Lessons from Counting California Condors

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Small numbers can be significant. Their significance may be due entirely to their being so small. As the population of California Condors (*Gymnogyps californianus*) diminished to a vanishingly small number, there was a debate over how low the population was. Some wondered whether any action was needed yet, because the population had never been very high. Others said the population had dropped to a low number but questioned just how low it was. Without knowing how many condors were still in the wild, it was hard to justify the cost of taking any action to save the condor from extinction. The species was wide-ranging and therefore hard to census, so it would be very difficult to determine how low the population actually was. This paper reviews some of the methods and issues regarding the 1978 California Condor survey, which played a critical role in deciding on a conservation strategy for the species.

Some species are difficult to find because they are rare, secretive, nocturnal, or occur in inaccessible habitats. Success or failure in locating an individual bird also may be affected by the bird's behavior, the searchers' methods, the duration and the intensity of the search, and the probability that the searched area is the spot where a bird is located. This last factor considers the likelihood of detection within the portion of the habitat that can be surveyed at one time versus how much habitat is available for the bird to occupy. Another consideration is whether the species is easy to see or, such as a bittern or a woodcock, is so well camouflaged that you may pass by within a few feet without detecting it.

Censusing the California Condor presents a mix of these issues. The condor never was numerous over the last several centuries. It largely inhabits remote wilderness areas. It is shy. These traits, behaviors, and habitat preferences make it difficult to see. Conversely, condors are huge and strikingly colored with bold black and white feathers and bright colors on the head. Condors fly high in the air, using thermals so that they are visible and identifiable from many miles away. They travel long distances in the open skies, so that a single bird may be seen by many people over a wide geographic area in one day. These factors make it difficult to get a good estimate of the condor's population. How can you eliminate duplicate sightings of a single bird while maximizing the chances that every bird gets counted only once in a census?

This paper provides a personal perspective on the methods and results of the 1978 statewide California Condor survey. The significance of the survey to the survival of the condor was underappreciated by the public at the time. The paper explains how the survey was done, how data was interpreted, and includes a post-hoc evaluation of how similar data led to multiple interpretations by different decision makers. Only with the benefit of hindsight can we fully comprehend the solemnity of those decisions. The purpose is not to criticize those who made these decisions and the methods they applied, but rather to help identify lessons that may be applied in the future to similar censuses of species with small populations and undetermined detectability. In this instance the high detectability of the condor almost lulled biologists into postponing action until it was too late. Ultimately, this example demonstrates that accuracy can be critically important when documenting or counting even tiny numbers.

CENSUS METHODS

Over a three-day weekend in the fall of 1978, 150 biologists, researchers, and volunteer birders spread out to all locations in California from Monterey and Porterville south to San Diego, where California Condors had been seen in previous decades. All condor observations were to be documented from noon to late afternoon on each of the three days.

It was recognized in preparing for the 1978 survey that, because the condor is a large high-flying bird that travels substantial distances, observers far apart could have multiple sightings of a single bird. Therefore, solely totaling observations without correcting for multiple sightings of the same individual would produce an inaccurate, inflated population estimate. Therefore, the censusing required attention to details, to ensure that the birds were not counted multiple times. Birds were to be identified to age class and then further identified individually by noting molt patterns of specific flight feathers. Birds were also individually identified by noting locations at specific times along with behaviors and travel directions.

California Department of Fish and Game (now Wildlife) biologist Paul Kelly and I were positioned on top of a peak south of the Tehachapi Mountains. As the count period started at noon that first day, one adult and one immature condor flew towards us from the north-northwest in a long glide. They were so stable in the air that they looked like glider planes. They then circled, gaining altitude in the thermals overhead. Our censusing team had succeeded; we had observed two condors during the first 15 minutes of the count period! Through spotting scopes, we noted the individual flight feathers (remiges and rectrices) on each bird that were being molted at that time and recorded the other observational data. After the two birds flew on, moving due east and out of view, we continued watching over the three-day

period. We saw no more condors. Over the three days, the total observations by all 150 observers identified 13 individual birds by age and molt patterns.

USING CENSUS AND CAPTURE DATA TO ESTABILISH A RETROACTIVE POPULATION ESTIMATE

The official count organizers faced an issue with their count of 13 individuals. They did not want to be alarming. They had to consider, "What is the likelihood that additional birds avoided detection?" Nobody could say for certain, so they assumed it was possible that the survey detected only half of the population. Therefore, officials decided to announce that no more than 26 condors were estimated to still exist in the wild as of the winter of 1978-1979. The was consistent with survey estimates by Sandy Wilbur of the US Fish and Wildlife Service throughout the 1970s of 25 to 30 still in the wild (U. S. Fish and Wildlife Service 1996).

The subsequent population dynamics of the wild and free condor population can be used as a basis for determining the true population during the 1978 survey and thus the accuracy of the count and the interpreted numbers of reported birds (California Department of Fish and Wildlife, no date). In 1987, the last free-flying California Condor, AC-9, was captured and sent to the captive breeding program. This was the ninth and last free-flying bird to be captured for the breeding program in the 1980s. During that decade, 13 hatchlings were produced in captivity from eggs taken from wild birds, and four hatchlings were taken from nests of wild birds. Topa Topa, a condor who had been in captivity already for many years, plus the nine free-flying birds captured during the 1980s were augmented by the 17 hatchlings to comprise the 27 condors that made up the initial captive flock. That flock comprised all the California Condors that remained in the world.

Among the nine free-flying California Condors caught between 1985 and 1987 were some immatures that had hatched after the 1978 census, including AC-9. Six free-flying birds also died and disappeared from the wild population in the 1980s. Together, the six mortalities and nine free-flyer captures shows that there were at least 15 total wild condors in the Southern California mountains between 1978 and 1987. Some of the birds that were captured, however, were young. Up to six birds were likely fledged in the wild between 1978 and 1987. Adding 6 fledglings to the 13 seen during the census, shows that there were 19 rather than 15 birds. Subtracting the six known mortalities from the 19 total, yields a total of 13 living condors. This calculation of 13 birds, compared to the nine captured, means that maybe as many as 4 additional birds died and disappeared in the wild between 1978 and 1987.

The population had dropped so low that fledgling recruitment of six condors in a decade was exceeded by mortality of 10 birds in that same decade. Using a fudge factor of doubling the number seen in the 1978 survey

to account for birds that may have not been seen may have seemed appropriate at the time. In hindsight, it would have been more prudent to use a 10% or 20% margin to account for the possibility that large, soaring condors were undetected. The actual margin of uncertainty for this condor census was perhaps 5%, or within a precision of +/- one bird. In short, the actual count of 13 condors was accurate. The 1978 method of doubling the number of birds seen was not supported by the subsequent population analysis. Even the inflated number of 26 birds, however, was still so dramatically low that immediate action was justified.

WHEN SHOULD A POPULATION DECLINE TRIGGER CAPTIVE BREEDING

In the 1970s, there was wide-spread concern that there were fewer condors alive in the wild then previously, but there was no consensus on the magnitude of the decline, the accuracy of the data, what to do about it. Before the suspected decline was used to trigger intervention to save the condor from extinction, the population data were checked to confirm and quantify the actual decline. Some people still questioned the new data, wondering if the detection rate might even be lower than 50% because some condors had been documented staying at a feeding location for multiple days.

With no easy way to confirm the data, some felt that protection in the wild from poachers was all that was needed for the population to recover. Others noted that each pair only laid a single egg every two years and that reproductive rate was too low for the species to ever recover. Many said it was time to begin captive breeding before it was too late. Many others were convinced that no action should be taken because it was not necessary to help the species, which had always had a small population or, conversely, because it was already too late to save the species destined for extinction. Some of the fatalists wanted the last few to remain in the wild so that listers would be able to “count” them, even if that would contribute to an earlier extinction. Some felt that the remaining condors should be left in the wild to “die with dignity” rather than becoming captives.

A population decline was documented and that fact was used to trigger interventions. Even those who believed that there was only a 50% detection rate for condors, however, were nonetheless alarmed. A population of fewer than 30 individuals was critically low, so they supported taking action. A captive breeding effort based upon capturing all the free-flyers would mean there would be none left in the wild. It was feared that removal of all birds from the wild could cause the population to lose its traditional knowledge of nesting and foraging areas and eliminate protections on key condor habitat since the birds would no longer be occupying it. A compromise was reached to leave adults in the wild and to take eggs and chicks from the wild to promote double clutching. Those young and eggs taken would become the future captive breeders.

A determination of best practices was needed before permits would be issued for working with such an Endangered Species as the California Condor. There was an effort to initiate studies of removal of eggs and hatchlings from other vultures in the wild. When subsequent surveys documented that the wild population dropped to only nine birds, however, that triggered the capture of some of the non-breeders. There was no more time for studies of congenitors. The wild population then dropped to six, with no breeding pairs in 1986. Only then was there consensus, and the decision made to capture all remaining condors.

The 1978 census was pivotal in deciding to bring all California Condors into captive breeding. By 2017, the captive breeding program had increased the population to 460 birds, including 170 birds released and breeding in the wild in California (California Department of Fish and Wildlife, no date). The captive breeding population has accumulated enough fledglings to establish reintroduced populations in the Ventana Wilderness, Sespe Condor Reservation, Baja California, and Arizona's Grand Canyon. Captive breeding saved the California Condor from extinction. In the end, it did not matter whether there were 13 or 26 left in the wild; the total population was critically low, and action was justified only after accurately documenting that fact.

The California Condor census result illustrates the importance of recording small numbers. When a population is very small, it may be difficult to separate the possible causes, including lack of observations, the lack of effort to seek observations, and failure to record observations, from a true absence or low number of individuals of the species. Therefore, it is important to record data, whether it is positive or negative (i.e., no individuals observed). California Audubon, National Audubon, State of California, and Federal resource agencies got together for the 1978 surveys to record positive and negative data for the California Condor. Many surveyors did not record a single condor. Those absences clarified the dire condition of the population, which led to captive breeding and a dramatic population increase.

CONCLUSIONS AND LESSONS LEARNED

Sometimes factors other than true abundance affect the number of observations of declining species. While condor numbers were dropping, the number of observations were increasing because more birders were looking for and reporting observations over wide areas. The number of reported observations thereby masked the true population decline. The severity of the population decline was also masked by how easy such a large soaring bird can be seen, even at a great distance. This easy detection was counter to the generally accepted idea that condors were hard to see because they are shy and stay in remote wilderness.

Determining with precision how low the population had dropped was difficult but necessary in order to allocate resources to the condor before it was too late. The organized, comprehensive survey almost occurred too late, as the population turned out to be much lower than reported. What had been organized to be a sampling survey to calculate a population estimate, actually was a complete census of the entire population of condors.

There are now about 15 times more California Condors flying in California than in the 1970s and 1980s. We can hope that, through the success of the captive breeding program, we can continue to count on California Condors flying in the skies of California, Baja California, and Arizona for many more years.

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California Condor (*Gymnogyps californianus*). 26 March 2016. Pinnacles National Park, San Benito, California.

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