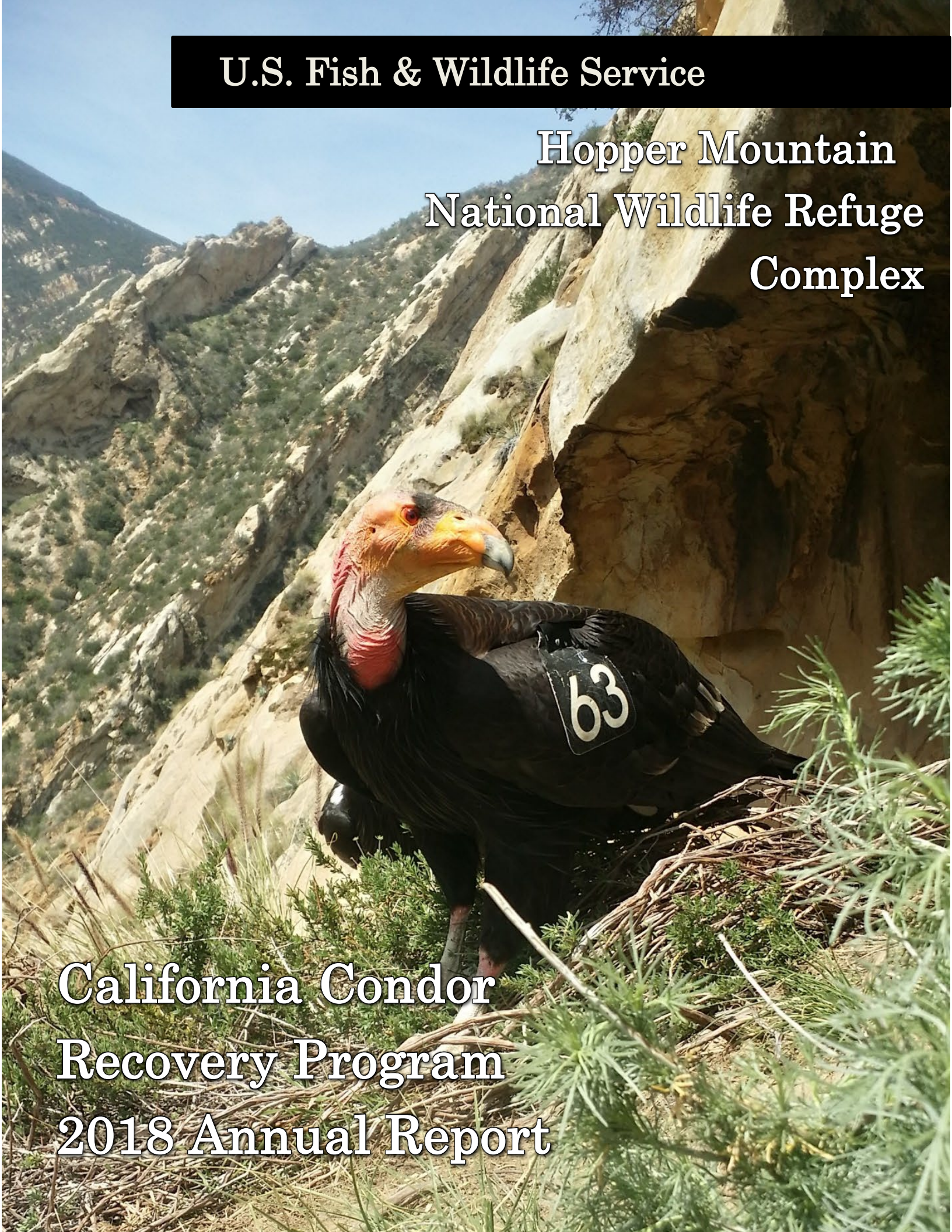
U.S. Fish & Wildlife Service

Hopper Mountain National Wildlife Refuge Complex



California Condor Recovery Program 2018 Annual Report

On the Cover: California condor #563 eclipses her mate, #237 as she perched near her nest at Hopper Mountain National Wildlife Refuge, Ventura County, California.
Photo credit: Joseph Brandt, USFWS

Date of Issue: January 23, 2021

Prepared By:
Molly Astell, Wildlife Biologist, USFWS
Erin Arnold, Wildlife Biologist, USFWS
Nicole Weprin, Wildlife Biologist, USFWS
Marina Barton, Biological Science Technician, USFWS
Daniel Cook, Park Ranger, USFWS
Dave Meyer, Condor Biologist, Santa Barbara Zoo

Editors:
Laura McMahon, Wildlife Biologist, USFWS
Kirk Gilligan, Park Ranger, USFWS
David Ledig, Project Leader, USFWS

U.S. Fish and Wildlife Service
2493 Portola Road, Suite A
Ventura, CA 93003
Telephone: (805) 644-518

Acknowledgements

The management of condors in the Southern California region would not be possible without the support of our partners, volunteers, private land owners, and many others. We are grateful to Santa Barbara Zoo, Los Angeles Zoo, San Diego Zoo Global, Oregon Zoo, Peregrine Fund, Great Basin Institute, Cornell Lab of Ornithology, Western Foundation of Vertebrate Zoology, Wind Wolves Preserve, Tejon Ranch, University of California Davis and Santa Cruz, West Virginia University, Institute for Wildlife Studies, Friends of the California Condor Wild and Free, Santa Barbara Museum of Natural History, Seneca Resources, Carbon California Operating Company, Habitat Works, LightHawk, and a myriad of volunteers who all provided invaluable help and cooperation.

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.

List of Contributors

USFWS Condor Field Team
Joseph Brandt, Supervisory Wildlife Biologist
Molly Astell, Wildlife Biologist
Nicole Weprin, Wildlife Biologist
Marina Barton, Biological Science Technician

Refuge Complex Management and Administrative Team
Steve Kirkland, Condor Recovery Program Field Coordinator
David Ledig, Project Leader
Kirk Gilligan, Deputy Project Leader
Dan Tappe, Refuge Manager
Jason Storlie, Complex Wildlife Biologist
Debora Kirkland, Refuge Manager
Daniel Cook, Park Ranger
Josh Felch, Maintenance Worker
Irma Barraza, Administrative Support Assistant

Santa Barbara Zoo Staff
Estelle Sandhaus, Director of Conservation and Science
Nadya Seal Faith, Conservation and Science Associate
Erin Arnold, Condor Nest Biologist
Dave Meyer, Condor Biologist
Laura Echavez, Condor Nest Technician

Great Basin Institute Interns
Kylie Smith
Nathan Pinckard
Miles Ebell
Cristina Partipilo
Laura Echavez
Robin Jenkins
Nicole Durtschi
Kara Fadden
Andy Parks
Katie Fitzgerald
Nevin Klein
Casey Andrews

Institute for Wildlife Studies
Russell Kuhlman, Non-lead Outreach Coordinator
Chad Thomas, Non-lead Outreach Coordinator

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, 2018, the California condor population managed directly by the Complex consisted of 91 free-flying condors. The population produced six wild chicks fledged from 12 nests in 2018. Three of these nests were remotely monitored using nest cameras. Twelve captive-reared juvenile condors were released at Bitter Creek National Wildlife Refuge in 2018, along with one adult that had previously been released in Baja, Mexico, and another that was previously part of the population but held in captivity for several months for medical reasons. As a result of the successful wild nests and captive releases, the population increased by 10.98%.

The condor population in Southern California continues to recolonize its former range, exemplified by new nest territories established in the Tehachapi backcountry, as well as the southern Sierra Nevada foothills. The range of condor activity continues to expand and move north, and includes 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 2018.

The field team attempted to trap condors during two trapping periods to replace transmitters and monitor for lead exposure that 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 2018, 17 condors (22% 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.

A total of 13 condors were declared dead in 2018. Four of those condors went missing in the wild and were therefore declared dead, while the carcasses of nine free-flying condors were recovered. Three of the recovered dead condors were

determined to have died of lead toxicosis, two condors died of gunshot wounds, one condor died of emaciation, one condor died of a bacterial infection, one condor's cause of death is undetermined but suspected to be lead toxicosis, and one was euthanized due to several broken bones.

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 (https://www.facebook.com/TheCondorCave/). The Condor Cave has increased its following by 8.1% with a total of 15,059 followers as of December 31, 2018. 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 approximately 500,000 times, from over 120 countries, for a total of 1.2 million minutes (2.28 years). The CondorKids program also continued in 2018 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 seven events reaching 2,114 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 the Refuge Radio podcast, Sagehill Films, and Tandem Stills + Production to create content for the CondorKids program.

Southern California Population Highlights

Population Size

(as of December 31, 2018)

	Adults (≥6 years old)	Juveniles (<6 years old)	Total
Males	22	26	48
Females	21	17	38
Total	43	43	86

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

Nesting

	Successful Nests	Failed Nests	Total
Nests in 2018	6	6	12
All Nests since 2001	44	50	94

For more information on annual nesting success see Figure 3.4.1

Captive Releases

	Number of Condors
Releases in 2018	14
Total Number of Releases since 1992	163

For more information on the 2018 captive releases see Table 3.5.1

Condor Deaths

	Number of Condors
Deaths reported in 2018	13*
Total Number of Deaths since 1992	131

For more information on the condor deaths in 2018 see Table 3.3.1

*One of these birds was also included on the California Condor Recovery Program 2017 Annual Report

Table of Contents

Acknowledgements ..... *iii*
Disclaimer ..... *iii*
List of Contributors ..... *iv*
Executive Summary ..... *v*
Population Highlights ..... *vii*
Table of Contents ..... *viii*
List of Figures ..... *ix*
List of Tables ..... *ix*
1.0 Introduction 1
1.1 Funding 5
2.0 Primary Operations 6
2.1 Monitoring Resource Use 6
2.2 Lead Monitoring and Mitigation 9
2.3 Detecting Mortalities 11
2.4 Nest Management 12
2.5 Captive Releases and Transfers 13
2.6 Outreach 19
3.0 Outcomes 22
3.1 Monitoring Resource Use 22
3.2 Lead Monitoring and Mitigation 29
3.3 Detecting Mortalities 32
3.4 Nest Management 35
3.5 Captive Releases and Transfers 43
3.6 Outreach 47
4.0 Discussion 53
Works Cited 55
Appendix I: Contributions to Ongoing Research 59
Appendix II: Flyer provided to residents where condor habituation is a concern 63

List of Figures

Figure 1.0.1: Map of Refuge locations in Southern California 3
Figure 2.0.1: A conceptual model for the Hopper Mountain NWRC California Condor Field Program.. 7
Figure 3.1.1: Southern California condor activity in 2018 estimated using a fixed kernel density estimate (KDE) for California 26
Figure 3.1.2: 2018 condor activity near industrial wind turbines 27
Figure 3.1.3: Locations of condor nests in 2018 28
Figure 3.2.1: Summary of condor blood lead levels from 2010-2018 with the 5 year average 31
Figure 3.4.1: Nesting success before and after implementation of Nest Guarding Program 36
Figure 3.5.1: Number of wild California condors from 1992 through 2018 46

List of Tables

Table 3.1.1: 2018 condor activity within two miles of industrial wind turbines 24
Table 3.1.2: Non-proffered feeding events in 2018, 2008-2017, and in total by type of carrion 25
Table 3.2.1: Comparison of condors trapped between sessions and in total for 2018 30
Table 3.3.1: California condor mortalities in 2018 34
Table 3.4.1: Nesting attempts and outcomes for the 2018 breeding season 35
Table 3.4.2: Nest observation hours by personnel type 36
Table 3.4.3: Microtrash recovered from nests during 2002-2018 seasons 42
Table 3.5.1: Pre-release condors held at the Bitter Creek NWR flight pen in 2018 45
Table 3.5.2: Captive release efforts in 2018 45
Table 3.6.1: Non-lead Outreach presentations given in 2018 49
Table 3.6.2: Media contacts in 2018 50
Table 3.6.3: On Refuge Outreach performed in 2018 51
Table 3.6.4: Off Refuge Outreach performed in 2018 52

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 #76 flies over the Bitter Creek NWR, Kern County, California. *Photo credit: Stephanie Herrera, USFWS Volunteer*

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) that originated in 1980 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 when the Complex was established and took over the Program from the Patuxent Wildlife Research Center. 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 26 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) and Hopper Mountain National Wildlife Refuge (Hopper Mountain NWR) (Photo 1.0.2) 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, Madera, Mariposa, and Inyo Counties (Figure 1.0.1). The California Condor Recovery Plan (Recovery Plan) provides the overarching guidance for recovery strategies and field activities.

Photo 1.0.2: View east from Hopper Mountain NWR, Ventura County, California. *Photo credit: Nicole Weprin, USFWS*

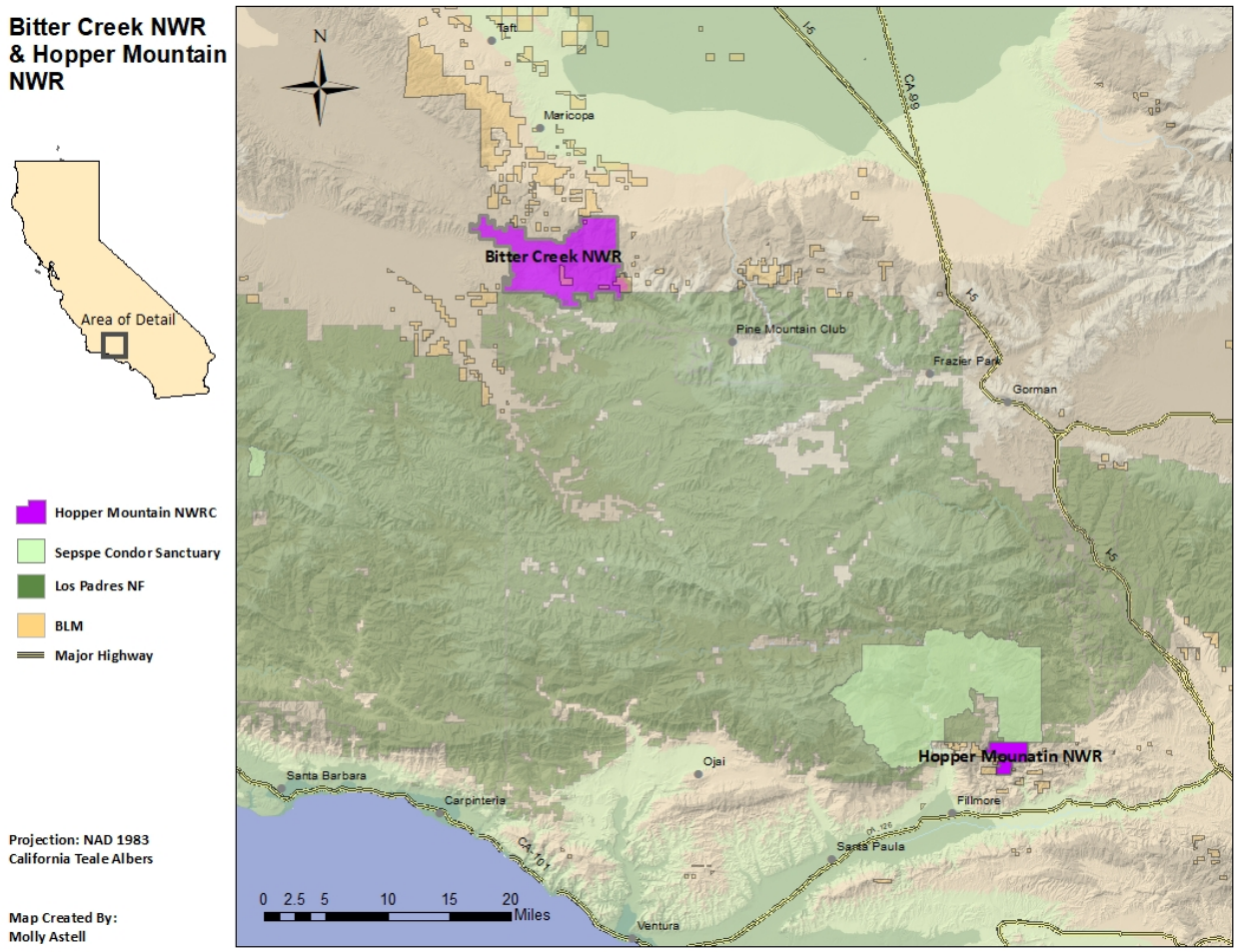


Figure 1.0.1: Hopper Mountain NWR and Bitter Creek NWR are the primary locations for management conducted by the field team.

The primary objective driving the reintroduction effort is to establish one of at least 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).

The main focus of the efforts of the field team are in implementing the second, third, and fifth key actions of the Recovery Plan. To support the second key action, 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). To support the fifth key action, the field team conducts outreach to educate the public in an effort to support recovery of the species.

The field team is comprised of a number of different members including Service employees, partner employees, interns and volunteers. In 2018, the Service employed one full-time permanent supervisory wildlife biologist, two full-time term wildlife biologists, and a Biological Science Technician. The Complex also employed one park ranger who assisted with 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 biologist and a more general condor biologist. The Santa Barbara Zoo also partners with the Complex CondorKids, a major education and outreach project funded by the Service's Urban Refuge Initiative.

In addition to the various Service and Santa Barbara Zoo positions, the field team has four biological 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 upon completion of 900 hours worked.

Some field activities are also supported by volunteers or other program partners. Volunteers primarily assist with monitoring nests during the ten month nesting season, but they also assist with condor monitoring via radio telemetry and assisting with trapping 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. Lastly, several universities collaborated on condor research relevant to conservation needs.

1.1 Funding

In 2018, 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 Science (Photo 1.1.1) and Condor Survival Fund at the Santa Barbara Museum of Natural History also made significant contributions.

One of the funding and operational challenges that the program faced in 2018 was a government shutdown that occurred due to a lapse in federal appropriations. This began on December 21, 2018 and lasted 34 days. All activities were stopped aside from those deemed to be essential.

Photo 1.1.1: Members of the USFWS field team prepares to hike down equipment, provided by the Santa Barbara Zoo, to set up a cross-canyon camera at condor nest HB18. Ventura County, California. *Photo credit: Molly Astell, USFWS*

2.0 Primary Operations

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

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 (tail feathers; Kenward 1978), or a combination of one VHF transmitter and one patagial mounted (leading edge of the wing; Wallace 1994) GPS transmitter. Some condors in the population do not have transmitters or the transmitters are non-functional because transmitters become unattached 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/non-transmittered 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 newly released birds, nesting condors, or sick/injured birds. VHF transmitters are an important tool in identifying when a condor has died (see 2.3 Detecting Mortalities) as each transmitter contains a mortality or no movement sensor. The VHF transmitters used are produced by Holohil Systems Incorporated (Model # RI-2C, 10 grams).

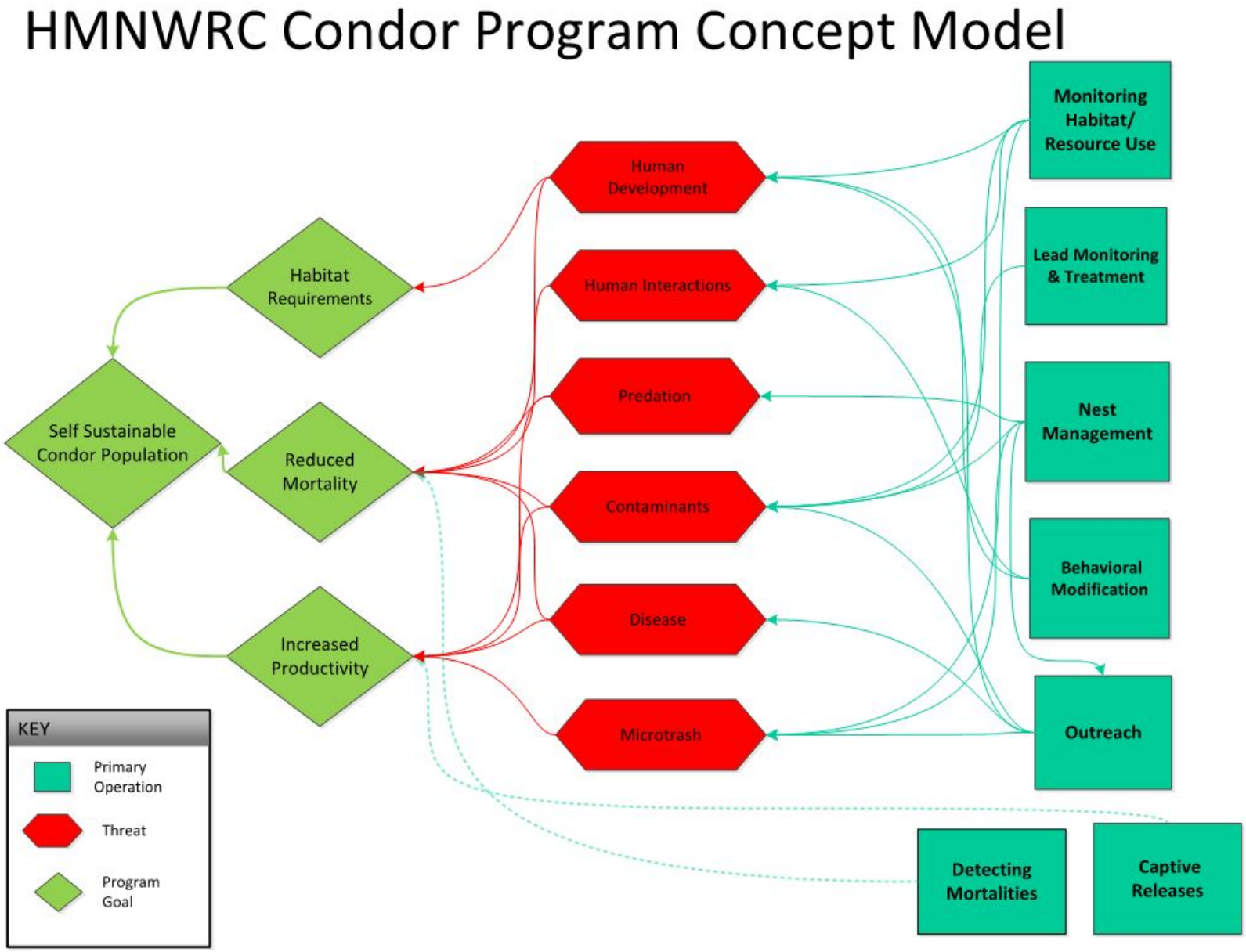


Figure 2.0.1: A conceptual model for the Hopper Mountain NWRC California Condor Field Program. The program's goal is to establish a wild self-sustaining population of condors. The three program objectives are limited by one or more of the seven identified threats, which are in turn addressed by the seven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

Use of GPS Transmitters

In 2018, 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) collect GPS locations every 2 to 15 minutes depending on peak voltage periods when the amount of sunlight is greatest, keeping the batteries at full charge. The GPS location data collected by these transmitters are transmitted using cell towers via the Global System for Mobile Communications (GSM) network.

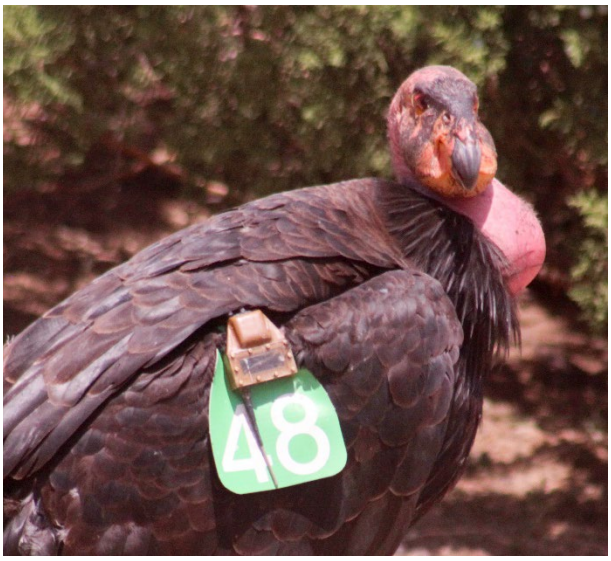


Photo 2.1.1: California condor #748 wearing a MTI GPS/GSM transmitter. *Photo credit: Laura Echavez, Great Basin Institute.*

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.

Photo 2.1.2: A new tag and CTT GPS/GSM transmitter attached to California condor #895. *Photo credit: Laura Echavez, Great Basin Institute*

Data generated by all transmitters is collated and distributed daily using 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 (Poessel et al., 2018a), assess the impact and distribution of lead on the landscape (Bakker et al., 2017, Poessel 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.

Analysis of condor feather lead data indicate the majority of lead-poisoned birds are not prescribed chelation for lead poisoning until 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 indicated that the frequency of lead exposures was much higher than previously indicated by just blood lead level data alone. If a condor only has its blood sampled during biannual trapping efforts, only about 11.5% of the annual lead exposure window would be represented (USFWS 2017). Primary wing feather sampling represented a much larger proportion of the annual exposure window (Finkelstein et al., 2007) and indicated that on average, a condor experienced one lead exposure event surpassing past the threshold at which would be treated under past protocol every 50 days (range 0-3 events, n = 48 feathers) (Johnson et al., 2013). Thus, past blood lead monitoring did not detect the vast majority of condor lead exposure events and those events went untreated.

In order to better understand the population level benefits of the 2011-2016 lead exposure treatment protocols, and as part of a larger study including condors managed by Recovery Program partners in Central California, the criteria and protocols for chelation treatment were modified in 2017. This year marked the second year of instituting this new protocol, where condors were only chelated if they exhibited visible symptoms of lead poisoning. The new protocol will continue for a period of four more years, after which indicators of the condor populations' health and lead exposure will be compared to the five years before 2017 in order to determine whether the

change in treatment had a measurable effect on the population. The field team will continue to evaluate data collected under the new protocol to assess changes in lead exposure and lead-related mortality on an annual basis.

Population level survival will also be analyzed on a biennial basis using known-fate models, following a framework established by Bakker et al., (2017). This allows for a more detailed understanding of population changes due to lead poisoning mortality. A large increase in lead-related mortality without a concomitant increase in lead-exposure levels would trigger a detailed survival analysis 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. However, some condors are trapped at other times of the year if necessary. Some examples of this include if a condor is suspected to be sick, exhibits behavioral concerns, or needs an adjustment to its 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). Per the 2017 change in protocol, 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 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 identifying that a feather is growing, 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 the Microbiology and Environmental Toxicology Department at the University of California, Santa Cruz. For condors that are discovered after they are deceased, the entire growing feather can be sampled at that time. All feather samples are sent to this department for lead concentration and isotopic analysis.

Physical Exams

Under the 2017 protocol, rather than using a field blood lead test result of >35 µg/dL as the threshold to treat condors,

condors are observed and examined for clinical symptoms of lead poisoning. The field team conducted exams after trapping the birds to look for 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 are 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 are 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 recognizing potential symptoms of lead poisoning, performing diagnostic blood tests, radiographing the condor to identify possible metallic objects in the digestive system, administering chelation treatment to remove lead from the bloodstream (Photo 2.2.1), and possibly performing surgery to remove harmful lead fragments.

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 from 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 monitor 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 up to a year.

Photo 2.2.1: Los Angeles Zoo Condor Keepers prepare to chelate a lead poisoned California 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 transporting it 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).

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.

One way in which the field team detects mortalities is by using VHF transmitters attached to each condor. All deployed VHF transmitters have a 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 (i.e., 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 of more than a day or two 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. 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 (Photo 2.3.1). These flights are conducted independent of the Service and do not involve Service personnel.

Photo 2.3.1: Telemetry equipment attached to an airplane, as seen from a LightHawk flight over California condor habitat. *Photo credit: Erin Arnold, Santa Barbara Zoo*.

Condor chick mortalities are detected through routine nest monitoring (see: 2.4 Nest Management). 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 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 (i.e., 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: Stephanie Herrera, USFWS Volunteer.*

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 mounted inside of the nest cavity (Photo 2.4.3). The make and model camera used in 2018 was the Axis P3367-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.

Photo 2.4.3: Nest camera and microphone installed at California condor nest, PC18. *Photo credit: Joseph Brandt, USFWS.*

The 2018 season was also the first time the field team deployed a cross-canyon camera (Photo 2.4.4). The make and model camera used in 2018 was the Axis P5635-E Mk II PTZ Dome Network Camera. This camera was installed directly across from the nest cavity on the opposite side of the canyon and provided a view of the outside of the nest cavity and the surrounding cliff face. This allowed the field crew to monitor the newly fledged chick outside of the nest for the first time via camera, providing greater insight into fledgling behavior. As with nest cavity cameras, not all canyons are suitable for cross-canyon cameras. Adequate installation locations across from the nest cavity may not be present or may be too far away.

Photo 2.4.4: A USFWS condor field biologist stands next to the newly-installed cross-canyon camera. *Photo credit: Nadya Seal Faith, Santa Barbara Zoo.*

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.

Nest Entries

The field team also monitors condor nests with regularly scheduled nest entries (Photo 2.4.5). 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. 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 microtrash during each entry. Egg shells are also collected while sifting the nest. The chick is 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 and telemetered at 120 days of age. Nest cameras allow the chick's development and health to be monitored remotely so chick exams prior to handling 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 2.4.5: Los Angeles Zoo Lead Condor Keeper, Chandra David, handles California condor #926 at nest TC18. The 60-day-old chick was kept calm by blocking its vision with a modified sock. *Photo credit: Molly Astell, 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 support 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 or recycling. 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 after 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: 2.5 Captive Releases and Transfers). We aim to understand if fledglings are integrating into the population, displaying normal behavior, and continuing to receive parental care through observation and telemetry tracking of the young condor.

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 three to five 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: Captive California condor #859 inside the Bitter Creek NWR flight pen, where she and the other captive birds are able to acclimatize and interact with the wild population before release. Kern County, California. *Photo credit: Nicole Durtschi, Great Basin Institute.*

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 are provided educational interpretation while watching 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 page (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 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, art, and math (also known as STEAM) 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). The Complex and the Santa Barbara Zoo are working to develop curriculum for 7th and 8th grade, along with a CondorKids Field Guide coloring book.

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 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 and clinics, conducting shooting events, 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 for hunters and shooters to help inform about how to make 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 Group, and presents to local schools. When possible, the Service accommodates media requests and contributes to several social media outlets and scientific publications.

3.0 Outcomes

3.1 Monitoring Resource Use

GPS Transmitter Locations

In 2018, 81 of 91 condors in the Southern California condor population wore GPS transmitters for at least part of the year. GPS transmitter data produced 3,022,405 locations. Ten condors wearing MTI transmitters produced 731,211 locations and 71 condors wearing CTT transmitters produced 2,291,194 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 9,536 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 Big Mountain near the city of Moorpark in Ventura County, east to the southern Sierra Nevada Range in Kern and Tulare Counties, and to the north near the town of Mariposa in Mariposa County. This marks the northernmost extent of condors from the southern California population have reached since the reintroduction. 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 extent of the population's range in 2018. 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 3.1.1). Though less than the Tehachapi Mountains or the southern Sespe Wilderness, condors also concentrated activity near Bitter Creek NWR. The concentration of activity in the foothills of the southern Sierra Nevada Mountains north of the town of Glenville continues to increase and has become a the primary roosting and foraging area during the summer months.

Activity near Wind Turbines

Sixty-eight of the 81 condors wearing GPS transmitters were detected within two miles of industrial energy producing wind turbines in the eastern Tehachapi Mountains in 2018 (Table 3.1.1; Figure 3.1.2). Condor activity within two miles of turbines occurred every month of the year except March. All but two individuals of the 68 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 (29 days; n = 29 condors) than the second half of the year (130 days: n=67 condors). The most active months of condor use of the area in 2018 occurred in September and October, and the highest number of condors detected in a single day was 48

condors on September 26. The number of condors detected by GPS in close proximity to operational wind energy facilities increased from 52 condors in 2017 to 68 condors in 2018, this marks a 10% increase (74% in 2017 and 84% in 2018).

Nest Distribution

Condor nesting activity in 2018 occurred on public and private land. A total of 12 nests were confirmed, the highest number of nests on record since the recovery program was initiated. Five nests were located on the Los Padres National Forest, four of which were in the Sespe Condor Sanctuary and Wilderness. The fifth was located in the San Rafael Wilderness in Santa Barbara County, which was the first successful nesting attempt in Santa Barbara County since the 1980s. One nest was located on the southwest portion of Hopper Mountain NWR. Three nests were located on private property just south and west of the Hopper Mountain NWR border. Three nests were located in Kern County. One was located on the Wind Wolves Preserve, managed by The Wildlands Conservancy east of Bitter Creek NWR. The second nest was located on private land in the Tehachapi Mountains. The third was on Sequoia National Forest land in the Kern River Canyon and marks a significant range expansion in condor nesting. (Figure 3.1.3).

.

Non-Proffered Feeding

The field team confirmed five non-proffered (i.e., not provided by the field team) feeding events in 2018 (Table 3.1.2). Two of these carcasses were cows, one was a deer, and the other two were unknown (Photo 3.1.1). 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 2018. Many clusters of GPS locations (that often indicates feeding events) were not ground-truthed due to accessibility (private land) or 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: 2018 condor activity within two 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
77	Y	9
98	Y	26
156	Y	43
161	Y	30
247	Y	50
262	Y	25
289	Y	35
326	Y	14
369	Y	11
374	Y	36
457	Y	36
462	Y	28
467	Y	20
480	Y	21
483	Y	25
487	Y	44
493	Y	23
509	Y	29
513	N	1
518	Y	27
526	Y	4
542	Y	25
563	Y	23
568	Y	23
570	Y	17
576	Y	25
585	Y	23
590	Y	38
594	Y	30
596	Y	17
599	Y	38
604	Y	30
616	Y	38
627	Y	49
636	Y	24
642	Y	22
648	Y	32
654	Y	26
666	Y	20
676	Y	41
712	Y	45
730	Y	27
732	Y	38
733	Y	25
737	Y	46
740	Y	36
748	Y	38
749	Y	37
755	Y	37
771	Y	26
772	Y	24
774	Y	53
784	Y	37
791	Y	35
794	Y	38
796	Y	19
805	Y	24
807	Y	35
811	Y	30
816	Y	21
818	Y	25
819	Y	22
839	Y	35
846	Y	31
871	N	1
895	Y	12
949	Y	8
Total	**66 (Y)**	**157 (days with at least one condor <2 miles from wind turbines)**

Table 3.1.2: Confirmed non-proffered feeding events in current (2018), years prior (2008-2017), and all years (2008-2018) 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 2018		Years Prior 2008-2017		All Years 2008-2018	
Cow	2	40%	59	33%	61	33%
Ground Squirrel	0	-	3	2%	3	2%
Elk	0	-	4	1%	4	2%
Pig	0	-	58	33%	58	33%
Deer	1	20%	25	13%	26	14%
Horse	0	-	8	5%	8	4%
Sheep	0	-	7	3%	7	4%
Unknown	2	40%	7	3%	9	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	1%	1	1%
House Cat	0	-	1	1%	1	1%
Total	5		179		184	

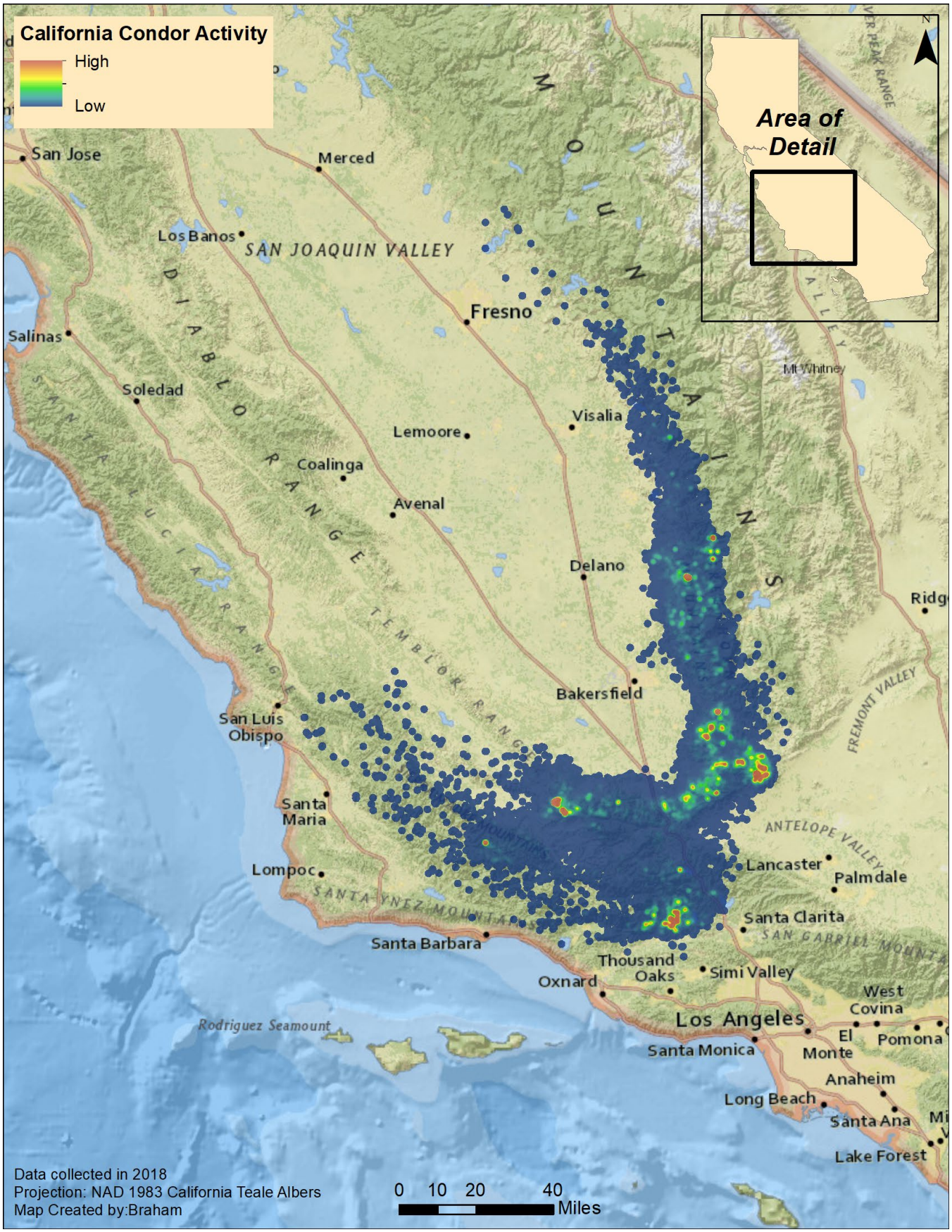


Figure 3.1.1: Southern California condor activity in 2018 estimated using a fixed kernel density estimate (KDE) for all California condors wearing GPS transmitters. KDE averaged across individuals (n=82) using a neighborhood of one kilometer (cell size = 100 meters) and stretched using two and a half standard deviations. KDE provided by Melissa Braham, Survey Technician (Division of Forestry and Natural Resources, West Virginia University).

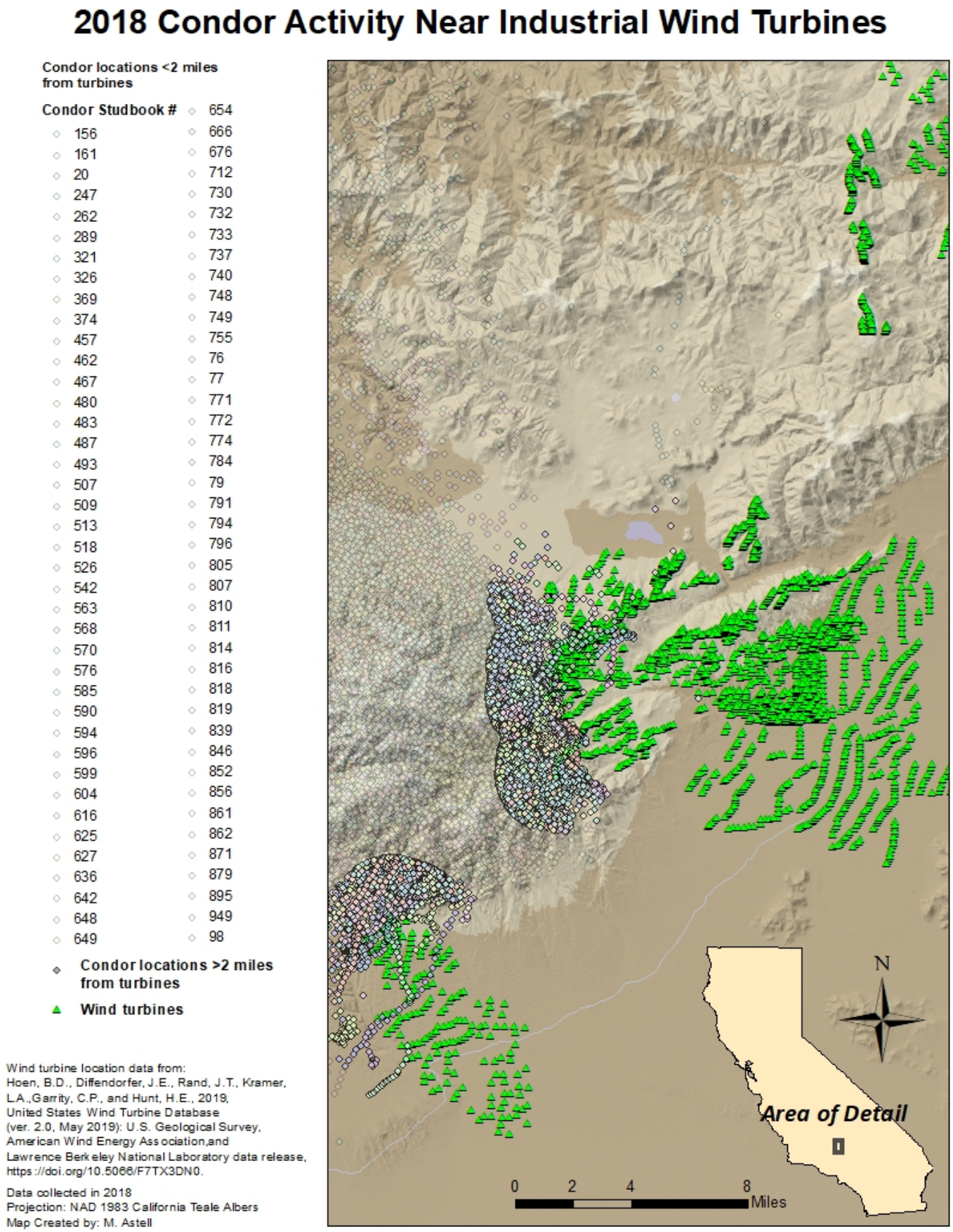


Figure 3.1.2: 2018 California condor locations near industrial wind turbines. 68 of the 81 condors wearing GPS transmitters (84%) flew within two miles of an operational turbine in the Tehachapi Wind Resource Area in Kern County, California.

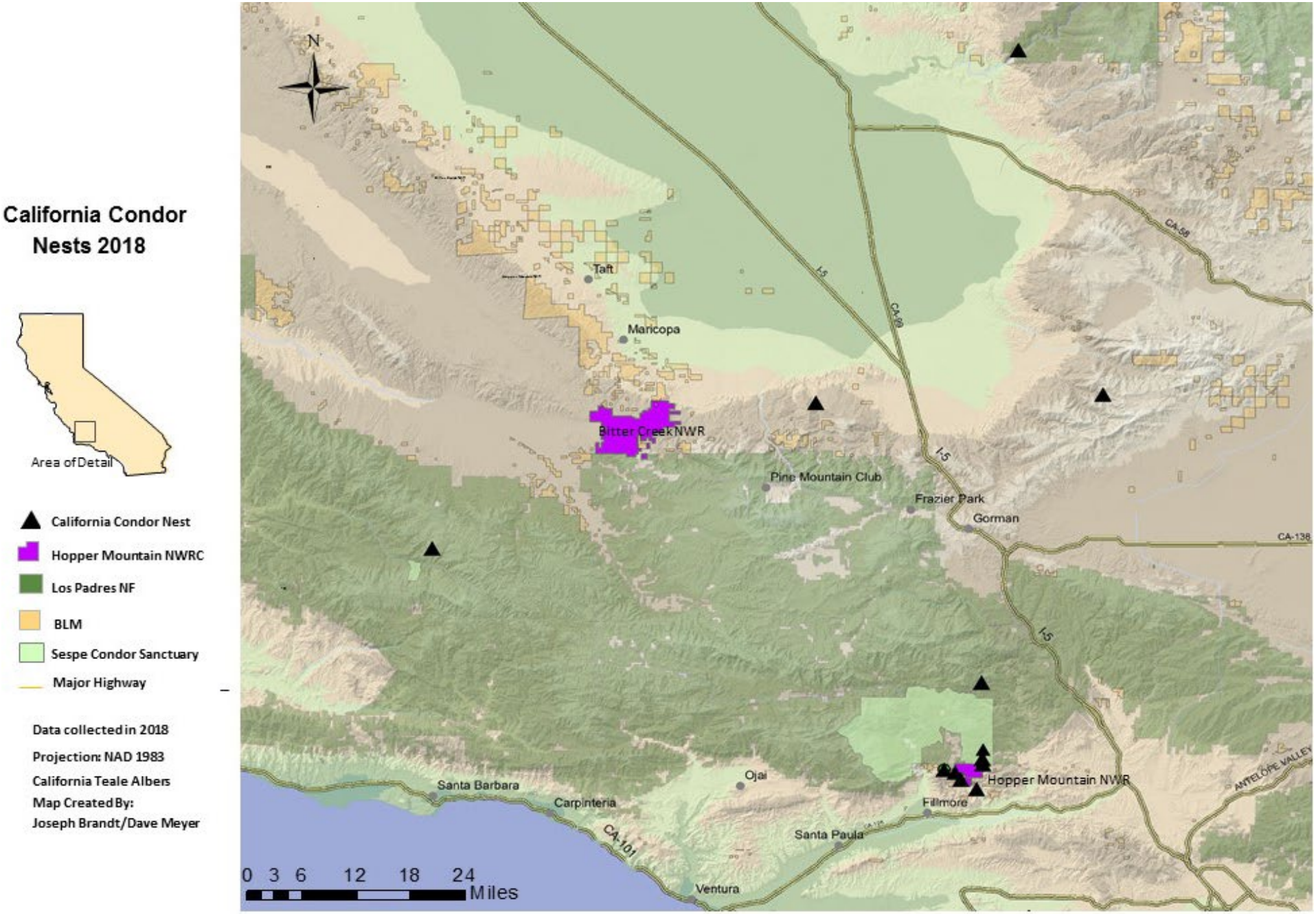


Figure 3.1.3: Locations of California condor nests in Southern California during 2018 (n = 12 nests).

3.2 Lead Monitoring and Mitigation

Trapping Effort

The end of the 2017 trapping session was delayed slightly, so eight birds were trapped and processed in January of 2018. The results from those birds were included in the 2017 report and will not be included here. The first official 2018 trapping session to monitor for blood and feather lead levels began in May of 2018 and finished at the end of July, with the last condors being handled on August 1. Trapping began again for the second period in November and continued through mid-December, with the last birds being handled just a few days later on December 18. The trapping period ended earlier than planned due to the government shutdown of operations.

The field team and volunteers spent approximately 600 hours attempting to trap condors in 2018. During each trapping period, team members and volunteers spent approximately five to seven days per week in trap blinds (Photo 3.2.1).

Trapping Success

During the two 2018 trapping periods, 62 of the 79 (78%) targeted condors were trapped, down from 87% in 2017 (Table 3.2.1). There were 79 trappable condors, which differs from the end of the year population size of 91. 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 of 2018, 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 18 separate days in 2018 with 1 to 15 condors handled on each occasion. Eleven of these handling days occurred during June through July and seven occurred during November through December. As mentioned earlier, one day in January was spent handling condors from the remaining 2017 fall trapping session. Each condor requires about 30-45 minutes of handling time. Depending on the number of condors needing to be handled, between 2 to 10 biologists assisted at each handling event.

Photo 3.2.1: Condors feeding inside the walk-in trap at the Bitter Creek NWR flight pen as seen from inside a trapping blind, Kern County, California. *Photo credit: Laura Echavez, Great Basin Institute*

Blood Lead Test Results

Sixty-two condors in the Southern California population were tested a total of 101 times in 2018 (excluding wild chicks). Twenty-five condors were tested once in 2018, Thirty-five condors were tested twice, and two condors were tested three times. Similar to 2017, the largest proportion of the blood lead test results in 2018 fell within the 31 to 100 µg/dL range (Figure 3.2.1). This differed from years previous to 2017, as well as the five-year average, where the largest portion of results was within the 11 to 30

µg/dL range. The number of results >100 µg/dL was still higher than most previous years, but was less than 2017. When using the highest lab blood lead level for each condor tested, 61 of the 62 condors (98%) had blood lead levels above 10 µg/dL.

The field team tested the blood lead level of five wild condor chicks eight times during the 2018 nesting season. At 60 days of age, condor chick #926 had a blood lead level of 27 µg/dL, #938 had a blood lead level of 5.9 µg/dL, and #950 had a blood lead level of 14 µg/dL. Condor chicks #923 and #925 both had blood lead levels of 28 µg/dL when tested at 120 days of age. Condor chicks #926, #938, and #950 were also tested at 120 days old and had the results of 29 µg/dL, 22 µg/dL, and 10 µg/dL respectively.

Treatment

The field team only transported one condor to the Los Angeles Zoo for veterinary care and treatment because she 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 to the new treatment protocol starting in 2017 (see 2.2 Lead Monitoring and Mitigation). 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 2018 would have been much higher. Using the 2018 lab blood lead level results to estimate the previously used protocol's field lead level of 35 µg/dL, 34 condors would have been treated for lead exposure 34 times.

On November 23, the field team noticed that #730 had not moved for a number of days based on her GPS locations. The field team located the bird and observed symptoms of lead poisoning. #730 was trapped and transported to the Los Angeles Zoo where lab tests determined her blood lead level to be 400 µg/dL. The Los Angeles veterinary team performed surgery to remove a large lead fragment from the gastrointestinal tract, and the bird began chelation therapy. Despite treatment, she did not recover and died on December 11. Prior to her discovery in the field and subsequent death, #730's blood was drawn and sent for lab testing during a routine work-up in May. At that time, her blood lead level came back at 31 µg/dL.

Table 3.2.1: Comparison of California condors trapped at Bitter Creek and Hopper Mountain National Wildlife Refuges between sessions and in total for 2018. 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 (2018)	Number of Individual Condors Targeted	Number of Individual Condors Trapped	Percentage of Targeted Condors Trapped
Jan - Jul	76	56	74%
Aug - Dec	70	42	60%
Total	79	62	78%

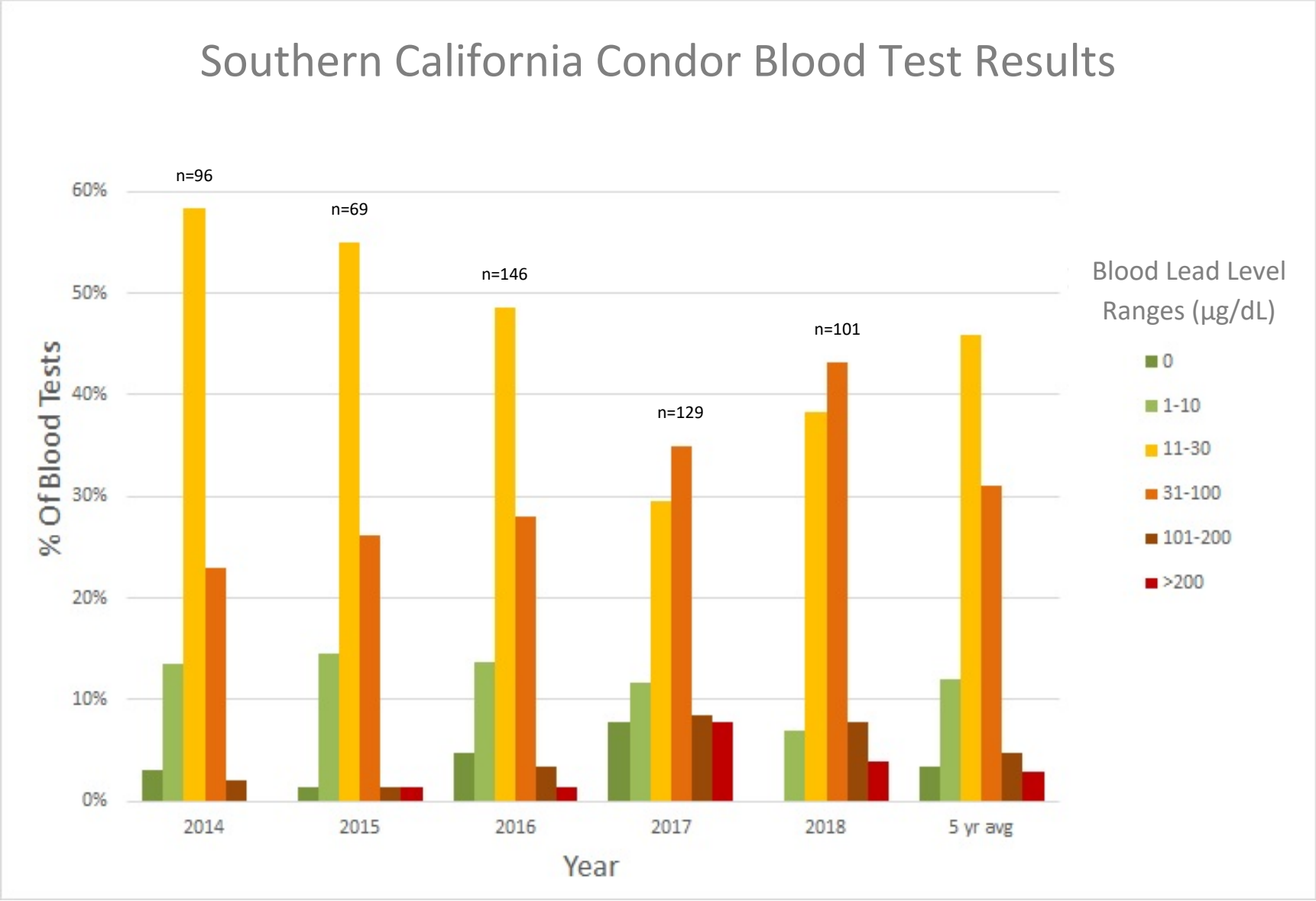


Figure 3.2.1: Summary of the Southern California population of condor blood lead levels by year from 2014-2018 and the 5 year average (2014-2018). All of the lead values represent lab blood lead values. Values returned as "not detected" are indicated by zero. Number of tests performed on the Southern California population of condors each year represented as "n" for each year.

3.3 Detecting Mortalities

Nine free-flying condors and three chicks died in Southern California during 2018 (Table 3.3.1). In addition to these deaths, one condor went undetected in the wild for greater than a year and is presumed dead with an approximate death date in 2017 (dates of last detection). Of the 2018 mortalities, three condors died of lead toxicosis, three went missing in the wild and are presumed dead, two condors died of gunshot wounds, one condor died of emaciation, one condor died of a bacterial infection, one condor's cause of death is undetermined but suspected to be lead toxicosis, and one was euthanized due to several broken bones.

Death of Condor #76

Condor #76 was discovered dead outside of the Bitter Creek flight pen on September 02, 2018. Her neck was partially pulled into the flight pen through the wire mesh netting. There were also a number of body feathers located on the inside of the flight pen adjacent to where Condor #76's carcass was located. The field team conducts morning and evening checks at the flight pen, and discovered the bird shortly after death the following morning. Postmortem examination revealed she died of emaciation, which likely began well before the bird became entangled.

Death of Condor #507

Condor #507 was discovered dead on private property in Bear Valley Springs, California. Bone lead levels were highly elevated at 170.56 ppm, and post-mortem findings noted metal particulates in the crop and ventriculus. However, due to the state of decomposition, there was no liver available to be tested that may have provided valuable information about any recent lead exposure.

Death of Condor #513

The field team went to look for condor #513 after the GPS data uploaded from the same location multiple days in a row. The condor was found dead on the Tejon Ranch property (Photo 3.3.1). Postmortem examination revealed a high bone and liver lead level, 67.23 ppm and 636 µg/g respectively, and lead fragments in the crop and ventriculus. The cause of death was determined to be lead toxicosis.

Photo 3.3.1: California condor #513 fresh carcass, Kern County, California. *Photo credit: Dave Meyer, Santa Barbara Zoo.*

Death of Condor #526

Condor #526 was recovered in Kern County on private property after the field team noticed her GPS locations had not moved over four days. They noticed a small puncture in the abdomen, and the necropsy found the cause of death to be from a gunshot wound.

Death of Condor #625

The field team went to look for condor #625 after her GPS had uploaded from the same location several days in a row. They were given permission by the landowner to access private property, and found the desiccated carcass with feathers and tissue intact. According to the necropsy report, the cause of death was from a gunshot wound.

Death of Condor #649

Condor #649 was found dead on the Wind Wolves Preserve, Kern County, California on January 30, 2018. He had been released into the wild for the first time on December 14, 2017, and was closely tracked through GPS, VHF, and visual observations. Despite flying to and over several proffered carcasses, some of which were brought directly to the bird's location, condor #649 was never observed feeding. The field team noted that condor #649 felt underweight upon recovery of the carcass, and the weight at necropsy was 10.6 lbs. According to the necropsy report, the cause of death was from bacterial infection.

Death of Condor #730

The field team went to look for condor #730 after the GPS had uploaded from the same location for multiple days in a row. They located the bird in a draw on Bitter Creek NWR, and captured her. The condor was transported to the Los Angeles Zoo and underwent surgery to remove lead fragments from her ventriculus. Condor #730's symptoms included crop stasis, which indicative of lead poisoning, and she was given chelation treatment but was unable to recover. The necropsy revealed a bone lead level of 19.32 ppm and a liver lead level of 25.45 µg/g, and lead toxicosis as the cause of death.

Death of Condor #814

The remains of condor #814 were heavily scavenged and found in what appeared to be a predator cache at Hopper Mountain NWR. The postmortem examination revealed highly elevated bone lead of 33.62 ppm. A necropsy was unable to confirm a cause of death and reports it as undetermined due to the remains being scavenged, but it is suspected to be lead toxicosis.

Death of Condor #925

Condor chick #925 was evacuated from the nest due to an apparent wing injury noticed after a nest entry, and was later euthanized at the Los Angeles Zoo by the veterinarians after they determined the wing could not be repaired with surgery (see 3.4 Nest Management). The necropsy revealed that the chick had multiple bone fractures throughout his body that had occurred at different points during his development and were at various stages of healing. The wing that was injured and triggered the emergency evacuation had broken several weeks prior, and likely was re-injured during the initial nest entry. In addition, the necropsy revealed microtrash in the gastrointestinal tract of condor chick #925.

Missing Condors

One free-flying condor and two chicks went missing in the wild and were declared dead in 2018. Adult condor #237 went missing in the wild, last seen on the PC18 nest camera on May 1, 2018 (Photo 3.3.2). Due to his status as a breeding adult related to an active nest that was well-monitored via camera, condor #237 was declared dead before the one-year mark. The two 2018 chicks that went missing from their nests were #924 and #932 on May 16 and May 2, 2018, respectively. The field team made an effort to locate their remains, but was unsuccessful.

One condor whose last detection was in 2017 was also declared dead in 2018. Condor #797 was last detected via VHF signal 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. This mortality was reported in the 2017 California Condor Recovery Program Annual Report due to the author's knowledge at the time and the delay in publication of the document, but is included here for sake of consistency in reporting. Without the carcasses, the cause of death for these four condors remains unknown.

Photo 3.3.2: One of the last views captured by the nestcam of California condor #237 and his chick, #924. *Photo credit: USFWS.*

Table 3.3.1: California condor mortalities within the Southern California population in 2018

Studbook ID	Sex	Hatch Date	Mortality Date	Cause of Death	Location of Death
76	F	23-Mar-92	2-Sep-18	Emaciation	CA; Bitter Creek NWR
237	M	22-Mar-01	28-May-18	Missing in the wild	CA
507	F	10-Apr-09	4-Jun-18	Lead toxicosis	CA; Bear Valley Springs
513	F	17-Apr-09	20-May-18	Lead toxicosis	CA; Tejon Ranch
526	F	04-May-09	8-Jul-18	Shot - gun	CA; Kern County
625	M	21-May-11	15-Apr-18	Shot - gun	CA; Tulare County
649	M	24-Apr-12	26-Jan-18	Disease bacterial infection	CA; Wind Wolves Preserve
730	F	15-Apr-14	11-Dec-18	Lead toxicosis	CA; Los Angeles Zoo
797	M	9-May-15	6-Apr-17	Missing in the wild	CA
814	M	1-Apr-16	10-Jan-18	Undetermined, lead suspected	CA; Hopper Mountain NWR
924	UNK	9-Apr-18	16-May-18	Missing in the wild	CA; Hopper Mountain NWR
925	M	10-Apr-18	21-Aug-18	Trauma; euthanized	CA; Los Angeles Zoo
932	UNK	27-Apr-18	2-May-18	Missing in the wild	CA; Hopper Mountain NWR

3.4 Nest Management

The first egg of the 2018 nesting season was laid on January 18, and the nesting season ended on November 20, when the last chick of the season fledged. There were 12 active nests during the season (Table 3.4.1), the highest number of recorded nests for a breeding season in southern California since the program began. Four of this year's breeding pairs had nested previously as pairs. Eight were first-time pairs. Two of these first-time pairs established new territories in Kern County, resulting in a significant northeastern expansion of the range of recent nests in Southern California.

One of the male condors of the returning pairs was #20, a 38 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 in captivity, producing young condors for reintroduction and the captive flock. This was his second nesting attempt in the wild and his first successful wild fledge. His mate, #654, was also wild-fledged, making their chick the first second-generation wild-fledged chick of the southern California flock.

This was the first ever breeding attempt for 11 of the condors that paired this year. This included a 13-year-old male, 10-year-old male, two 10-year-old females, an 8-year-old female and male, a 7-year-old male and three 7-year-old females, and a 6-year-old female.

Nesting Success

Nesting success, calculated as the total number of chicks fledged 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). Six of the 12 nests in 2018 had chicks that fledged, resulting in 50% nesting success.

Table 3.4.1: California condor nesting attempts and outcomes for the 2018 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
LW18	16-Mar	247	156	FW118	18-Jan	NA	NA	1	Failed, 16-Mar
HB18	1-Mar	374	289	FW218	7-Feb	6-Apr	923	2	Fledged, 2-Oct
OM18	15-Mar	326	518	FW318	12-Feb	10-Apr	925	5	Failed, 21-Aug
PC18	19-Feb	237	563	FW418	11-Feb	9-Apr	924	4	Failed, 17-May
TC18	7-Mar	462	594	FW518	15-Feb	13-Apr	926	3	Fledged, 23-Oct
HC18	17-Mar	509	161	FW618	18-Feb	16-Apr	950	4	Fledged, 5-Nov
AB18	NA	585	493	FW718	19-Feb	NA	NA	0	Failed, 27-Mar
LB18	30-Mar	20	654	FW818	27-Feb	29-Apr	933	1	Fledged, 24-Oct
WW18	29-Mar	369	483	FW918	27-Feb	25-Apr	938	3	Fledged, 25-Oct
KG18	31-Mar	360	596	FW1018	26-Feb	27-Apr	932	2	Failed, 2-May
ST18	8-May	457	507	FW1118	6-Mar	NA	NA	0	Failed, 14-Apr
3C18	18-Apr	590	604	FW1218	3-Apr	30-May	953	0	Fledged, 20-Nov

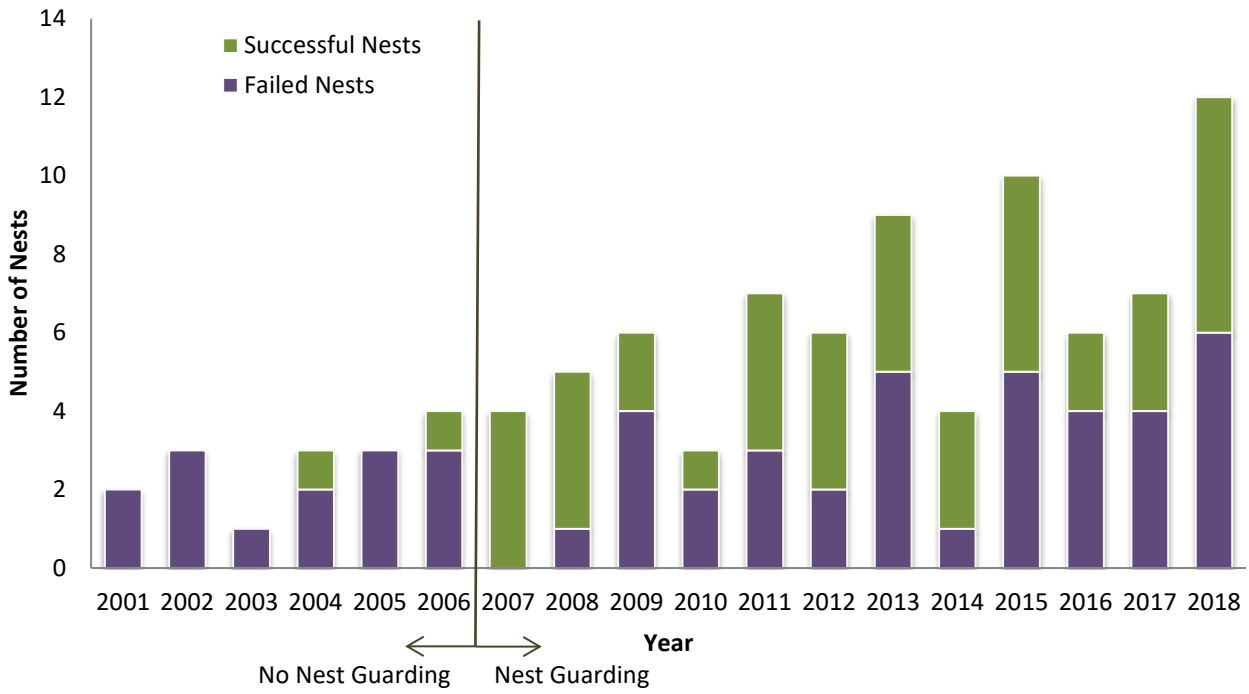


Figure 3.4.1: California condor nesting success in Southern California before and after implementation of the Nest Guarding Program (2001-2018). Nests are defined by pairs or trios of condors that produce at least one egg. Nesting success is any nest where a chick fledges from the nest.

Nest Observations

In 2018, condor nests were observed over the course of the breeding season using direct observation via spotting scopes, binoculars, and/or nest cameras. Nest cameras were used for monitoring three of the nests: HB18, OM18, and PC18. HB18 was observed with a nest camera that was streamed live online to a worldwide public audience through a partnership with Cornell Lab of Ornithology, while OM18 and PC18 were also observed with nest cameras but were accessible only to the field team on a local network at Hopper Mountain NWR. The camera for HB18 was installed in 2016 during a previous nesting attempt. The PC18 camera was installed during the first nest entry and recorded the hatch of the chick a few days later. The OM18 camera was installed during the 60-day chick health check nest entry.

Chicks and fledglings were directly observed for a total of 946 observation hours taking place over 261 observer days. Unpaid volunteer observer hours accounted for 38% 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 192 hours reviewing 5,274 hours of video footage.

Table 3.4.2: California condor nest observation hours in 2018 by personnel type.

Personnel Type	Observation Hours
Service Staff	13
Santa Barbara Zoo Staff	247
GBI Research Associates	320
Unpaid Volunteers	366
Total Observation Hours	946

Nest Entries

The field team performed 25 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 21 of these entries, Los Angeles Zoo staff assisted with two entries, and the Oregon Zoo and the World Center for Birds of Prey staff assisted with one entry. In lieu of more frequent nest entries, nest cameras were a useful tool for monitoring and ensuring proper chick development.

Nest Fates

Condor nest LW18 was entered once during the egg stage. A rotten egg was discovered indicating the egg was infertile. The entry team removed and collected the egg in an effort to prompt the pair to lay another egg in the 2018 breeding season, but condors #247 and #156 did not recycle and attempt to nest again. This was their third known nesting attempt.

Condor nest HB18 was entered on two occasions. The first entry was to check the fertility of the egg and to make adjustments to the nest camera. Through candling of the egg it was determined to be fertile. The nest was entered again to tag the chick, #923, when it was 125 days old. The field team also took a blood sample to test for sex and lead exposure, and administered a West Nile virus vaccine. Concurrent to this last entry the field team also installed a cross-canyon camera. Condor #923 fledged on October 2, 2018 and was monitored for the following month via the Cross-Canyon Camera to ensure that the fledglingwas capable of flight and continued to receive care from its parents. This was condor #374 and #289's first nesting attempt together as a pair and their first successful fledge.

Photo 3.4.1: Los Angeles Zoo Senior Condor Keeper, Chandra David, ascends up from the entrance of California condor nest TC18. *Photo credit: Molly Astell, USFWS.*

Condor nest OM18 was entered five times while the nest was active: three per standard protocol, one for camera maintenance, and one in response to an injury noticed by observers on the nest camera video.

The field team discovered a freshly hatched, 2-day-old chick on the first entry, condor #925. The second entry occurred just after the chick turned 60 days old, and the field team took a blood sample to test for sex and lead exposure,

and administered a West Nile virus vaccine. The field team installed a nest camera during this entry. The third entry immediately followed the second entry due to camera installation issues, which were fixed. The fourth entry was performed when #925 was 128 days old. During this entry the field team tagged #925, took a blood sample to test for lead exposure, and administered a West Nile virus vaccine. However, there was a small struggle when the chick suddenly and quickly attempted to lunge past the entry team for the entrance of the cave. To keep the chick from jumping out of the cave before it had the ability to fly, the entry team blocked the exit and properly restrained the chick. The team closely monitored the chick during the rest of the entry and checked that the chick had normal range of motion and use of its limbs, no signs of injury were present in that moment.

Over the next few days after the fourth entry, observers viewed the chick via the live-streaming camera and saw that it was not holding its wing properly. It progressively became worse until eventually the wing was fully drooping to the side of the chick. A critical response entry was performed five days after the previous entry to evacuate the chick to the Los Angeles Zoo and determine the extent of the chick's injuries (Photo 3.4.2).

Veterinarians at the Los Angeles Zoo found the chick had a broken humerus, a broken toe, and a lead particle in the gastrointestinal tract. The injury of the humerus was in such a position that the wing would not be able to be repaired. The Los Angeles Zoo staff decided euthanasia was the best and most humane option for the chick. The chick was euthanized on the same day, August 21, 2018. Later, the necropsy report revealed that the chick had previously broken its wing at least two weeks earlier in that same location on the humerus and it was healing. In addition, post-mortem examination revealed multiple fractures throughout the body including rib fractures, all of which occurred at various times during the chick's development. Lastly, 212 grams of microtrash was found in the ventriculus, though the chick had normal development of fat and muscle tissue.

Photo 3.4.2: The field team works together to carefully transport condor chick #925 up to the vehicle staging area, where it can be transported to the Los Angeles Zoo for medical evaluation. *Photo credit: Nadya Seal Faith, Santa Barbara Zoo.*

The chick never appeared to have an injury on the live-streaming camera, so the moment of the initial wing injury was not observed, nor was its existence known. However, the camera review notes mention that the cave was quite small and the growing chick would often hit its wings on the side of the cavity during hop-wing-flap. The chick would often squat down before engaging in a wing-flap to allow himself more room. Ultimately, the injury was re-broken

during the fourth entry resulting in euthanizing the chick. This was condor #326 and #518's second nesting attempt.

Condor nest PC18 was entered four times: one per standard protocol, two for camera maintenance, and one in critical response. The field team found a pipped and hatching egg on their first entry to install the nest camera. The microphone of the camera was not functioning properly and two more nest entries were conducted to address this issue.

The chick appeared normal and healthy via the live-streaming camera, however, one of the parents, condor #237, was last seen on camera on May 1, 2018 and later declared to be dead and missing in the wild. The field team considered the options of allowing the sole parent, female #563, to raise the chick alone or to bring the chick into captivity to give it a better chance of survival. The field team decided to wait a short period of time to see if condor #237 would return to the nest before making the decision to take the chick into captivity, since condor #563 was adequately caring for the chick on her own during the interim.

On May 17, 2018, condor #563 was sitting towards the left of the cave entrance from the camera view, and the chick was in the cave. The chick walked across the field-of-view of the camera toward the right side of the cave entrance and was not seen again. It is possible the chick fell out of the nest. A critical response entry was performed five days later, but no chick or chick remains were found in or below the nest. This was condors #237 and 563's first nesting attempt together as a pair.

Condor nest TC18 was entered three times, all per standard protocol. At the first entry, the field team discovered a recently hatched 7-day-old chick, condor #926. The second entry occurred just after the chick turned 60 days old. The field team took a blood sample to test for sex and lead exposure and administered a West Nile virus vaccine. The field team entered the nest a final time to tag the chick when it was 124 days old. During this last entry, the field team also took a blood sample to test for lead exposure, and administered a second course of West Nile virus vaccine. Condor #926 fledged on October 23, 2018 and was monitored for the following month via in-field observations to ensure that it was capable of flight and continued to receive care from its parents. This was condor #462 and #594's first nesting attempt together as a pair and their first successful fledge.

Condor nest HC18 was entered four times, all per standard protocol. The first entry was a fertility check and the field team determined the egg to be fertile through candling. The second entry occurred just after the chick turned 60 days old. The field team took a blood sample to test for sex and lead exposure and administered a West Nile virus vaccine. The chick appeared healthy and developing normally, but more than 40 pieces of microtrash were discovered in the nest cavity. As per nest guarding protocol, the field team would need to do an additional entry at 90 days to perform an additional chick health visit and check for and remove any additional microtrash. On the 90-day check, the chick still appeared healthy and developing correctly, and the nest had fewer pieces of microtrash. The last

entry was to tag the chick, #950, when it was 129 days old. The field team also took a blood sample to test for lead exposure and administered a West Nile virus vaccine. Condor #950 fledged on November 5, 2018 and was monitored for the following month via in-field observations to ensure that it was capable of flight and continued to receive care from its parents. This was condor #509 and #161's first nesting attempt together as a pair.

Condor nest AB18 failed before the field team was able to get into the U.S. Forest Service's Condor Sanctuary and locate the physical location of the nest. The Agua Blanca nesting area was inaccessible during the winter due to road conditions. Nesting activity was confirmed via GPS when condors #585 and #493 began alternating attendance and showing gaps in GPS data, indicating they were exchanging incubation bouts. Their GPS locations were concentrated in three main areas of the Agua Blanca territory. A regular pattern of attendance dropped off on March 22, 2018, and on March 27, 2018 both #585 and #493 were observed via GPS roosting in Tejon Ranch Conservancy for the night. This inattendance of the egg would have caused the development of a possible embryo to fail if it had not already. This was condor #585 and #493's first nesting attempt together as a pair.

Condor nest LB18 was entered on one occasion. On this entry the field team discovered a pipped and hatching egg, condor #933. The pair had used this nest cavity in 2017 when the field team discovered a relatively large hole in the bottom of the cave during the last entry. Knowing this, they installed a piece of plywood over the hole on this 2018 entry. For safety reasons, and to maintain the integrity of the nest and avoid any further floor collapse, no other nest entries were conducted. Condor #933 fledged on October 24, 2018 and was monitored for the following month via in-field observations to ensure that it was capable of flight and continued to receive care from its parents. This was condor #20 and #654's second nesting attempt as a pair and their first successful fledge.

Condor nest WW18 was located in a new territory on the Wind Wolves Preserve and marks the first recorded condor nest in this area. It was entered on three occasions, all per standard protocol. On the first entry, the field team found a recently hatched 7-day-old chick, condor #938. The second entry occurred just after the chick turned 60 days old. The field team took a blood sample to test for sex and lead exposure and administered a West Nile virus vaccine. Condor #938 was tagged on the last entry at 125 days old. The field team also took a blood sample to test for lead exposure and administered a West Nile virus vaccine. Condor #938 fledged on October 25, 2018 and was monitored for the following month via in-field observations to ensure that it was capable of flight and continued to receive care from its parents. This was condor #369 and #483's first nesting attempt together as a pair and their first successful fledge.

Condor nest KG18 was located in a new territory in Sequoia National Forest along the Kern River Gorge and Highway 178. This marks the northernmost recorded nest in the southern California reintroduced flock

thus far. It was entered on two occasions. The field team discovered a pipped egg on the first entry, condor #932. The second entry occurred just before the chick was to turn 60 days old, but when the field team arrived the chick was not present. They found no chick remains in or around the nesting area, but did collect eggshell fragments. The loss of the chick may have been due to predation given the lack of sheer cliffs and easy access to the nest. The field team was able to hike to the bottom of the nest and then safely scramble up to where it was located. During nest searching observations, condors #360 and #596 were also observed chasing off ravens on a regular basis, which could have also predated the chick. This was condor #360 and #596's first nesting attempt together as a pair.

Remote condor nest ST18 was located on the property of the Tejon Ranch Conservancy. It took the field team several months before nest searching could commence for condor nest ST18, largely due to inclement weather and unsafe road conditions early in the nesting season. No nest entries were conducted at this nest as the physical location was found at the time the nest failed. Nesting activity was confirmed via GPS when condors #457 and #507 began alternating attendance and showing gaps in GPS data, indicating they were exchanging incubation bouts. However, condor #507 stopped attending, leaving condor #457 alone for several weeks to incubate the egg at the nest. Condor #507 was later recovered dead in the spring (see 3.3 Detecting Mortalities). Condor #457 eventually abandoned the nest, most likely due to hunger and lack of a mate to exchange incubation duties with, just as the nest was located. This was condor #457 and #507's second nesting attempt together as a pair.

Condor nest 3C18 was considered a remote nest and no nest entries were conducted. The field team confirmed the egg hatched when they observed the chick at the nest, and they continued to monitor through in-field observations. Condor #953 fledged on November 20, 2018 and was monitored for the following month through in-field observations to ensure that it was capable of flight and continued to receive care from its parents. This was condor #590 and #604's first nesting attempt together as a pair and their first successful fledge.

Table 3.4.3: Microtrash recovered from nests of each pair of California condors during 2002-2018 seasons. Values represent the total number of trash items collected from each nesting attempt or associated chick each year.

	Year																
Pair	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
20/654	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0*	1
21/192	-	-	109	235	1*	233	-	60	-	3*	-	164	-	244	-	-	-
21/289	-	-	-	-	-	-	-	-	-	-	-	-	-	-	104	-	-
63/147	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-
98/155	125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
98/216	-	-	-	5*	-	-	-	-	-	-	-	-	-	-	-	-	-
98/112	-	-	-	-	unk*	-	-	-	-	-	-	-	-	-	-	-	-
98/289	-	-	-	-	-	-	322	12*	-	-	-	-	-	unk*	-	-	-
100/108	54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
107/156	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-
125/111	0	44	57	43	-	43	11	10*	26	3	9*	189	16	-	-	-	-
107/112	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
107/161	-	-	unk	-	46	19	26	103	-	56	-	49	-	125	-	2*	-
206/255	-	-	-	-	-	39	-	52	32*	-	-	-	-	-	-	-	-
206/370	-	-	-	-	-	-	-	-	-	-	34	-	-	-	-	-	-
206/513	-	-	-	-	-	-	-	-	-	-	-	-	-	0	unk*	15	-
237/214	-	-	-	-	65	-	115	-	-	-	-	-	-	-	-	-	-
237/255	-	-	-	-	-	-	-	-	-	36	-	53	-	12	-	-	-
237/563	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0*
239/289	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
247/79	-	-	-	-	-	-	0	unk	0*	10	1	31	21	15*	-	-	-
247/156	-	-	-	-	-	-	-	-	-	-	-	-	-	-	72	unk*	1*
262/449	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-
326/364	-	-	-	-	-	-	-	-	-	0*	-	-	-	-	-	-	-
326/518	-	-	-	-	-	-	-	-	-	-	-	-	-	45	-	-	25
328/216	-	-	-	-	-	-	-	-	-	22	1*	3*	-	-	-	2	-
360/596	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	unk*
365/487	-	-	-	-	-	-	-	-	-	-	-	-	-	unk*	unk*	-	-
369/483	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26
374/180	-	-	-	-	-	-	-	-	-	-	66	-	46	-	-	-	-
374/79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-
374/289	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	118
457/507	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	unk*	unk*
462/594	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	105
509/111	-	-	-	-	-	-	-	-	-	-	-	-	-	93	31	-	-
509/161	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	154
585/493	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	unk*
590/604	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	unk
?/156	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-
Average	49	44	83	139	56	84	95	72	26	25	26	69	21	75	54	9	72

*Nest failed prior to the chick being 90 days of age, value was not included in the average.

3.5 Captive Releases and Transfers

In 2018, the field team released 12 captive-bred juvenile condors into the wild at Bitter Creek NWR. Additionally, two adult condors were released that had previously spent time in the wild but were brought back into captivity for health or management reasons (Table 3.5.1). In total during 2018, there were 14 condor released into the Southern California flock. One of the adults, condor #321, was initially released into the wild as a juvenile in July of 2005 in Baja, Mexico. She was recaptured to treat lead toxicity two years later. While captive, she was injured during an aggressive interaction with other captive condors, and remained in captivity as a mentor for juvenile condors for 11 years. The second adult, condor #79, was first released into the wild as a juvenile in 1992 and was brought back into captivity in July of 2017 after the field team reported her having unusual behavior, and subsequently underwent cataract eye surgery. She was released with the 2018 cohort of release candidates after an 18-month period of treatment and rehabilitation. The other 12 condors released into the wild for the first time were juveniles between one and a half and two and a half years of age. Prior to release, all 14 condors were held in the flight pen at Bitter Creek NWR for a minimum of six weeks, starting in August. This allowed them to adjust to the new surroundings and interact with other free-flying condors that were in the flight pen area. Releases occurred during the months of October, November, and December.

Transport and Husbandry

Fourteen condors intended for release into the wild were held in the Bitter Creek NWR flight pen in 2018. These condors came from the San Diego Zoo Safari Park and the Los Angeles Zoo after they cleared a health inspection.

Four condors, #810, #856, #859, and #861, were transferred to Bitter Creek from the San Diego Zoo Safari Park on August 7. On August 22, five condors (#79, #852, #864, #866, and #879) were transferred to Bitter Creek from the Los Angeles Zoo. Two days later, #862, #867, and #893 arrived at Bitter Creek from the San Diego Zoo Safari Park. Finally, #321 was transferred from the San Diego Zoo Safari Park on September 28 and #882 was transferred from the Los Angeles Zoo on November 1.

The field team conducted visual health and behavior checks on the condors in the flight pen daily and detailed four-hour observations three to five days a week. . While held in captivity, the condors were provided food and water. In case of an emergency at least one field team member or volunteer was on the Refuge at all times while birds were in the flight pen.

Condor Releases

Releases began at Bitter Creek NWR on October 5, 2018. The 14 condors were released in groups of two or three over the next two months (Table 3.5.1). Prior to release each captive condor received a health check and was fitted with a tail mounted VHF transmitter and/or a GPS transmitter and a numbered wing tag (Photo 3.5.1).

Photo 3.5.1: The field team enters the flight pen to net a young captive condor in order to perform a health check and attach tags and transmitters before releasing it into the wild the following day. *Photo credit: Nicole Weprin, USFWS*

Post Release Monitoring

All 14 birds were closely monitored after release to ensure they exhibited appropriate feeding and roosting behaviors (Photo 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 a few individuals at a time. This ensured that each condor displayed proper behavior before releasing the next group. Monitoring the newly released condors required an average of two to three people per week for approximately 10 hours per day from October 5 to December 22 (Table 3.5.2). After December 22, staff could no longer be on the refuge monitoring the birds due to the government shutdown. Partners were able to occasionally monitor the birds, primarily through VHF and GPS, around the borders of the Refuge. The field team was able to continue to provide carcasses as a food source, as this was an essential operation to support the success of the newly released birds.

Update on #649

The 2017 Annual Report made note that as of the end of the year, condor #649 (released on December 14, 2017) had yet to exhibit normal feeding and roosting behaviors. Unfortunately, and despite efforts to place food carcasses as close as possible to the bird's location, the field team never observed this bird feeding and it was found dead on January 26 of this year. Refer to 3.3 Detecting Mortalities for more information.

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 91 condors, an 11% increase to the southern California population in 2018 (Figure 3.5.1).

Photo 3.5.2: Newly released condor #893 perches on a branch while being tracked and observed by the field team. *Photo credit: Stephanie Herrera, USFWS Volunteer.*

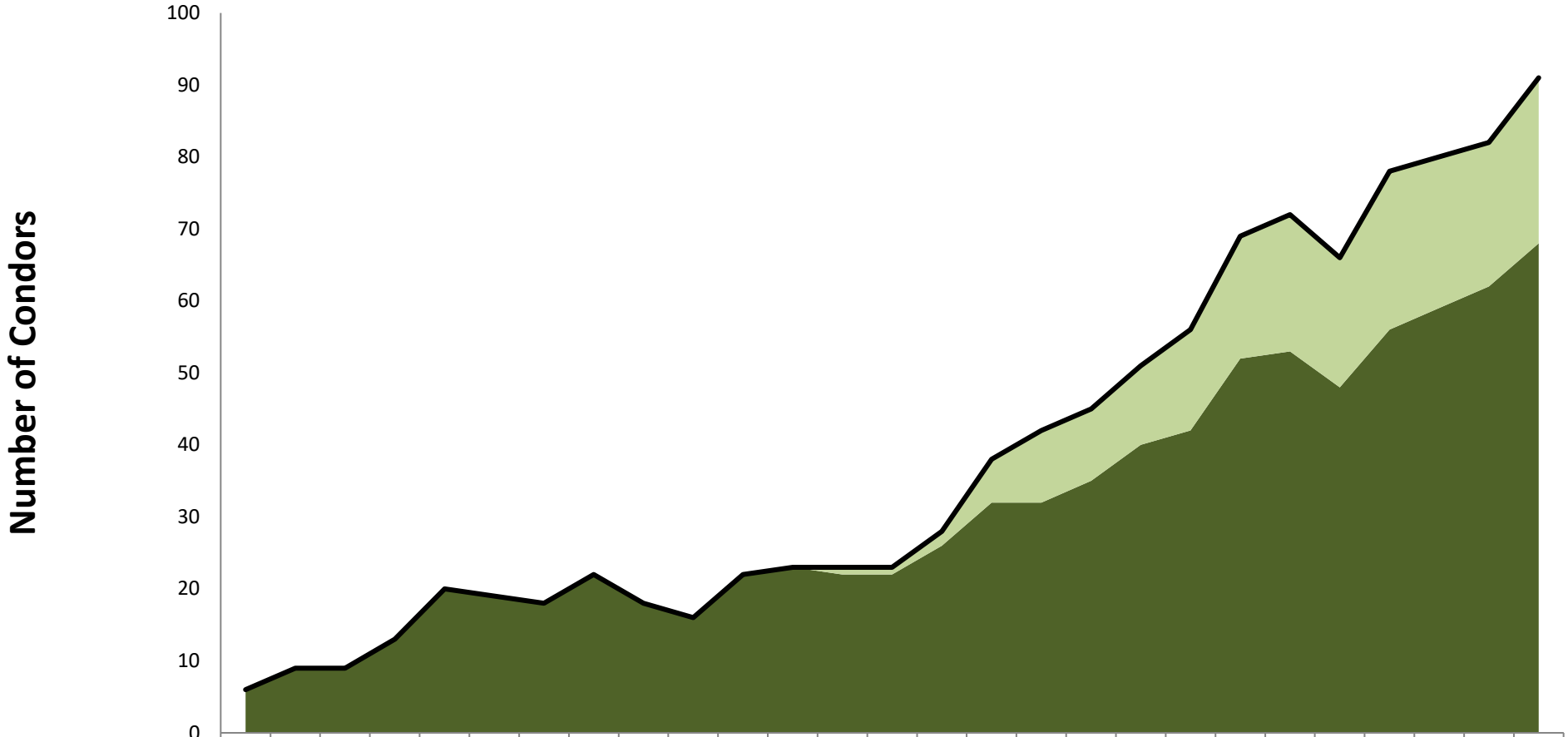
Table 3.5.1: California condors released at the Bitter Creek NWR in 2018. A successful fate indicates that the released condor was alive and remained in the wild population without having to be recaptured for 90 days following its initial release.

SB#	Sex	Hatch date	Hatch location	Transfer date	Release date	Fate	Age at Release (in years)
79*	F	18-Apr-92	Los Angeles Zoo	22-Aug-18	19-Dec-18	Successful	26.6
321**	F	19-Mar-04	San Diego Zoo Safari Park	28-Sep-18	08-Nov-18	Successful	14.7
810	F	18-Mar-16	San Diego Zoo Safari Park	07-Aug-18	05-Dec-18	Successful	2.7
852	F	8-Mar-17	Los Angeles Zoo	22-Aug-18	18-Oct-18	Successful	1.5
856	M	31-Mar-17	San Diego Zoo Safari Park	07-Aug-18	05-Oct-18	Successful	1.5
859	F	3-Apr-17	San Diego Zoo Safari Park	07-Aug-18	05-Oct-18	Successful	1.5
861	M	8-Apr-17	San Diego Zoo Safari Park	07-Aug-18	05-Oct-18	Successful	1.5
862	M	10-Apr-17	San Diego Zoo Safari Park	24-Aug-18	05-Dec-18	Successful	1.7
864	M	10-Apr-17	Los Angeles Zoo	22-Aug-18	08-Nov-18	Successful	1.6
866	F	15-Apr-17	Los Angeles Zoo	22-Aug-18	08-Nov-18	Successful	1.6
867	M	17-Apr-17	San Diego Zoo Safari Park	24-Aug-18	05-Dec-18	Successful	1.6
879	F	23-Apr17	Los Angeles Zoo	22-Aug-18	18-Oct-18	Successful	1.5
882	M	6-May-17	Los Angeles Zoo	01-Nov-18	19-Dec-18	Successful	1.5
893	M	9-Jun-17	San Diego Zoo Safari Park	24-Aug-18	18-Oct-18	Successful	1.3

SB# = Studbook Number; *released after medical treatment, trapped on June 26, 2017, **released after 11 years in captivity, original release in 2005 in Baja, Mexico.

Table 3.5.2: Field team and volunteer efforts to release captive-bred California condors in 2018 at Bitter Creek NWR.

	2018											
	January	February	March	April	May	June	July	August	September	October	November	December
Number of condors released	0	0	0	0	0	0	0	0	0	6	3	5
Approximate staff hours tracking new releases	0	0	0	0	0	0	0	0	0	540	600	440
Total number of calf carcasses provided	19	16	13	13	12	16	23	9	15	25	28	21



	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	2018
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	23
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	68
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	91

Figure 3.5.1: Number of wild California condors within the Southern California population from 1992 through 2018. 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 and recovery continued for the field team in 2018. The field team, together with partners, 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 2018, interest and engagement by the public in the Condor Cave Facebook webpage increased, with a total of 15,265 followers at the end of the year. This was a 22.5% increase as compared to 2017. The Santa Barbara Zoo staff plays the primary role in developing the content for this page, providing two to three online 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 California Condor Recovery Program.

Online Condor Nest Camera

The live-streaming condor nest camera installed in the HB18 nest cavity went live online on May 31, 2018 when the chick was 55 days old. Viewers were able to observe condors #289 and #374 raise their chick, #923. This is the first year viewers could watch from both a close-up view inside the nest, and later in the nesting season from a cross-canyon camera (Photo 3.6.1). For the first time, viewers could watch as the chick explored the world outside the nest cavity and observe the fledging process. Condor #923 fledged while on camera on October 9, 2019.

Photo 3.6.1: View of condor chick #923 and parent #374 from the cross-canyon camera, as seen by viewers on the Cornell allaboutbirds.org website. *Photo credit: USFWS.*

During the six months that the camera was online, it was viewed over 500,000 times from 120 countries and watched for 1.2 million minutes (2.3 years).

CondorKids

The CondorKids third grade curriculum was again used by the Fillmore Unified School District during the 2017 - 2018 school year. All 12 third grade classes participated, involving over 300 students. To culminate the completion of the curriculum, students and teachers took a field trip to the Santa Barbara Zoo. Each day at the zoo, 150 students were able to view captive condors on exhibit and interact with many of the field team members that provided interactive opportunities for the students, parents and teachers. Four condor related activities were offered: rock climbing, radio telemetry, using scopes and binoculars, and condor bio-facts (Photo 3.6.2).

Photo 3.6.2: CondorKids learn from a field team member 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 seven outreach activities, directly reaching 2,114 people in Southern California. These activities included staffing hunting and shooting sports event booths, providing non-lead ammunition presentations, and hosting ammunition and ballistics shooting demonstrations (Photo 3.6.3, Table 3.6.1). Topics of discussion for these activities included non-lead ammunition performance, ammunition ballistic performance, the role of hunting in conservation, current state hunting laws, 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 as well as the website huntingwithnonlead.org.

Preventing Habituation

Outreach activities were the primary means of addressing behavioral modification of California condors that are in and habituate to the Northern Tehachapi Mountain communities. The field team posted educational flyers at the Bear Valley Springs Police Department, Post Office, and Bear Valley Market. Flyers were electronically distributed via the Bear Valley Springs 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 responded to seven media outlet requests to provide information about various aspects of condor conservation. These media outlets included: an Audubon Club, Tandem Stills + Motion, local news media, a children's book author, a documentary crew, a refuge podcast, and USFWS public affairs staff (Table 3.6.2).

The field team led and assisted with 21 refuge tours in 2018. Eight tours were at Hopper Mountain NWR and 13 tours were at Bitter Creek NWR (Table 3.6.3). The tour recipients included local Audubon chapters, a young birders club, secondary schools, colleges, summer educational programs, Chumash tribe representatives, Youth Conservation

Corps, and the general public. The Friends of the California Condor Wild and Free also assisted with many of the Refuge tours.

Photo 3.6.3: Shooting demonstration performed by Institute of Wildlife Studies Non-lead Outreach Specialist at Bitter Creek NWR, Kern County, California. *Photo credit: Chad Thomas, Institute for Wildlife Studies*

In addition to the non-lead outreach presentations, information about other condor recovery efforts was provided at 17 other off-refuge locations in 2018. These activities included presentations for schools, colleges, community events or fairs, online, and conservation groups (Table 3.6.4).

Field team members were also co-authors on one article published in a scientific journal in 2018. The article titled: "Flight response to spatial and temporal correlates informs risk from wind turbines to the California Condor" was published in the journal *The Condor* in April.

Table 3.6.1: Non-Lead outreach presentations given to the public in 2018. The Institute for Wildlife Studies (IWS) non-lead outreach coordinator organized and lead these activities with assistance from others on the field team.

Description	Location	Date
International Sportsmen's Expo: 1354 contacts	Sacramento, CA	18-January
Shooting demonstration for local ranchers: 19 contacts	Bitter Creek NWR	10-February
Northern California Hunter Education Instructor Conference: 152 contacts	San Rafael, CA	24-February
Fred Hall Sportsman's Expo: 346 contacts	Bakersfield, CA	02-March
California Department of Fish and Wildlife's Advanced Hunter Education Clinic: 51 contacts	Gilroy, CA	10-March
Southern California Hunter Education Instructor Conference: 154 contacts	Carpentaria, CA	17-March
Shooting demonstration for The Wildlife Society's San Joaquin Valley Chapter: 38 contacts	Bitter Creek NWR	07-November

Table 3.6.2: Media outreach and contacts for the field team during 2018.

Description	Location	Date
Audubon Club writer toured the Refuge and interviewed members of the field team	Bitter Creek NWR	31-January
Production company Tandem Stills + Motion recorded video to be used in Condor Kids media (available online: https://www.youtube.com/playlist?list=PL7DwgqibsD_SN02yBMS1SctUUOQscjBzZ)	Hopper Mountain NWR	12-April → 13 April, 19 April
Childrens Author Sy Montgomery and Tia Strombeck visit refuge to collect content for a children's book.	Bitter Creek NWR, Hopper Mountain NWR	05-June → 08 June
CAPS Media filmed condor handling and conducted interviews	Hopper Mountain NWR	16-June
Sage Hill Productions record video of a nest entry to be used in a documentary	Hopper Mountain NWR	16-August
Refuge Radio podcast interviewed Joseph Brandt (available online: https://anchor.fm/refugeradio/episodes/Refuge-Radio---Episode-11---Joseph-Brandt-and-the-California-Condor-Recovery-Program-e2edh2/a-a5uu1k)	Ventura, CA	15-October
Public Affairs Specialist Meagan Racey attended handling and interviewed members of the field team to be used in a featured article (available online: https://www.fws.gov/cno/newsroom/highlights/2018/we_got_20/)	Bitter Creek NWR	14-November
Sage Hill Productions records video of field team near a condor nest to be used in a documentary	Los Padres National Forest, Wind Wolves Preserve	19-December → 20 December

Table 3.6.3: California condor related on-Refuge tours and activities performed by the field team and partners in 2018.

Description	Location	Date
Refuge tour for public with Friends of the California Condor Wild and Free	Bitter Creek NWR	12-January
Refuge tour for public with Friends of the California Condor Wild and Free	Bitter Creek NWR	2-February
Refuge tour for Pasadena Audubon Young Birders	Hopper Mountain NWR	31-March
Refuge tour for Taft College class	Bitter Creek NWR	1-May
Refuge tour for public with Friends of the California Condor Wild and Free	Hopper Mountain NWR	5-May
Condor handling for University of California Santa Barbara class	Hopper Mountain NWR	19-May
Refuge tour for public with Friends of the California Condor Wild and Free	Bitter Creek NWR	19-May
Refuge tour for public with Friends of the California Condor Wild and Free	Hopper Mountain NWR	02-June
Refuge tour and condor handling for public with Friends of the California Condor Wild and Free	Hopper Mountain NWR	16-June
Showing of The Condors Shadow, tour, and condor handling for Santa Barbara Natural History Museum's Quasars to Sea Stars program with assistance of Pasadena Audubon Young Birders	Bitter Creek NWR	21-June → 22-June
Refuge tour and condor handling with Friends of the California Condor Wild and Free and USFWS staff	Bitter Creek NWR	27-June
Refuge tour for Percy Family	Hopper Mountain NWR	06-July
Condor handling with Kern Youth Conservation Corps and USFWS staff	Bitter Creek NWR	25-July
Refuge tour for Chumash Tribe	Hopper Mountain NWR	17-August
Refuge tour for public with Friends of the California Condor Wild and Free	Bitter Creek NWR	22-September
Refuge tour for public with Friends of the California Condor Wild and Free	Bitter Creek NWR	13-October
Refuge tour for Los Angeles Audubon Club	Hopper Mountain NWR	27-October
Refuge tour for public with Friends of the California Condor Wild and Free	Bitter Creek NWR	27-October
Refuge tour and condor handling Taft College class	Bitter Creek NWR	30-October
Refuge tour, condor handling, training, and discussions with Redwoods National Park, Sequoia Park Zoo, and Yurok Tribe	Bitter Creek NWR	04-December → 05-December
Refuge tour for Havasi Wilderness Foundation	Bitter Creek NWR	12-December

Table 3.6.4: California condor related off-refuge outreach activities performed by the field team and partners in 2018.

Description	Location	Date
Table at Eliot Arts Magnet Middle School Science Fair	Altadena, CA	26-January
Egg Stage Observer Training	Ventura, CA	22-February
Egg Stage Observer Training	Ventura, CA	27-February
Table at Isbell Middle School STEM Night	Santa Paula, CA	06-March
Presentation for California State University Channel Islands GIS Class	Camarillo, CA	06-March
Table at Oxnard Earth Day event	Oxnard, CA	14-April
Presentation for Cal State Channel Islands Conservation Biology Class	Camarillo, CA	16-April
Table for Los Angeles Zoo Wild for the Planet event	Los Angeles, CA	22-April
Chick Stage Observer Training	Ventura, CA	24-April
Table for Los Angeles Wild for the Planet event	Los Angeles, CA	29-April
Chick Stage Observer Training	Ventura, CA	01-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 to classes at Rio Mesa High School	Oxnard, CA	30-May
Presentation to classes at Anacapa Middle School	Port Hueneme, CA	30-May
Presentation for California Oil Museum	Santa Paula, CA	23-August
Presentation for Kern Audubon Club	Kern, CA	30-October

4.0 Discussion

Monitoring Resource Use

The field team increased the number of GPS transmitters deployed in 2018 by 40% (58 to 81 transmitters). This follows a 190% increase in the number of birds wearing GPS transmitters in 2017. With the majority of condors now wearing GPS transmitters providing location data, the use of daily VHF radio telemetry for monitoring has been adapted to some extent from previous years. Rather than trying to detect every condor in the population every few days with hand-held VHF telemetry receivers, GPS transmitters provide a much higher level of detail for detecting condors.

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. As the increasing number of condors in the Southern California population's expands their wild range, more personnel will be required to cover additional office and field monitoring of the birds.

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 in 2017. The changes in this protocol, and the rationale behind these changes, are explained in the 2.2 Lead Monitoring and Mitigation section.

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 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.

Detecting Mortalities

Radio telemetry using VHF transmitters is still a very necessary tool of the program in determining the location of dead condors. The primary benefit of using VHF transmitters had previously been to provide daily location data as well as presence/absence of individuals of the population, and monitoring which condors had gone missing for long periods of time and may be sick, injured, or dead. With the availability of lightweight GPS transmitters that provide highly detailed data that can be

uploaded from almost anywhere, VHF transmitters have become most useful as a tool to help us locate birds in the field after GPS data has already helped us to identify it as a bird of concern. GPS location data is generally uploaded every one to three days, and though it is extremely useful and provides far more information than VHF, it does not provide an instantaneous location. By pairing GPS and VHF, we are able to identify concerns within a day or so in a wide geographic area, and can go to the location and track it in real time to observe, capture, or recover the bird.

There have been an increasing amount of instances in which we were able to identify sick, injured, and dead birds using this combination of GPS and VHF tools. This has helped contribute to our ability to get birds in for medical treatment, and to quickly recover carcasses to better understand the causes of mortality.

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.

Nest Management

This was a record breaking year for the southern California condor nesting population, with a total of 12 nests. As the number of breeding birds in the population continues to slowly grow, so does the opportunity for nest establishment.

In 2015, the field team adjusted protocol to reduce the intensity of our nest guarding program from what was established in 2007. Given limited staff, it was not possible to provide nest management to this higher standard for all 12 nests. As the wild condor population continues to grow, and as the number of nests increases, we will need to continue to look at the efficacy and impacts of our nest management actions and the resources we have available to make the best management decisions.

Outreach

This was the third 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 assists in scheduling classroom visits, planning tours, and works to expand the curriculum into new schools and classrooms. The position was refilled in late 2018 after being vacant since 2017, which will greatly expand the success of the CondorKids program. During the 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.

Works Cited

Bakker, V.J., Smith, D.R., Copeland, H., Brandt J., Wolstenholme, R., Burnett, J., Kirkland, S., and. Finkelstein,M.E. 2017 Effects of Lead Exposure, Flock Behavior, and Management Actions on the Survival of California Condors (Gymnogyps californianus). EcoHealth Vol. 14: Pp. 92. https://doi.org/10.1007/s10393-015-1096-2

Bukowinski, A.T., Bercovitch, F.B., Alberts, A.C., Wallace, M.P., Mace, M.E., and Ancona, S. 2007. A Quantitative Assessment of the California Condor Mentoring Program. Pp. 197-211 in A. Mee and L.S. Hall (eds.), California condors in the 21st century. Nuttall Ornithological Club Series in Ornithology No. 2. Nuttall Ornithological Club, Cambridge, MA, and American Ornithologists' Union, Washington, D.C.

Burnett, L.J., Sorenson K.J., Brandt J., Sandhaus E.A., Ciani D., Clark M., David C., Theule J., Kasielki S. and R.W. Risebrough. 2013. Eggshell Thinning and Depressed Hatching Success of California Condors Reintroduced to Central California. Condor Vol. 115(3): Pp. 477-491.

Cade, T.J., Osborn S.A.H., Hunt W.G., and Woods C.P. 2004. Commentary on released California condors Gymnogyps californianus in Arizona. Pp. 11-25 in R.D. Chancellor and B.-U. Meyburg, [eds.]. Raptors Worldwide. World Working Group on Birds of Prey and Owls/MME-Birdlife, Budapest, Hungary.

Cade, T.J. 2007. Exposure of California condors to lead from spent ammunition. Journal of Wildlife Management Vol. 71: Pp. 2125-2133.

Clark, M., Wallace M., and David C. 2007. Rearing California condors for release using a modified puppet-rearing technique. Pp. 213-226 in A. Mee and L.S. Hall (eds.), California condors in the 21st century. Nuttall Ornithological Club Series in Ornithology no. 2. Nuttall Ornithological Club, Cambridge, MA, and American Ornithologists' Union, Washington, D.C.

Cogan, C. B., D'Elia J, Convery K., Brandt J., and Bulgerin T. 2012. Analysis of California condor (*Gymnogyps californianus*) activity using satellite telemetry data. The Open Ornithology Journal Vol. 5: Pp82-93.

Diffendorfer, J.E., Compton R.W., Kramer L.A., Ancona Z.H., and Norton D. 2015. Onshore industrial wind turbine locations for the United States to March 2014: U.S. Geological Survey data release, https://doi.org/10.5066/F7251G8Q.

Emslie, S.D. 1987. Age and diet of fossil California condors in Grand Canyon, Arizona. Science Vol. 237: Pp768-770.

Finkelstein M.E., Doak D.F., George D., Burnett J., Brandt J., Church M., Grantham J., and Smith D. 2012. Lead poisoning and the deceptive recovery of the critically endangered California condor. Proceedings of the National Academy of Sciences Vol. 109(28): Pp.11449-11454.

Fry D.M and Maurer J. 2003. Assessment of lead contamination sources exposing California condors. California Department of Fish and Game: Species Conservation and Recovery Program Report. 2003-02.

Grantham, J. 2007. Reintroduction of California condors into their historic range: the recovery program in Southern California. Pp. 123-138 in A. Mee and L.S. Hall (eds.), California condors in the 21st century. Nuttall Ornithological Club Series in Ornithology no. 2. Nuttall Ornithological Club, Cambridge, MA, and American Ornithologists' Union, Washington, D.C.

Johnson C, T. Kelly, M. E. Finkelstein, D. Smith. 2013. Monitoring Post-ban Lead Exposure in the California Condor (Gymonogyps californianus). California Department of Fish and Wildlife Final Report Agreement P1082005-01.

Kelly, T.R., Grantham J., George D., Welch A., Brandt J., Burnett L. J., Sorenson K., Johnson M., Poppenga R., Moen D., Rasico J., Rivers J., Battistone C., and Johnson C. K. 2014. Spatiotemporal Patterns and Risk Factors for Lead Exposure in Endangered California Condors during 15 Years of Reintroduction. Conservation Biology. Pp. 13-845.R1.

Kelly, T. R., Rideout B. A., Grantham J., Brandt J., Burnett L. J., Sorenson K. J., and Johnson C. K. 2015. Two decades of cumulative impacts to survivorship of endangered California condors in California. Biological Conservation, Vol. 191: Pp391-399. DOI: 10.1016/j.biocon.2015.07.012

Kenward, R.E. 1978. Radio transmitters tail-mounted on hawks. Ornis Scand. Vol. 9: Pp. 220-223.

Lindsey, G. D. 1992. Nest guarding from observation blinds: strategy for improving Puerto Rican parrot nest success. Journal of Field Ornithology. Vol 63: Pp. 466-472

Lowney. M. S. 1999. Damage by Black and Turkey Vultures in Virginia, 1990-1996 Wildlife Society Bulletin, Vol. 27(3), Pp. 715-719

Mee, A., Hamber J.A., and Sinclair J. 2007. Low nest success in a reintroduced population of California condors. Pp. 163-184. in A. Mee and L.S. Hall [eds.]. California condors in the 21st Century. Nuttall Ornithological Club, Cambridge, MA, and American Ornithologists' Union, Washington, DC.

Poessel, S. A., Brandt, J., Miller, T. A. and Katzner, T. E. 2018a, Meteorological and environmental variables affect flight behavior and decision-making of an obligate soaring bird, the California Condor Gymnogyps californianus. Ibis, Vol. 160: Pp. 36-53. doi:10.1111/ibi.12531

Poessel, S. A., Brandt, J., Uyeda, L., Astell, M. and Katzner, T. E. 2018b, Lack of observed movement response to lead exposure of California condors. Journal of Wildlife Management Vol. 82: Pp. 310-318. doi:10.1002/jwmg.21378

Poessel, S.A., Brandt, J., Mendenhall, L., Braham, M.A., Lanzone, M.J., T. E. 2018c, Flight response to spatial and temporal correlates informs risk from wind turbines to the California Condor. Condor: Ornithological Applications Vol. 120: Pp 330–342.

Ralls, K. and Ballou J. 2004. Genetic status and management of the California condors. Condor Vol. 106: Pp. 215-228.

Rideout B.A., Stalis I., Papendick R., Pessier A., Puschner B., Finkenstein M.E., Smith D.R., Johnson M., Mace M., Stroud R., Brandt J., Burnett J., Parish C., Petterson J., Witte C., Stringfield C., Orr K., Zuba J., Wallace M., and Grantham J.. 2012. Patterns of mortality in free-ranging California condors (*Gymnogyps californianus*). Journal of Wildlife Diseases Vol. 48: Pp. 95-112.

Ridley-Tree Condor Preservation Act. 2008. In Assembly Bill No. 821. California State Assembly, Sacramento, CA. Available at http://www.leginfo.ca.gov/bilinfo.html.

Rivers J.W., M. Johnson, S.M. Haig, C.J. Schwarz, L.J. Burnett, J. Brandt , D. George, J. Grantham. 2014 An analysis of monthly home range size in the critically endangered California condor. Bird Conservation International 24.

Smith D. and Strupp BJ. 2013. The scientific basis for chelation: animal studies and lead chelation. Journal of Medical Toxicology. Vol. 9(4): Pp. 326-38. doi: 10.1007/s13181-013-0339-2.

Snyder, N.F.R. 2007. Limiting factors for wild California condors. Pp 9-33. in A. Mee and L.S. Hall (eds.), California condors in the 21st century. Nuttall Ornithological Club Series in Ornithology no. 2. Nuttall Ornithological Club, Cambridge, MA, and American Ornithologists' Union, Washington, D.C.

Snyder, N.F.R and J.A. Hamber. 1985. Replacement-clutching and annual nesting of California condors. Condor Vol. 87: Pp. 374-378.

Snyder, N.F.R, R.R.Ramey, and F.C. Sibley. 1986. Nest-site biology of the California condor. Condor Vol.88: Pp. 228-241.

U.S. Fish and Wildlife Service (Service). 1979. California Condor Recovery Plan, first revision. USFWS, Pacific Region, Portland, Oregon.

U.S. Fish and Wildlife Service (Service). 1996. California Condor Recovery Plan, Third Revision. Portland, Oregon.

U.S. Fish and Wildlife Service (Service). 2013. California Condor (Gymnogyps californianus) 5-Year Review: Summary and Evaluation. Sacramento, California.

U.S. Fish and Wildlife Service (Service). 2019. California Condor Recovery Program 2017 Annual Report. Ventura, California.

Wallace, M.P, Fuller M.R., and Wiley J. 1994. Patagial transmitters for large vultures and condors. Pp. 381-387 in B.U. Meyerburg and R.D. Chancellor, editors. Raptor conservation today. Pica Press, East Sussex, United Kingdom.

Appendix I: Contributions to Ongoing Research

Field, laboratory, and telemetry data collected on the Southern California condor population over the course of 2018 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 2018 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.

An assessment of the biological impact of contaminants and management actions that influence the long-term persistence of the California condor
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

California condor Nest Guarding Project
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.

Use of accelerometry data to interpret California condor behavior
Years: 2017-2021

Study objective: Develop statistical models that interpret accelerometry data to describe behavior of wild California condors, especially as related to fire frequency, and model associations of behavior with landscape features. Data are collected by patagial tags specifically manufactured and designed for this project. We expect to use these models to develop ethograms for condors. Association of behaviors with landscape features will allow us to understand and predict places where risk to condors may be especially high.

Principal Researchers: Jonathan Hall and Darren Gross from West Virginia University, Todd Katzner from US Geologic Survey, Maitreyi Sur and Melissa Braham from Conservation Science Global, Inc.

Funding Source: National Fish and Wildlife Foundation

Results to date: We are now able to use accelerometer data from GPS/GSM telemetry units to identify specific behaviors of free-flying condors, a significant advancement in the field of wildlife telemetry and conservation. Additionally, we have a clearer overall picture of the behavioral and landscape patterns of condors' presence within Los Padres that we believe will aid landscape management, particularly as it relates to wildfires.

Anticipated Completion: 2021

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

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

2493-A Portola Rd.

Ventura, CA 93003

(805) 644-5185