events reaching 445 people. Other condor related outreach activities included tours of the wildlife refuges; educational booths; presentations to interest groups, elementary, high school, and college students; and interviews with media outlets including television programs: Xploration Awesome Planet, KCET SoCal Connected, and Jay Leno's Garage.

Southern California Population Highlights

Population Size

(as of December 31, 2017)

	Adults (≥6 years old)	Juveniles (<6 years old)	Total
Males	24	19	43
Females	22	17	39
Total	46	36	82

For more information on the change in population size see Figure 3.5.1 on page 43

Nesting

	Successful Nests	Failed Nests	Total
Nests in 2017	3	4	7
All Nests since 2001	38	44	82

For more information on annual nesting success see Figure 3.4.1 on page 33

Captive Releases

	Number of Condors
Releases in 2017	9
Total Number of Releases since 1992	150

For more information on the 2017 captive releases see Table 3.5.2 on page 42

Condor Deaths

	Number of Condors
Deaths reported in 2017	10
Total Number of Deaths since 1992	118

For more information on the condor deaths in 2017 see Table 3.3.1 on page 32

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1.0 Introduction

The California condor [*Gymnogyps californianus*] is a federally listed endangered species. The current recovery priority ranking for the California condor is 4C. The "4" 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.

California condors are among the largest flying birds in the world, with a wingspan measuring up to 2.9 meters (9.5 feet; Photo 1.0.1). Condors are a long-lived species with an estimated lifespan of 60 years. They are slow to mature and typically begin to reproduce at six years of age. Condors often form long-lived pairs and fledge one chick every other year. If a nestling fledges relatively early (in late summer or early fall), its parents may nest again the following year (Snyder and Hamber 1985).

California condor habitat can be categorized into nesting, foraging, and roosting components (USFWS 1975). Condors forage in the open terrain of foothill grassland, oak savanna, woodland habitats, and on the beaches of steep mountainous coastal areas. Condors maintain wide ranging foraging patterns throughout the year, which is an important adaptation for a species that may be subjected to an unpredictable food supply (Meretsky and Snyder 1992).

Photo 1.0.1: California condor, #509, takes flight near the Bitter Creek NWR Flight pen, Kern County, California. *Photo credit: Molly Astell, USFWS.*

Condors feed on the carrion of mule deer (*Odocoileus hemionus*), tule elk (*Cervus canadensis nannodes*), pronghorn antelope (*Antilocapra americana*), feral hogs (*Sus scrofa*), domestic ungulates, and smaller mammals such as ground squirrels. Their diet also includes the carrion of whales, sea lions, and other marine species if foraging along the coast (Koford 1953; USFWS 1984; Emslie 1987; Burnett et al. 2013).

California condors are primarily a cavity nesting species typically choosing cavities located on steep rock formations or the burned out hollows of old growth conifers such as coastal 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; USFWS 1996). Condors repeatedly use roosting sites on ridgelines, rocky outcrops, steep canyons, and in tall trees or snags near foraging grounds or nest sites (USFWS 1984).

The U.S. Fish & Wildlife Service (Service; USFWS) Hopper Mountain National Wildlife Refuge Complex (Complex) serves as the lead office for the California Condor Recovery Program (Recovery Program) and is one of many partners that support this multi-state and international recovery effort. The Complex has participated in the California condor reintroduction effort since 1992. In Southern California, the Service operated a number of different release sites both on refuges and U.S. Forest Service lands and has annually released condors produced from captive breeding facilities. Over time, these releases led to the establishment of the Southern California condor population, the group of condors directly managed by the Complex's Condor Field Team (field team).

Over the last 24 years, the field team has been responsible for the continued monitoring and management of the reintroduced population, working both on and off refuge. Today, two of the wildlife refuges in the Complex, Bitter Creek National Wildlife Refuge (Bitter Creek NWR) (Photo 1.0.2) and Hopper Mountain National Wildlife Refuge (Hopper Mountain NWR) are the primary management locations for the Southern California condor population, which currently inhabits portions of Monterey, San Luis Obispo, Santa Barbara, Ventura, Los Angeles, Kern, Tulare, Fresno, and Inyo Counties. The California Condor Recovery Plan (Recovery Plan) provides the overarching guidance for field activities.

Photo 1.0.2: A biologist enters the flight pen as the sun rises at Bitter Creek NWR, Kern County, California. *Photo credit: Jimmy Rogers, Great Basin Institute.*

The primary objective driving the reintroduction effort is to establish one of two wild, self-sustaining populations of 150 individuals with 15 breeding pairs (USFWS 1996). The Recovery Plan consists of five key actions: 1) establish a captive breeding program, 2) reintroduce California condors into the wild, 3) minimize mortality factors, 4) maintain condor habitat, and 5) implement condor information and educational programs (USFWS 1984). In accordance with the Recovery Plan, "Released California condors should be closely monitored by visual observation and electronic telemetry" (USFWS 1984).

To support the second key action in the Recovery Plan, the field team manages a condor release site at Bitter Creek NWR. To support the third key action, the field team monitors the free-flying population of condors to identify threats and reduce adverse effects to condors, which includes minimizing mortality factors. Both refuges provide facilities designated for trapping and holding condors which allows condors to be handled for attaching tags and transmitters and performing routine health checks. Also in accordance with the Recovery Plan: "Condor blood, feathers, eggshells, and other tissues will be collected opportunistically and analyzed for heavy metals, pesticides, and other potential contaminants." (USFWS 1984).

The field team is comprised of a number of different members including Service employees, partner employees, interns and volunteers. In 2017, the Service employed one full-time permanent supervisory wildlife biologist and three full-time term wildlife biologists. In 2017, a newly created park ranger position at the Complex also assisted in the CondorKids program and coordinated activities with the Friends of the Condor Wild and Free.

The Santa Barbara Zoo has been an essential partner for the field team. Since 2007 the zoo has assisted with nest management and research in the Southern California condor population with two full time permanent condor biologists, a condor nest technician and a more general condor biologist. The Santa Barbara Zoo also partners with the Complex on a major education and outreach project, CondorKids, funded by the Service's Urban Refuge Initiative.

In addition to the various Service and Santa Barbara Zoo positions, the field team has four intern positions that are filled throughout the year. These positions are funded by the Service through a cooperative agreement with the Great Basin Institute. Great Basin Institute interns commit to working 40 to 50 hours a week for a period of six months for a daily stipend. These positions are also AmeriCorps volunteers and are eligible to receive an educational award dependent on the number of hours worked.

Some field activities are also supported by unpaid volunteers or other program partners. Unpaid volunteers primarily assist with monitoring nests during the 10 month nesting season, but also assist with condor monitoring via radio telemetry on a more limited basis.

A variety of support also comes from other program partners. The Los Angeles Zoo provides assistance in caring for sick and injured condors, and helped during handling events and nest entries. The Friends of the California Condor Wild and Free helped with outreach events and maintenance projects. The Cornell Lab of Ornithology and the Western Foundation of Vertebrate Zoology assisted with live-streaming a condor nest camera online. The Institute for Wildlife Studies conducted a variety of non-lead outreach activities in coordination with the field team. Several universities collaborated on condor research relevant to conservation needs.

1.1 Funding

In 2017, the Complex received $728,028 in U.S. Fish and Wildlife Service Recovery funds (1113). The Complex used these resources to fund the field team and their activities as well as a condor coordinator position and office space costs. Refuge management funds (126x) also contributed significantly to condor related equipment, activities, and administration costs

In addition to Service funds, various non-government funds contributed to condor recovery activities at the Complex. The Santa Barbara Zoo's Department of Conservation and Research (Photo 1.1.1) and Condor Survival Fund at the Santa Barbara Museum of Natural History also made significant contributions.

Photo 1.1.1: The Santa Barbara Zoo provides equipment for condor nest cameras such as this solar powered microwave repeater located at Bitter Creek NWR, Kern County, California. *Photo credit: Jimmy Rogers, Great Basin Institute.*

2.0 Actions

The condor field team based within the Complex office in Ventura, California performs seven primary recovery actions with the goal of achieving a self-sustaining population of condors in California (Figure 2.0.1). The actions performed are: Monitoring Resource Use, Lead Monitoring and Mitigation, Detecting Mortalities, Nest Management, Behavioral Modification, Captive Releases & Transfers, and Outreach. These actions are meant to address the major threats condors face in the wild and assist in the recovery of the species (Figure 2.0.1).

2.1 Monitoring Resource Use

The loss and modification of California condor foraging, roosting, and nesting habitat is recognized as a historic threat to the recovery of the species. As noted in the 1979 Recovery Plan (USFWS 1979), adequate nest sites, roost sites, and foraging habitat with adequate food are the basic habitat needs of the condor. The 1996 Recovery Plan acknowledges the presence of sufficient remaining condor habitat in the Southwestern United States but notes that maintaining this habitat is a key recovery action (USFWS 1996).

The field team monitors nesting, roosting, and foraging habitat use across Southern California using data from global positioning system (GPS) transmitters attached to condors. GPS transmitter locations are used to understand condor resource use over a large geographic and temporal scale.

The goal of the field team is to equip all California condors in the Southern California population with either two very high frequency (VHF) transmitters attached to retrices (Kenward 1978), or a combination of one VHF transmitter and one patagial mounted (Wallace 1994) GPS transmitter. Some condors in the population do not have transmitters because transmitters are dropped or malfunction in between trapping sessions, or condors are not trapped for a prolonged period of time. Nestlings are typically fitted with a VHF transmitter at 4 months of age. Wild nests that are not entered may also result in untagged condors until those fledglings are trapped after they have fledged.

Use of VHF Transmitters

VHF transmitters allow condors to be tracked in real time. The field team uses handheld VHF receivers and Yagi antennas to locate condors by following the direction of the VHF signal in order to obtain visual observations on specific condors, such as new releases, nesting condors, or sick/injured birds. VHF transmitters are an important tool in identifying when a condor has died (see 2.3 Detecting Mortalities). The VHF transmitters used are produced by Holohil Systems Incorporated (Model # RI-2C, 10 grams).

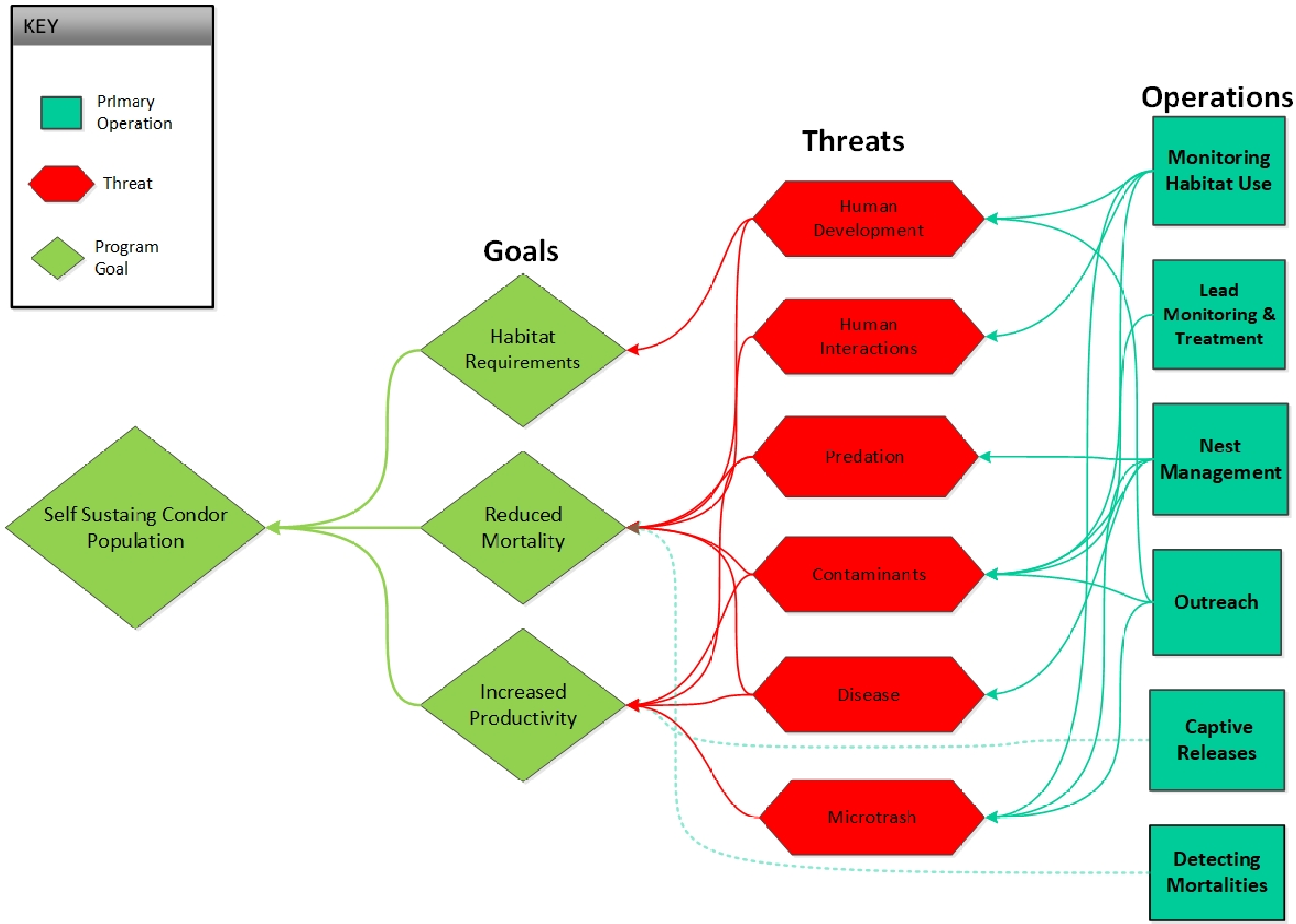

Figure 2.0.1: A conceptual model for the Hopper Mountain NWRC California Condor Field Program. The program's goal is to establish a wild self-sustaining population of condors. The three program objectives are limited by one or more of the six identified threats, which are in turn addressed by the seven primary operations.

Photo 2.1.1: California condor #625 wearing a MTI GPS/GSM transmitter. *Photo Credit: Stephanie Herrera, Great Basin Institute.*

Photo 2.1.2: CTT GPS/GSM transmitters awaiting deployment. *Photo credit: Stephanie Herrera, USFWS Volunteer.*

Use of GPS Transmitters

In 2017, GPS transmitters were produced by two manufacturers, Microwave Telemetry Incorporated (MTI) and Cellular Tracking Technologies (CTT). Both types of transmitters are solar-powered and patagially mounted. GPS Transmitters are assigned to condors as they are available and when condors without a functioning transmitter are trapped.

The Solar GSM/GPS 50g Patagial PTT transmitters produced by MTI (Photo 2.1.1) were very similar in design to the Solar ARGOS/GPS 50g Patagial PTT transmitters that were previously used on condors in Southern California (from 2005 to 2014). The MTI transmitters collect GPS locations every 2 to 15 minutes depending on peak voltage periods. The GPS location data collected by these transmitters are transmitted using cell towers via the Global System for Mobile Communications (GSM) network.

The 50g Evolution Series 400 3G GSM transmitter was manufactured by CTT (Photo 2.1.2). These transmitters also use the GSM network to transmit the GPS locations. The CTT transmitters collect locations every 15 minutes.

Data generated by all transmitters is collated and distributed daily using Movebank.org an application (CCMAP) developed in partnership with the USGS Fort Collins Office (Waltermire et al 2016). Once received, the field team monitors condor locations produced by the GPS transmitters on a daily basis to target locations of interest for on-the-ground investigation, an action referred to as ground-truthing. Feeding events and potential threats are prioritized for ground-truthing.

Condor GPS transmitter locations also inform program-wide objectives via long-term research projects including efforts to better understand weather conditions and condor movement (Possel et al. 2018a), assess the impact and distribution of lead on the landscape (Bakker et al. 2017, Possel et al. 2018b, Kelly et al. 2014), and monitor wind energy development as a potential threat to condors. Findings from these studies may influence management strategies and policy aimed at addressing the threats to condor survival and recovery.

2.2 Lead Monitoring and Mitigation

Lead poisoning is a major ongoing concern for all wild California condors, including those in the Southern California population. The Ridley-Tree Condor Preservation Act (RTCPA; 2008) regulates some use of lead ammunition within the range of condors in California and may reduce the amount of lead-contaminated carrion available to scavengers throughout the condor range. California Assembly Bill 711 (AB711) expands upon RTCPA legislation to restrict the take of all wildlife with lead ammunition throughout California, but will not be fully implemented until July 1, 2019. Despite these regulations, there is still potential for condors to encounter lead fragments from animal carcasses that were shot with lead ammunition (Finkelstein et al. 2012, Kelly et al. 2015). The purpose of monitoring and mitigating lead exposure in California condors is to reduce lead related mortalities and to provide guidance on management decisions and policy making.

Recent analysis of condor feather samples collected during monitoring efforts has increased the understanding of both frequency and severity of condor lead exposures. This information combined with a more thorough review of the efficacy of chelation as a treatment for lead poisoning calls into question whether recent (2011-2016) lead exposure treatment protocols (which involved chelating condors when a specific blood lead level was detected) have been as beneficial to the population as previously thought.

Analysis of condor feather lead data indicate the majority of lead-poisoned birds are not prescribed chelation for lead poisoning after their blood lead levels have already declined by about fourfold (Finkelstein et al. 2012). Typically condor lead exposures are identified weeks after the primary exposure event has occurred and the source of the exposure (ingested lead ammunition or fragments) has been completely digested or passed (excreted or regurgitated) from the body of the bird.

The analysis also indicates that the frequency of lead exposures (i.e., feeding on lead contaminated carcasses) is much higher than previously indicated by just blood lead level data alone. Lead in blood has a half-life of about two weeks (Fry et al. 2003), and thus depending on the magnitude and duration of exposure an elevated blood lead level (e.g., 100 μg/dL) might be detectable for approximately three weeks. If a condor has its blood sampled twice each year (when trapped) this only represents about 6 weeks of lead exposure history or about 11.5% of the annual exposure window. When using primary wing feathers to detect lead exposure in condors, a much larger proportion of the annual exposure window can be sampled (30-40% per feather sampled; Finkelstein et al. 2007). Analysis of feather samples, especially when multiple feathers that grew during consecutive periods of time are analyzed, makes it possible to gain a much better understanding of a condors' lead exposure history. On average, a condor experiences one lead exposure that would surpass 35 µg/dL blood lead level (the threshold for treatment in recent protocols) every 50 days (range 0 - 3 events, n = 48 feathers) (Johnson et al 2013). Thus, current blood lead monitoring does not detect the vast majority of condor lead exposure events and these events go untreated.

Recent studies about chelation treatment efficacy reported that, for moderately lead-exposed rodent and non-human primates, chelation therapy is no more effective at reducing blood lead levels than the cessation of lead exposure alone (Smith and Strupp 2013). This suggests that the prescription of chelation therapy in condors with greater than 35 µg/dL blood lead level may be overprescribed and have little benefit to the population.

In order to better understand the population level benefits of the 2011-2016 lead exposure treatment protocols, the field team, in coordination with condor program veterinarians and partners, have modified the criteria and protocols for chelation treatment. The new protocols are described below under the sub-headings *Blood Lead Tests*, *Physical Exams*, and *Treatment.* The new protocol started in 2017 will be implemented for a period of five years after which indicators of the condor populations' health and lead exposure will be compared to the previous five years in order to determine whether the change in treatment had a measurable effect on the population. On an annual basis, data collected under the new protocol will be evaluated to assess changes in lead exposure and lead-related mortality.

To allow for a more detailed understanding of population changes due to lead poisoning mortality and the change in chelation treatment protocol, population level survival will also be analyzed in the same framework as the recently published survival analysis (Bakker et al. 2017) on a biennial basis. A large increase in lead-related mortality without a concomitant increase in lead-exposure levels would trigger a detailed survival analysis at a sooner time interval and potentially a re-evaluation of the approach to managing lead exposures in the Southern California condor population.

Trapping Condors

Each year the field team attempts to trap and handle the entire Southern California condor population to monitor blood lead levels and, if necessary, treat condors for lead exposure. Trapping typically occurs during two periods of time, from June 1 until July 31 and then from November 1 until December 31. Some condors are trapped at other times of the year. For example, if a condor is suspected to be sick, for behavioral concerns, or for transmitters. For the purposes of comparison in this report annual trapping activities are separated into two periods: January through July and August through December.

Blood Lead Tests

While handling each condor, the field team collects two blood samples from the medial metatarsal vein using blood vials containing Edetate (EDTA). During the above described change in treatment protocols, a field blood lead test will not be performed when handling condors.

Under the new protocols the blood samples collected from condors are refrigerated and sent to the California Animal Health and Food Safety Laboratory System at the University of California, Davis for lab analysis of lead concentrations, and the Microbiology and Environmental Toxicology Department at the University of California, Santa Cruz, for lead isotope analysis.

Feather Sampling

Primary wing feathers are sampled opportunistically on condors wearing GPS transmitters. Feather sampling involves fist identifying that a feather is growing and then most often measuring the growing feather and marking that feather so it can be identified during a subsequent handling and sampled. When sampling feathers the field team uses a standardized protocol developed by Microbiology and Environmental Toxicology Department at the University of California, Santa Cruz. All feather samples are sent to this department for lead concentration and isotopic analysis.

Physical Exams

Under the new protocol, rather than using a field blood lead test result of >35 µg/dL, as the threshold to treat condors, condors were observed and examined for clinical symptoms of lead poisoning. The field team conducted exams while birds are trapped and handled to identify clinical symptoms that can occur in birds with lead poisoning. The symptoms that may be observed in condors include neurological symptoms, such as weakness, ataxia (loss of coordination), blindness, seizures, nystagmus (involuntary eye movement), head tilt, clenched toes, drooping wings, closed eyelids, tremors, and instability or the inability to stand. Additional gastrointestinal symptoms can include crop stasis, vomiting or regurgitation, green excreta, or green staining on feathers, legs or feet (in combination with other symptoms). To the extent possible, condors that are trapped and handled will be evaluated for these conditions and indicators of lead poisoning (as well as any other signs of obvious disease, injury, or illness). In addition, any condors showing signs of these symptoms in the wild will be closely observed and targeted for trapping so they can be examined in-hand and treated if necessary.

Treatment

Condors that do not show any symptoms of lead poisoning are released back into the wild while condors exhibiting any of the aforementioned symptoms are transported to the Los Angeles Zoo for veterinary diagnosis and treatment. Treatment involves performing a field lead blood test and other diagnostic blood tests, radiographing the condor to identify possible metallic objects in the digestive system, and administering chelation treatment to remove lead from the bloodstream (Photo 2.2.1). Chelation treatment consists of daily intramuscular injections of Calcium EDTA given in conjunction with subcutaneous fluids. Lead poisoning can result in crop stasis, or the inability to transfer food past the crop, which can result in starvation leading to severe muscle and mass loss. Treatment time varies between weeks to months depending on the level of lead exposure. Zoo veterinary staff and technicians are able to identify metallic objects in radiographic images but are not able to determine the type or composition of these objects unless recovered. Los Angeles Zoo staff closely monitors condors with metallic-positive radiographs. When possible, they recover castings and fecal material, and remove metallic objects for analysis. If the objects are determined large enough and the condor's condition is stable surgery may be performed to remove metallic objects as well. A condor's treatment ends when its lab blood lead level is less than 35 µg/dL, and it is no longer showing clinical signs of lead poisoning.

Condors that have endured a prolonged bout with lead poisoning will be held in captivity in order to physically recover from the weight loss and poor body condition that is often associated with lead poisoning. This period of physical rehabilitation often takes several months and up to a year.

Photo 2.2.1: Los Angeles Zoo Condor Keepers prepare to chelate a lead poisoned condor. *Photo credit: Los Angeles Zoo.*

Wild Nests

Lead poisoning may occur in chicks if a parent condor feeds the chick contaminated food. The field team also tests the blood lead levels of wild chicks during routine nest entries. Chicks also receive physical exams for signs of health issues. If warranted, treatment can also occur by evacuating the chick from the nest and transport to the Zoo, or through additional nest entries. However, a variety of factors, such as the age of the chick and nest location determine the ability to treat wild condor chicks (see: 2.4 Nest Management section).

2.3 Detecting Mortalities

Identifying the causes of California condor mortalities is an important aspect of California condor recovery. Despite decades of research, the reasons for the species' decline in historic populations are poorly documented or largely inconclusive (Service 2013). Understanding the factors contributing to mortalities in the reintroduced wild populations is essential to the conservation of the species (Rideout et al. 2012). It is important to quickly identify and locate dead condors in order to determine the cause of death and to detect any immediate threats that may affect other condors. Detection of mortalities by radio telemetry and GPS monitoring is one of the highest priority operations conducted by the field team.

The field team usually detects condor mortalities using VHF transmitters attached to each condor. All deployed VHF transmitters have normal frequency pulse (i.e., pulse) and an automatic mortality signal function. After a 12-hour period of inactivity, the VHF transmitter mortality function will activate and the transmitter will emit a pulse that is about twice as fast as the normal rate; this is called a mortality signal. When a mortality signal is detected by a field team member using a telemetry receiver, it can indicate the VHF transmitter has fallen off the condor via a molted feather, the condor has not moved for some time (mortality signals can occur in the morning before the condor has moved from its roost), or the condor is gravely ill or dead.

GPS transmitter data can also alert the field team to potential condor mortalities. When reviewing condor GPS transmitter locations, stationary GPS transmitter locations for a single condor over an unusually long period may indicate a mortality.

Condors are monitored by the field team throughout the day using radio telemetry at both Hopper Mountain and Bitter Creek NWRs, as well as throughout the population's range. If a condor goes undetected for more than one week, the field team will expand their search for the missing condor by mobile tracking. Mobile tracking involves driving to various locations throughout the Southern California condor range to search for the signal of the missing condor (Photo 2.3.1). Additionally, the Santa Barbara Zoo has also developed the ability to conduct radio telemetry flights with LightHawk (lighthawk.org) in order to search for condors that are not detected by traditional mobile tracking on the ground. These flights are conducted independent of the Service and do not involve Service personnel.

Photo 2.3.1: Volunteer from Los Angeles Conservation Core Sea Lab tracks condors using radio telemetry. *Photo Credit: Molly Astell, USFWS*.

Condor chick mortalities are detected during routine nest monitoring (see: Nest Management section). Monitoring nests regularly allows the field team to identify chick mortalities immediately or shortly after they occur.

All condor carcasses recovered from the wild population are transferred to the National Fish and Wildlife Forensics Laboratory in Ashland, Oregon, for postmortem examination in order to determine cause of death. Condors that have not been detected either visually or remotely (VHF or GPS transmitter) for greater than a year are also considered dead and missing in the wild.

2.4 Nest Management

Nesting in the Southern California condor population began in 2001. Between 2001 and 2006, only two condor chicks fledged from 16 nests. During this time period the field team identified the leading cause of nest failure due to chick mortality as the consumption of small, human-made materials, also called microtrash, brought to nests by parent condors. Documented microtrash items include nuts, bolts, washers, copper wire, plastic, bottle caps, glass, and spent ammunition cartridges (Mee et al. 2007; Photo 2.4.1). When a chick ingests a large quantity of microtrash, it can result in digestive tract impaction, gastrointestinal perforation, internal lesions, and death (Grantham 2007; Snyder 2007; Rideout et al. 2012).

Photo 2.4.1: Microtrash removed from the digestive tract of a wild California condor chick in 2008. *Photo Credit: USFWS*.

In 2007, the Service partnered with the Santa Barbara Zoo to create an intensive nest management strategy referred to as the California Condor Nest Guarding Program. The program is modeled after a nest guarding program for the endangered Puerto Rican Parrot (*Amazona vittata;* Lindsey 1992). It combines monitoring nests with direct intervention to detect threats and prevent nest failure. The goals of the California Condor Nest Guarding Program are to identify the leading causes of nest failure and to increase the number of wild fledged condor chicks in Southern California.

Nest Searching

The field team locates nests using visual observations, radio telemetry, and ground-truthing GPS locations of breeding age condors (Mee et al. 2007; Snyder et al. 1986). The field team first identifies pairs by monitoring courtship behaviors using visual observations or as indicated by radio telemetry data and GPS transmitter data (e.g., pair flights, nest site investigations, courtship displays, copulations; Photo 2.4.2). Existing pairs will often re-nest in previously used cavities or in cavities located close to previously used nest cavities. A nest is identified following visual confirmation of an egg. In the case of difficult-to-view cavities, nests are indicated by parent attendance behavior (switch outs in egg incubation duties, chick feeding or nestling attendance).

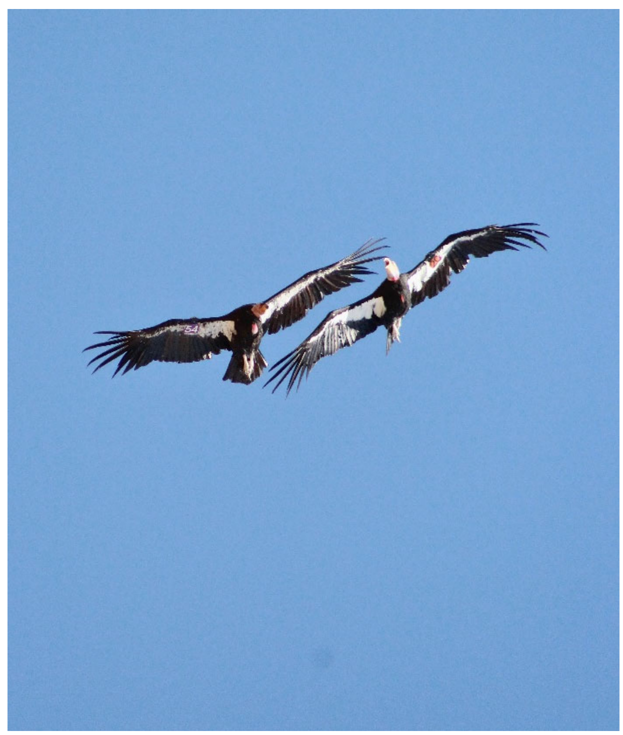

Photo 2.4.2: California condors #20 and #654 in a pair flight. *Photo Credit: Jimmy Rogers, Great Basin Institute.*

The field team observes nests to determine that they are still active and to monitor for any problems. Nest observers travel to a designated nest observation point and watch for activity from that location. Typically, each nest is observed from the nest observation point two to three times per week for two to four hours at a time. Remote nests are observed less frequently or not at all. Nest cavities that are not fully visible are monitored for attendance using radio telemetry or GPS transmitter locations until the chick reaches an age where it can be observed spending time outside the obscured area of the cavity.

The field team also monitors some nests with nest cameras (Photo 2.4.3). The make and model camera used in 2017 was the Axis P3346-VE Network Camera. Nest cameras are typically installed in nests during the first nest entry conducted during the egg stage of the nest. Not all nests are suitable for cameras. Nests need to be large enough for the camera to fit without obstructing the activity of the parent or chick and have a location to mount the camera so that the viewing angle and lighting are effective at capturing most of the parent and chicks' activity at the nest. Nest locations may also be very remote, and thus too difficult for the field team to access for camera setup and maintenance.

Nests with cameras are not typically watched from an observation point. Instead, nest camera footage is streamed over a wireless network and archived. The field team reviews nest camera video footage every three to four days. Reviewers view the footage checking for parental attendance, chick activity levels, and any signs of physical distress or abnormal behavior.

Nest cameras allow observers to review nesting activity much more efficiently than direct field observations due to the ability to speed up the video during times of inactivity and more closely review events of interest. Nest cameras are programmed to record during daylight hours and capture infrequent events that are often missed by less comprehensive direct field observations. The level of observational detail is greatly increased because of the proximity or angle of the camera to the egg, chick, and/or parents.

Photo 2.4.3: Nest camera and microphone installed at condor nest, DG17. *Photo Credit: Joseph Brandt, USFWS.*

Nest Entries

The field team also monitors condor nests with regularly scheduled nest entries. Nest entries occur to check egg fertility and to confirm the hatch of an egg when it cannot be seen from an observation point or nest camera (Photo 2.4.4). The field team will enter nests to give the chick a health exam and to assess the chick's development. This includes palpating the chick's stomach and crop for foreign bodies or blockages, taking a blood sample, weighing, and measuring tail feather length. Nests are sifted for any mircotrash during each entry. Egg shells are also collected while sifting the nest. The chick is also vaccinated against West Nile virus while being examined. Nests are entered twice during the chick stage to examine the condor chick. These entries occur at 60 days and 120 days of age. During the 120-day nest entry, the chick is fitted with a patagial tag and VHF transmitter. Biologists do not enter the nest after 120 days in order to avoid possible premature fledging.

Nests with nest cameras are also entered during the egg stage for the camera installation and when the chick is tagged at 120 days of age. Nest cameras allow the chick's development and health to be monitored remotely so chick exams prior to tagging are not necessary unless the chick's health is in question.

Some condor nests are very remote, too difficult, or unsafe to access for routine nest entries. These nests are monitored through visual observation or VHF and GPS tracking of the nesting adults. If a chick fledges from a remote nest, the patagial tag and VHF transmitter will be attached once the chick is trapped during the biannual trapping effort, at which time the bird will receive a West Nile virus vaccination.

Photo 2.4.4: USFWS Biologist, Joseph Brandt, handles condor #895 at nest OD17. The 4-day-old chick was kept warm in an incubator while installing a nest camera. *Photo Credit: Steve Kirkland, USFWS*.

In order to enter condor nests safely, field team members are trained in using ropes to descend and ascend the steep cliff faces where nests are located. They also must learn techniques of handling condor eggs and chicks of various ages.to ensure the safety of the condor eggs and chicks. The Service conducts ropes training at a local rock climbing area annually at the start of the nesting season, and Los Angeles Zoo captive breeding personnel provide the egg and chick handling training for the field team.

Nest Interventions

The field team conducts nest interventions when problems arise at the nest to ensure success of the nest. During the egg stage, nonviable eggs (e.g., infertile, addled) are removed so there is a chance that the breeding condor pair will lay a second egg within the same breeding season; known as double clutching. In previous years (2007-2016) nonviable eggs would be replaced with viable eggs produced in captivity. This practice changed in 2017 because population models indicate that captive laid eggs that hatch and go on to be captive releases to the wild have a higher rate of survival than captive produced eggs placed in wild nests and thus are more beneficial in increasing the population size (Bakker et al 2017).

Additional interventions will occur as needed to mitigate threats detected through observations or nest camera video monitoring, such as chick injuries, poor development, or abnormal behaviors. If a significant amount of microtrash (n > 40 items) is collected during the 60-day entry, the nest is entered again at 90 days to perform a chick health check and re-sift the nest for microtrash.

When possible, the field team will use nest cameras after some interventions to closely monitor the results, continue to evaluate the chick's condition, or track parental attendance. In these instances, video footage is shared with Zoo veterinarians and behavioral experts to assess a chick's status and prognosis of recovery while it remains in the nest post treatment. The presence of cameras has allowed for interventions that would otherwise not be attempted without the ability to closely monitor the chick via the camera.

Fledgling Observations

When chicks fledge, they are monitored much like newly released captive-bred condors (see: Captive Releases and Transfers section). Through observation and telemetry tracking of the young condor, we aim to understand if fledglings are integrating into the population, displaying normal behavior, and continuing to receive parental care.

Nest Failure

In the event of a nest failure, biologists enter the nest to recover the remains of the egg or chick. Recovered eggs are collected and frozen in a conventional freezer for use in contaminants research. To assist in determining chick mortality factors recovered chick carcasses are submitted for necropsy to the U.S. Fish and Wildlife Service Wildlife Forensics Laboratory in Ashland, Oregon.

.2.5 Captive Releases and Transfers

During the fall of each year, the field team releases captive-bred juvenile California condors into the wild at Bitter Creek NWR. The purpose of releasing captive-bred condors is to augment the wild population, offset mortalities that occur in the wild, and ensure genetic diversity in the Southern California population of condors.

The California condor is one of many endangered species managed to maximize the genetic diversity present in the original population, minimize genetic loss, and emphasize optimal productivity (Ralls and Ballou 2004; USFWS 1996). As outlined in the 1996 Condor Recovery Plan, it is necessary to increase productivity beyond the California condor's intrinsic rate of reproduction through a captive breeding program (USFWS 1996). Captive-bred California condors selected for release in the wild must be physically and behaviorally healthy, have been successfully socialized with other release candidates, have been kept in isolation from humans to prevent habituation, and have undergone aversion training to condition avoidance to landing on power poles (Bukowinski et al. 2007, Clark et al. 2007, USFWS 1996).

Husbandry

Prior to release, captive-bred condors spend time in a flight pen (or captive enclosure) at Bitter Creek NWR (Photo 2.5.1). These pre-release condors spend at least six weeks in the flight pen to allow the birds to acclimate to their new surroundings and interact with wild condors perching or feeding nearby. During this time, the field team monitors pre-release condors two to four days per week during four-hour observation periods and record social behavior and physical health. On the day prior to release, the field team attaches VHF and or GPS transmitters on each condor, and the condors are moved into a secondary enclosure within the flight pen.

Photo 2.5.1: Wild California condors perched on the flight pen at Bitter Creek NWR, Kern County, California. *Photo Credit: Kirk Gilligan, USFWS.*

Releases

The field team typically releases captive-bred condors during the fall months (September through November) because the weather is cooler, and there are fewer thermal updrafts. These weather conditions are conducive to keeping newly released condors close to the release site where supplemental food and water sources are available.

Condors are usually released in trios or pairs to encourage socialization. The field team monitors the newly released condors for a minimum of 30 days, paying careful attention to social interactions, feeding, and roost selection. Additional releases take place only after the previously introduced condors roost appropriately off the ground and become familiar with the location of provided water and supplemental feeding sites.

Carrion is provided near the release pen in order to lure other free-flying condors in to feed and interact with the newly released condors. Supplemental feeding of newly released birds is an integral component of the condor release program

(USFWS 1996). Supplemental food and water act as a substitute for the parental care that the released condors would have otherwise received had they fledged from a wild nest.

The field team will trap a newly released condor and return it to captivity (temporarily or permanently) if it exhibits undesirable behavior in the wild. These detrimental behaviors includes approaching humans, not socializing with other condors, roosting on the ground, and/or the inability to locate supplemental food.

2.6 Outreach

The field team performs outreach to create awareness and to educate the public about issues pertaining to California condor conservation in Southern California. Performing outreach for condors also helps further the Service's goals of connecting people with nature and broadening awareness of endangered species conservation and the National Wildlife Refuge System (Photo 2.6.1). Targeted outreach can also be used as a tool to help educate specific communities that are essential in addressing threats that condors face. Non-lead Outreach and Preventing Habituation are examples of this type of targeted outreach

Photo 2.6.1: CondorKids, 3rd grade students from the Fillmore Unified School District, watch a condor feeding during a field trip to the Santa Barbara Zoo, Santa Barbara, California. *Photo Credit: Robyn Gerstenslager, USFWS.*

Condor Cave

The "Condor Cave" is a Facebook webpage (https://www.facebook.com/TheCondorCave/) that is being managed in partnership with the Santa Barbara Zoo. The webpage has been active since 2012 and highlights the condor conservation efforts taking place in Southern California. Additionally, the webpage showcases condor courtship and nesting behaviors using video footage from the condor nest cameras.

Online Condor Nest Camera

The Cornell Lab of Ornithology's All About Birds website (http://cams.allaboutbirds.org/) hosts live streaming nest cameras for many different species. The field team has partnered with Cornell Lab of Ornithology along with the Santa Barbara Zoo and the Western Foundation of Vertebrate Zoology to host a livestreaming condor nest camera online. This cooperative public outreach tool has been in use annually since 2015.

CondorKids

Starting in 2014 the Complex also partnered with the Santa Barbara Zoo to create a new education program within the Urban Refuge Program called CondorKids. This youth outreach effort is an education program that uses the California condor to introduce students to conservation and connect them with nature. Funded by the Urban Refuge Initiative and National Fish and Wildlife Foundation, CondorKids provides an award-winning third grade curriculum for students that meets Common Core and Next Generation Science Standards. The curriculum teaches skills in science, technology, engineering, and math (also known as STEM) through diverse lesson plans that cover topics such as geography, biology, history, and conservation. All curriculum and lesson plans are available online to any interested individual or teacher (condorkids.net). Locally, CondorKids targets urban youth in Ventura County. For these local groups it also provides students the opportunity to experience condor recovery firsthand by offering field trips to the Hopper Mountain or Bitter Creek NWRs, or the Santa Barbara Zoo.

Non-lead Outreach

The Institute for Wildlife Studies Southern California Non-lead Outreach Coordinator is stationed at the Complex office in Ventura. This position conducts much of the non-lead education and outreach in the range of the Southern California condor population. The major non-lead outreach activities include attending and setting up educational booths at sportsman shows (Photo 2.6.2), conducting shooting events at local shooting ranges, making contacts with local ranchers and providing them with free non-lead ammunition, and providing presentations for other interested outdoor organizations and groups. The Institute for Wildlife Studies also hosts huntingwithnonlead.org, a webpage of hunters and shooters to help inform about making the switch to non-lead ammunition.

Preventing Habituation

The field team conducts outreach to the general public, land management agencies and organizations, and private landowners when condors come into close proximity to human activity or human structures. The goal of this outreach is to reduce the potential for condor-human conflicts, which can arise when condors perch on structures (e.g., homes, radio towers, roads) or are in regular close proximity to humans. Condors are behaviorally flexible making them susceptible to becoming habituated to human activity and structures. This can affect their ability to survive in the wild (Cade et al. 2004). Condors can also cause property damage and jeopardize human safety in the event that a habituated condor comes in contact with people. A common example of this type of outreach is providing information to local residents within condor range where the potential for condor habituation with humans and structures is likely. In these cases, the field team provides information about how best to discourage condor habituation (Appendix II). This includes safe techniques for flushing condors off residences, information about installing anti-perching devices, and removing items that may attract condors to their homes.

Other Outreach Activities

The field team performs a number of additional types of outreach activities with the intention of creating awareness and educating the public about condor conservation issues. The Service authorizes refuge tours, co-hosts events with program partners such as the Friends of the California Condor Wild and Free, and presents to other local schools and colleges. When possible, the Service accommodates media requests and contributes to several social media outlets and scientific publications.

Photo 2.6.2: Non-lead outreach table at Women in Wildlife Event in Ojai, CA. *Photo Credit: Dorothy Horn, USFWS.*

3.0 Outcomes

3.1 Monitoring Resource Use

GPS Transmitter Locations

In 2017, 70 of 85 condors in the Southern California condor population wore GPS transmitters for at least part of the year. GPS transmitter data produced 2,148,975 locations. Eight condors wearing MTI transmitters produced 939,818 locations and 68 condors wearing CTT transmitters produced 1,209,157 locations.

Population Distribution

Condor activity across the landscape, based on location data derived from GPS locations of the Southern California population of condors, spanned approximately 17,558 square miles (the area of a single buffered polygon derived from a kernel density estimate of all GPS locations; Figure 3.1.1). Condors from the Southern California population ranged south from the San Gabriel Mountains near the San Gabriel Reservoir in Los Angeles County, east to the southern Sierra Nevada Range in Kern and Tulare Counties, and to the north near the Pine Flat Reservoir in Fresno County. The birds ranged through eastern Santa Barbara County, north into the Los Padres National Forest's Ventana Wilderness in the Santa Lucia Mountains of Monterey County, which was the western extant of the population's range in 2017. The Tehachapi Mountains of Kern County was the area with the largest concentration of condor activity, followed by the southern portion of the Sespe Wilderness, managed by the Los Padres National Forest, in Ventura County near Hopper Mountain NWR (Figure 3.1.2). Though less than the Tehachapi Mountains or the southern Sespe Wilderness, condors also concentrated activity near Bitter Creek NWR. There was also a new concentration of activity in the foothills of the Southern Sierra Nevada Mountains north of Glenville, in Tulare County.

Activity Near Wind Turbines

Fifty-two of the 70 condors wearing GPS transmitters were detected within two miles of industrial energy producing wind turbines in the eastern Tehachapi Mountains in 2017 (Table 3.1.1; Figure 3.1.5). Condor activity within two miles of turbines occurred every month of the year except February. All but one individual of the 52 condors had at least one GPS location detected within two miles of a turbine with flight speeds less than 10 km per hour, indicating that these condors were perched on or close to the ground at the time the locations were detected. The first six months of the year had far fewer days of condor activity (12 days; n = 6 condors) than the second half of the year (147 days: n=52 condors). The most active months of condor use of the area in 2017 occurred in September and October, and the highest number of condors detected in a single day was 29 condors on October 7, 2017 (Figure 3.1.6). The number of condors detected by GPS in close proximity to operational wind energy facilities increased from 27 condors in 2016 to 52 condors in 2017, but was very similar when comparing the proportion of condors wearing GPS transmitters (73% in 2016 and 74% in 2017).

Nest Distribution

Condor nesting activity in 2017 occurred on public and private land. Four nests were located on the Los Padres National Forest, three of which were in the Sespe Condor Sanctuary and Wilderness. The fourth was located in the San Rafael Wilderness in Santa Barbara County. This was the first nesting attempt in Santa Barbara County since 2001. One nest was located on private property south of the Sespe Condor Sanctuary east of Hopper Mountain NWR and south of the National Forest. Two nests were located in Kern County. One was located on Bureau of Land Management's (BLM) lands adjacent to Bitter Creek NWR. The second nest in Kern County was located on private land in the Tehachapi Mountains (Figure 3.1.3). The nests located in the Tehachapi Mountains and Santa Barbara County greatly expand the range of nest locations for the Southern California population of condors.

Non-proffered Feeding

The field team confirmed four non-proffered (i.e., not provided by the field team) feeding events in 2017 (Table 3.1.2). One of these carcasses was a cow, one was a deer, and the other two were unknown but suspected to be deer. The two unknown carcasses were located on private land that could not be accessed. The reported feeding events were only discovered incidentally while tracking the Southern California population of condors. It is likely that this represents only a small portion of the number of non-proffered feeding events that occurred in 2017. Many clusters of GPS locations (that often indicates feeding events) were not ground-truthed due to accessibility (private land) or a limited staff, thus it is likely that many, if not most of the non-proffered feedings, went undocumented.

Photo 3.1.1: Condor #518 feeds on the leg of deer carcass in the Tehachapi Mountains, Kern County, California. *Photo Credit: Dave Rivas.*

Table 3.1.1: 2017 condor activity within 2 miles of industrial wind turbines. Stationary locations are defined as any location data point with a flight speed less than 10 km/hr.

SB#	Stationary locations? (y/n)	Number of individual days active within 2 miles of a wind turbine
20	y	4
98	y	6
107	y	19
156	y	26
161	y	44
247	y	9
262	y	2
289	y	42
369	n	2
374	y	42
457	y	23
462	n	1
480	y	23
483	y	23
487	y	43
493	y	28
507	y	24
509	y	45
513	y	30
518	y	45
526	y	25
542	y	3
568	y	20
570	y	20
576	y	32
585	y	21
590	y	41
596	y	1
599	y	2
625	y	25
627	y	28
636	y	16
648	y	10
654	y	25
666	y	36
694	y	1
732	y	29
733	y	24
740	y	31
748	y	32
749	y	14
755	y	20
771	y	77
772	y	12
774	y	45
784	y	17
791	y	35
794	y	23
796	y	15
805	y	3
807	y	25
846	y	26
Total	51(y)	159 (days with at least one condor <2 miles from wind turbines)

Table 3.1.2: Confirmed non-proffered feeding events in current (2017), years prior (2008-2016), and all years (2008-2017) by type of carrion. Non-proffered carrion is any food item that is not provided for condors by the condor field team.

Carrion Type	Current 2017		Years Prior 2008-2016		All Years 2008-2017	
Cow	1	25%	58	33%	59	33%
Ground Squirrel	0	-	2	2%	3	2%
Elk	0	-	4	1%	4	2%
Pig	0	-	58	33%	58	33%
Deer	1	25%	24	13%	25	14%
Horse	0	-	8	5%	8	4%
Sheep	0	-	7	4%	7	4%
Unknown	2	50%	5	3%	7	4%
Coyote	0	-	2	1%	2	1%
Bison	0	-	2	1%	2	1%
Goat	0	-	1	1%	1	1%
Donkey	0	-	1	1%	1	1%
Rabbit	0	-	1	0%	1	1%
House Cat	0	-	1	0%	1	1%
Total	4		175		179	

Figure 3.1.1: Southern California condor activity in 2017 estimated using a fixed kernel density estimate (KDE) for all California condors wearing GPS transmitters. KDE averaged across individuals (n=70) using a neighborhood of one kilometer (cell size = 100 meters) and stretched using two and a half standard deviations. KDE provided by Melissa Braham, Survey Technician (Division of Forestry and Natural Resources, West Virginia University).

2017 Condor Activity Near Industrial Wind Turbines

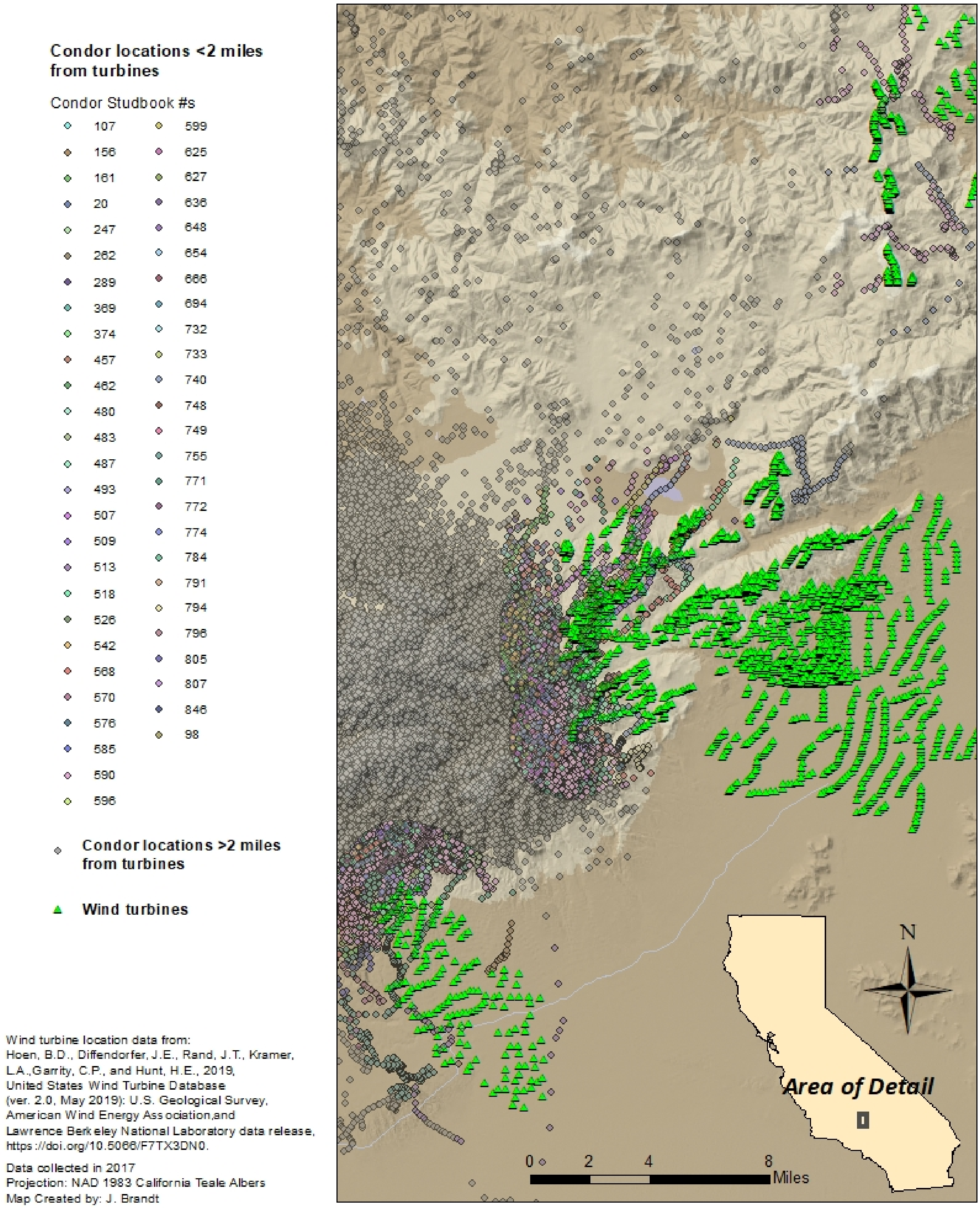

Figure 3.1.2: 2017 California condor locations near industrial wind turbines. 52 of the 70 condors wearing GPS transmitters (74%) flew within two miles of an operational turbine in the Tehachapi Wind Resource Area in Kern County, California.

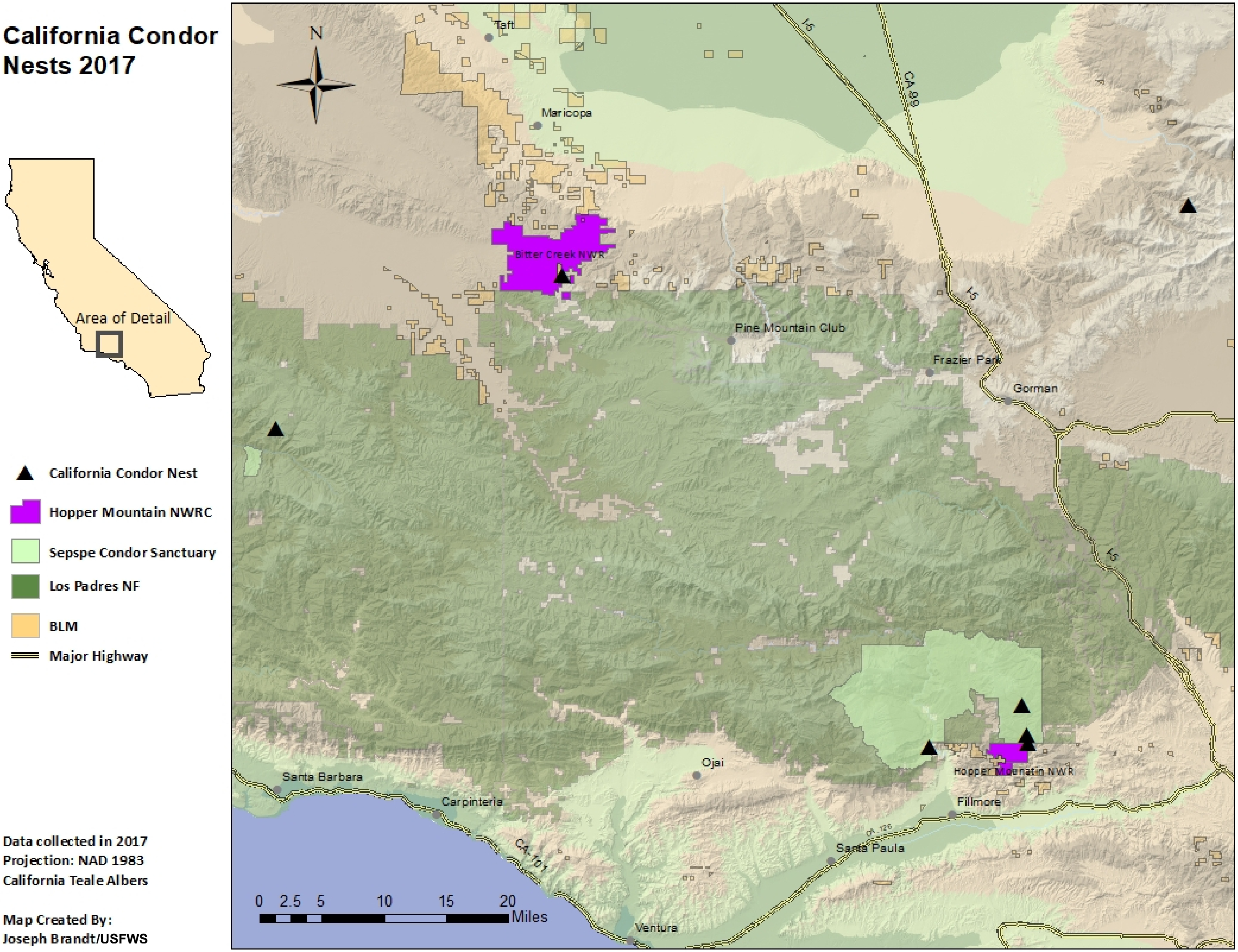

Figure 3.1.3: Locations of California condor nests in Southern California during 2017 (n = 7 nests).

3.2 Lead Monitoring and Mitigation

Trapping Effort

With the exception of trapping two condors in February and March to attach GPS transmitters, the field team began trapping condors to monitor for blood and feather lead levels in June of 2017. This first trapping session finished at the end of July and the last condors were handled on August 2. The November/December session was slightly delayed due to the death of captive condor #783 (see section 3.5 for more detail). The first condors trapped during that period were handled on November 14, and the final birds to be handled during this period occurred early in 2018 on January 3. The Thomas Fire, which started on December 4, also prevented any trapping from occurring at Hopper Mountain NWR during the November/December trapping session.

The field team and volunteers spent approximately 600 hours attempting to trap condors in 2017. During each trapping period, team members and volunteers spent approximately four to five days per week in trap blinds (Photo 3.2.1).

Trapping Success

During the two 2017 trapping periods, 67 of the 77 (87%) targeted condors were trapped (Table 3.2.1). There were 77 trappable condors which differs from the end of the year population size of 81. The number of trappable condors differs from the end of year population number because it does not include newly released captive-bred condors in the fall 2017, newly wild-fledged condors, or condors that died prior to the start of a trapping period.

Condors (excluding chicks) were handled for blood and feather sampling on 24 separate days in 2017 with 1 to 19 condors handled on each occasion. Thirteen of these handling days occurred during June through July and seven occurred during November through December. The four remaining days occurred in February, March, August, and January, 2018. Each condor requires about 30-45 minutes of handling time. Depending on the number of condors needing to be handled, between two to 10 biologists assisted at each handling event.

Photo 3.2.1: Eleven condors feeding inside the walk-in trap at the Bitter Creek NWR flight pen as seen from inside a trapping blind. *Photo Credit: Jimmy Rogers, Great Basin Institute.*

Blood Lead Test Results

Sixty seven condors in the Southern California population were tested a total of 129 times in 2017 (excluding wild chicks). Thirty-one condors were tested once in 2017. Twenty-one condors were tested twice. Thirteen condors were tested 3 times. Four condors were tested 4 times, and 1 condor was tested 5 times. In 2017 the largest proportion of the blood lead test results fell within the 31 to 100 µg/dL range (Figure 3.2.1). This differed from previous years and the 5 year average where the largest portion of results are in the 11-31 µg/dL range. A greater number of results also fell within ranges >100 µg/dL than in previous years. When using the highest lab blood lead level for each condor tested, 61 of the 66 condors (91%) had lab blood lead levels above 10 µg/dL.

The field team tested the blood lead level of two wild condor chicks during the 2017 nesting season. Condor chick #871 had a blood lead level of 44 µg/dL when tested at 120 days of age. Condor chick #895's blood did not have a detectable amount of lead.

Treatment

The field team transported four condors to the Los Angeles Zoo for veterinary care and treatment because they exhibited symptoms for lead poisoning. This was a drastic reduction in the number of birds treated for lead exposure compared to years past due in large part from the new protocols being used in 2017 (see section 2.2). Were the previous protocol for treatment threshold of 35 µg/dL (as determined by a field blood lead level test) used, the total number of condors treated in 2017 would have been much higher. Using the 2017 lab blood lead level results to estimate the previously used protocols field lead level of 35 µg/dL (field lead levels were not performed in 2017), 35 condors would have been treated for lead exposure 43 times.

On July 11, Condor #584 was transported to the Los Angeles Zoo because of observed symptoms for lead poisoning. While being handled, #584 was observed to be weak and lethargic. This condor held its neck in an unusual position that made the handler suspect a possible neck injury or neurological problem. At the zoo blood was sampled and lab tested and results determined that #584 had a blood lead level of 680 µg/dL. While in treatment for acute lead poisoning #584's symptoms progressed, and the condor died on August 3, 2017.

Two condors were released after being initially trapped and sampled but were re-trapped when observed to show signs of illness. Condor #694 was recaptured on July 20 in the Tehachapi Mountains. The field team located, hand- net-captured, and kenneled #694 after GPS location data showed the bird was stationary for several days. The bird was transferred to the zoo for treatment and sampling. Laboratory blood lead test results revealed a lead level of 420 µg/dL and veterinarian staff started a treatment of chelation. This blood level was lower than the 740 µg/dL result from the initial capture on June 27 when #694 was not showing any obvious symptoms of lead poisoning. Condor #694 died while in treatment on August 1, 2017. Condor #717 was recaptured on July 23. A local farmer in the Tehachapi Mountains discovered #717 grounded, lethargic, and sick. The farmer captured the condor, held it in a barn enclosure, and immediately reported the sick condor to the Service. The field team responded and transported the condor to Los Angeles Zoo. At the start of treatment, #717's blood lead level was 240 µg/dL. This was lower than the 530 µg/dL blood lead level it had when it was first captured on June 21. When #717 was first handled and released it did not exhibit any signs of lead toxicity. Condor #717 died while in treatment on August 7, 2017.

An additional condor, #526, was trapped in early June and transported to the Los Angeles Zoo for reasons unrelated to lead exposure (tail injury), but was then tested and treated by the zoo's health center because blood lead level test results indicated an elevated level of 95 µg/dL. Condor #526 did not present any symptoms for lead exposure and would not have been treated had it not been at the zoo for other reasons. This condor was released back into the wild 27 days after capture and treatment.

Another condor was transported to the zoo for suspected lead exposure but had not been recently exposed to lead. Condor #79 was observed acting less dominant while feeding with other condors and had green urate stains on her tail feathers and legs. While being handled, #79 felt underweight and had a poor body condition (i.e., thin breast musculature). The condor was trapped on June 26 and transported to the Los Angeles Zoo for treatment. While at the zoo her blood lead lab results were relatively low (38 µg/dL) and did not indicate a need for treatment. Instead it was determined that she was suffering from an advanced cataract and was likely blind in her right eye which likely limited her physical ability to maintain body weight and condition. After consulting with an ophthalmologist, surgery was performed on November 2 to remove the cataract and restore her vision as best as possible. The surgery was successful in restoration of her sight in the problematic eye. She remained captive for the rest of 2017 but there is hope to re-release her into the wild in the fall of 2018 after assessing her behavior, feeding, and interacting with other condors in a flight pen. It was also noted that her left eye has fibrosis in the cornea with a small area of brown discoloration in the iris from which may have been caused by a previous trauma (e.g., grass seed, intra-interspecific conflict), but this eye did not require treatment.

Table 3.2.1: Comparison of California condors trapped at Bitter Creek and Hopper Mountain National Wildlife Refuges between sessions and in total for 2017. The number of condors targeted for trapping was the number of wild condors that needed to be trapped during each session. This number differs from the total population because condors that are newly released or fledged are typically not re-trapped until the following year.

Trap Session (2017)	Number of Individual Condors Targeted	Number of Individual Condors Trapped	Percentage of Targeted Condors Trapped
Jan - Jul	74	60	81%
Aug - Dec	72	39	54%
Total	77	67	87%

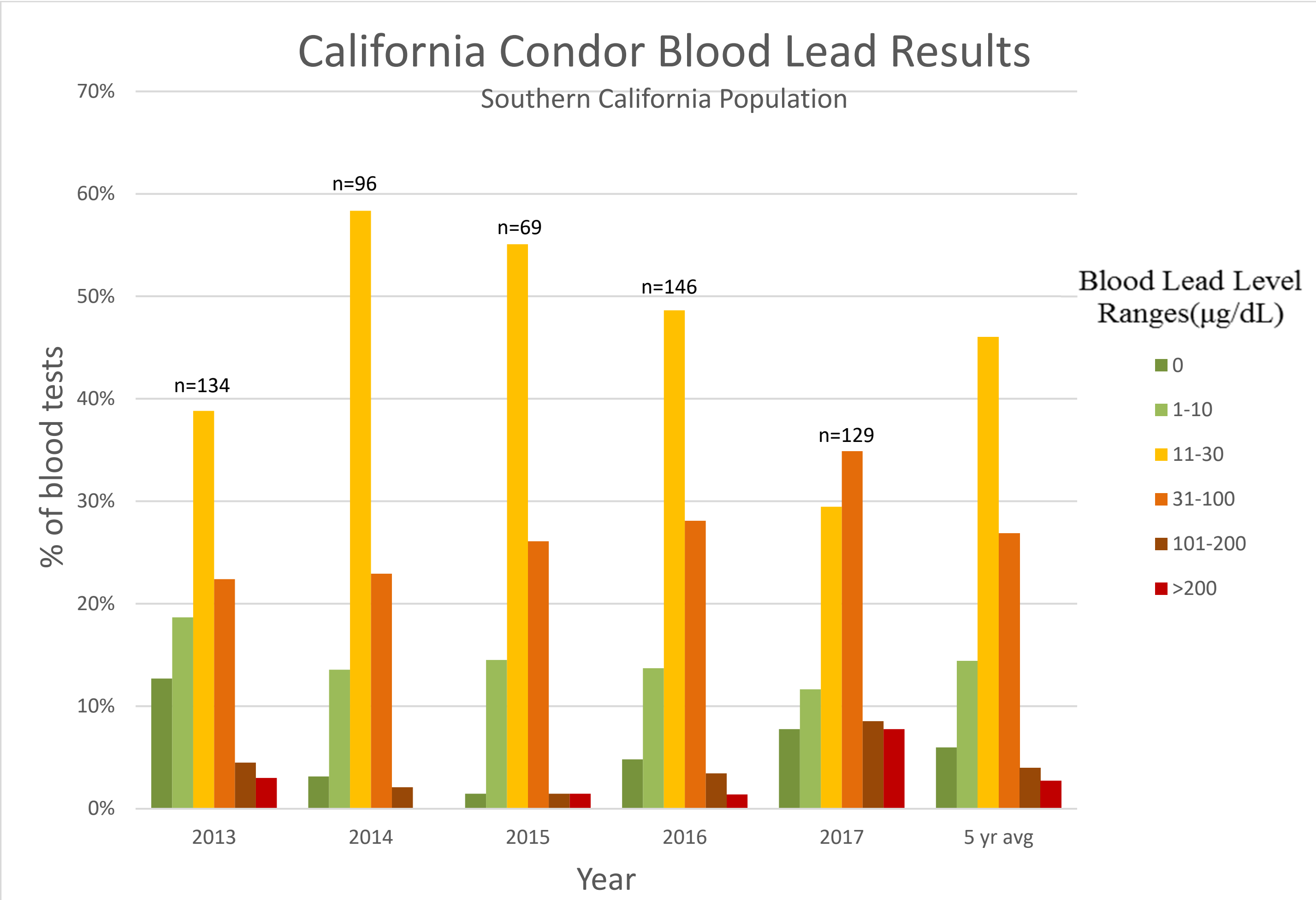

Figure 3.2.1: Summary of the Southern California population of condor blood lead levels by year from 2013-2017 and the 5 year average (2013-2017). All of the lead values represent lab blood lead values. Values returned as "not detected" are indicated by zero. Number of tests performed on the Southern California population of condors each year represented as "n" for each year.

3.3 Detecting Mortalities

Six free-flying condors died in Southern California during 2017 (Table 3.3.1). In addition to these deaths, four condors went undetected in the wild for greater than a year and are presumed dead with approximate death dates in 2016 (dates of last detection). In 2017, three condors died of lead poisoning, two condors went missing in the wild, and one condor's cause of death is still pending necropsy results.

Death of Condor #107

Adult male condor #107 was found dead on February 21, 2018. He was located on Tejon Ranch in the Tehachapi Mountains. Based on GPS transmitter data, #107 arrived at the location of death on November 27, 2017, and it appears the condor died shortly thereafter. Due to the length of time (about 2 months) between #107's likely death and the recovery, his remains were scavenged. The carcass amounted to some primary feathers, bones, and the GPS transmitter (Photo 3.3.1). Prior to death, on November 14, #107 was trapped, handled, and released from the Bitter Creek NWR. During the handling, #107's body was in good condition, appeared generally healthy, and had a lab blood lead level of 77 µg/dL. After being handled and released, #107 traveled between Bitter Creek and Hopper Mountain NWRs, and the Tehachapi Mountains before dying. The cause of #107's death is still pending.

Photo 3.3.1: Remains of condor #107, Kern County, California. *Photo Credit: Molly Astell, USFWS.*

Photo 3.3.2: Condor #717 located and trapped while still alive but showing acute signs of lead toxicosis. *Photo Credit: Josh Felch, USFWS.*

Death of Condors #584, #694, and #717

Condors #584, #694, and #717 all died from lead poisoning. Prior to their death each of these condors were trapped (separately) and transported to the Los Angeles Zoo because they exhibited symptoms of lead poisoning. These condors all died while in treatment at the Los Angeles Zoo for lead poisoning. The capture circumstances of each of these condors are described under *Treatment* in Section 3.2 Lead Monitoring and Mitigation of this report.

Missing Condors

Two free-flying condors went missing in the wild in 2017 and were declared dead. Adult condor #449s last GPS location and VHF signals originated on private land in northern portions of the Tehachapi Mountains. Data from the GPS attached to #449 indicated she was stationary while her VHF transmitter emitted the signal indicating a mortality as well. Condor #449 was not located because the field team was not given permission to access the private land. Based on the location and signal from her transmitters she died on July 6, 2017. Prior to her death #449 was trapped and handled on June 27, 2017. She appeared in good health, but her blood lead level was 280 µg/dL.

Juvenile condor #797 also went missing in 2017. His last detection was via VHF in the Tehachapi Mountains on April 6, 2017. Condor #797 was not trapped in 2017 prior to going missing and was not wearing a GPS transmitter.

Four condors whose last detection was in 2016 were also declared dead in 2017. Condor #147 was last detected via radio telemetry from Bitter Creek NWR on May 24, 2016. Condor #489 was last detected via radio telemetry and condor #560's last detection was a visual observation; both occurred in the Tehachapi Mountains on April 15, 2016. The fourth condor declared dead was #736. This condor was last observed visually on June 23, 2016 in the Tehachapi Mountains and has not been detected since.

Studbook ID	Sex	Hatch Date	Mortality Date	Cause of Death	Location of Death
107	M	29-Apr-94	28-Nov-17	PENDING	CA; Tejon Ranch
147	F	26-Apr-96	25-May-16	MISSING IN THE WILD	CA
449	F	12-May-07	6-Jul-17	MISSING IN THE WILD	CA; private property - unable to access and recover carcass
489	M	13-May-08	15-Apr-16	MISSING IN THE WILD	CA
560	F	12-Apr-10	15-Apr-16	MISSING IN THE WILD	CA
584	F	21-May-10	3-Aug-17	LEAD TOXICOSIS	LA Zoo
694	M	25-Apr-13	1-Aug-17	LEAD TOXICOSIS	LA Zoo
717	F	30-May-13	7-Aug-17	LEAD TOXICOSIS	LA Zoo
736	F	19-Apr-14	23-Jun-16	MISSING IN THE WILD	CA
797	M	9-May-15	6-Apr-17	MISSING IN THE WILD	CA

Table 3.3.1: California condor mortalities within the Southern California population in 2017.

3.4 Nest Management

The first egg of the 2017 nesting season was laid on January 23, and the nesting season ended on December 15, when the last chick of the season fledged. There were seven active nests during the season (Table 3.4.1). Four of this year's breeding pairs had nested previously as pairs. Three were first-time pairs who established new territories in Santa Barbara and Kern Counties, resulting in a significant expansion of the range of recent nests in Southern California. One of the male condors within these new pairs was #20, a 37 year old condor that was trapped as a wild condor in 1985 and then re-released into the wild in 2015. Condor #20 bred successfully producing young with captive females while in captivity but had never nested in the wild. This was the first ever breeding attempt for the other five condors that paired this year.

One nest, HW17, was not known or monitored for the entire nesting season. The field team discovered this nest when an untagged first year juvenile was observed on April 4, 2018. The parents of this recently fledged condor were determined via a blood paternity test. Egg laying and hatch dates were estimated based on the parents (condors #467 and #576) GPS and VHF telemetry data.

Nesting Success

Nesting success, defined as the total number of chicks to fledge out of the total number of nests, has increased since nest guarding was implemented across all Southern California condor nests in 2007 (Figure 3.4.1). Three of the seven nests in 2017 had chicks that fledged resulting in 43% nesting success.

Table 3.4.1: California condor nesting attempts and outcomes for the 2017 Southern California breeding season. Sire and Dam Studbook Number is the studbook number of the male and female attending the nest respectively. Chick Studbook Number is the studbook number of the chick that hatched in the wild nest.

Nest Identification	Date Nest Located	Sire Studbook Number	Dam Studbook	Egg Identification	Lay Date	Date Hatch	Chick Studbook Number	Number of Nest Entries	Nest Fate
HC17	4-Feb	107	161	FW117	23-Jan	NA	NA	2	Failed, 22-Mar
OD17	4-Mar	328	216	FW217	24-Feb	21-Apr	895	3	Fledged, 10-Oct
DG17	23-Mar	206	513	FW317	13-Feb	11-Apr	871	2	Fledged, 15-Dec
LW17	11-May	247	156	FW417	7-Mar	UNK	NA	0	Failed, 5-May
ST17	NA	457	507	FW517	19-Feb	NA	NA	0	Failed, 13-Apr
LB17	9-Sep	20	654	FW617	2-Mar	UNK	NA	1	Failed, 30-Apr
HW17	NA	467	576	FW717	14-Mar	10-May	949	0	Fledged, date unk

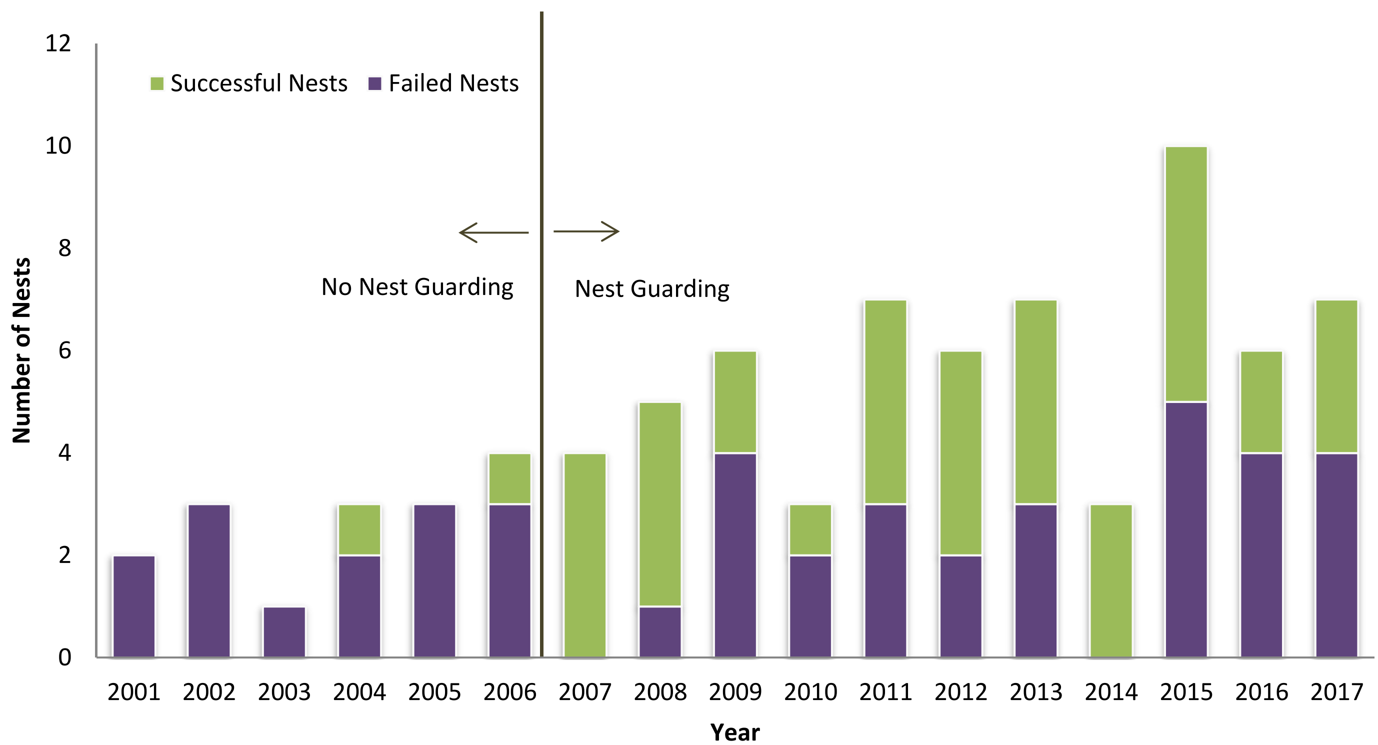

Figure 3.4.1: California condor nesting success in Southern California before and after implementation of the Nest Guarding Program (2001-2017). Nests are defined by pairs or trios of condors that produce at least one egg. Nesting success is any nest where a chick fledges from the nest.

Nest Observations

In 2017, condor nests were observed over the course of the season using direct observation using spotting scopes or binoculars and nest cameras. Nest cameras were used for monitoring two of the nests: DG17 and OD17. DG17 was streamed live online to a worldwide public audience through a partnership with Cornell Lab of Ornithology, while OD17 was accessible only to the field team on a local network at Bitter Creek NWR. The camera for DG17 was installed in 2015 during a previous nesting attempt. The OD17 camera was installed shortly after the egg hatched when the chick was five days old. The chick was placed in a portable incubator to keep it warm during the camera installation.

Chicks and fledglings were directly observed for a total of 433 observation hours taking place over 127 observer days. Unpaid volunteer observer hours accounted for 48% of all observation hours (Table 3.4.2). For nests with cameras, observers checked nest activity daily and reviewed video footage in detail every two to three days each week. The field team spent 208 hours reviewing 4,788 hours of video footage.

Table 3.4.2: California condor nest observation hours by personnel type.

Personnel Type	Observation Hours
Service Staff	3
Santa Barbara Zoo Staff	109
GBI Research Associates	113
Unpaid Volunteers	208
Total Observation Hours	433

Nest Entries

The field team performed nine nest entries (Photo 3.4.1) over the course of the year. Each entry required two to four personnel for eight to twelve hours to drive, hike, perform the check, and return to the office. Santa Barbara Zoo staff provided assistance on eight of these entries. In lieu of more frequent nest entries, nest cameras were a useful tool for monitoring and ensuring proper chick development.

Photo 3.4.1: U.S. Fish and Wildlife Service Wildlife Biologist, Joseph Brandt (circled in red), at the entrance of condor nest HC17. *Photo Credit: Luisa Bergeron, Great Basin Institute.*

Nest Fates

Condor nest HC17 was entered once during the egg stage and through candling of the egg it was determined to have a fertile egg. The nest appeared to be active beyond the expected hatch date and up until chick day 60. However, when the nest was entered to perform a chick nest entry, the nest was found to be empty. Reviewing photos from a Bushnell 8MP Trophy Cam game camera installed in this nest cavity two years prior, the field team was able to determine that the egg failed to hatch due to unknown causes, but the pair continued to incubate the addled egg for 102 days until it went missing; that is 45 days longer than the typical incubation period of 57 days for California condors.

Condor nest DG17 was entered on two occasions. The first entry was to check the fertility of the egg and to make adjustments to the nest camera. It was entered again to tag the chick, #871, when it was 119 days old. Condor #871 fledged on December 15, 2017. This nest fell within the footprint of the Thomas Fire along its eastern flank. Not knowing whether the chick had survived the fire, which burnt down the nest cliff toward the canyon bottom, the field team searched the area near the nest once the fire was under control and it was safe for personnel.

The field team located the now fledged chick and observed it with both parents across the canyon from the nest site. The three condors were only a few hundred yards from where the fire was stopped by U.S. Forest Service and CalFire suppression actions. Upon visually inspecting the fledgling with a high powered spotting scope, it was clear that the tips of #871's primary feathers had been damaged and were likely singed from the fire. Condor #871 was monitored for the following month to ensure that it was capable of flight and continued to receive care from its parents.

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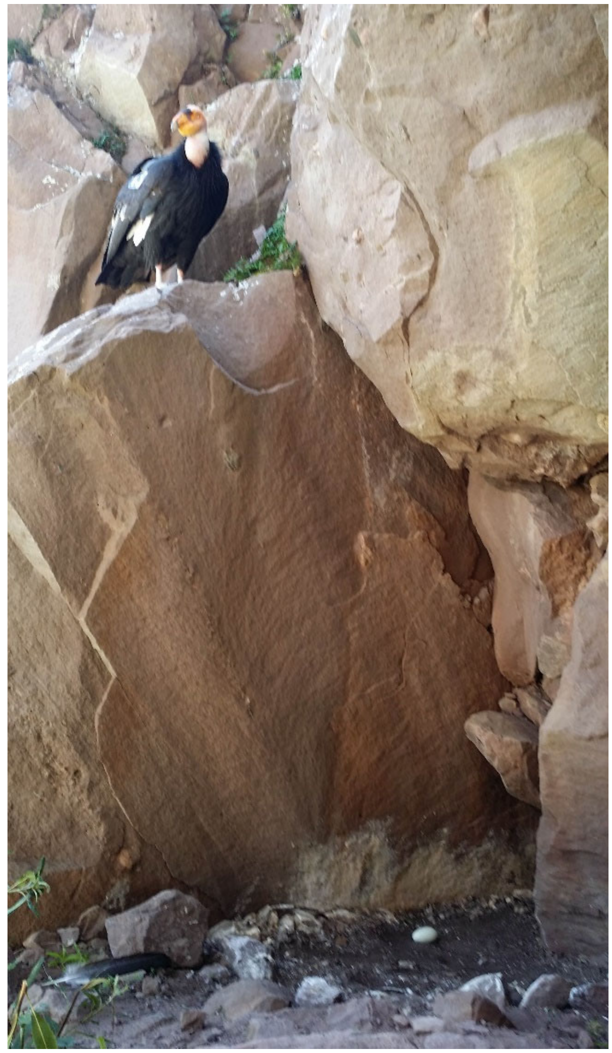


Photo 3.4.2: California condor #513 perched above her egg at nest site DG17. *Photo Credit: Joseph Brandt, USFWS.*

Condor nest LW17 was not entered until after the egg had failed to hatch. The pair was still attending eight days following the anticipated hatch date when the field team entered the nest to find an unhatched and nonviable egg. The addled egg was removed from the nest at that time.

Largely due to inclement weather and unsafe road conditions early in the nest season, it took several months to find the exact location of condor nest LB17 within the challenging and remote terrain of the Santa Barbara county backcountry. The field team entered nest site LB17 a single time to check for a chick. During that entry egg shell fragments were recovered but there were no signs of a condor chick.

The exact location of condor nest ST17 was never discovered although there were clear signs as determined through GPS location data of nest attendance exhibited by the pair. Inclement weather and the inaccessibility of the nest cliff impeded the field team's ability to locate the nest prior to its failure. It was still possible to estimate the nest's location in a remote rock outcropping located in the Tehachapi Mountains. This estimated location is based on the attending pair's GPS location data and visual observations of the pair while searching for the nest.

Condor nest OD17 was entered three times while the nest was active. The first entry occurred the day the nest cavity was discovered. This nest entry was a fertility check and through candling of the egg it was determined to be fertile. The second entry occurred shortly after the egg hatched, producing condor #895, and a nest camera was installed inside the nest cavity. The final entry was performed when #895 was 120 days old. During this last entry the field team tagged #895, took a blood sample to test for sex and lead exposure, and administered a West Nile virus vaccine. The nest camera was also relocated outside the cavity in order to monitor the chick as it approached fledging. Nest OD17 successfully produced a fledged chick, which was the first successful nesting attempt for condors #328 and #216.

The field team was unaware of nest HW17 during the 2017 nesting season. Condor pair #467 and #576 were not wearing GPS transmitters during their period of courtship and through the early stages of nest attendance. Without GPS data the pair could not be monitored remotely for signs of nesting activity. Their territory, unbeknownst to the field team at the time, was also located in a remote and largely inaccessible part of the Sespe Condor Sanctuary, allowing the presence of the actively breeding pair to go undetected by the field team that was monitoring for nesting activity near Hopper Mountain NWR. The first indication of this nest occurred when an untagged juvenile condor that had the characteristics of plumage, head color, and behavior of a recently fledged chick was observed in March of 2018. After the fledgling, #949, was observed the field team began to review GPS data and field observations to determine its origin. During the 2017 June/July trapping season the HW17 pair had been trapped and fitted with GPS transmitters. It was only after retroactively reviewing these data, in combination with radio telemetry location data, that the field team strongly suspected #467 and #576 of nesting and producing #949. Paternity blood tests later confirmed them as the parents of #949.

Table 3.4.3: Microtrash recovered from nests of each pair of California condors during 2002-2017 seasons. Values represent the total number of trash items collected from each nesting attempt or associated chick each year (*Nest failed prior to the chick being 90 days of age, value was not included in the average).

	Year															
Pair	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
20/654	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0*
21/192	-	-	109	235	1*	233	-	60	-	3*	-	164	-	244	-	-
21/289	-	-	-	-	-	-	-	-	-	-	-	-	-	-	104	-
63/147	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-
98/155	125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
98/216	-	-	-	5*	-	-	-	-	-	-	-	-	-	-	-	-
98/112	-	-	-	-	na	-	-	-	-	-	-	-	-	-	-	-
98/289	-	-	-	-	-	-	322	12*	-	-	-	-	-	unk*	-	-
100/108	54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
107/112	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
107/156	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-
107/161	-	-	unk	-	46	19	26	103	-	56	-	49	-	125	-	2*
125/111	0	44	57	43	-	43	11	10*	26	3	9*	189	16	-	-	-
206/255	-	-	-	-	-	39	-	52	32*	-	-	-	-	-	-	-
206/370	-	-	-	-	-	-	-	-	-	-	34	-	-	-	-	-
206/513	-	-	-	-	-	-	-	-	-	-	-	-	-	0	unk*	15
237/214	-	-	-	-	65	-	115	-	-	-	-	-	-	-	-	-
237/255	-	-	-	-	-	-	-	-	-	36	-	53	-	12	-	-
239/289	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
247/79	-	-	-	-	-	-	0	unk	0*	10	1	31	21	15*	-	-
247/156	-	-	-	-	-	-	-	-	-	-	-	-	-	-	72	0*
262/449	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-
326/518	-	-	-	-	-	-	-	-	-	-	-	-	-	45	-	-
326/364	-	-	-	-	-	-	-	-	-	0*	-	-	-	-	-	-
328/216	-	-	-	-	-	-	-	-	-	22	1*	3*	-	-	-	2
365/487	-	-	-	-	-	-	-	-	-	-	-	-	-	unk*	unk*	-
374/180	-	-	-	-	-	-	-	-	-	-	66	-	46	-	-	-
374/79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-
457/507	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	unk*
467/676	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	unk*
509/111	-	-	-	-	-	-	-	-	-	-	-	-	-	93	31	-
?/156	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-
Average	49	44	83	139	56	84	95	72	26	25.4	26	69	21	75	54	8.5

3.5 Captive Releases and Transfers

In 2017, the field team released nine captive-bred condors into the wild at Bitter Creek NWR (Table 3.5.1). Releases occurred during the months of January, February, November, and December. Two of the condors released were adults, which were first released as juveniles in late 1992. These condors were trapped one and a half years after their first release and held as captive breeders until 2016 when they were transferred back to Bitter Creek NWR. These two adults and a juvenile condor that hatched in 2015 were scheduled for release in 2016, but a delay in the release schedule caused them to be released in early 2017. The other six condors released into the wild for the first time were juveniles between one and a half, and five and a half years of age. Prior to release the six juvenile condors were held in the flight pen at Bitter Creek NWR for a minimum of five weeks starting in late August. One condor held in the flight pen at Bitter Creek for eventual release died due to heart lesions of unknown origin. Based on consultation with program veterinarians, there is a strong suspicion of West Nile Virus.

Installation of Exterior Mock Power Poles

After observing wild fledged condors perching on power poles in some of the mountain residential communities of the Tehachapi Mountains, the condor field team worked with Southern California Edison to install additional electrified mock power poles near, but external to, the flight pens located at Hopper Mountain and Bitter Creek NWRs in order to provide these wild fledged chicks power pole aversion training. Similar in design to the poles inside the flight pen, these poles were meant to provide the same aversion training to wild fledged condor chicks that had yet to be captured and to reinforce the aversion training of captive release birds.

Southern California Edison provided the materials, equipment and crews to help install the new power poles (Photo 3.5.1). They also refurbished the poles inside each flight pen.

Photo 3.5.1: Lineworkers from Southern California Edison install an electrified mock power pole at Bitter Creek NWR. *Photo Credit: Josh Felch, USFWS.*

Transport and Husbandry

Eleven condors intended for release into the wild were held in the Bitter Creek NWR flight pen in 2017. These condors came from the San Diego Safari Park, World Center of Birds of Prey, Oregon Zoo and the Los Angeles Zoo. Three were held due to a delay in release from the previous year, and three were transferred to a different release site. One condor (#783) died while in the flight pen, and the remaining six were condors scheduled to be released in 2017.

Four condors, #809, #811, #812, and #847, were transferred to Bitter Creek from the San Diego Safari Park on August 22. Condor #811 was held at Bitter Creek until it was released to the wild. The other three condors from San Diego Safari Park were transferred to the Vermillion Cliffs release site in Northern Arizona on September 14. On September 9, five more condors were transferred to Bitter Creek from the World Center for Birds of Prey (#649, #783, #816, and #819) and the Oregon Zoo (#818). Condor #839 was transferred to Bitter Creek on September 22 from Los Angeles Zoo.

Visual health checks on the condors in the flight pen were conducted daily and four-hour observations were made on the captive condors two to three days a week. While held in captivity, these condors were given regular food and water, which necessitated at least one field team member or volunteer to be on the Refuge at all times in case of an emergency.

Accelerometry Study

The seven condors that were scheduled for release in the fall of 2017 were fitted with specially programmed CTT patagial transmitters in order to collect accelerometer data while simultaneously recording video footage of their behaviors inside the flight pen. Six accelerometer transmitters were deployed on nine condors while in the flight pen at Bitter Creek NWR. This study was in partnership with the US Geologic Survey and West Virginia University to develop models based on accelerometer data that predict the behaviors of condors wearing accelerometer capable GPS transmitters.

Death of Condor #783

Eighteen days after being transferred to the Bitter Creek Flight Pen from the World Center for Birds of Prey, condor #783 died. Condor #783 collapsed and fell from his perch when field team members entered the flight pen to net and release a condor that was from the wild flock. Upon seeing #783's collapse, the team quickly responded but #783 had already died. There was no indication prior or at the time of death that #783 had any health issues. During the time in the flight pen, #738 behaved normally and it was observed interacting and feeding with the other captive condors. Thirteen days prior to his death #783 was netted and handled for the accelerometer study. During this handling, #783 was observed to be have good body condition and behaved normally. The cause of death was determined by necropsy to be related to heart lesions suspected as resulting from West Nile virus exposure. West Nile virus was not detected during the necropsy indicating that if the death was related to West Nile infection, then this infection likely occurred prior to #783's arrival at Bitter Creek NWR.

Condor Releases

Due to the soft bodied tick (*Argas ricei*) infestation of the Bitter Creek Flight Pen (see the 2016 annual report for more details), three condors that were scheduled to be released in 2016 were delayed and not released until early 2017. Condor #805 was a captive reared bird hatched in 2015. Condors #76 and #77 were two older female condors originally released in 1992 at the Hopper Mountain NWR and recaptured in 1994 to be placed in captivity. Both condors bred in captivity at the World Center for Birds of Prey. They became candidates for release because their genetics were no longer optimal for captive breeding purposes.

Fall releases of captive-bred condors began at Bitter Creek NWR on November 2, 2018. Typically, releases begin in October but in order to be certain that nothing would endanger the wild flock, the field team waited for the pathology results for the dead condor #783. The condors that were housed with #783 could have carried any pathogens #783 may have had, thus the need for laboratory results.

The day prior to release each captive condor was handled and VHF transmitters and/or a GPS transmitter were attached. The six captive-bred condors were released from the Bitter Creek NWR flight pen in two groups of three during November and December (Photo 3.4.2, Table 3.5.1).

Post Release Monitoring

The nine newly released captive-bred condors were closely monitored by the field team for appropriate feeding and roosting behaviors after release (Photo 3.4.3). This monitoring required an average of two people per week for approximately 10 hours per day from January 25 until February 28 and November 2 to December 31 (Table 3.5.2). Releasing the birds in smaller groups, rather than all at once, allowed the field team to focus their observations on the behaviors of each group. This ensures that the condors exhibit proper roosting and feeding behavior before releasing the next group.

At the end of 2017, all but one of the nine newly released condors had successfully integrated into the wild flock by roosting in trees and feeding with other condors. As of the end of 2017, condor #649 has yet to demonstrate these behaviors. Further updates on the progress of this one condor will be made in the 2018 annual report.

Population Increase

Loss of free-flying condors from mortalities and gains from new releases and wild reproduction resulted in an end-of-year population size of 82 condors; a 2.5% increase to the Southern California population in 2017 (Figure 3.5.1).

Photo 3.5.2: Great Basin Institute biological intern, Kylie Smith, attaches a GPS transmitter on California condor #816 the day prior to her release at Bitter Creek NWR, Kern County, California. *Photo Credit: Robyn Gerstenslager, USFWS.*

Photo 3.5.3: A newly released California condor roosts on the artificial snag near the flight pen at Bitter Creek NWR, Kern County, California. *Photo Credit: Stephanie Herrera, USFWS volunteer.*

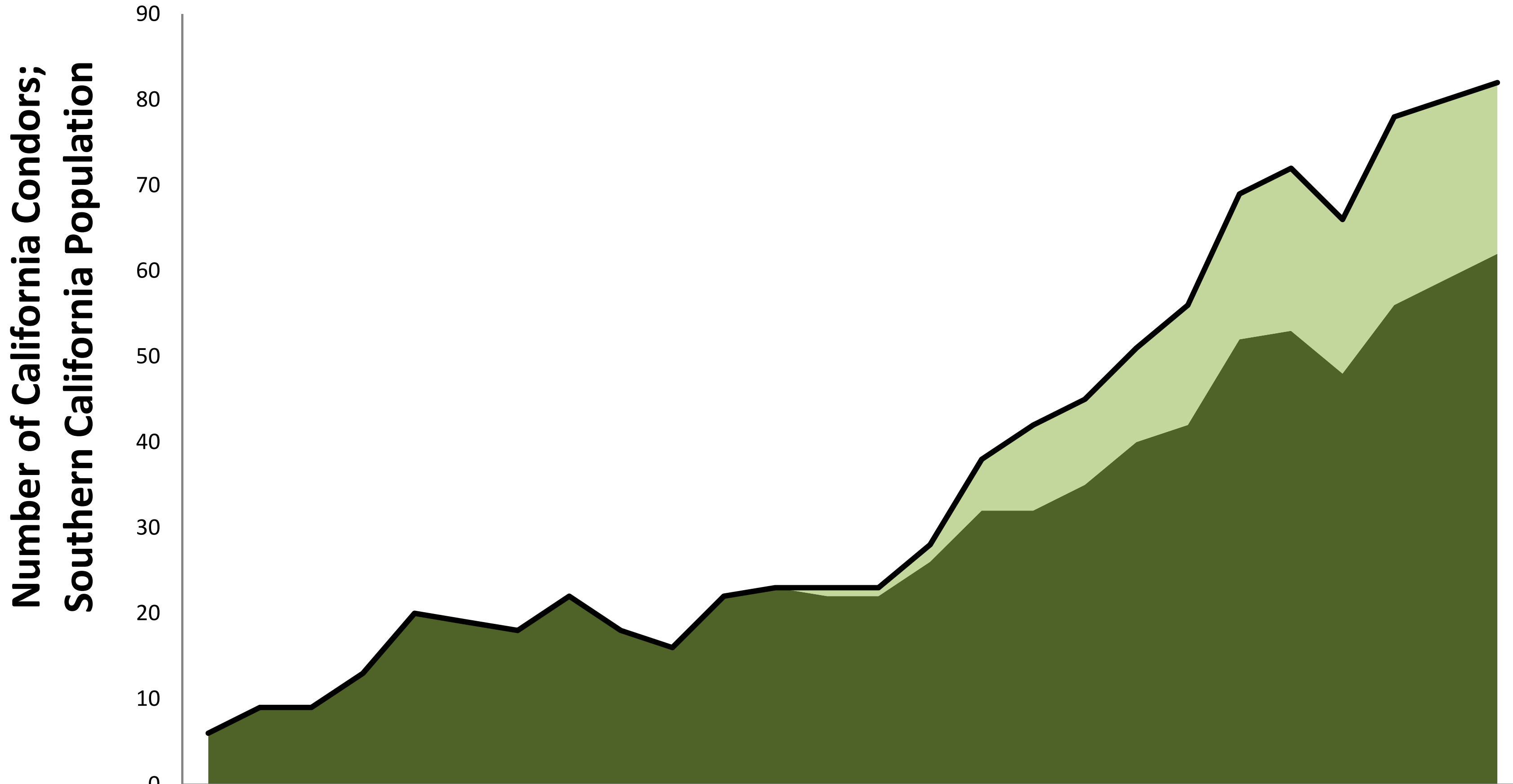
Table 3.5.1: California condors released at the Bitter Creek NWR in 2017. A successful fate indicates that the released condor was alive and remained in the wild population without having to be recaptured for 90 days following its initial release.

SB#	Sex	Hatch date	Hatch location	Transfer date	Release date	Fate	Age at Release (in years)
805	m	2-Jun-15	Los Angeles Zoo	26-Aug-16	25-Jan-17	Successful	1.7
76*	f	23-Mar-92	Los Angeles Zoo	8-Sep-16	26-Jan-17	Successful	24.9
77*	f	21-Apr-92	Los Angeles Zoo	8-Sep-16	16-Feb-17	Successful	24.8
811	f	24-Mar-16	San Diego Safari Park	22-Aug-17	2-Nov-17	Successful	1.6
816	f	5-Apr-16	World Center for Birds of Prey	9-Sep-17	2-Nov-17	Successful	1.6
818	m	7-Apr-16	Oregon Zoo	9-Sep-17	2-Nov-17	Successful	1.6
649	m	24-Apr-12	World Center for Birds of Prey	9-Sep-17	14-Dec-17	Unsuccessful	5.6
819	f	9-Apr-16	World Center for Birds of Prey	9-Sep-17	14-Dec-17	Successful	1.7
839	m	17-Apr-16	Los Angeles Zoo	27-Sep-17	14-Dec-17	Successful	1.7

(SB# = Studbook Number; * = Condor was released after long period of captivity original release date was in December of 1992.)

Table 3.5.2: Field team and volunteer efforts to release captive-bred California condors in 2017 at Bitter Creek NWR.

	2017											
	January	February	March	April	May	June	July	August	September	October	November	December
Number of condors released	2	1	0	0	0	0	0	0	0	2	3	3
Approximate staff hours tracking new releases	160	160	0	0	0	0	0	0	0	0	160	220
Total number of calf carcasses provided	19	12	10	13	8	10	15	12	9	11	17	14



	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Wild Fledged	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	6	10	10	11	14	17	19	18	22	21	20
Captive Released	6	9	9	13	20	19	18	22	18	16	22	23	22	22	26	32	32	35	40	42	52	53	48	56	59	62
Total Population	6	9	9	13	20	19	18	22	18	16	22	23	23	23	28	38	42	45	51	56	69	72	66	78	80	82

Figure 3.5.1: Number of wild California condors within the Southern California population from 1992 through 2017. The size of the population represents the number of condors at the end of each calendar year.

3.6 Outreach

Using outreach to raise awareness about condor conservation continued to be a growing activity for the field team in 2017. The field team continued to assist with non-lead outreach, expand its following on social media, initiated new programs, and built upon existing outreach efforts.

Condor Cave

Throughout 2017, interest and engagement by the public in the Condor Cave Facebook webpage increased, with a total of 13,930 followers at the end of the year. This was a 22% increase as compared to 2016. The Santa Barbara Zoo staff plays the primary role in developing the content for this page, providing two to three posts a week. Posts included photos, nest camera videos, and updates from the Southern California field team and other condor release actions within the larger Condor Recovery Program.

Online Condor Nest Camera

The live streaming condor nest camera went live on May 31, 2017 when the chick was 50 days old. This allowed viewers to follow the chick's development until the Thomas Fire started on December 4, 2017. During the five months that the camera was online, it was viewed over one million times from 150 countries and watched for 19 million minutes (36 years). The start of the Thomas Fire ended the live stream prior to fledge, and the chick had fledged by the time the fire was extinguished.

CondorKids

The CondorKids third grade curriculum was again used by the Fillmore Unified School District during the 2016 - 2017 school year. All 12 third grade classes participated, reaching over 300 students. A presentation was given by a biologist at each participating elementary school in Fillmore, and all third grade classes at each school attended. This gave students the opportunity to directly ask condor biologists questions and to learn about conservation careers. To culminate the completion of the curriculum, students and teachers took a field trip to the Santa Barbara Zoo on May 24 and 25, 2017. Each day, 150 students were able to view condors on exhibit and interact with many of the field team members. Four condor related activities were offered to the students who participated: rock climbing, radio telemetry, using scopes and binoculars, and condor bio-facts.

Photo 3.6.1: CondorKids learn about California condor nests and climb a simulated rock wall during a field trip to Santa Barbara Zoo, Santa Barbara, California. *Photo Credit: Dorothy Horn, USFWS.*

Non-Lead Outreach

The Institute for Wildlife Studies' Non-lead Outreach Coordinator for Southern California was involved in 11 outreach activities, directly reaching 445 people in Southern California. These activities included booths, presentations, shooting demonstrations, and interviews (Table 3.6.1). Topics included non-lead ammunition, ammunition ballistic performance, the role of hunting in conservation, and the effects of lead on condors and other wildlife. The Institute for Wildlife Studies also manages and updates content for a Hunting with Non-lead Facebook page and the website huntingwithnonlead.org.

Preventing Habituation

Outreach activities were the primary means of addressing behavioral modification in the Northern Tehachapi Mountain communities. The field team posted educational flyers at the BVS Police Department, Post Office, and Bear Valley Market. Flyers were electronically distributed via the BVS Community Services District website, Stallion Springs Community Services District website, and Alpine Forest Park Property Owner's Association website. Each community service district also provided flyers through community newsletters and sent them to residents by mail (Appendix II).

Other Outreach Activities

The field team led and assisted with 19 refuge tours in 2017. Six tours were of Hopper Mountain NWR and 13 tours were at Bitter Creek NWR (Table 3.6.3). The tour recipients included local Audubon chapters, secondary schools, colleges, a natural history club, a veteran's home, and the general public. The Friends of the California Condor Wild and Free also assisted with many of the Refuge tours.

In addition to the non-lead outreach presentations, information about other condor recovery efforts was provided at 20 other off Refuge locations in 2017. These activities included presentations and educational booths for schools, colleges, community events or fairs, online, and during conservation group meetings (Table 3.6.4). One of the more notable outreach events in 2017 for the complex was the screening of the documentary, The Condor's Shadow, at the Libby Bowl in Ojai, California. The Screening was part of an evening to acknowledge Trail Blazing Women in Science. After the film, Jan Hamber, a long time condor conservationist, was presented with an award for her dedication to the condor recovery effort. The Friends or the Condor Wild and Free and the Ojai Raptor Center partnered with the Complex to hold the event, and 300 people were in attendance.

The field team responded to five media outlet requests to provide information about various aspects of condor conservation. These media outlets included: Xploration Awesome Planet, KECT SoCal Connected, Jay Leno's Garage, public radio, and a children's book author (Table 3.6.2).

Field team members were also co-authors for three articles published in scientific journals in 2017. The article titled: Effects of Lead Exposure, Flock Behavior, and Management Actions on the Survival of California Condors (Gymnogyps californianus) was published by EcoHealth in March. The article titled: Meteorological and environmental variables affect flight behavior and decision making of an obligate soaring bird, the California Condor *Gymnogyps californianus* was published by IBIS in September. The article titled Lack of Observed Movement Response to Lead Exposure of California Condors was published by The Journal of Wildlife Management in October.

Photo 3.6.2: Non-lead bullet display at a Hunting With Non-lead outreach booth. *Photo credit: Russell Kuhlman, Institute for Wildlife Studies.*

Table 3.6.1: Non-Lead outreach presentations given in 2017. The Institute for Wildlife Studies (IWS) non-lead outreach coordinator organized and led these activities with assistance from others on the field team.

Description	Location	Date
Advanced Hunter Education Clinic: 63 contacts	San Luis Obispo, CA	29-July
Bear Valley Springs National Night: 74 contacts	Bear Valley Springs, CA	2-August
Backcountry Hunters and Anglers Pint Night: 24 contacts	San Diego, CA	5-August
Backcountry Hunters and Anglers Pint Night: 15 contacts-	Los Angeles, CA	14-August
Santa Barbara Zoo's International Vulture Awareness Day: 51 contacts	Santa Barbara, CA	3-September
The Wildlife Society Conference Non-lead Presentation and Shooting Demonstration: 25 contacts	Albuquerque, New Mexico	23-September
Sequoia National Park Shooting Demonstration: 4 contacts	Tulare County, CA	4-October
Mojave National Park Youth Hunt: 97 contacts	Mojave National Preserve, CA	6-October → 8-October
Shooting demonstration with National Park personnel: 16 contacts	Arcata, CA	8-November
Southern California County Wildlife Commissioners Meeting: 35 contacts	Pasadena, CA	1-December
Kern River Valley Gun Association Event: 41 contacts	Kernville, CA	9-December

Table 3.6.2: Media outreach and contacts for the field team during 2017. Each year the field team interacts with journalists, authors, television productions, and other media outlets to provide information and footage about condor recovery efforts being conducted by the Complex.

Description	Location	Date
Television Series Xploration Awesome Planet filmed a condor handling and conducted interviews for episode on animal coexistence (Season 4, Episode 11)	Bitter Creek NWR	19-July
Television program KCET SoCal Connected filmed a condor handling and conducted interviews for a news broadcast on California condor recovery (aired 12-Dec-17 and available online: https://www.kcet.org/shows/socal-connected/comeback-kids)	Bitter Creek NWR	26-July
Reporter from Valley Public Radio attended a condor handling and conducted interviews	Bitter Creek NWR	14-September
Producer and photographer for Jay Leno's Garage scouts Refuge for upcoming day of filming.	Bitter Creek NWR	1-November
Children's Author Sy Montgomery and T. Strombeck visit refuge to collect content for a children's book.	Bitter Creek NWR	14-November → 16-November
Children's Author Sy Montgomery and T. Strombeck visit refuge to collect content for a children's book.	Hopper Mountain NWR	16-November → 19-Novemebr
Television Series: Jay Leno's Garage filmed a condor handling and conducted interviews for segment on electric vehicles and California condors (Season 4 episode 4)	Bitter Creek NWR	11-December

Table 3.6.3: California condor related on-Refuge tours and activities performed by the field team and others in 2017.

Description	Location	Date
Refuge tour for Pasadena Audubon Young Birders: 16 contacts	Bitter Creek NWR	14-February
Refuge tour for Santa Barbara Zoo board member: 1 contact	Hopper Mountain NWR	1-March
Refuge tour for UC Berkeley Geology group: 12 contacts	Hopper Mountain NWR	1-April
Refuge tour for public with Friends of the California Condor Wild and Free: 24 contacts	Hopper Mountain NWR	15-April
Refuge Tour for Taft Community College General Zoology: 12 contacts	Bitter Creek NWR	25-April
Refuge tour with Fillmore Unified School teachers: 7 contacts (CondorKids)	Hopper Mountain NWR	29-April
Refuge tour for public with Friends of the California Condor Wild and Free: 20 contacts	Bitter Creek NWR	29-April
Refuge tour for public with Friends of the California Condor Wild and Free: 24 contacts	Bitter Creek NWR	13-May
Refuge Tour for UC Santa Barbara, Endangered Species Management class: 45 contacts	Bitter Creek NWR	20-May
Condor Handling with Los Angeles Conservation Corps Sea Lab: 6 contacts	Bitter Creek NWR	11-July
Los Angeles Conservation Corps Sea Lab shadows field team: 6 contacts	Hopper Mountain NWR	12-July → 15-July
Condor Handling for Pasadena Audubon Young Birders: 12	Bitter Creek NWR	26-July
Refuge tour and condor handling for Ventura County Veterans Home: 17 contacts	Bitter Creek NWR	11-October
Refuge tour for public with Friends of the California Condor Wild and Free: 24 contacts	Bitter Creek NWR	14-October
Refuge tour for Los Angeles Audubon tour with Friends of the California Condor Wild and Free: 20 contacts	Bitter Creek NWR	29-October
Refuge tour for American Zoos and Aquariums Gorilla Workshop with Santa Barbara Zoo: 10 Contacts	Hopper Mountain NWR	9-November
Refuge tour and condor handling for Taft Community College General Zoology: 15 contacts	Bitter Creek NWR	14-November
Condor handing with Taft Community College Environmental Studies class: 15 contacts	Bitter Creek NWR	29-November
Condor handling with the Tehachapi Wind Resource Group and Operators: 18 contacts	Bitter Creek NWR	13-December

Table 3.6.4: California condor related off-refuge outreach activities performed by the field team and others in 2017.

Description	Location	Date
Presentation for Cal State Channel Islands Conservation Biology Class	Camarillo, CA	8-March
CondorKids 3rd grade teachers training for Fillmore Unified Schools	Fillmore, CA	15-March
Trailblazing Women in Science and Condor's Shadow Screening at Libby Park	Ojai, CA	18-March
Presentation for Cal State Channel Islands: Principals of Resource Management Class	Camarillo, CA	11-April
Presentation for Rio Vista Elementary School	Fillmore, CA	18-Apr-17
Table for Los Angeles Zoo, Wild for the Planet event	Burbank, CA	22-April→ 23-April
Table at Fillmore Unified Schools Open House	Fillmore, CA	27-April
Presentation for Cal State Channel Islands Conservation Biology Class	Camarillo	11-May
Table for Los Angeles Zoo, Wild for the Planet event	Burbank, CA	13-May
Presentation to UC Santa Barbara Endangered Species Management Class	Santa Barbara, CA	15-May
Classroom presentation at South Fork Elementary School	Weldon, CA	16-May
Presentation to Haydock Academy of Arts in Science (Middle School)	Oxnard, CA	17-May
CondorKids Fillmore Elementary Schools 3rd Grade field trip to Santa Barbara Zoo	Santa Barbara, CA	24-May
CondorKids Fillmore Elementary Schools 3rd Grade field trip to Santa Barbara Zoo	Santa Barbara, CA	25-May
Presentation at Rio Mesa High School	Oxnard, CA	30-May
Presentation at San Cayetano Elementary School	Fillmore, CA	31-May
Classroom presentation for Topa Topa Elementary school for condor outreach	Ojai, CA	14-June
Condor presentation for biological staff at Sequoia National Park	Three Rivers, CA	3-October
Condor presentation for Veterans Home of California, Ventura	Ventura, CA	10-October
Seneca Oil's Sespe Oil Field Annual BBQ	Fillmore, CA	11-October

4.0 Discussion

Monitoring Resource Use

The field team increased the number of GPS transmitters in 2017 by 190% (20 to 58 transmitters). With the majority of condors now wearing GPS transmitters, the use of daily radio telemetry for monitoring has changed to some extent. Rather than trying to detect every condor in the population every few days with hand-held telemetry receivers, GPS transmitters provide a much higher level of detail for detecting living condors. There have also been a few instances in 2017 of detecting sick condors by using GPS data. The increase in the number of GPS transmitters attached to condors has meant more time needed to inspect the location data from these transmitters on a regular basis. A dedicated data manager/GIS position would aid in more effectively using this new source of information. Creating a new position dedicated to this task would likely be a tradeoff in the number of field based personnel working directly with the condors, which might be challenging given the increasing number of condors in the Southern California population's expanding wild range.

Detecting Mortalities

Radio telemetry is also still a very necessary tool of the program in determining the location of dead condors. While data from GPS transmitters might provide more information about condor movements and their daily whereabouts, they still do not allow condors to be located in real time. This is accomplished using radio telemetry in the field. However, a new field team workflow process is developing where radio telemetry is being used in a more focused manner. Often data from GPS transmitters might indicate the initial need to search for and locate a condor. This is either because the GPS data has indicated that a condor has been stationary over a period of several days, or that the transmitter has failed to transmit for several days. Then VHF telemetry can be used to more accurately locate the bird or dropped transmitter starting at the last position indicated by the GPS location data.

Exploring other types of transmitters used for the specific purposes of detecting mortalities might improve the field team's ability to recover dead condors in a timelier manner as their range increases, which in turn will assist the program in determining limiting factors effecting the Southern California population of condors.

Lead Monitoring and Mitigation

In conjunction with the other condor release sites in Central California, the field team in Southern California changed their protocol for treatment of lead exposures in condors. The changes in this protocol, and the rationale behind these changes, are explained in section 2.2. One of the motivations for this change was to better understand the assumed benefits of the past protocol and its prescription of chelation treatment on condor survival. Improving our understanding of the protocol's actions and their results will help better inform how best to manage condor populations as they grow in number and expand their range. As wild condor populations increase and expand across a wider geographic range, it is critical for the recovery program, and thus the field team, to use its resources in a manner that will most effectively achieve a self-sustaining population. Understanding the relative benefits of management actions is an essential step towards an adaptive approach when transitioning from the focus on individual condor survival to managing the species effectively at a population level.

Outreach

This was the first year that the CondorKids program had dedicated staff to assist in implementing the program. A Park Ranger position funded under the Urban Refuges Program and filled by the Complex worked to schedule classroom visits, plan tours, and explore expanding the curriculum into new schools and classrooms. The position was short lived due to personnel turnover after only 4 months. It is planned that this position will be refilled in 2018 which will greatly expand the success of the CondorKids program. Due to the unexpected vacancy, the Complex worked with the Santa Barbara Zoo to grow the program in other ways, such as the development of a condor field program coloring book, and the creation of a CondorKids middle school curriculum. Both should be available by the end of 2018.

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Appendix I: Contributions to Ongoing Research

Field, laboratory and telemetry data collected on the Southern California condor population over the course of 2017 significantly contributes to ongoing research conducted by the Service or in conjunction with various universities, federal, state and local agencies, and private organizations and individuals. Examples of this ongoing research in 2017 include:

California condor flight response in a variable meteorological and topographic environment
Years: 2014-2019

Study Objective: The objective of this study is to record movements of California condors to understand how their flight behavior (especially altitude above ground level) responds to variation in topography and weather. Previous work with other species suggests that flight altitude is strongly influenced by these parameters and the type of subsidized lift the bird is using. Information on condor flight behavior will be used to (a) predict risk to birds from existing and proposed individual turbines within existing condor range; and (b) predict risk to birds from existing and proposed turbines within the projected (and expanded) future range of condors (c) identify wind and/or topographic variables that may be preferentially used by condors.

Principal Researchers: Todd Katzner and Sharon Poessel from US Geologic Survey, Forest and Rangeland Ecosystem Science Center; Johnathan Hall and Melissa Braham from West Virginia University.

Anticipated Completion: 2019

Genetic map and whole genome sequences of California condors
Years: 2006-present

Study Objective: Utilize robust genetic and genomic approaches, 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, identification of carriers of chondrodystrophy allele.

Principal Researchers: Oliver A. Ryder from San Diego Zoo Global, Stephan C. Schuster from Nanyang Technological University, Singapore, Webb Miller from Pennsylvania State University, Center for Comparative Genomics and Bioinformatics, Michael Romanov from University of Kent, Canterbury School of Biosciences.

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 one year. More detailed analyses of demography and evolutionary population genetics would follow. Priority will be given to reporting recovery-relevant findings.

<u>An assessment of the biological impact of contaminants and management actions that influence the long-term persistence of the California condor</u>
Years: 2011-2020

Study Objectives: Synthesize existing data and collect new data on the risks of contaminant exposure to California condors. We will also 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 condor performance (e.g., survival, reproductive success) and how these rates are influenced by the effects of contaminants (e.g., lead, organochlorines, microtrash) and future habitat suitability from changes in human demographics, climate. Develop demographic modeling approaches for each condor population in California that allows estimation of how contaminants, global climate change, future habitat suitability, and management efforts will impact population recovery.

Principal Researchers: Donald R. Smith and Myra Finkelstein from University of California, Santa Cruz. Daniel F. Doak from University of Colorado, Boulder, Vickie Bakker from Montana State University.

Sponsors: Department of Environmental Toxicology University of California, Santa Cruz; U.S. Fish & Wildlife Service, Hopper Mountain National Wildlife Refuge Complex, National Park Service, Pinnacles National Monument; US Geological Survey, Forest and Rangeland Ecosystem Science Center; U.S. Fish & Wildlife Service Water Pollution Control Laboratory CA Dept. of Fish and Game, Office of Spill Prevention and Response; University of Wyoming, USFWS Ventura Ecological Service Office

Funding Sources: Montrose Settlement Restoration Funds, USFWS Environmental Contaminants Program On-Refuge Investigations Sub-Activity

Anticipated Completion: 2020

Eggshell thinning and depressed hatching success of California condors reintroduced to Central California.
Years: 2006-2019

Study Objective: Compare condor hatching success and eggshell thickness between reintroduced populations of California condors in Central and Southern California. Evaluate the cause of egg failure in wild laid eggs and assess the potential sources of organochlorine contamination and determine its impact of the condor population in Central California.

Principal Researchers: Joe Burnett and Kelly Sorenson from the Ventana Wildlife Society, Joseph Brandt from U.S. Fish & Wildlife Service Hopper Mountain National Wildlife Refuge Complex, Bob Risebrough from the Bodega Bay Institute.

Sponsors: Ventana Wildlife Society, U.S. Fish & Wildlife Service Hopper Mountain National Wildlife Refuge Complex, the Bodega Bay Institute, Los Angeles Zoo and Botanical Gardens, Santa Barbara Zoo.

Funding Source: Ventana Wildlife Society and USFWS Hopper Mountain NWRC

Results to date: Burnett et al. 2009 (presentation); Burnett, L. Joseph, Kelly J. Sorenson, Joseph Brandt, Estelle A. Sandhaus, Deborah Ciani, Michael Clark, Chandra David, Jenny Schmidt, Susie Kasielke, and Robert W. Risebrough. 2013. Eggshell Thinning and Depressed Hatching Success of California Condors Reintroduced to Central California. The Condor 115 (3), 477-491

Anticipated Completion: 2019

<u>California condor Nest Guarding Project</u>
Years: 2007- present

Study objective: Analysis of nest success in Southern California's reintroduced population of California condors along with the trends of breeding effort and nest success within this population in response to changes in foraging, demographics, and management strategy (tentative plan).

Principal Researchers: Estelle Sandhaus from the Santa Barbara Zoo and Joseph Brandt from the U.S. Fish & Wildlife Service Hopper Mountain National Wildlife Refuge Complex.

Sponsors: Santa Barbara Zoo; U.S. Fish & Wildlife Service Hopper Mountain NWRC; Los Angeles Zoo.

Funding Source: U.S. Fish & Wildlife Service Hopper Mountain NWRC and Sana Barbara Zoo.

Results to date: 6% Nesting Success (2001-2006) increased to 60% nesting Success (2006-2011), Brandt et al. 2008 (presentation), Brandt et al. 2010 (poster), Sandhaus et al. (2012) Wynn & Stringfield 2011.

Appendix II: Flyer provided to residents where condor habituation is a concern.

CALIFORNIA CONDORS OBSERVED NEARBY

An unforeseen hurdle in the reintroduction of California condors is undesirable behaviors related to condors coming into close proximity with human structures and humans. Residential areas and other development (e.g. power poles or antennae arrays) have caused serious injury to condors. Condors can ingest small items around homes and feed them to their chicks; this can cause starvation, stunted growth, and death. Condors that come in close proximity to humans are also at risk of becoming "habituated" resulting in subsequent removal from the wild. In addition to the risks to condors, there is also a high potential for property damage due to condors' curious nature and sharp, powerful beaks.

Condors can engage in these behaviors for a variety of reasons, including attraction to nearby food or water sources or use of structures in close proximity to roosting habitat. The landscape in your area contains habitat conducive to condor foraging and roosting. Condors have historically used this area and have recolonized the area since their release back into the wild.

Please assist us in keeping condors and residents' property out of harm's way.

IF YOU SEE A CONDOR:

- **Record wing tag # and color whenever possible**
- **Do not approach or feed condors**
- **Contact the USFWS California Condor Recovery Program at (805) 644-5185**
-

California condors are an endangered species and are protected by state and federal law. HOWEVER, that does not mean that residents are helpless in trying to keep condors from perching on their homes and causing damage. It simply means that no one is permitted to harm or kill California condors.

Please see backside of flyer for information on condor deterrents and actions.

U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

CALIFORNIA CONDOR RECOVERY PROGRAM

Friends of California Condors Wild and Free

EFFECTIVE CONDOR DETERRENTS AND ACTIONS:

- **Scarecrow motion-activated animal deterrent (most effective method available)** **http://www.contech-inc.com/products/home-and-garden-products/animal-repellents/scarecrow-motion-activated-animal-deterrent**
- **Removing attractants (e.g. open trash and recyclable containers, wires, seat cushions, drinkable water sources)**
- **Constructing barriers to vulnerable property that is not able to be moved (e.g. barriers to AC unit wires, metal conduit around exposed wires, protective caps around insulation on outside water spouts)**
- **Immediate response by homeowners in scaring visiting condors away (e.g. spraying water, owning outdoor dogs, yelling/clapping/loud noises)**

UNTESTED DETERRENTS THAT MAY BE EFFECTIVE:

- **Electric track/electric strip tape (http://www.birdbgone.com/products/electric-track.html ; http://www.birdbarrier.com/products/bird-shock-flex-track/ ; http://www.nixalite.com/shocktape.aspx)**
- **Avian Control Bird Repellent Spray (http://solveyourbirdproblems.com/)**
- **Rollers for deck railings and ledges (http://coyoteroller.com/)**
- **Avian anti-perching spikes (http://www.nixalite.com/Nixalitemodels.aspx#Premium_Model_S)**
- **Artificial effigies (http://www.hankenimports.com/artificial-animals/93-15-inch-artificial-heads-up-vulture.html)**
- **Gull sweep/daddi long legs (http://www.gullsweep.com/index.html ; http://www.birdbusters.com/pigeon_control_repellent.html)**

*** The following list does not imply endorsement of any of these products by the USFWS. It is simply a list of options.**

U.S. Fish & Wildlife Service

California Condor Recovery Program

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