

Bringing Back the Condor



Adaptive Management Guides the Recovery Effort

The team arrived before dawn at the trap site on Hudson Ranch. It was 19 April 1987—Easter Sunday—and they came to this remote area north of Los Angeles to capture a single bird known as Adult Condor 9, or AC9. Netting procedures like this had been done before, but each team member knew the momentous nature of this morning's capture. AC9 was the last of his kind.

As the sun rose in a cloudless sky, several ravens and a Golden Eagle arrived at the trap site baited with a calf carcass. Shortly after 10:00 a.m., AC9 alighted near the bait. He began to feed, and the cannon net fired. As the mesh entrapped AC9, an era ended for the majestic California Condor. For the first time in tens of thousands of years, not a single condor roamed North American skies.

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With the last free-flying condor now in captivity, a new chapter began for the California Condor Recovery Program, a multi-agency effort led by the U.S. Fish & Wildlife Service. Due to the condor's small population and remote breeding range, when AC9 was captured, much about the species was a mystery. Nevertheless, the recovery program's options had narrowed to an all-or-nothing captive-breeding effort. On that Easter Sunday, when they placed AC9 into a sky kennel and transported him to the San Diego Zoo's Wild Animal Park, only 27 condors remained in the world. And the recovery team had yet to produce a single California Condor in captivity.

Due to the complexity and unpredictability of natural systems, conservation biologists have increasingly come to rely on "adaptive management", a process by which they adjust management



Condors use their large primary feathers to help them achieve great stability in flight; they often fly for an hour or more with hardly a wing flap. Some condors have been known to soar more than 150 miles in day. *Grand Canyon, Arizona; 13 March 2004. © C. Parish / The Peregrine Fund.*

direction as new or better information emerges. Mike Mace, Curator of Birds at the San Diego Zoo's Wild Animal Park, says that no blueprint exists for a program like the one to save the condor. Team members have to adaptively manage the effort and literally write history as they go. The program's eventual goal is to establish two geographically separate, self-sustaining wild condor populations. Each of these non-captive populations needs a minimum of 150 birds, including at least 15 breeding pairs. In addition, each population must include genetic descendents from the original group of founding birds (Kiff et al. 1996).

A Resilient Species

With a wingspan stretching to nearly 10 feet and a body weight that can exceed 21 pounds, the California Condor is North America's largest bird (Snyder and Schmitt 2002). Condors are considered to be New World vultures in the family Cathartidae, and DNA-DNA hybridization studies have shown that condors are more closely related to storks than to the Old World vultures in the family Accipitridae, to which they bear a superficial resemblance (Sibley et al. 2001).

Before the late-Pleistocene extinction of dozens of large mammal species about 10,000 years ago, carrion-eating condors scavenged across North America. Once the large mammals vanished, condors gradually retreated to the continent's West Coast, ranging from what is now British Columbia to Baja California. Human encroachment in the twentieth century, however, decimated the condor population and shrank its range to a six-county area north of Los Angeles. Environmental pressures included shooting, egg collecting, poisoning by chemicals and lead, fatal collisions with power lines, and habitat loss (Kiff et al. 1996).

The bird's plight fostered the notion that condors were an evolutionary relic not fit for the modern world. Cynthia Stringfield, veterinary coordinator for the recovery program, observes that from a veterinary standpoint, the condor is not a fragile species. It's a myth that they are threatened with extinction because they haven't adapted well, Stringfield says, noting that condors can tolerate blood lead levels that would kill numerous other species of birds and that condors bounce back rapidly from wounds and fractures. An evaluation of eggshells from the original wild condor population by Snyder and Meretsky (2003) showed that even DDT, a serious problem for other species, appears



Unlike adult condors, this immature bird has a dark-colored head and neck, and it lacks the distinctive long, narrow white triangle on the anterior half of the undersides of the wings. All released condors carry number tags and either GPS or radio transmitters. *Grand Canyon, Arizona; 13 March 2004. © C. Parish / The Peregrine Fund.*

not to have been a major factor in the condor's decline.

Although the condor remains one of the world's most imperiled vertebrate species, the bird's resiliency provided an unexpected advantage for the recovery team. At the San Diego Zoo's Wild Animal Park, Mace says the condor's robustness has led to current hatchability and survivability rates in the captive-breeding program of a "phenomenal" 90%. Captive-breeding facilities at the San Diego Zoo's Wild Animal Park, the Los Angeles Zoo, the Peregrine Fund's World Center for Birds of Prey in Idaho, and a newly opened facility at the Oregon Zoo all produce birds. With a growing number of mature birds that have a life expectancy of 50 years or more, the production of condor chicks is expected to continue to grow at an exponential rate. Since the captive-breeding program began, the total condor population has increased to 247 birds (CFG 2004).

Evolving Captive-breeding Practices

The captive-breeding program encountered two initial challenges: the condor's tiny population and the bird's slow reproduction rate. In the wild, a condor pair typically produces one chick every two years. Biologists in the captive-breeding program use double-clutching to increase production, removing the first egg a female lays and

prompting the breeding pair to produce a replacement egg. With double-clutching, a captive-breeding pair can produce four chicks in two years. The extra chicks are raised by humans using puppets resembling adult condors. Puppet-raised condor chicks never see their human benefactors face to face.

Five years after a net trapped AC9, the program released its first captive-bred condors into the wild. But all did not go well, says Mike Wallace, Wildlife Scientist for the Zoological Society of San Diego, and the program had to reassess its captive-breeding practices. Wallace says that during the late 1980s and early 1990s, cohorts of chicks were raised in a group social environment with no older birds present. Without modeling by adult birds, the chicks didn't learn appropriate behaviors. Once released in the wild, the young birds acted like teenagers with no parental supervision. This "Lord of the Flies" syndrome caused released birds to engage in dangerous activities such as seeking out people, frequenting campsites, and even entering buildings.

The California Condor is what ecologists call a "K-selected species"—one that produces few young, is long-lived, and requires extensive parental care. Adult condors invest heavily in their offspring, and a chick's initial psy-

chological and social environment affects its later behavior. Veterinarian Stringfield compares condors to wolves: smart, inquisitive, and highly social.

Nowadays, says Wallace, biologists have learned to keep young chicks in the controlled environment of captivity longer—sometimes two years or more—to modify the chicks' behavior and better prepare them socially and behaviorally before release. The early months of a captive-bred chick's life now more closely mimic nesting practices of wild condors, in which a newborn chick sits by itself in a cave or cavity and sees primarily adult condors. In using this new approach of raising chicks "singly in a social environment", captive-bred birds are allowed to see an adult "mentor" condor to learn proper behaviors and are introduced to peers slowly over time.

Behavior training continues when birds are moved to five release-sites in central and southern California, in Arizona, and in Baja California. In a release-site flight pen, young condors spend several more months adapting to the area under further tutelage by a mentor condor. The flight pens are mesh-enclosed structures with 60-foot sides and a height of about 30 feet. They have built-in blinds containing one-way glass that allows biologists to monitor the birds unseen.

Intensive Field Management

Dangers abound for newly released young condors. Birds have been killed by collisions with power lines, electrocuted, shot, eaten by predators, and even poisoned by drinking antifreeze. To protect and monitor the birds, biologists equip each condor with numbered wing tags and lightweight radio transmitters. This allows researchers to track released birds and head off danger or provide support if a bird gets in trouble. The rugged terrain that condors favor, however, can block radio signals, and birds sometimes disappear for two or three days at a time. A few recently released birds sport a new GPS (Global Positioning System) monitoring system that provides biologists with improved tracking and a plethora of information on condor movement and behavior. Researchers make arduous journeys through chaparral-choked canyons and rappel down cliffs to remote nest sites to monitor the birds. Released condors are also recaptured to run health checks and replace radio transmitters. Recently, the recovery team recaptured released birds to vaccinate against the West Nile virus.

Field management varies from site to site. Kelly Sorenson, Executive Director for the Ventana Wilderness Society that manages the central California Condors, says the new release-site at Pinnacles National Monument offers visitors some of the best opportunities to view condors in the wild.

But to keep birds from getting too comfortable around people, support personnel carry water guns to "haze" birds landing near trails or benches. Biologists at other locations have used similar techniques to train condors to avoid dangerous areas.

Hazards In The Wild

The first releases of captive-bred birds began in 1992 in Southern California, but by 1994, according to Wallace, a high rate of electrocutions and fatal collisions with power lines virtually stopped the reintroduction program. The recovery team scrambled to adapt their practices to counter this danger. Biologists experimented with placing a replica of a power pole in condor flight pens that gives a mild electric shock when a bird alights on it (Kiff et al. 1996). Condor power-pole-aversion training proved effective, and these days, the danger for released birds from power lines has greatly diminished. In addition, some energy companies have hung visibility markers on power lines or even buried cables in areas frequented by condors.

Other hazards remain more difficult to overcome. Lead poisoning played a significant role in the condor population's drastic decline. It still plagues the recovery effort today. As scavengers, condors sometimes ingest lead bullet



The first fledgling from the recovery program is pictured on the left. The chick fledged in November 2003 near the Grand Canyon release-site. The male parent is on the right. Grand Canyon, Arizona; 24 March 2004. © C. Parish / The Peregrine Fund.



Captive-bred chicks are raised with hand puppets such as the one pictured here. Condors normally raise one chick every two years. Using condor puppets to feed chicks allows for double-clutching and increases the condor population faster. *San Diego Zoo, California. © Zoological Society of San Diego.*

fragments when eating carcasses of game such as deer and wild pigs left by hunters. Condors that accumulate toxic lead levels become lethargic and suffer from paralysis of the digestive system, causing them to starve (Fry et al. 2003). According to Chris Parish, Condor Project Supervisor for the Peregrine Fund in Arizona, within a year of their release, almost all of the condors in the Grand Canyon area show elevated blood levels of lead. He says about half of the Arizona birds have been treated for lead poisoning. It's a similar story in California, with every released bird showing detectable lead in blood samples (Fry et al. 2003).

To resolve the lead problem, the recovery team established a subcommittee devoted to this issue and is reaching out to the hunting community for help. Parish says that surveys of hunters found that most were unaware that lead poses a problem for condors and other wildlife. The same surveys also show that most hunters are willing to help out

once they know about the problem.

The recovery team works with educational outreach programs, such as Project Gutpile, that encourage hunters to bury the entrails of slain animals so that lead doesn't enter the food chain (Project Gutpile 2004). Another option is supporting the use of bullets made from either copper or a composite of tin, tungsten, and bismuth. As an interim step while the program works to find solutions to the lead issue, biologists are putting out lead-free stillborn calves near release-sites for condors to feed on. But with a bird that can fly 150 miles or more in a day, released condors still end up straying from the managed feeding stations and eating "mystery crops" (Fry et al. 2003).

A new concern has emerged as some of the released condors have begun reaching sexual maturity at age five or six. While a pair of condors in Arizona achieved a major milestone in 2003 with the first successful fledging of a wild

chick, several other young birds have died in their nests. Greg Austin, Deputy Project Leader for the Hopper Mountain National Wildlife Refuge complex, says necropsies have shown that some of the dead chicks had swallowed bottle caps, pieces of car tail-lights, pull-tops, glass shards, and other bits of metal and plastic. The debris can block chicks' digestive tracks, either killing them outright or retarding their growth.

Adult condors want to feed their chicks calcium and, according to veterinarian Stringfield, apparently have an instinctual behavior to seek out bone fragments. Unfortunately, the search image is fairly general, and condors don't differentiate between a piece of metal or plastic and a bone chip. The adult condors ingest the objects, then regurgitate them for a chick at the nest site. Stringfield hasn't seen any harm to adult condors from ingesting trash and theorizes that condors have strong digestive tracks and probably regurgitate material they shouldn't have eaten. Chicks apparently try to do the same thing but not as effectively.

Recovery-team biologists are trying out several remedies. These include sifting nest sites to clear out any foreign objects, as well as cleaning up nearby locations that have trash which condors can get into. Team members also put out bone chips with the calf carcasses that they feed the condors to provide nesting birds with needed calcium.

The Long Road To Recovery

By their nature, recovery programs for charismatic megafauna such as the condor become high-profile environmental efforts. To date, the cost for the condor recovery program has totaled an estimated \$40 million (USFWS 2004). Intensive field management means long hours and hard physical work for those on the recovery team. Is the cost and effort worth it?

The condor is a flagship species. Bird curator Mace says that by protecting the condor's habitat in California, more than 50 other bird, mammal, reptile, and plant species benefit. In addition, lessons learned from the effort to save the condor have helped guide recovery programs for other endangered species. The recovery program is also a testament to identifying problems that humans have foisted on a species and then rectifying the situation to maintain that species for future generations.

Since AC9's capture, the condor recovery program has moved from answering basic questions about the species to passing the critical landmarks of the first fledging of a chick in the wild and the reestablishment of more than 100 birds flying free. Some of the birds now being hatched by the program will outlive the recovery team members.

As a symbol of how far the program has come, AC9 was released after 15 years in captivity to return to

A condor's bare, orange-colored head and neck darkens when the bird is excited or upset. Condors also inflate air sacs in their neck when agitated. Pictured is Topatopa, who was brought to the Los Angeles Zoo in 1967 as a starving wild fledgling. *Los Angeles Zoo, California.*
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Viewing Condors In The Wild

With more than 100 free-flying birds, opportunities abound to see condors in the wild. The following web sites offer field notes and updates on viewing information in the release areas.

- **Big Sur, California.** Information at the Ventana Wilderness Society web site at <www.ventanews.org>.
- **Pinnacles National Monument, California.** Information at the Ventana Wilderness Society web site at <www.ventanews.org> and at the National Park Service web site at <www.nps.gov/pinn/condor/release.htm>.
- **San Luis Obispo County, California.** Information at the Hi Mountain Condor Lookout Project web site at <www.condorlookout.org>.
- **Southern California.** Information on condor viewing areas in Santa Barbara, Kern, and Ventura Counties at the Hopper Mountain National Wildlife Refuge Complex web site at <hoppermountain.fws.gov>.
- **Grand Canyon, Arizona.** Information at the Peregrine Fund web site at <www.peregrinefund.org/notes_condor.asp>.
- **Baja California.** Information at the San Diego Zoo's web site at <www.sandiegozoo.org/wap/condor/tracking/baja_release.html>.

his old haunts deep in the Los Padres National Forest. In 2004, AC9 mated with a released captive-bred female. With a fortuitous bit of timing, their first egg hatched on Easter Sunday.

But with all the progress, there's still a long road ahead to create self-sustaining wild condor populations. The recovery team biologists continue to change and adaptively manage the reintroduction effort as they write the still-evolving story that will determine the fate of the California Condor.

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The goal of condor recovery program, of course, is to restore self-sustaining populations of California Condors in western North America. For the time being, though, sightings of "wild" condors will be of wing-tagged individuals such as this one. *Hopper Mountain National Wildlife Refuge, California; December 2001. © Ned Harris.*