

Pinnacles National Park California Condor Reestablishment Program Annual Report 2018



Pinnacles National Park Report
Submitted to US Fish and Wildlife Service
Endangered Species Recovery Permit TE157291-2

Prepared by:

Alacia Welch, Condor Field Crew Leader

Kris Dudus, Condor Field Crew Leader

Rose Fielding, Condor Crew Bio-technician

Gavin Emmons, Raptor Biologist

Rachel Wolstenholme, Condor Program Manager

National Park Service

Pinnacles National Park

5000 Highway 146

Paicines, CA 95043

Permit contact:

Rachel Wolstenholme, Condor Program Manager, Pinnacles National Park

Cover photo: *Rose Fielding at event with LA Zoo Condor Ambassador, "Dolly." NPS Photo by Kris Dudus*

Please cite this publication as:

Welch, A. et al. 2019. Pinnacles National Park California Condor Reestablishment – Annual Report 2018. Pinnacles National Park, National Park Service, Paicines, California.

Table of Contents

ACKNOWLEDGEMENTS.....	1
INTRODUCTION.....	2
METHODS.....	3
Population Monitoring.....	3
Survival Monitoring.....	3
Trapping	4
Nest monitoring	4
Baiting	6
Remote Monitoring.....	6
Non-proffered Food	6
Monitoring Captive Birds	6
Missing Birds	7
Management.....	7
Lead exposure treatment	8
Veterinary care	8
Vaccination.....	9
Hazing.....	9
Collaborative Research	9
Outreach	9
Personnel	10
RESULTS.....	11
Population Monitoring.....	11
Survival Monitoring.....	12
Trapping	14
Reproduction	14
Microtrash.....	17
Baiting	17
Remote Monitoring.....	18
Non-proffered Food	18

Management.....	18
Captive-bred Releases	18
Lead Sampling	18
Treatment	19
Vaccination.....	22
Hazing.....	22
Collaborative Research	22
Chelation Efficacy Research	22
Chelation Treatment Impacts on Short-term Survival Research	22
Blood Parasite Research	23
Rodenticide Exposure Research.....	23
Condor Range and Movements Research	23
Outreach	23
NPS Education and Interpretation	24
Targeted Non-lead Outreach	25
RECOMMENDATIONS	25
Monitoring	25
Management.....	25
Research.....	25
Outreach	26
Recovery Planning and Multi-agency Coordination	26
Appendix A.....	27

ACKNOWLEDGEMENTS

We are thankful to many collaborators and partners that support our work to restore this species. We gratefully recognize Ventana Wildlife Society, not only as the founder of the Pinnacles National Park condor release site, but as our primary partner in the management of condors in central California. We would also like to thank the Institute for Wildlife Studies, US Fish and Wildlife Service, UC Davis, UC Santa Cruz, NPS Biological Resources Division, Dr. Michelle Verant, Dr. Amy Wells and the Avian and Exotic Clinic of the Monterey Peninsula, Tim Huntington, the California Department of Fish and Wildlife, LightHawk, Oakland Zoo, and the Bureau of Land Management. We greatly appreciate all of the divisions at Pinnacles National Park for helping Condor Program operations. The release of captive-reared condors would not be possible without the exhaustive efforts of the Los Angeles Zoo, San Diego Zoo Safari Park, The Peregrine Fund's World Center for Birds of Prey, and the Oregon Zoo. We give special thanks to the Amah Mutsun Tribal Band for ceremonial prayers. Trapping and care of condors in temporary captivity would not be possible without the organic dairy farmers that generously provide calf carcasses to use as bait and food. Pinnacles National Park Foundation provided direct support for condor recovery. Finally, we cannot thank our volunteers and interns enough for their amazing dedication.

Volunteers

Joseph Belli, Mike Baird, Darryl Zimmerman, Bob Quaid, Andrew Haney, Susanna Langstaff, Angela Fletcher, Sean and Sarah Parnell, Barbara Lutes, Jeff Robinson, Katie Fitzgerald, Kira Gunderson, Rakesh Agarwal, Badsah and Anwesha Mukherji, Jackie Doremus, Josh Simister, Joselyn Perez, Tia Alexander, Shoshana Coplan, Dinkar Jain, Ben Sims, Richard Neidhardt, Megan Gnekow, Ashlynn Petty, Clare-Ann and Duane Ruth-Heffelbower, Vanessa Suarez and Jennie Jones Scherbinski.

Interns

Kyle Tibor, Kimber Godfrey, Jack Obergfell and Savannah Robinson.

INTRODUCTION

California condors are one of the rarest bird species in the world and biologists have been committed to their recovery for over four decades. The Condor Reestablishment Program at Pinnacles National Park (PNP) has several objectives with the ultimate goal of species recovery in the wild:

- monitoring central California condor population trends by documenting foraging, movements, nesting, and reproduction;
- detecting mortalities and recovering condor carcasses so cause of death can be determined;
- managing threats to condors;
- increasing public awareness of threats to condors; and
- conducting cooperative research to aid condor recovery.

Together with Ventana Wildlife Society (VWS), PNP manages a flock of 97 condors in central California. During 2018, PNP monitored all birds using the central California area, as well as PNP-managed condors that traveled beyond their typical range. PNP-managed condors and VWS-managed condors make up a single flock, overlap in range, feed together, and are captured at three release sites: one in the park and two in Big Sur, CA. This report focuses on Pinnacles Condor Program management of birds released from the park but also includes some VWS-managed condor data, courtesy of VWS.

METHODS

Population Monitoring

Condors are monitored year-round to document reproduction, mortality, and movements. Condor health, foraging, interactions, and breeding behavior are monitored through visual observations. Biologists use standard equipment to radio-track and locate condors. A detailed equipment list is available in: *Pinnacles National Park California Condor Reestablishment – Annual Report 2013. Pinnacles National Park, National Park Service, Paicines, California. Pp. 20.*

Survival Monitoring

Nearly 80 percent of the condors managed by PNP are monitored remotely via GPS transceivers, or “GPS tags,” on their wings, Photo 1. Argos satellite GPS data are downloaded daily from CLS America and mapped in ESRI ArcGIS version 10.3. PNP also deploys GSM (cellular technology) GPS tags manufactured by Microwave Telemetry (MT). Data from MT GSM tags are received via email when a tagged condor flies within range of a cellular tower. In addition, both satellite and GSM data are viewed through Movebank’s online interface. PNP staff uses ArcGIS and Google Earth to map and view all condor location data daily. PNP uses a greater proportion of Argos satellite tags over GSM tags due to poor cellular coverage in the central California condor range.



Photo 1, GPS tag on condor. NPS Photo by Gavin Emmons.

Radio tracking within and around PNP is conducted five to seven days per week. Biologists use high points to increase probability of hearing a signal. Monitoring outside of the park is conducted along public roads in San Benito County, portions of western Fresno County, northern San Luis Obispo County, and eastern to southern Monterey County. Prolonged stationary GPS locations or mortality signals (triggered by a radio transmitter that is immobile for four to ten hours) are located to confirm dropped tags or the presence of sick or deceased condors. This activity takes priority above most others to maximize the chance of treating a sick or injured bird or retrieving a carcass before it decomposes. PNP follows USFWS condor carcass collection procedures. All field data is recorded in Access databases. Additionally, summary

data from daily monitoring activities are entered into a secure online database developed by a VWS volunteer software engineer.

Trapping

Trapping condors is critical to maintain vinyl identification tags and functioning VHF radio and GPS tags on as many individuals as possible. PNP conducted two trapping seasons in 2018 to measure condor blood lead levels, perform transmitter maintenance, and take samples for ongoing research studies. The winter-spring trapping season spanned January through April. The autumn trapping season was conducted from late September through December.

Before handling condors, biologists receive extensive training in handling protocols, collecting samples, and processing birds from highly experienced LA Zoo keepers and PNP co-workers who are already listed on PNP's USFWS recovery permit as approved handlers. Personal protective equipment (PPE) during handling includes eye protection, long-sleeved shirts and pants, closed-toe boots, and leather and nitrile gloves, Photo 2.

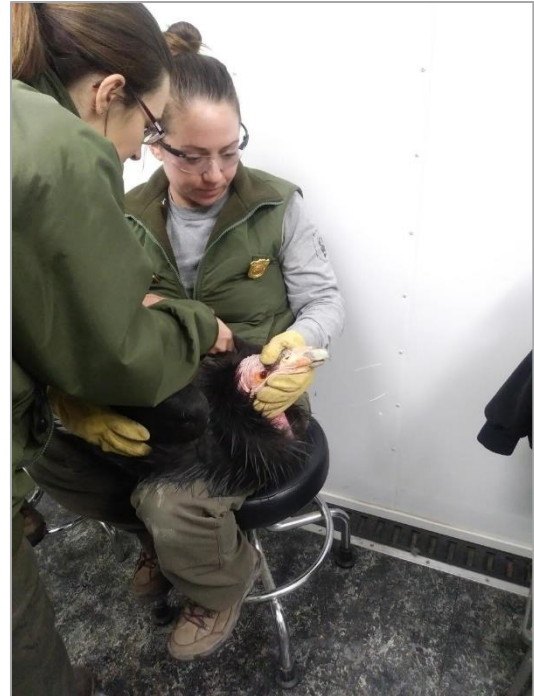


Photo 2, NPS field crew member wearing PPE while holding a condor. NPS Photo.

Nest monitoring

PNP and VWS manage nests based on geographic location and ease of monitoring as opposed to who manages the adult condors.

Biologists monitor active nest sites from survey locations 300-800 meters from the nest depending on topography. They look for egg incubation, hatching, nestling health, behavioral interactions, adult-nestling feeding events, and fledging of young. Where feasible, biologists enter active nests following standard procedures for egg candling as well as nestling health checks, conducted at 45-60 and 120 days of age. As in 2017, PNP aimed to conduct an egg fertility check and two nestling checks per accessible nest.

Once a nest site is confirmed, biologists may enter the nest to check the fertility of the egg. They use a high-powered flashlight in a dark space to view inside the egg. If an egg is fertile, it is weighed, measured, and left in the nest. If an egg is not fertile, it is removed from the nest and may be replaced with an artificial egg until an egg laid in captivity is available to replace the artificial one. Access to nests on private property, nest location, parent and nestling behavior or health, and staff capacity may result in changes to planned nest entries to ensure safety for the field crew as well as the condors.

During nest entries, PPE includes all appropriate climbing equipment, eye protection, and leather and nitrile gloves. Biologists and/or a veterinarian check a nestling's blood lead levels, general health, and administer a West Nile Virus vaccination, Photo 3. If a nestling has high lead exposure it may be evacuated from the nest for emergency care or monitored more closely. Biologists search and/or sift nest sites for eggshell fragments and trash, which are removed when found. Annual nest entry trainings are conducted at PNP and additional technical ropes trainings are planned year-round to maintain staff experience with relevant technical skills.



*Photo 3, NPS crew member holding a condor nestling during a health check.
NPS Photo by Rose Fielding.*

Biologists install remote video cameras in suitable nests when possible. Factors determining suitability include nest location, level of risk to access the nest, and ability to see into the nest from a nearby location. Biologists follow an installation design and method developed by the USFWS Condor Program. After locating a nest cavity, they ideally enter the nest for an egg fertility check and to install a video camera. They set up a solar panel and battery within a few hundred feet of the nest and connect to an internet camera secured inside or next to the nest. A microwave antenna is also powered with the solar power system and sends the video signal to a receiving antenna connected to a computer running video monitoring software. This software records multiple days of video so it can be reviewed at a later time or live.

Nest video cameras greatly increase the number of hours of nest observations, enhance the quality of observations, and reduce the amount of time field biologists spend hiking to remote

nest. The cameras allow biologists to observe nestling health, nestling-parent interactions and other important events that would otherwise not be observed.

Baiting

Biologists use “clean” food supplies acquired from organic dairies and place carcasses approximately twice per week at one or two established bait stations in the park. Other carcasses may also be placed after they are radiographed to ensure there are no foreign or metallic objects in the carcass, such as spent ammunition. Bait stations include the captive pen and ‘Hilltop’ semi-permanent bait site, both located in areas in the park that are closed to the public. Safety protocols during baiting require proper PPE, four-wheel drive training, and placement of carcasses by at least two people. Carcasses are placed at night to minimize interactions with condors and any association with humans as food suppliers.

Remote Monitoring

Remote video cameras stationed at the captive pen and Hilltop bait site record during daylight hours, allowing biologists to observe condor interactions, feeding patterns, and behaviors. Memory cards from motion-sensitive cameras are retrieved each time food is placed and the photographs are reviewed for presence of birds and predators. Weight data are collected using scales with perches mounted near bait. Photos and video recordings allow biologists to track the general condition of condors.

Non-proffered Food

Non-proffered food is any carcass that PNP or VWS biologists have not placed for condors at a bait site. When condors are observed feeding on non-proffered food, biologists identify the carcass species when possible. Observing condors feeding on private land from public roads limits biologists’ ability to identify carcass species. Landowners are only contacted about a carcass on their property when there is a specific concern.

Monitoring Captive Birds

Captive condors are held at PNP’s captive pen, Photo 4, to minimize interactions with humans. An electrified power pole at the pen delivers negative reinforcement to discourage them from landing on or near power poles when they are in the wild. During handling and prior to initial releases of young juveniles, biologists monitor captive condor health and interactions at the captive pen. When captive-reared young condors first arrive at PNP from zoos, they spend at least 60 days in the pen prior to their release to the wild.



Photo 4, PNP captive pen with six captive condors perched inside and one free-flying condor perched on top. NPS Photo by Gavin Emmons.

Missing Birds

When a condor goes undetected by any of the standard monitoring methods (visual observation, VHF radio signals, camera/video images, or GPS data) for over a week, monitoring efforts increase by extending the radio-tracking search area and planning aerial telemetry flights through partner organizations or contractors. If, after four months and an extensive and coordinated search, biologists are unable to locate a particular condor, the bird's status is categorized as 'missing.' Following USFWS guidance, missing birds not detected for 12 months are considered dead and are removed from the population total.

Management

The main threat to central California condors is lead exposure from spent ammunition fragments in scavenged carcasses. Other risk factors may include microtrash consumption, West Nile Virus exposure, electrocution from perching on power poles or flying into power lines, and human interactions. PNP biologists conduct management with established protocols to study and reduce the impacts of these risks.

Lead exposure treatment

Trapping condors allows for tag and transmitter maintenance as well as managing risk factors that affect condor survival. Biologists take blood samples to determine blood lead levels each time a bird is captured from the wild. LeadCare Analyzers, suitable for field use, are used to collect immediate results that determine whether a condor requires treatment for high blood lead levels, Photo 5. In 2018, biologists transitioned from using a LeadCare Analyzer to a LeadCare II Analyzer for all field blood lead testing. The lead treatment protocol for PNP-managed condors, remained the same as previous years; where the threshold used to initiate chelation treatment is a blood lead value of 35 µg/dL or greater. Condors with elevated blood lead levels on a LeadCare II Analyzer are radiographed in the park's Condor Care Unit (CCU), at zoos, or clinics to help inform treatment needs. Radiographs taken at PNP may be emailed to veterinarians for their review after being taken. Birds with possible metallic densities in their gastrointestinal tracts, or those with blood lead levels >65 µg/dL, are transported to the Oakland or LA Zoos for treatment. Condors with clear radiographs and blood lead levels between 35-65 µg/dL may be treated at PNP when there is sufficient staff capacity. In addition, condors with clear radiographs and blood lead levels between 25 and 35 µg/dL may be monitored in the captive pen for two weeks at PNP for a lead depuration study.

For VWS-managed condors, treatment of lead exposure is initiated if clinical signs are observed in the bird prior to or during handling. Blood samples are not analyzed in the field, but are shipped to a lab for analysis. In 2018, PNP staff worked with NPS Biological Resources Division (BRD) staff to modify their Institutional Animal Care and Use Committee (IACUC) permit to allow VWS treatment protocols to be applied when VWS-managed condors are trapped in the park.

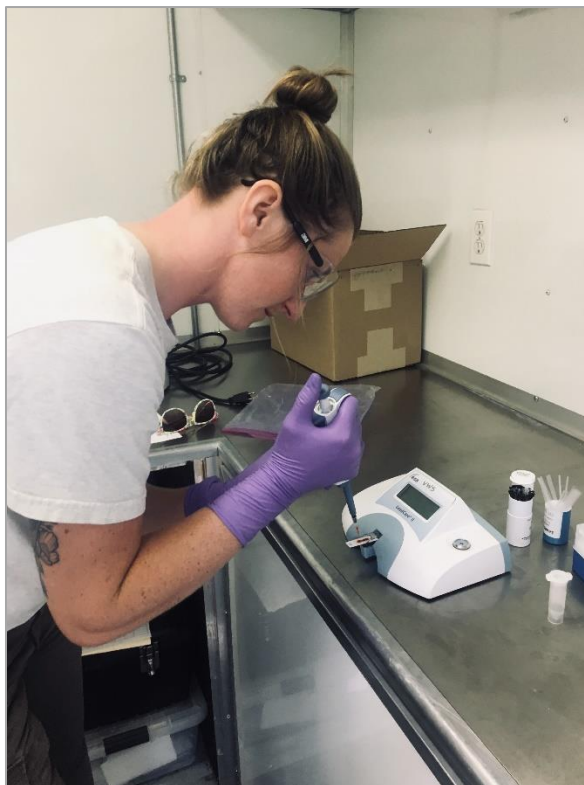


Photo 5, NPS employee using LeadCare II Analyzer. NPS Photo by Rose Fielding.

Veterinary care

PNP biologists are permitted to conduct basic first aid for superficial wounds discovered during handling. Any treatment requiring veterinary care is conducted by or under the guidance of a permitted veterinarian in the field, at a clinic, or at a zoo.

Vaccination

Captured condors receive West Nile Virus vaccinations and boosters on a schedule provided by veterinarians. In 2018, the schedule remained the same as recent years, with a goal of vaccinating 100% of the flock on an annual basis and giving nestlings a minimum of two injections while still in the nest. This protocol was followed for all captured birds and for nestlings where nest entries were possible.

Hazing

Hazing may be needed when condors endanger themselves by staying in close proximity to humans or human infrastructure. Hazing methods vary depending on location and include clapping and running, clapping wood blocks together, spraying water, using an air horn, and throwing pebbles near a condor.

Collaborative Research

In 2018, PNP biologists continued to work closely with researchers at Colorado State University (CSU) on a spatial risk analysis, San Francisco State University (SFSU) on a blood parasite project, and the University of California at Santa Cruz (UCSC) to gather scientific data to measure condor responses to environmental risk factors. PNP also worked with US Geological Survey (USGS) and Integral Ecology Research Center to study potential impacts of rodenticides on condors. New research projects implemented in 2018 are described later in this report.

Outreach

The PNP Condor Program defines outreach as any activity that provides an opportunity for greater understanding of a particular resource or issue. Activities include, but are not limited to: promoting awareness, presenting information, and building partnerships through education, providing volunteer opportunities, and engaging others in community, or “citizen,” science projects. Outreach to surrounding communities and those affected by conservation actions on public lands provide an opportunity for greater trust and cooperation between PNP and local residents. Building a foundation of trust and cooperation can lead to partnerships, with the ultimate goal to steward natural resources together.

Outreach fosters communication and understanding of the needs and concerns beyond the park boundary and creates opportunities to realize aspects of natural resource conservation that have not been previously considered. These benefit immediate and long-term efforts,

whether they are related to condor recovery, the use of non-lead ammunition, or any community conservation effort.

As lead exposure in wild condors continues to be the primary obstacle to recovery, PNP Condor Program staff continued outreach with other park staff, local landowners, ranchers, hunters, and the general public about the impacts of spent ammunition to scavenging wildlife. PNP has dedicated staff time to conduct outreach and work closely with the Institute for Wildlife Studies (IWS), VWS, and other partners to collaborate on outreach efforts. Additionally, during the course of routine fieldwork, the field staff speaks with park visitors and local residents. Outreach is conducted in the local community, statewide, and at larger scales in coordination with other partners and NPS Regional and National staff to address the complexity of this issue, from local perceptions to nationwide non-lead ammunition availability.

Hunting and ranching operations are essential to condor recovery. These operations depend on clean water and healthy habitats to sustain livestock and game species. Condors benefit from related water resources, as well as the availability of nesting and foraging habitat. Carcasses left on the land from hunting and ranching operations are an important food source for condors.

PNP's outreach message is focused on how condors benefit from hunting and ranching operations when non-lead ammunition is used. With hunting and ranching audiences, available alternatives to lead ammunition are discussed, as well as how to achieve the best performance from non-lead ammunition. With park visitors and the general public, staff stresses the need for continued hunting and ranching, as well as how those traditions play an important role in wildlife conservation.

Personnel

Implementing a long-term endangered species recovery program requires consistent staff capacity with highly-trained, experienced biologists. Our program consists of a manager, two field crew leaders, a biological science technician, and two interns, all working full-time and year-round. An additional wildlife biologist works with the program full-time for six months per year. Another wildlife biologist works throughout the year part-time on wildlife health issues and non-lead outreach. During 2018, this position was vacant for more than half the year.

Volunteers provide vital program support and receive extensive training prior to assisting in the field. Volunteers are asked to make a year-long commitment to the program for a minimum of two days per month. Volunteers assist in radio tracking, field observations, and a wide variety

of logistical tasks that support management of the species. In 2018, 30 volunteers contributed over 2,534 hours.

RESULTS

Population Monitoring

In January 2018, PNP managed 39 condors, which made up about 40% of the flock in central California. There was one death in 2018 and two captive reared birds were released in December. There were six nesting attempts in central California, with four of those including at least one PNP condor. Four nests successfully fledged chicks. One new fledgling was managed by PNP and three by VWS. The total number of PNP-managed condors at the end of 2018 was 40, plus one that could not be located and was classified as ‘Unconfirmed (missing).’ The sex ratio is fairly even with 22 males and 18 females, excluding the missing condor.

Combined with condors managed by VWS, 97 birds occupied the central California area at the end of the year, not including the missing bird, Figure 1.

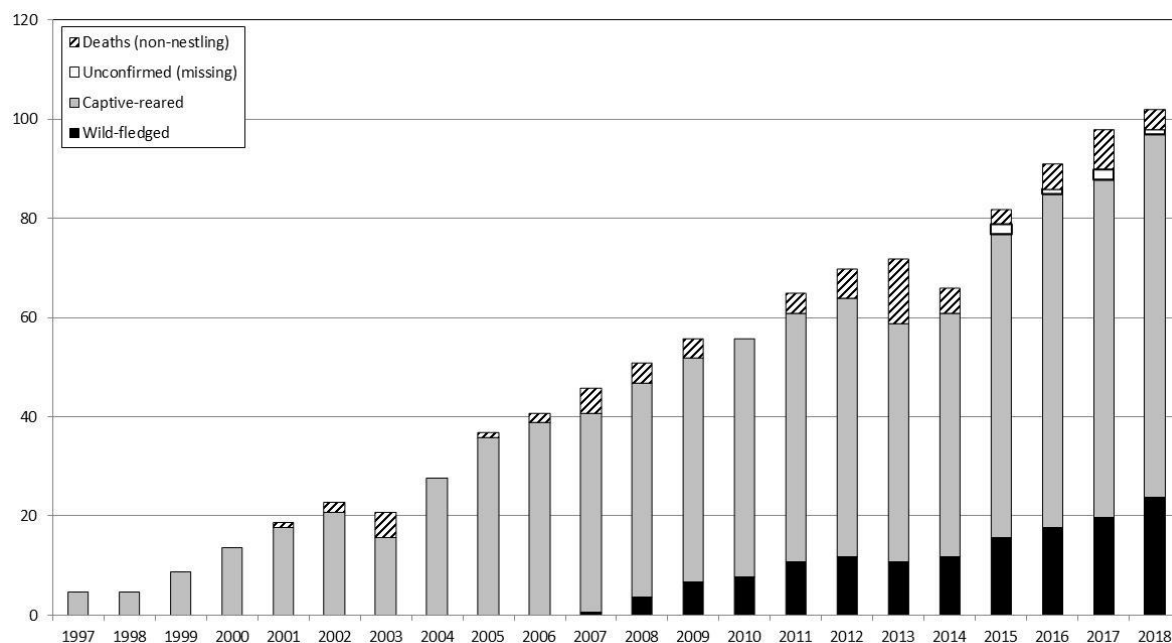


Figure 1, Summary of wild-fledged condors, captive-reared releases, and annual number of deaths in central California. Chart presents total number of condors in the wild (both wild-fledged and captive-reared) currently managed by PNP and VWS in the central California area, in addition to the number of condor deaths each year. Note that condor nestling deaths are not included in this chart and condors missing 4-12 months are categorized as ‘Unconfirmed (missing),’ but still make up part of the population total. VWS data provided by J. Burnett, Big Sur Condor Program Coordinator and Senior Biologist.

Survival Monitoring

Throughout the year, PNP monitored radio and GPS-tagged condors almost daily. Condors without functioning tags were observed opportunistically. This year, there were 5,658 visual observations of wild condors by PNP biologists in the field or seen on remote cameras. Additionally, there were 392 observations of captive condors. On 345 days of the year, staff recorded at least one sighting of one or more condors. Of that total, 35 days of visual observations came only from remote cameras. Whenever possible, biologists closely monitored any condor behaving abnormally and any bird with a GPS tag that did not move in over 24 hours to determine if the individual was injured or sick.

Staff used GPS data to efficiently locate approximately 80% of PNP-managed birds daily and these data often directed where staff focused efforts for a given day. Hundreds of thousands of GPS locations were downloaded from GPS tags on 32 PNP-managed condors throughout the year. Condors released by both VWS and PNP use the landscape in all directions surrounding the park. Figure 2 maps a selection of satellite GPS location data from several PNP-managed condors and represents the core range used by condors in central California in 2018. Because condors are social, monitoring them via GPS tags adds great efficiency to locating all released condors, including those without functioning radio transmitters or GPS tags.

Long Range Movements

In 2018, the central California condors with GPS tags remained in their core area and did not take any significant long range flights.

Mortality

This year one condor carcass was collected and one condor that had been missing for over a year was recorded as dead, bringing the total loss for PNP-managed condors to 25 birds since the beginning of the program in 2003, Appendix A. Condor 614 was found dead in January and submitted to the USFWS Forensic Lab for necropsy. The final determination for cause of death was lead poisoning. Condor 534 was missing for over 12 months (since April 2017) and was added to the list of mortalities for 2018.

Pinnacles National Park California Condor Recovery

National Park Service
U.S. Department of the Interior

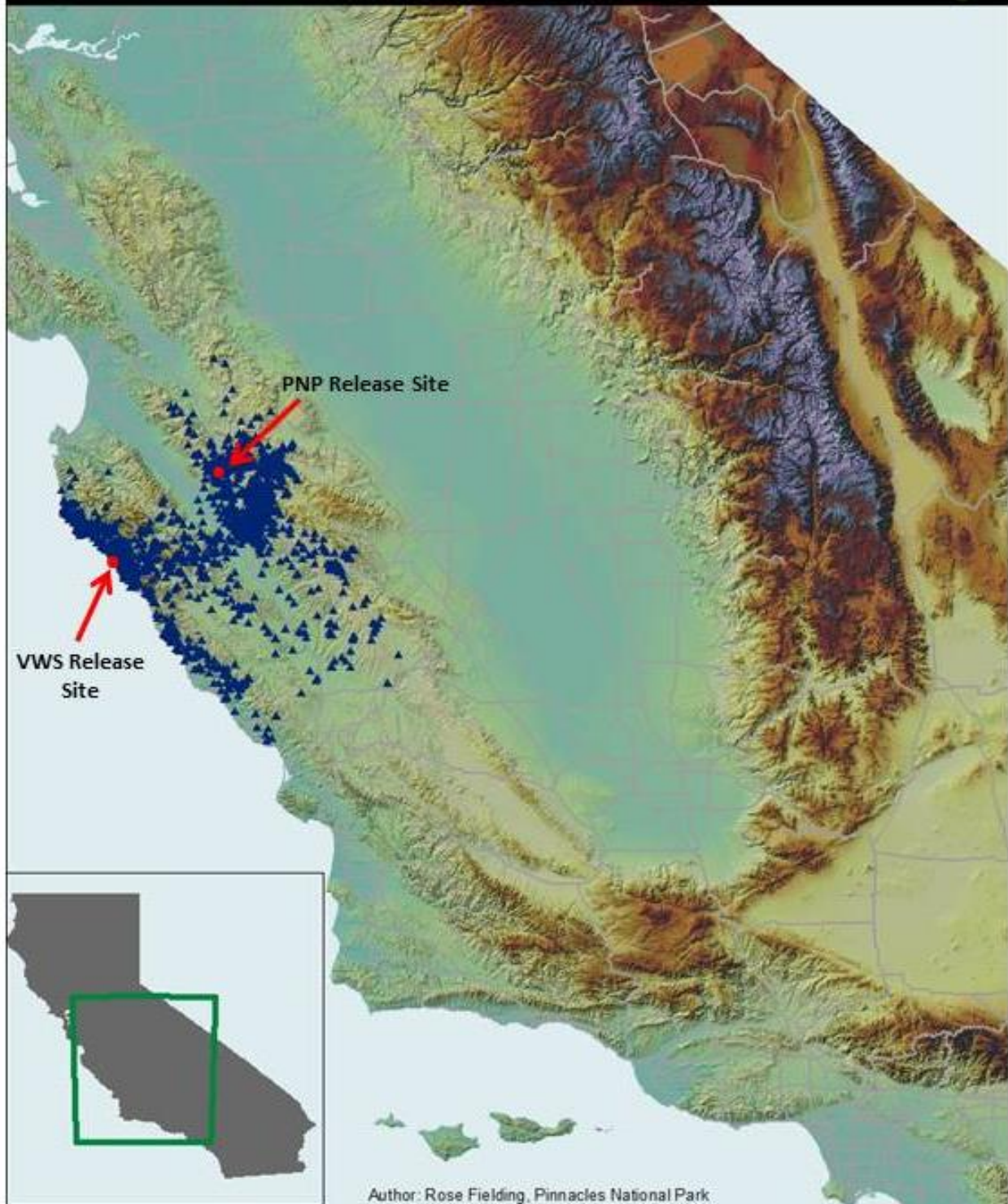


Figure 2, Typical range of PNP-managed condors in 2018.

Missing Birds

One PNP condor, 687, has been missing since 21 May 2018.

Trapping

PNP had two focused trapping seasons in 2018, January-April and late September-December. Trapping conducted by VWS allowed for a greater number of condor captures. In total, 28 PNP-managed condors were trapped in 2018 at both PNP and VWS facilities combined. Six were trapped in both the spring and autumn seasons.

In 2018, PNP staff spent 158 person-days trapping and captured 23 condors, Table 1. Capture data only include condors that were trapped at the PNP captive pen.

Table 1, 2018 trapping effort and captures of PNP and VWS-managed condors at PNP.

Date Range	Total handling days ^a	Total captures ^b	Total individuals captured ^c	Person Days ^d
January - April	6	19	15	77
September - December	5	12	12	81
Opportunistic Year Round	0	0	0	0
Totals	11	31	23	158

^aDays biologists initially handled any condors trapped at Pinnacles. These include condors caught for health checks, transmitter replacements, or as non-targets. Nestling handlings that occurred at nests are not included.

^bNumber of condors trapped including multiple captures of the same individual during the given time frame.

^cNumber of individual condors trapped during the given time frame at Pinnacles.

^dNumber of days a staff member could have trapped a condor if a target condor went into a trap.

Reproduction

In 2018, there were six nests in central California, Table 2. Five PNP-managed condors attempted to nest: three paired with VWS-managed condors and two PNP birds paired together at one nest. This year, PNP managed two of the six nests in central California. One failed while there was an egg in the nest and the other successfully fledged. An additional nest in central California failed at the egg stage. In all, there were four fledglings in 2018.

Table 2, 2018 central California nesting summary. VWS data provided by J. Burnett, Big Sur Condor Program Coordinator and Senior Biologist.

Nest ID	Nesting Male	Nesting Female	Wild Egg ID	Estimated Lay Date	# of Nest Entries	Wild Egg Fate	Foster Egg Used	Foster Egg ID	Nestling Studbook	Nest Outcome
MAC5	340	236	CC118	01/29/18	3	Hatched in nest	No	NA	912	Fledge
AC	167	190	CC218	01/30/18	0	Hatched in nest	No	NA	914	Fledge
RC	199	438	CC318	02/04/18	0	Failed before hatch	No	NA	NA	Fail
TCR	477	547	CC418	02/14/18	0	Hatched in nest	No	NA	936	Fledge
Castle	567	311	CC518	02/14/18	0	Hatched in nest	No	NA	937	Fledge
MP1	431	687	CC618	03/16/18	1	Failed before hatch	No	NA	NA	Fail

PNP Condor Nesting Details

PNP manages accessible condor nests to maximize the likelihood of them fledging young successfully. This includes replacing infertile eggs with viable ones, monitoring the health of nestlings, providing care or treatment if needed, and the removal of micro-trash if found within nest cavities. Nesting results should be interpreted with this in mind. In addition, each year a greater number of condors in the central California flock reaches breeding age, which should increase the number of nesting attempts over time.

The first nest to include a PNP-managed condor was in 2009, six years after PNP began its reestablishment program. The PNP 2015 Annual Report summarized all nesting since 2009. Nesting attempts by PNP-managed condors continued to be successful in 2018, but there has not been a sustained upward trend of nests and fledglings over the last five years, Figure 3. A drop in reproduction in 2014 was most likely due to mortality of seven breeding-age condors the previous year. In 2018, for unknown reasons, a couple of established central California pairs separated and multiple pairs that could have nested did not.

Of the six central California nests in 2018, PNP managed two: one in the park and one on public land in San Benito County, Photo 6.

PNP biologists only enter nests when conditions are suitable. This year biologists entered both of the PNP-managed nests. For the nest in the park, it was the third time that condors used the site. In 2012, the nest failed due to egg predation by ravens. In 2016, the nest was successful. In 2018, biologists did not do an egg fertility check in order to minimize potential predator attention at the site due to the history of raven predation. Biologists planned nestling health checks at 60-days and 120-days old, but since older nestlings can easily evade capture at this site a check was done at 90-days, as well. As in 2016, the nestling evaded capture and handling during the 120-day check. Also consistent with 2016, the nestling fledged three to four weeks early, which may be attributed to the physical characteristics of the nest, located on a ledge

hundreds of feet long where nestlings can walk prior to flying. This was the third fully successful nest within the park boundary in the past 100 years.

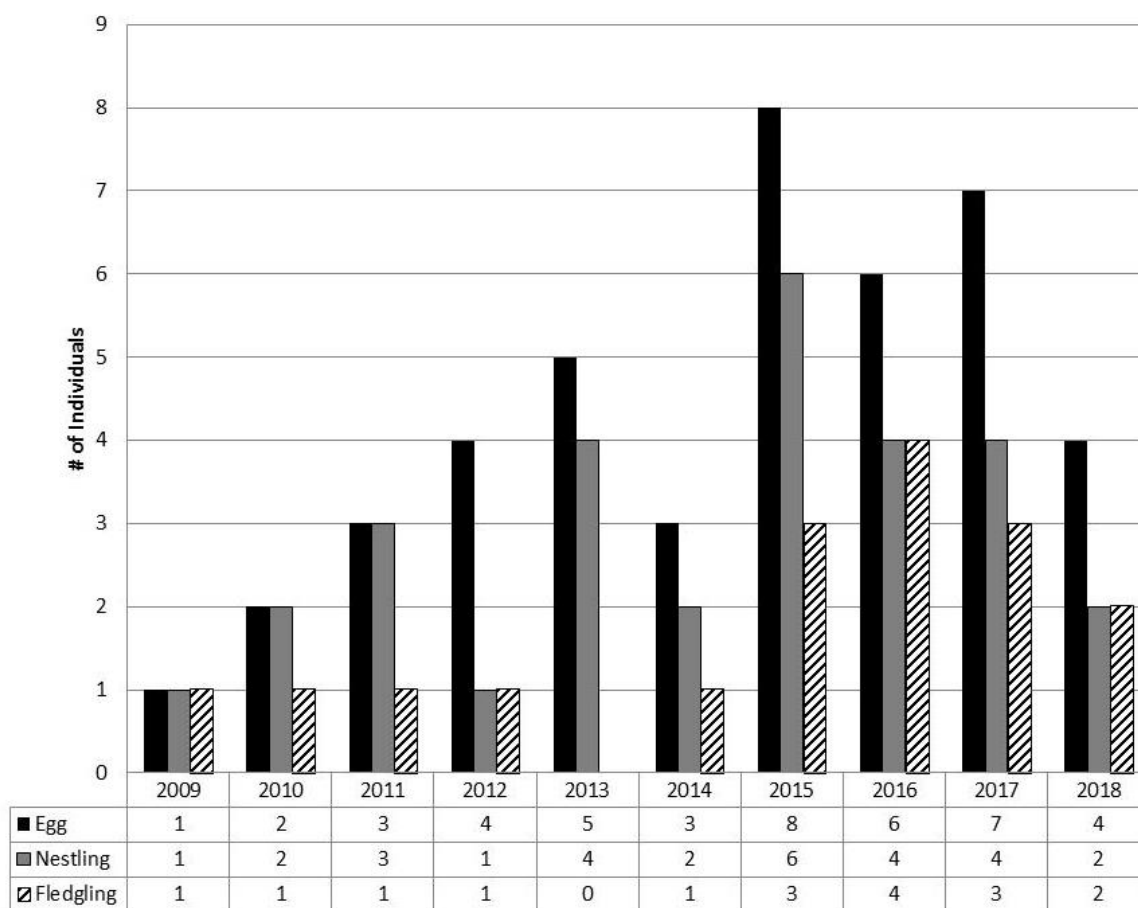


Figure 3, Nesting trends of condors managed by Pinnacles: 2009-2018. Eggs, nestlings, and fledglings for PNP-managed condors. *Note: these data include nests that had a PNP-managed breeder, but the nestlings were not necessarily PNP-managed. VWS and PNP assign nestlings based on nest location, not parents.*

Biologists entered the nest on public land in San Benito County after it had failed. They collected a few eggshell fragments, but could not determine the cause of failure or whether the egg hatched at all.

Although PNP did not have a video camera in an active nest this year, there was one in an inactive nest. The pair that used the nest in 2017 was recorded going into the site beginning in October. By December they were seen together in the nest for an hour or more at least once a week.



Photo 6, Condor nest discovered in 2018. NPS Photo by Alacia Welch.

Microtrash

Whenever possible during nest entries, staff searched for small trash, or “microtrash,” brought to the nest by the parent condors. Since 2009, 56 nest entries at 16 nests included a search for microtrash. The searches resulted in locating and removing trash from seven of those nests. The nest in the park in 2018 contained five metal bottle caps, one plastic bottle cap and four pieces of glass, which staff removed during two nest entries. For the nest outside PNP, one metal bottle cap, one plastic bottle cap, two thin pieces of plastic, and 13 small pieces of thicker plastic were removed during one nest entry. In all, trash removed from nests over the years included items made of bottle caps and items made of plastic, rubber, and metal; and items weighed between .07 and 26.9 grams.

Baiting

In 2018, biologists placed 162 calves procured from organic dairies near Modesto, CA to bait the captive pen during trapping, to feed captive condors and to attract condors to a video

monitored hilltop. During trapping seasons, carcasses were placed exclusively at the pen to increase trapping success.

Remote Monitoring

To supplement radio and GPS monitoring, tens of thousands of remote motion-triggered photos were collected and reviewed regularly throughout the year, Photo 7. Additionally, thousands of hours of video were recorded and reviewed by PNP biologists.



Photo 7, Condor 589 seen on a remote camera. NPS Photo.

Non-proffered Food

This year, biologists and members of the public reported observations of 16 non-proffered feeding events that resulted in 203 observations of condors feeding on carcasses other than those provided at the PNP or VWS bait sites. Many feeding events in the wild go unrecorded due to limited access to private land.

Management

Captive-bred Releases

Three captive bred condors (two males, one female) arrived from The Peregrine Fund's World Center for Birds of Prey in Boise, ID via LightHawk volunteer pilots in September 2018. Two of the captive-bred juveniles were released in December and one was held due to injury and behavioral concerns.

Lead Sampling

Blood lead level sampling continued to be a priority management action for any PNP-managed condor, whether captured during a scheduled trapping season or opportunistically. Figure 4

summarizes the lab blood lead values for all PNP condors since 2007. In 2018, a total of 25 PNP-managed condors were tested. Birds with levels <35 µg/dL on a field lead tester did not receive chelation treatment. Note that lab values are often greater than field values.

Treatment

Chelation

In 2018, 10 condors required chelation treatment and two were treated twice in the year. Five condors were treated at PNP, two at the LA Zoo, and four at the Oakland Zoo. Figure 4 includes the number of PNP condors that received chelation treatment following capture since 2007.

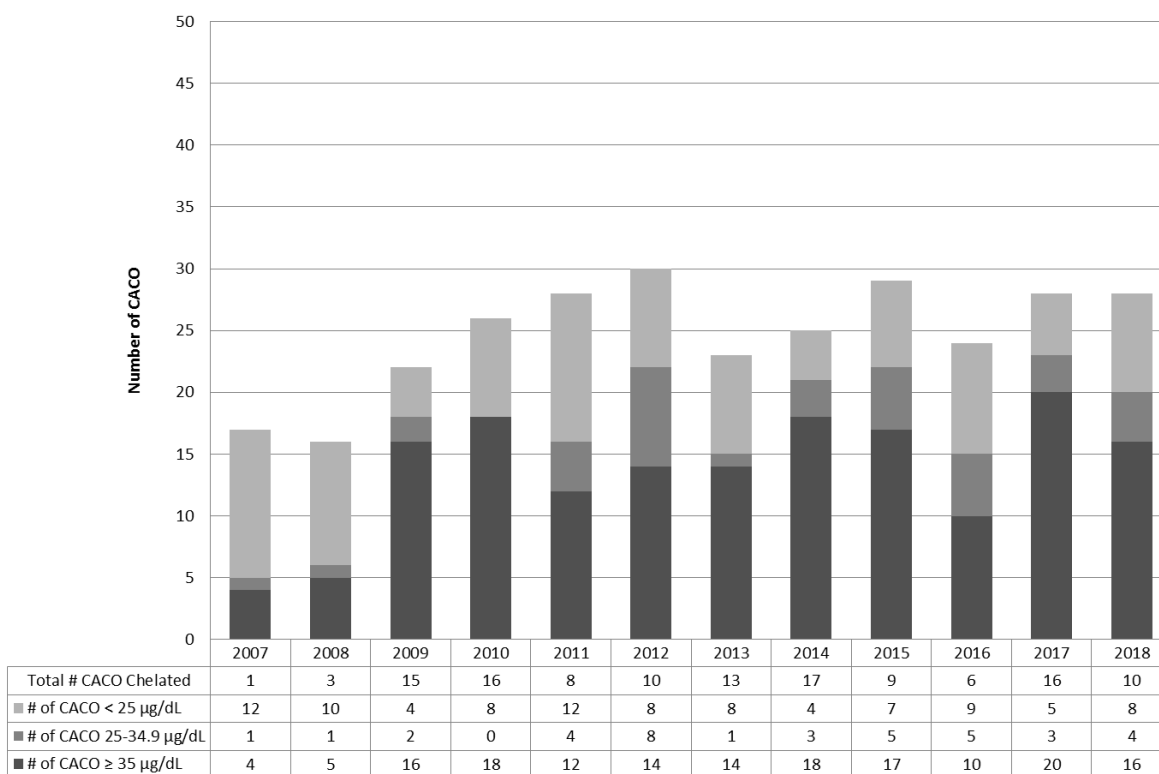


Figure 4, Blood level lab test outcomes in µg/dL and number chelated for PNP-managed condors: 2007-2018

Radiographs

Condors with blood lead levels >35 µg/dL based on the result from a LeadCare or Lead Care II Analyzer were radiographed to determine whether metallic densities were present. All condors taken to Oakland or LA Zoos for chelation treatment were radiographed by veterinary staff on site, Table 3.

Table 3, *Radiograph information for PNP-managed condors in 2018, Photo 8.*

Condor	Location	Purpose	Metallic Density	Outcome
431	Pinnacles	Lead Exposure	No	
438	Oakland Zoo	Lead Exposure	No	
463	Oakland Zoo	Lead Exposure	No	
463	Pinnacles	Lead Exposure	No	
550	Pinnacles	Lead Exposure	Yes	Multiple metallic densities in lower gastrointestinal area. To LA Zoo for care.
550	LA Zoo	Lead Exposure	Yes	4-5 metallic densities in the ventriculus and 1 in small intestine. Passed all items and released back into wild.
550	LA Zoo	Lead Exposure	No	
602	Oakland Zoo	Lead Exposure	No	
606	Pinnacles	Lead Exposure	No	
688	Pinnacles	Lead Exposure	No	
692	Pinnacles	Lead Exposure	No	
692	Pinnacles	Lead Exposure	No	
785	Oakland Zoo	Lead Exposure	No	
835	Pinnacles	Lead Exposure	No	
835	LA Zoo	Lead Exposure	No	
835	LA Zoo	Lead Exposure	No	
835	Pinnacles	Lead Exposure	No	
872	Avian Clinic	Leg/foot Injury	No	No breaks or abnormalities in legs/feet



Photo 8, Condor 550 radiograph with metallic densities (circled) present in lower gastrointestinal area. Large metallic density on right side of body is the wing tag attachment bolt. NPS Photo.

Surgeries

In 2018, no PNP-managed condors required surgery.

Vaccination

In 2018, West Nile Virus vaccinations were given to 21 PNP condors.

Hazing

In 2018, staff hazed six condors from locations that were deemed unsafe or too close to people.

Collaborative Research

Working collaboratively with USFWS, VWS, universities, and other researchers is a high priority for PNP and helps accomplish recovery goals. Multiple studies are underway to better understand threats to condors and how management can reduce their impacts.

Chelation Efficacy Research

A PNP/UCSC chelation efficacy research study began in 2015 to evaluate the benefits of chelation on condors over time in terms of reduced mortality. Blood and feather sample collection supports this effort. Evaluating lead concentrations and isotopic compositions in sequential feather segments from individual birds is providing data on the degree, frequency, and severity of lead exposures in condors. These data will be considered with chelation history of individual birds. When feasible, PNP biologists measure and mark at least one growing primary feather at the time of capture. Any previously marked feathers are sampled, if possible. This research project is ending this year and results will be published in a peer-reviewed journal. Because of the high value of data from feathers, PNP staff will continue to collect these samples for future research.

Chelation Treatment Impacts on Short-term Survival Research

PNP and VWS began a three-year research study comparing survival of condors with and without treatment to asymptomatic lead exposure. All PNP-managed condors continue to be radiographed and chelated if field blood lead values are 35 µg/dL or greater. All VWS-managed condors are radiographed and chelated only if showing symptoms of lead exposure. Blood samples are taken for all PNP and VWS condors and submitted to a lab for analysis. These data

will be tied to the treated and not-treated groups to better understand the effectiveness of chelation on survival rates between the two groups.

Blood Parasite Research

San Francisco State University (SFSU) researchers in collaboration with USFWS, VWS, and PNP, are analyzing blood samples for parasites that can be associated with diseases, such as avian malaria. This study involves a small blood sample, <1 ml from each condor in the central California flock. To date, 34 samples for avian malaria testing have been collected and sent to SFSU for analysis and all samples were negative for parasites. Data collection for this project was completed in 2018 and a written summary of results is expected in 2019.

Rodenticide Exposure Research

Preliminary results from condor liver samples analyzed in recent years showed that some condors were exposed to rodenticides and highlighted the need to continue research that began in 2014 on prairie falcons at PNP. Collaboration between the NPS Washington office, PNP, and USGS will continue through 2020.

In addition, Redwood National Park and PNP are collaborating with Integral Ecology Research Center to conduct spatial modeling of central and northern California to map areas of high risk for illegal marijuana grow sites and their related toxins. This work began in 2018 and will continue in 2019.

Condor Range and Movements Research

In 2018 PNP's research collaboration with Colorado State University continued. Researchers are analyzing condor behavior, environmental parameters, and GPS data to predict long term movements into areas beyond their current range. The research will help managers better understand condor behavior as well as new and current threats that exist in areas not presently occupied by condors. This project is planned for completion in 2019.

Outreach

A large component of PNP's Condor Recovery Program is educational outreach and interpretation. As the only condor release site in a national park, park visitation gives staff an opportunity to reach thousands of people from all over the world. Providing the public with information about the natural resources in the park and the surrounding landscape is an

essential pathway to inspire environmental consciousness and enthusiasm and is one of the duties of a national park.

NPS Education and Interpretation

This was the final year of a three-year, multi-park project to ensure that all national parks with condors have consistent messages and interpretive materials. Specifically, information about condor biology, threats to their survival, and recovery efforts underway in California, Arizona, Utah, and Baja California, Mexico. Enhancing park visitors' experiences was the primary focus for this interpretive project, although non-lead education and outreach, both within parks and beyond their boundaries in local communities, is highly relevant. During 2018, the project shared updated interpretive materials among eight national park units across California, Arizona and Utah, including Redwood National and State Parks, Grand Canyon National Park, Sequoia-Kings Canyon National Parks, Cedar Breaks National Monument, Zion National Park, Bryce Canyon National Park, Pipe Spring National Monument, and Grand Canyon-Parashant National Monument. These park units received materials based on their needs, such as condor egg and skull replicas, educational photos, non-lead ammunition brochures, handheld resins containing lead and nonlead bullets for comparison, condor wingspan banners, transmitters and tags, radio tracking antennas and receivers, and scientific illustrations depicting differences between condors and other large birds found in western North America. NPS staff from PNP, Grand Canyon, and Sequoia-Kings Canyon National Parks are continuing work on a condor subject site that will serve as an online information hub for facts and details about condor biology, threats, management, recovery, and non-lead outreach that will benefit all parks and the public.

PNP also conducted education and interpretation in the park and in the surrounding communities. While in the field, biologists and trained volunteers answered questions and provided visitors with informal interpretation about condors. This year condor staff and volunteers spoke with 4,323 park visitors within the park and 86 individuals while tracking outside of the park boundary. In addition to informal contacts, biologists presented six educational programs to over 160 individuals.

Outreach about lead as an environmental contaminant is recognized as one of the most important actions that can positively impact condor recovery. PNP staff employed various efforts to educate diverse groups on the impacts of lead on condors, other wildlife, and human safety, as well as the benefits of removing lead from the landscape.

Targeted Non-lead Outreach

This year PNP continued conducting outreach related to the use of non-lead ammunition and lead poisoning in condors from the inadvertent ingestion of spent ammunition from animal remains left in the field. However, with PNP's wildlife biologist outreach position vacant for nine months, it was not possible to conduct as much outreach locally or state-wide as desired. Even so, during the summer and fall of 2018, IWS and PNP staff worked together with Oregon Zoo, The Peregrine Fund, and VWS to coordinate outreach efforts. In 2019, PNP will continue working with other agencies and non-profit partners to expand outreach.

RECOMMENDATIONS

Monitoring

Maintaining staff capacity and efficient monitoring creates a well-rounded program, including outreach and research components that are coordinated with condor management. The increase in the number of condors with GPS tags over time has increased monitoring efficiency by reducing the number of missing birds that were difficult to locate and by guiding the field crew's efforts after viewing GPS data each morning. Further increasing the number of birds with GPS tags would simultaneously result in more data of higher precision and better use of personnel time. Increasing the number of condors with GPS tags remains among the highest priorities to streamline and improve monitoring efficiency.

Management

Lead in the environment remains the primary threat to condor recovery. Condors will continue to use the public and private lands from PNP to the coast that offer excellent foraging, roosting, and nesting habitat. Addressing the threat of lead across these lands is an ongoing need, as is providing the best care possible to condors exposed to lead. A greater understanding of the efficacy of chelation treatment will help all condor release sites determine when it is most useful. Chelation treatment for condors should be further researched and evaluated to increase the understanding of its effectiveness in relation to survival trends. NPS/VWS collaboration on chelation efficacy will help inform this evaluation and will continue through 2020.

Research

Each research project conducted to date has informed management decisions that affect the recovery of the species. PNP biologists continue to work closely with researchers and prioritize

the collection of samples and data that support scientific research. With funding for research limited, condor recovery partners should continue to work together with USFWS leadership and discuss highest priority needs, research proposals, joint funding opportunities, data sharing, and collaboration.

Outreach

Developing strong partnerships will continue to be an important step in successful outreach efforts. Fostering inclusion and cooperation while addressing the issue of lead will create better understanding and appreciation among interest groups. Multiple organizations and agencies work together to coordinate their efforts to reach the greatest number of people each year and to provide accurate information to interested hunters. Outreach efforts, considered paramount for condor recovery, are still limited by insufficient funding and therefore staff capacity. Condor release sites and all recovery partners should continue to work together to coordinate and fund successful outreach.

Recovery Planning and Multi-agency Coordination

Condor field team meetings (held approximately annually and coordinated by USFWS) bring together a diversity of perspectives including experts in the field, captive breeding programs, management agencies, veterinarians, and others. With an ever-increasing number of attendees at meetings, the need exists to develop a facilitated framework for discussion and decision making. Developing such a framework could help inform changes to management at release sites and could ensure inclusive, well-informed decisions that are based on the best available information and science. It could also aid in research prioritization, joint funding proposals, and increased collaboration among the many interested stakeholders in condor recovery.

Appendix A

Condor mortality of PNP and VWS-managed condors since 2001.

Estimated date of death is used instead of date found and reflects first day of possible death date range (if applicable). For chicks with no carcass recovery, estimated nest fail date is used. *VWS data provided by J. Burnett, Big Sur Condor Program Coordinator and Senior Biologist.*

Condor ID	Estimated Date of Death	Manager	Cause Of Death
230	5/9/2001	VWS	Powerline Electrocution: Bird electrocuted on line (mid-span)
233	5/17/2002	VWS	Missing
212	10/30/2002	VWS	Powerline Electrocution: Bird electrocuted on line (mid-span)
254	2/19/2003	VWS	Powerline Electrocution: Bird electrocuted on line (mid-span)
260	5/20/2003	VWS	Malnutrition
170	6/15/2003	VWS	Lead Toxicosis
256	10/17/2003	VWS	Unknown: Bird recovered in desiccated state
179	12/20/2003	VWS	Missing: Bird disappeared after wildfire at Hopper NWR
164	9/30/2005	VWS	Unknown: Bird recovered in desiccated state
376	6/30/2006	VWS	Powerline Electrocution: Bird electrocuted on line (mid-span)
363	7/14/2006	VWS	Malnutrition: Bird died from poor body condition
417	5/12/2007	PINN	Trauma to neck, possible predator
301	5/15/2007	VWS	Powerline Electrocution: Bird electrocuted on line (mid-span)
307	5/16/2007	PINN	Unknown - possible snake envenomation
356	10/2/2007	VWS	Unknown: Found dead near release site in desiccated state
429	12/4/2007	VWS	Missing
278	6/25/2008	VWS	Missing
377	6/25/2008	VWS	Missing
336	9/7/2008	PINN	Lead Toxicosis
475	12/21/2008	VWS	Trauma
286	5/11/2009	VWS	Lead Toxicosis
503	7/6/2009	VWS	Trash Ingestion
422	7/12/2009	PINN	Unknown
303	10/23/2009	VWS	Lead Toxicosis
621	4/28/2011	VWS	Trauma
624	5/25/2011	VWS	Trauma
294	6/7/2011	VWS	Unknown: Bird recovered in desiccated state
499	11/9/2011	VWS	Aspiration
478	4/21/2012	PINN	Lead Toxicosis
588	7/21/2012	PINN	Unknown
298	10/22/2012	VWS	Lead Toxicosis
644	11/10/2012	VWS	Exposure: hypothermia.
318	11/30/2012	VWS	Lead Toxicosis
598	12/8/2012	PINN	Unknown
312	4/4/2013	PINN	Lead Toxicosis

681	4/13/2013	PINN	Unknown, chick - nothing in nest to recover, no necropsy report
715	5/20/2013	VWS	Unknown, chick disappeared
345	5/28/2013	PINN	Lead Toxicosis
335	6/1/2013	PINN	Lead Toxicosis
686	6/1/2013	VWS	Unknown, chick recovered in desiccated state
306	6/9/2013	PINN	Electrocution, possible indirect lead exposure
332	7/2/2013	PINN	Lead Toxicosis
194	7/11/2013	VWS	Missing
708	7/12/2013	VWS	Trauma, chick died in nest
313	8/6/2013	PINN	Lead Toxicosis
714	9/4/2013	VWS	Trauma, chick died in nest
693	9/8/2013	PINN	Unknown, chick - no collection based on remote nest location
501	9/25/2013	VWS	Missing
451	12/7/2013	PINN	Lead Toxicosis
739	4/28/2014	VWS	Unknown, chick disappeared before fledge
400	4/29/2014	PINN	Lead Toxicosis
401	6/15/2014	PINN	Lead Toxicosis (proximate) perforation of the ventriculus
444	8/26/2014	VWS	Lead Toxicosis
411	12/6/2014	PINN	Unknown: Bird recovered in desiccated state
664	12/31/2014	VWS	Lead Toxicosis
753	4/16/2015	VWS	Missing (last detected 4/16/2015)
788	4/30/2015	VWS	Unknown, chick - nothing in nest to recover, no necropsy report
713	5/15/2015	PINN	Missing (last detected 5/15/2015)
782	5/23/2015	PINN	Unknown, chick - nothing in nest to recover, no necropsy report
798	6/10/2015	VWS	Unknown, chick - nothing in nest to recover, no necropsy report
242	7/30/2015	VWS	Lead Toxicosis
769	8/29/2015	VWS	Unknown, suspected trauma
615	11/17/2015	VWS	Trauma - Predation
481	4/22/2016	PINN	Missing (last detected 4/21/2016)
742	5/1/2016	PINN	Septicemia
251	7/4/2016	VWS	Lead Toxicosis
838	12/1/2016	VWS	Trauma, fledgling euthanized due to injuries
514	3/17/2017	PINN	Anticoagulant toxicity
534	4/17/2017	PINN	Missing (last detected 4/16/2017)
583	6/28/2017	VWS	Missing (last detected 6/27/2017)
597	7/1/2017	VWS	Drowning
760	7/1/2017	VWS	Drowning
703	7/2/2017	VWS	Lead Toxicosis
460	7/7/2017	PINN	Egg binding
525	8/1/2017	PINN	Lead Toxicosis
787	12/24/2017	VWS	Drowning
614	1/19/2018	PINN	Lead Toxicosis
706	6/11/2018	VWS	Lead Toxicosis