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Report to the California Fish and Game Commission on Condor Mortality Issues, Actions and Recommendations

October 18, 1985

Prepared Jointly by

U.S. Fish and Wildlife Service - California Department of Fish and Game*

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INTRODUCTION

This report summarizes our knowledge about the decline in the California Condor (Gymnogyps californianus) population and the steps that have been taken, that are being taken, and that are planned to reduce mortality of wild birds. We have prepared this document at the request of the California Fish and Game Commission at its August 30, 1985 meeting.

Much of the background information and recovery program tasks and recommended actions are contained in the 1984 California Condor Recovery Plan. Current and planned projects referred to in this document are summarized in Appendix B.

Population Trends

The decline in the condor population began before this century. In recent decades the decline has been well documented. Wilbur (1980)* estimated that the population decreased from 50-60 birds in the late 1960s to 25-35 birds by 1978. In the following years, census methods improved, and projections of the continuing downward trend in numbers suggested that the wild condor population would become extinct around 1990.

Data from observations of nesting pairs and from photographic censusing indicated that recent wild production was about two fledgling condors per year through 1982. The recent estimates of population size and productivity indicated that the wild condor population experienced an average net loss of about 2 to 3 birds per year from the late 1960s through the early 1980s.

Beginning in late 1982, selected condors were trapped from the wild and in the 1983-85 nesting seasons, all eggs and nestlings were removed from wild nests to build the captive breeding population. During this period the wild

*For literature citations, refer to the 1984 Condor Recovery Plan.

population continued to decline from a minimum of 21 birds in 1982 to 15 in the fall of 1984, while the captive population increased. The loss rate in the wild increased dramatically in the fall/winter 1984-85, when 6 birds died and the number of known breeding pairs decreased drastically from five in 1984 to one in 1985. Currently, there are 6 wild condors (including one breeding pair) and 21 captive condors.

The recent losses in the wild suggest an overall annual mortality rate exceeding 15% of the population. Verner (1978) calculated that a species with demographic characteristics of the condor could not sustain itself if adult mortality exceeded 5% annually and mortality of immature birds exceeded 15% annually.

Reasons for the Population Decline

No single environmental or human-related factor can explain the sustained decline of the condor population during this century or before. Many factors have been identified as having contributed to reduced productivity of breeding pairs or increased mortality of birds. The relative importance of each factor, such as egg collecting, shooting and poisoning, cannot be quantified, but the significance of many of these factors has varied throughout this century.

The historical decline in the number of condors was probably related to the arrival of the first settlers. The increasing human population eliminated the great herds of large native mammals, introduced poisons to control large predators, collected condors and their eggs for museums, and shot the large birds for sport. The conversion of land for urban and agricultural uses in such areas as the Sacramento, San Joaquin, and Salinas Valleys has reduced the foraging areas available to condors. Numerous roads and trails have been constructed in mountain nesting and roosting areas resulting in increased disturbance to condors.

Historical and recent condor reproduction data indicate that 50% nesting success has been normal over the past 40 years, a rate comparing favorably with that found for several species of African vultures. Thus, although the nesting success of the condor has not been particularly high, evidence does not demonstrate that it is abnormally low or has changed greatly in recent decades. Unless the fraction of the adult population that attempts to breed has increased greatly in recent years (most adults were members of breeding pairs in 1984), it is apparent that the population decline has resulted more from mortality than from reproductive factors (Snyder 1983). However, productivity may have been adversely affected in the past during periods of DDT use in California. Kiff et al. (1979) showed that condor eggs contaminated with DDT have thinner shells. This phenomenon may have caused increased egg breakage or embryonic death and, hence, lower productivity.

Therefore, in recent decades, the decline in the condor population has been the result of excessive mortality of immature and adult condors. Although some natural mortality factors, such as old age or extremely harsh weather (e.g., hail storms), have been suggested as causes of death of some condors, human-related mortalities have been much more significant in affecting the population trend. In fact, every known cause of condor mortality since 1960 has been related to human activities (Table 1). During the past two decades, dead and debilitated condors have been found widely throughout the species' range (Figure 1).

Causes of Mortality

The significance of various mortality factors in free-flying condors has changed over the decades. Early in this century, shooting and collecting were

Table 1. Known Condor Mortalities and Causes, 1960-1985

(based on Wilbur, 1978, and recent CDFG files)

Date	County	Age/Sex	Cause
27 Jun 1960	Kern	Ad/M	U
Aug 1960	Ventura	U/U	U
11 Aug 1960	Kern	Imm/U	U
Fall 1960	Kern	U/U	Shot
About 1961	Kern	U/U	U
About 1961	Kern	U/U	U
23 Sept 1963	Kern	Ad/U	U
23 May 1965	Fresno	Imm/U	Collision
Aug 1965	Kern	Imm/U	U
Dec 1965	San Benito	U/U	U
27 Oct 1966	Ventura	Nestling/U	U
Fall 1972	S. L. Obispo	Ad/U	U
Fall 1972	S. L. Obispo	Ad/U	U
Fall 1974	Kern	Imm/U	U
Fall 1976	Kern	Ad/F	Shot
30 Jun 1980	Santa Barbara	Nestling/F	Handling
23 Nov 1983	Kern	Imm/F	Cyanide Poisoning
22 Mar 1984	Tulare	Imm/M	Lead Poisoning
10 Apr 1985	Tulare	Ad/M	Lead Poisoning

Key: U-Unknown, Ad-adult, Imm-immature, F-female, M-male

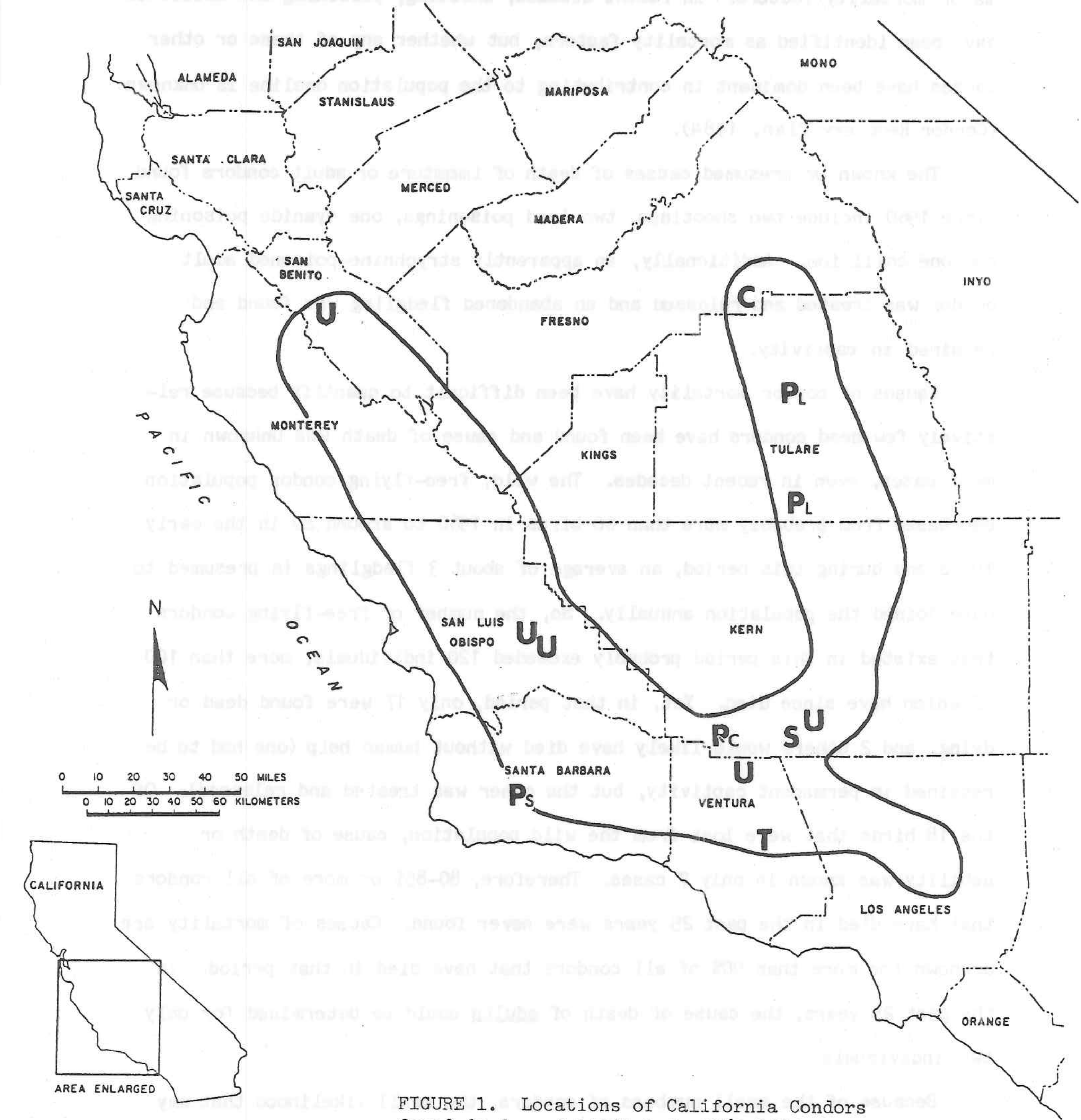

FIGURE 1. Locations of California Condors found dead or debilitated, 1965-1985, excluding nestlings. From Wilbur (1978) and CDFG files. U - unknown cause of death; C - collision with electrical line; S - shot; T - "Topatopa", abandoned fledgling; poisoning: PL - lead, PC - cyanide, PS - strychnine. All birds died except T and PS.

major mortality factors. In recent decades, shooting, poisoning and accidents have been identified as mortality factors, but whether any of these or other causes have been dominant in contributing to the population decline is unknown (Condor Recovery Plan, 1984).

The known or presumed causes of death of immature or adult condors found since 1960 include two shootings, two lead poisonings, one cyanide poisoning and one collision. Additionally, an apparently strychnine-poisoned adult condor was treated and released and an abandoned fledgling was found and retained in captivity.

Causes of condor mortality have been difficult to quantify because relatively few dead condors have been found and cause of death was unknown in most cases, even in recent decades. The wild, free-flying condor population decreased from probably more than 60 birds in 1960 to around 20 in the early 1980s and during this period, an average of about 3 fledglings is presumed to have joined the population annually. So, the number of free-flying condors that existed in this period probably exceeded 120 individuals, more than 100 of which have since died. Yet, in that period, only 17 were found dead or dying, and 2 others would likely have died without human help (one had to be retained in permanent captivity, but the other was treated and released). Of the 18 birds that were lost from the wild population, cause of death or debility was known in only 7 cases. Therefore, 80-85% or more of all condors that have died in the past 25 years were never found. Causes of mortality are unknown for more than 90% of all condors that have died in that period. In the past 25 years, the cause of death of <u>adults</u> could be determined for only two individuals.

Because of the small numbers of condors, the small likelihood that any dead birds could be found in searches of the vast range of the species, and the inherent bias of some types of mortality being relatively more likely to be detected than others, the best opportunities for determining sources of mortality would come from radiotelemetry studies. Unfortunately, the radiotagging effort progressed slowly and has been plagued with technical problems with transmitters. Also, by the time a significant proportion of the wild population had been radiotagged, the majority of birds in the more vulnerable age classes (nestlings and juveniles) had been removed from the wild to establish the captive population, and many other un-radiomarked birds had died. These factors have limited the value of the radiotelemetry program for determining causes of death; however, one of the two radio-marked condors that eventually died was successfully located by radio signals and cause of death was determined. Also, the new knowledge of condor movement patterns from radiotelemetry has contributed significantly to research and management relating to protection of the birds and their habitat.

PART I. MORTALITY FACTORS:

PROBLEMS, ACTIONS AND RECOMMENDATIONS

SHOOTING

The Problem

Mortality resulting from malicious or ignorant shooters is one of the factors most often cited as a major cause of condor decline (Wilbur 1978). Koford (1953) and Miller et al. (1965) recorded numerous incidents of injury and death to condors by shooting. Wilbur (1978) reported that at least 41 condors were shot between 1806 and 1976, but the frequency of reported shooting deaths has decreased greatly during recent decades because of new laws, increased law enforcement and public awareness. Since 1940, shooting was indicated as the cause of death of three condors for which museum specimens were obtained (1944, about 1959, and 1976) (Wilbur 1978), and four other shooting deaths (1943, 1948, 1957, 1960) were reported by Miller et al. (1965). The most recent confirmed shooting occurred in early September 1976 in the Tehachapi Mountains, Kern County. A rifle bullet had shattered the bones of a wing; the wounded bird was found two weeks later but died following amputation of the wing. An investigation was made, but no conclusion could be reached as to who shot the bird.

Most public lands used by condors are open to hunting. There are, however, several areas, including the Sespe Condor Sanctuary, where public access and hunting are not allowed. Studer (1983) found that hunting on private ranches in Kern County is limited and highly regulated, and that the most frequently hunted species include deer, quail, dove, chukar, and waterfowl (September-January); foxes (November-February); and jackrabbits and coyotes (all year).

Poaching and indiscriminate shooting appear to be increasing. Studer (1983) reported that most ranchers in Kern County reported poaching and wanton shooting to be problems on their ranches. The majority of vandal shooting occurs in remote areas situated near driveable roads.

Laws protecting condors and other endangered species are strict, but because some people disregard such laws and because of inadequate funding for law enforcement, there will always be a risk of condors being illegally shot.

Actions Taken

Recent actions taken to reduce the threat of shooting, such as firearms control, posting, patrolling, law enforcement agreements and area closures are given in the 1984 Condor Recovery Plan (see Appendix A).

Other recent actions that have been taken include:

- On June 7, 1985 the National Audubon society offered a reward of $1,000.00 for information leading to the conviction of any person responsible for the death or injury of a California Condor. This reward is in addition to rewards available through the Federal Endangered Species Act and through the State of California's CalTip Program.

- The Forest Service continues to maintain area closures and firearms controls in key condor areas. Recently (June 1985), increased protection was provided in the Pine Mountain area by expansion of an area closure.

- As a result of efforts to increase communication between law enforcement and research personnel, many of the Department of Fish and Game law enforcement personnel in the condor range have now had first-hand experience working with condor recovery program activities, such as nest watches, egg removals, mortality investigations, undercover work, or other condor projects. Additionally, there has been a consistent effort to update law enforcement people on the status of the recovery program and to develop a cooperative working relationship between wildlife management and law enforcement personnel.

Recommendations

Continue routine and special law enforcement efforts by CDFG, USFS, USFWS and cooperating law enforcement agencies in the condor range, and increase these efforts where needed based on activity patterns of the birds and of people who might be a threat to the birds. Also, when young condors are released from captivity during the reintroduction phase of the program, increased patrolling should be planned for those roads and areas near the release site and wherever young birds wander.

Continue maintaining close coordination between all condor field research staff and local law enforcement personnel through routine interagency and intra-agency communication. Also, continue to include law enforcement personnel in condor research and management projects.

Monitor hunting activities and patterns to assess the need for recommending additional area closures or to recommend changes in hunting regulations.

Continue to incorporate information on laws protecting condors and reward programs in public education materials.

Advertise widely throughout the condor range to ranchers, hunters, residents and recreationists, that every condor now in the wild is radio-tagged, and that all condors that will be released from captivity in future years will be radiotagged, and that every bird is continually being monitored by radio signals or observed by researchers and bird watchers. Vandals or other irresponsible individuals might be discouraged from shooting at a condor if they were aware that someone possibly is watching it. Similarly, the annual surveillance and monitoring by seasonal observers at Peregrine Falcon nesting sites has been a major deterrent to falconers who might otherwise climb to nest sites to illegally take nestlings.

All recommendations relating to increased patrolling and other law enforcement efforts for condor protection imply the hiring of additional personnel or shifting the priorities or assignments of existing personnel. New State legislation (approved SB 499 and pending SB 1385), on January 1, 1986, would add several CDFG warden positions and create special investigation units, which would help the Department implement the law enforcement recommendations for protecting condors.

LEAD POISONING

The Problem

Lead toxicosis was unknown as a cause of death in California Condors until March 1984 (Table 2), although a high lead level in blood sampled from a condor trapped in October 1982 raised concerns that condors possibly were being exposed to excessive levels of this metal. Before that, concerns over lead contamination in condors had been part of more general concerns about condors potentially obtaining heavy metals biologically incorporated in body tissues of their food or in polluted air. Several captive vultures had earlier died from accidentally ingesting lead fragments.

Two California Condors are known to have died of lead poisoning, a 5-year-old male found dead in March 1984 and a 7-year-old male found dying in April 1985, both in Tulare County. A copper-coated lead bullet fragment was found in the gizzard of the 1984 bird, the same bird that had an extremely high level of lead in the blood sample taken in October 1982.

Blood samples from 10 other wild condors trapped from 1982 to 1985 have been tested for lead. Samples from three adults contained clearly elevated concentrations of lead (more than double the highest level found in captive-reared California Condors), but levels were well below concentrations associated with severe effects or mortality. Two of these adults are still alive in the wild; the third was last seen on January 22, 1985.

Clearly elevated or excessive levels of lead have been detected in tissues of 5 of 15 wild-living condors tested since 1966 (Table 2). Of 10 captive-reared condors or wild nestlings tested, no samples indicated elevated lead levels (Table 3).

Table 2. Lead levels in wild condors

Condor	Sex	Age	Date Trapped (T) Died (D) Captured (C)	Date Sampled	Lead (ppm wet wt.) Blood	 Other Tissue
1	M	3-4 yr. 5-6 yr.	10/12/82 (T) 3/22/84 (D)	10/12/82 -/-/84	5.5* 24.0 (clot)	 35.0-liver, 47.0-kidney
2	M	Ad	11/13/82 (T)	11/13/82	n.d. (<0.05)	
3	F	Ad	11/13/82 (T) 10/2/84 (T)	11/13/82 10/2/84	n.d. (<0.05) 0.27	
4	M	4 yr.	10/11/84 (T) 6/25/85 (C)	10/11/84	0.13	
5	M	Ad	10/19/84 (T)	10/19/84	0.78	
6	M	Ad	10/22/84 (T)	10/22/84	1.2	
7	M	Ad	11/7/84 (T)	10/7/84	0.77	
8	F	Ad	10/12/84 (T)	10/12/84	0.19	
9	M	4 yr.	12/11/84 (T)	12/11/84	0.11	
UN1	F	Ad	8/8/85 (C)	8/85	0.32	
"Paxa"	M	1 yr.	12/5/82 (C)	12/5/82 8/29/84	n.d. (<0.05) 0.09	
"Broken Feather"	M	5 yr.	4/10/85 (D)	-/-/85		23.0-liver, 72.0-bone
"Bosley"	F	1 yr.	1/23/83 (D)	-/-/83		n.d. (<0.10)-liver
Pine-hurst	U	2 yr.	5/23/65 (D)	1/14/66		0.86-liver & kidney, 0.58-crop
"Tehachapi"	F	Ad	9/17/76 (C) 10/30/76 (D)	11/-/76		<0.5 ppm-kidney, <0.5 ppm-flesh; 1.6-liver, 1.0-kidney 79.0-bone, tarsus (ppm dry weight)

*Possible equipment contamination
n.d. - none detected

Table 3. Lead levels in captive-reared condors and wild nestlings

Condor	Sex	Hatched	Date Died (D)/ Captured (C)	Date Sampled	Lead (ppm wet wt.) Blood	Other Tissue
Xol Xol	M	1982	8/13/82 (C)	11/9/82	0.10	
Cuyama	M	1983	8/4/83 (C)	11/8/83	n.d. (<0.05)	
Cachuma	F	1983	11/8/83 (C)	11/8/83	0.062*	
Sequoia	M	1984	9/15/84 (C)	-/-/84	0.07	
Sisquoc	M	1983	1983 egg	1/31/84	0.19	
Tecuya	F	1983	1983 egg	1/31/84	0.12	
Sespe	F	1983	1983 egg	1/31/84	0.22	
Almiyi	F	1983	1983 egg	1/31/84	0.17	
S.B. chick	F	1980	6/30/80 (D)	-/-/80		1.00-liver, 0.38-kidney
Topa Topa	M	1966	3/13/67 (C)	8/29/84	0.35	

*Possible equipment contamination

Actions Taken

Monitoring Wild Condors

Tissue lead levels (primarily from blood samples) have been routinely analyzed for all wild and captive condors. This is an ongoing program.

Analysis of Food Items and Surrogate Species

In 1980 and 1981, tissues of deer, cattle, sheep, Turkey Vultures, Common Ravens, and vulture and raven eggs were sampled in the condor range and were analyzed for lead and other contaminants. Also, condor feathers from various collections were analyzed for these same contaminants. Lead concentrations in food items were generally low, but bone samples from some Turkey Vultures and some condor feathers had concentrations above normal background levels (Wiemeyer, Jurek and Moore, in press).

Lead Contamination Analysis of Condor Eggshells

A study is underway to determine lead concentrations in a large sample of condor eggshells. Recently collected eggshells and museum eggshells are being used. Results will be analyzed to determine whether this analytical method would be helpful in determining the extent of the lead contamination problem in condors.

Use of Lead Ammunition by Animal Damage Control

Following the probable cyanide-poisoning death of a condor in November 1983, apparently from an M-44 coyote control device, the USFWS modified its Animal Damage Control (ADC) activities in condor range. The procedures developed by ADC for improved protection for condors included the use by ADC personnel of steel shot for aerial shooting of coyotes or for dispatching leg-hold-trapped predators. For coyotes or other predators shot by ADC with lead ammunition, the new procedures call for burial or removal from the range of the carcass or part of the carcass that could contain bullet fragments.

Feeding Management to Reduce Exposure to Lead

Since it appears that available food that contains lead fragments or other toxins is contributing to condor mortality, supplying condors with food that is free of lead or other toxins may reduce the amount of contaminated food they consume. Since 3 April 1985 the Condor Research Center has been conducting a daily feeding program at Hudson Ranch. Only carcasses free of lead are used. Additional carcasses have been infrequently placed at Tejon Ranch, Hopper Mountain National Wildlife Refuge, and a private ranch in Glennville. Previous baiting/feeding programs for condors have been conducted on an irregular basis by U.S. Fish and Wildlife personnel. An additional program was conducted in the Sespe Condor Sanctuary. Both of these programs were carried out on a more or less seasonal basis without daily monitoring and without fresh carcasses being available on a daily basis.

During the 27-day period between 3 April and 29 April this year, there was a steady increase in the number of condors foraging at Hudson Ranch. Prior to initiation of the baiting program condors #5, 6, 8 and 9 had been known to forage only intermittently during the spring months at Hudson Ranch, yet their foraging activities at this location greatly increased from the time supplemental feeding began until early September. Since then, however, condor feeding has decreased, and almost no feeding occurred at Hudson Ranch in early October.

Since there has never been a consistent, daily placement and monitoring of carcasses for condors during the current research period (1980-1985) within currently known high-use foraging areas, we have little continuous data except for the period since April 1985 on what effects this could have on increasing the survivability of birds in the wild. We have documented a minimum of 184 feedings at clean carcasses at Hudson Ranch since 3 April 1985. Results of the current feeding program have been encouraging; the CRC staff is optimistic that condor mortality could be reduced by a larger manipulative feeding program. Such a program must be extensive enough to allow quick bait placement at any sites where condors are foraging.

The CRC staff has not been able to accurately quantify the amount of food ingested by condors; however, the birds have frequently been feeding at these carcasses and in the future more carcasses will be placed in the field.

The advantages of a closely monitored feeding program would be:

1. Uncontaminated food resources would be dependably available in certain foraging sites.
2. A dependable supply of food would increase the likelihood that the condors will spend a significant proportion of their time in safe foraging areas.
3. Greater use by condors of these feeding sites would increase the chances for closer associations among remaining birds, thus increasing chances for new pair formation or social contact.
4. Chances would be increased that birds would change present territories to safer areas near feeding sites and to use protected roosts (e.g., Brush Mountain and Bitter Creek) and nesting areas (e.g., Santa Barbara mountains) closer to feeding areas.
5. The dependable food supply may improve nutritional status, thus enhancing reproductive capacity.
6. More predictable condor foraging patterns should enhance efficiency of research and monitoring operations.

This feeding program can help to decrease the likelihood that condors would come into contact with contaminated food, but we should not expect that we can eliminate the possibility of condors feeding elsewhere on contaminated carcasses. This is something that can never be guaranteed for the present wild population or for released birds in the future. Therefore, reducing the number of contaminated carcasses available is needed in conjunction with the feeding management program.

Recommendations

Lead contamination in California Condors is a major concern for condor management and research agencies. Identifying sources of lead in the condor's environment, determining the effects of lead on condors, and minimizing or eliminating exposure of wild and captive condors to lead sources are the subjects of several ongoing and planned studies.

Physiological Effects of Lead on Condor Surrogate Species

This recommended research project is being reviewed by Patuxent Wildlife Research Center. Vultures will be used as the condor surrogate species. This study will determine how vultures retain, absorb and excrete lead and assess the effects of various amounts of lead on birds. In preparation for such work, Patuxent staff are reviewing all contaminant data now available relating to condors.

Lead Levels in Blood Samples of Golden Eagles

Golden Eagles and condors feed on many of the same food sources throughout the condor range. Frequently, both species feed on the same carcasses. Blood samples of eagles from the condor range are intended to be analyzed by Patuxent W.R.C. for lead and other contaminants for comparison with condor data. Despite differences in the physiology of the two species, knowledge of the exposure of eagles to lead in condor range may provide useful comparative information, such as seasonal or geographic differences in exposure to lead.

In preparation for these analyses, the staff of the CRC began trapping Golden Eagles for blood samples on August 22, 1985. By September 30, 19 Golden Eagles had been trapped in southern Kern County (mainly by pit trapping); the birds were released after blood samples were taken. All birds were banded and marked with patagial tags to identify previously sampled individuals and to assist in ecological studies of this common competitor of condors.

Lead Analyses of Potential Condor Food Items

This aspect of proposed research is part of the overall analyses of contaminants in condor food items, described later in this report.

Minimizing Exposure of Wild Condors to Lead in Bullets and Lead Shot

Background. Although condors may receive chronic, low-level exposure to lead compounds in the air and from biologically incorporated lead in body tissues of their food, the greater threat to condors apparently is acute, high-level exposure through ingestion of metallic lead in the form of bullets, fragments of bullets or lead shot lodged in animals that have been shot.

Current regulations restrict the type of rifle and pistol ammunition for use in hunting big game (e.g., deer, pigs, and bear) to center-fire cartridges with softnose or expanding bullets. Shotguns may be used for taking resident (e.g., pheasants) and migratory game birds and resident small game (e.g., rabbits and tree squirrels); rabbits and squirrels also may be taken by rifle or pistol, except in Los Angeles County. Furbearing mammals (e.g., gray fox, badger, and raccoon) and nongame mammals (e.g., coyotes and ground squirrels) may be taken by firearms.

Most rifle ammunition used on game mammals, nongame mammals and furbearers are center-fire cartridges, whereas most plinking and some nongame (e.g., ground squirrel) shooting is done using rim-fire cartridges (i.e., .22 caliber rifles).

Shot and slugs typically are made of lead alloys, most high-velocity rifle bullets are lead with a copper alloy coating, and .22 rim-fire bullets are very thinly copper coated or uncoated.

Most "sport hunting" lead rifle bullets are jacketed. The metal coat is made of a copper alloy, typically copper-nickel. The thickness and extent of this jacket is variable; however, bullets used in hunting are normally not completely jacketed because one end is not copper coated. The purpose of the jacket is to improve ballistics and to control or prevent expansion of the lead core on contact with the target. Controlled expansion or explosion of a jacketed hunting bullet helps prevent the passage of the projectile through the animal, thus conveying the full shocking power to the body. This increases the likelihood of a quick kill and lessens chances of the projectile passing through the animal and endangering people or property.

The so-called "full-jacketed" bullets are used in military ammunition, are available in military cartridge classes, and are also available for reloading in some calibers. Compared with copper jackets of "sport-hunting" bullets, the copper jacket of full-jacketed bullets is thicker, is composed of the same alloys, and is open at the base. Because of the thickness and coverage of these jacketed bullets, they tend to retain their shape and pass through objects better than sport-hunting bullets.

Most shotgun shells are loaded with uncoated lead pellets. Some pellets have a very thin copper coating. Steel pellets are now available for hunting where lead pellets are no longer allowed (certain waterfowl hunting areas).

Condors could obtain lead fragments in carcasses from a variety of animal species that are hunted in the condor range, such as deer, wild pig, and coyotes. Other game animals such as tree squirrels or waterfowl are normally hunted in habitats not frequented by foraging condors. Carcasses removed by hunters from the range would not present opportunities for lead exposure unless entrails or other discarded body parts containing lead fragments were left in open areas. Unretrieved, mortally wounded game animals that eventually die in more open areas would be important sources of lead to condors, as well. Small game, such as squirrels, are less likely to have lead fragments or expanded bullets than are larger species like deer.

The carcasses most likely to contain lead that could be ingested by condors would possibly be coyotes, deer, ground squirrels and rabbits, not necessarily in that order of importance. Livestock shot by vandals is another possible source. The relative importance of each of these animals, or others, as lead sources is unknown. For example, CDFG Hunter Surveys indicate that the number of coyotes and deer reported to have been shot annually in California is about the same, and in some years the take of coyotes exceeds that of the legal harvest of deer. Coyotes are less likely to be retrieved by shooters and may be more likely to die in open areas than deer would be. Also, the relative availability to condors of lead in legally shot animals and in animals shot by poachers is not known.

The opportunity for condors to ingest bullets or shot is expected to be greatest when a shot animal dies in a relatively open area, the projectile shatters or expands and stops in the body tissues, or the carcass or part of the carcass containing the projectile fragments is not retrieved by the shooter.

The amount of lead exposure to a condor eating a carcass may be affected by the amount of shattering of the lead, if any, and the extent of coating of any metal jacket. Other factors that could affect exposure or response of condors to lead ingestion include amount of surface area and mass of lead ingested, body lead level of the condor at exposure, and rate or effectiveness of mechanisms to rid the digestive tract of the object.

Recommendations. Several recommendations have been made to minimize the chances that condors would ingest metallic lead. One of these is the managed feeding program described earlier. Elimination of hunting on key condor feeding areas, such as Hudson Ranch, is another way of achieving this objective. This will be done if Hudson Ranch is acquired.

Other proposed or ongoing studies will help identify those circumstances that would increase the risk of condors ingesting lead so that effective remedial actions can be implemented. These include the Golden Eagle blood sampling, continued monitoring of lead levels in food items, and determining shot carcass availability.

Changes in hunting regulations affecting seasons and areas might reduce the chances of condors coming into contact with recently shot animals. However, so little is known about specific, or even general areas and seasons of lead exposure to condors, that any recommendations now would have to be made on speculation. Ongoing and planned studies should provide answers to these types of questions.

Changing hunting regulations affecting ammunition use would be another possible course of action. Use of fully-jacketed bullets in condor range for hunting may reduce the risk of lead poisoning in condors because bullets would likely pass through the game animal, and even if an intact bullet were ingested by a bird, most of the lead of the bullet would not be exposed to digestive fluids. However, current regulations prohibit this ammunition for hunting big game, such bullets would cause more crippling of game, and they are not available over-the-counter in as many calibers as semi-jacketed bullets. Also, the toxic effects of copper alloys (copper, nickel, etc.) on condors have not yet been assessed; such studies should be made part of the research on effects of lead on condors.

Encouraging use of specially jacketed bullets in condor range would likely not significantly reduce availability of lead to condors considering the expected low percentage of hunter compliance, the availability of lead from those bullets that explode on hitting bone, and the availability of lead from .22 rim-fire bullets or other non-jacketed or semi-jacketed bullets in rodents and illegally shot animals.

The many uncertainties about sources of lead and circumstances promoting lead toxicity in condors necessitates both field and laboratory studies. Such studies are needed before we can adequately assess proposed hunting regulations changes or recommendations affecting ammunition use in the condor range.

POISONING

The magnitude of condor mortality and illness from accidental poisoning is unknown, but the issue has been frequently debated. Historically, concerns have centered on the possibility that condors would accidentally ingest toxicants used in rangeland predator control programs, which in condor foraging areas are directed toward coyote control. In recent years, concerns have developed about the effects of DDT contamination and, as described earlier, about the significance to condors of incidental ingestion of toxic lead fragments in carcasses of animals that had been shot.

Predator Control

Wilbur (1978) found no substantial evidence that inadvertent poisoning had caused great losses in the condor population. He found only three first-hand accounts of probable condor poisoning deaths, and several illnesses; all were associated with the now illegal predator control method of poison-baited carcasses. Strychnine was the poison used in each of the cases in which the toxicant was known (Miller et al. 1965, Wilbur 1978).

Since 1972, strychnine has not been allowed for use in California as a predator poison, and no other toxicants have been allowed for predator control using carcasses or meat baits. The use of other predicides formerly used in poison-baited carcasses had earlier been discontinued in California: thallium sulfate in 1967 and Compound 1080 in 1971.

The last recorded poisoning of a condor near a poison-baited carcass occurred in Santa Barbara County in 1966; the bird was found sick, apparently from strychnine, but it recovered after treatment.

In 1974, sodium cyanide became the only poison registered for use in predator control in California. Although greatly restricted in its field application to avoid poisoning of non-target wildlife, a condor died in November 1983 probably from cyanide poisoning. Apparently, it had triggered a loaded M-44 cyanide-ejecting device set for coyotes. Federal agency use of M-44s throughout the condor range was temporarily discontinued while FWS conducted their consultation and review of Animal Damage Control activities in the condor range. On August 26, 1985, the consultation process was completed and new guidelines and procedures were developed for continued use of M-44 coyote control devices in the condor range to protect condors. These procedures allow only single sets of M-44s with a minimum of 1000 feet between M-44s and none set within 30 feet of carcasses. Also, new procedures concerning shooting of coyotes were developed.

USFWS administers predator control programs in California under cooperative agreements with the State, counties, federal agencies and private individuals.

Compound 1080 was registered by E.P.A. on July 18, 1985 for use in plastic neck collars on domestic sheep and goats. However, it currently is not registered for use in California. The California Department of food and Agriculture, the State's registration agency, is opposed to its use by private individuals as registered by E.P.A.

Bird Control

Application of poisons for bird control in condor counties is handled by the county agricultural agencies. Strychnine is the primary agricultural pesticide employed. Most control activity is in heavy agriculture areas for control of small birds. Other toxicants employed are anticoagulants, Starlicide® and Avitrol®, mostly for control of birds around warehouses, buildings, or other structures. None of these activities would be expected to harm condors.

Rodent Control

Miller et al. (1965) found circumstantial evidence for condor deaths from rodent poisoning, but the impacts on the condor population and degree of susceptibility of condors to the rodenticides were inconclusive. Although condor poisoning from rodent control activities has not been confirmed, use of rodenticides in condor range is restricted. Department of Fish and Game, Department of Food and Agriculture, and county rodent control agencies by co-operative agreement routinely review rodenticide use to avoid affecting condors and other non-target wildlife.

Rodent control programs in condor range are primarily operated by county agencies. The most commonly used poison in this range is Compound 1080 and is applied by county agents by air or from the ground. It's use is restricted to qualified applicators. Most of the rodenticides used on rangelands are for the control of ground squirrels. Gas cartridges (and to a much lesser extent methyl bromide and carbon bisulfide) are used, also, but they are applied underground and are not considered to be a hazard to condors. Anticoagulants are commonly used in the range of the condor for ground squirrel control, primarily by private property owners, but because they are expensive they are not commonly used in rangeland situations. Anticoagulants pose some hazard to raptors through secondary poisoning and could become a potential hazard to condors if they were to become widely used in condor foraging areas. Strychnine is allowed for use in rodent control in condor range, but by agreement between the State and counties, its use above ground for squirrel control is not recommended. It is a restricted use material. Strychnine baits are used for below-ground application for control of gophers (and in some areas outside condor range for jackrabbit control). Highly toxic thallium sulfate formerly was the primary rodenticide in California, but its use as a rodenticide and predicide has now been discontinued.

Zinc phosphide, also a restricted use material, is typically applied to grain baits and placed underground for ground squirrels, so it is unlikely to cause primary poisoning to scavenging birds. When consumed by an animal, it turns to phosphine gas, so secondary poisoning to wildlife is unlikely. It is used more by private property owners than by county agencies.

Compound 1080

Much of the controversy over effects of poisons on condors has centered on the use of Compound 1080 (Koford 1953, Miller et al. 1965), which has been used in condor range since 1945. Although condors have been seen feeding on 1080-poisoned rodents, and unexplained condor deaths have been reported in areas treated with 1080 (Miller et al. 1965), no condor death or illness has been conclusively attributed to this pesticide. In only one condor carcass has 1080 been detected, in a trace amount, and there was no indication that it had contributed to the death. Use of Compound 1080 is highly restricted in condor range. Recently, even tighter restrictions on application rates in condor range were recommended by the Environmental Protection Agency. Department of Fish and Game has already been working with Department of Food and Agriculture and county agencies in preparation for implementing possible new rules.

There is a great variation in susceptibility of birds and mammals to Compound 1080. Also, there is a potential hazard of a secondary poisoning to scavengers because 1080 is relatively stable. How the lethal and sub-lethal factors relate to condor vulnerability is unknown. Also, methods of detection of 1080 in carcasses have not been adequate in the past. Past studies of toxicity of 1080 to vultures have been inconclusive. A Department-funded investigation to help address these problems is underway and is expected to be completed by December 1985.

E.P.A. recently registered Compound 1080 for use in neck collars for predator control, but Department of Food and Agriculture has not registered it for use in California (see Predator Control).

Other Toxicants

Current exposure of condors to environmental contaminants, including organochlorine pesticides and derivatives, in food appears to be low (Wiemeyer et al. 1983, Wiemeyer et al. in press). However, DDT-related eggshell thinning may have contributed to reduced reproductive success (Kiff et al. 1979), and high levels of DDT derivatives have been found in some condors (Wiemeyer 1983).

Famphur, a veterinary drug, was implicated in the poisoning deaths of two Bald Eagles in northern California in early 1985 and in deaths of other scavenging birds in other states. This externally applied systematic insecticide is used on livestock to control fly larvae. The eagles had fed on a carcass of a cow earlier treated with famphur. This organophosphate drug is now under review to determine the hazards to scavenging wildlife.

Other Predator Control Methods

In the condor range from October 1981 to December 1983, M-44s were used by USFWS Animal Damage Control personnel only in Kern County. Other coyote control methods used in various parts of the condor range include aerial shooting, shooting from the ground, denning, snaring, and leg-hold traps. None of these methods is considered to be hazardous to condors under current safeguard procedures. For example, aerial gunning is little used, but in key condor use areas, it is coordinated between pilots and condor researchers.

Two condor deaths and three injuries reported by Koford (1953) from accidental trapping by leg-hold traps were associated with the now-illegal method of using traps near exposed baits.

Recent losses of condors to lead poisoning have given rise to changes in dispatching predators by USFWS in conjunction with these control procedures, such as use of steel shot and burial or removal of predator carcasses containing lead shot.

Recommendations

Continue state and county restrictions on pesticides and monitoring of rodenticide use in the condor range. Use patterns of all pesticides in condor range should be determined. Emphasis should be placed on those pesticides that have either caused condor illness or death or that could be available in some form to condors directly or secondarily through their food. Special monitoring efforts should continue on any county and private uses of strychnine and by ADC use of M-44 cyanide devices.

Current research on Compound 1080, when completed this year, should be evaluated for any needed research or administrative follow-up actions.

Ongoing, routine analyses of condor tissues from dead and living birds should be continued for those contaminants that could come from pesticide use. For example, the significance of zinc to condors is unknown, but some carcasses have contained measurable amounts of this metal contaminant. The relationship of the rodenticide zinc phosphide to condors needs to be assessed.

Department of Fish and Game Pesticides Unit should work with University of California Extension to investigate the hazards of famphur to scavenging wildlife, particularly the condor.

Fish and Wildlife Service and Department of Fish and Game are developing projects to investigate pesticide concerns (Appendix B).

COLLISIONS

The Problem

Two condors are known to have had fatal collisions with man-made objects, a surveyor's stake and an electrical distribution line. Both were immature birds. Lack of flying experience may have contributed to these accidents, but several other factors could be important in increasing the risk of such accidents occurring, even for adults. These include newly constructed obstacles in areas where condors might fly near the ground, inclement weather that would hamper visibility, or other factors. Distribution lines, high-voltage transmission lines, towers and other man-made obstacles are common in the condor range, and proposals for more lines and towers are being developed or are anticipated in future years.

Proposals for the new industry of "wind farming" as an alternative energy source present potential new obstacles to condors. These would be in the form of extensive clusters of wind turbines and their associated towers, moving blades, guy wires, above-ground distribution lines, and transmission lines. Perhaps less than 10% of the State's wind resource areas fall within the range of the condor, the most developable areas being in the southeastern parts of the range.

Actions Taken

In 1983 and 1984, the California Energy Commission (CEC) held workshops to address the potential conflict of wind energy development in condor range, and later in 1984 a map showing the relationship of current and potential condor use areas to wind resource areas was prepared by the staff of the CRC, the Recovery Team and CEC and widely disseminated to wind energy companies and county planning agencies. The Department and cooperating agencies have made a concerted effort to oppose wind energy development in those areas where conflicts with condor use might occur, either now or in the future when more condors would be in the wild. These efforts have been successful so far; no wind farms have been developed in condor range, the potential impacts to condors having been central issues in all proposals.

In recent years, FWS and DFG have opposed or recommended modifications in proposed communications facilities that could present new obstacles to flying condors in critical habitats, such as the Blue Ridge roosting area.

Recommendations

Continue close agency reviews of all proposed wind-energy developments in the range of the condor identified in the 1984 California Energy Commission map of condor range and wind-energy potential. Also, such reviews should extend to other projects that would significantly increase the number of obstacles in areas where condors forage, fly, roost or nest.

NEST SITE MORTALITY

The Problem

Biologists have long been concerned that disturbances at nest sites by humans, or predation at nest sites by animals, could result in decreased reproductive success of California Condors. Additional concern has been expressed that irregular substrates and sharp rocks on nest floors could result in an egg being accidentally broken as it is moved around by an adult bird.

Actions Taken

Since 1980, observers have kept continuous watch at all known nest sites to reduce the chances of human disturbance and predation. As a result of this activity, predators threatening condor eggs or nestlings have been driven away or killed, and in some cases nestlings and eggs have had to be brought into captivity because of perceived serious threats to their survival, mainly by foraging ravens. In addition, researchers have modified the structure of four nests and improved the substrates of several others to decrease chances of an egg being broken or an egg or young being viewed from outside the nest by an avian predator.

Recommendations

Surveillance of all active nest sites should be continued, predators removed when necessary, and additional nest sites enhanced, if needed.

OIL SUMPS

The Problem

Open sumps or pools used to store liquid waste products from oil producers appear to some animals to be pools of water. Countless thousands of animals of many species in the past have entered such pools and become oil-soaked and trapped. California Condors died in large numbers in Pleistocene times in the La Brea tar pits, and early this century some condors reportedly have died in man-made oil sumps. Condors might enter oil pools to bathe or drink or to feed on carcasses of other animals that had been trapped. Open oil sumps pose a potential threat to condors, especially juvenile birds.

Actions Taken

California law requires that oil sumps be covered by oil companies and landowners to protect wildlife, and much has been done over the past decade to identify and cover, or eliminate, open sumps. Other laws restrict dumping of these hazardous wastes, and the number of sumps has been decreasing. Law enforcement personnel routinely report instances of pools found uncovered or with deteriorating fences and netting to Division of Oil and Gas (D.O.G.) for enforcement.

The oil leakage problem at the Green Cabins parcel in the Sespe Sanctuary is being corrected this month. USFS, DOG, and private contractors are plugging the leaks from the abandoned wells and eliminating waste storage ponds.

Recommendations

CDFG, DOG, BLM, and USFS personnel should continue to monitor oil sumps for hazards to condors and other wildlife and to report violations and ensure compliance with laws.

Prior to releases of condors from captivity for reintroduction, all sumps within at least 50 miles of the release site should be systematically monitored by air and ground to identify and correct possibly hazardous conditions. This should be coordinated among the responsible agencies in the area.

PART II. MONITORING, HABITAT PROTECTION, AND PUBLIC EDUCATION

MONITORING CALIFORNIA CONDORS

Radio telemetry is a method by which researchers can track condors and 1) determine which parts of the habitat are important to the birds, 2) be able to recover sick, injured or dead birds, and 3) more efficiently locate birds on the feeding and nesting grounds.

The methods, problems and achievements of this program are discussed below.

Background

To begin, it seems appropriate to discuss the general nature of the signals received during field telemetry observations by ground and air trackers, and by the radio towers. In order to allow tracking at great distances, the transmitters have been designed to send quite powerful signals at a fairly high frequency range. At this frequency range, radio signals travel rather like beams of light, which means that they can be blocked by solid objects (e.g., mountains) and that they can be bounced off of certain landforms (e.g., sheer cliff faces). Blocking and bouncing are problems most often encountered by ground personnel. Near Pyramid Lake, for example, is a fairly large, steep-sided canyon. If a condor is on the opposite side of the canyon, below the rim, its radios will be inaudible, since the "line-of-sight" is through a mountain. If the condor is in the canyon, at the bottom of a steep ravine, the ravine walls may bounce the signal, making the perceived signal direction inaccurate: the signal may seem to come more sharply from a ravine wall than from the bird's actual location. Blocking and bouncing are problems associated with steep, rocky terrain, and are less of a problem in rolling hill country. Perched or dead condors are far more likely to send signals which are subject to blocking and bouncing because they are low in relation to the topography. The higher a bird is, the easier it is to get an unobstructed signal from it.

To the pilot, blocking and bouncing are somewhat less important, because he can get above the blocks. If a bird is dead in a narrow, steep-sided canyon, the pilot may still have to fly nearly directly over it in order to locate it, but when he does so, he will have almost complete faith in the location because when he is no longer directly over the bird he will lose the signal again. Flying birds are much easier to locate because they and he are above all the interference of mountains, etc., and he can basically fly right to them every time. This is what makes the semi-daily checks go so smoothly.

The towers are mainly subject to blocking. To bounce effectively, a sheer surface must be fairly close to the bird, and so the difference between the bounce location and the bird's location becomes insignificant the farther away the bird is. The towers are located at the edge of the condor's range and the bounce and the bird are in essentially the same place from the viewpoint of the tower. All three towers are subject to blocking when a bird roosts, unless it roosts on a face which is in a direct line to the towers. For this reason, the towers cannot assist directly in the location of dead birds. However, they can indicate the last location in which an aerial signal was received.

Using only telemetry information from the ground (observers or towers), two bearings on the bird are needed from different locations at nearly the same time; researchers than can plot the intersection of the two lines and come up with the bird's location. The resulting location is only accurate to within 1 to 5 square miles, since no observer can pinpoint the direction of a transmitter to better than +/- 1 degree, and +/- 5 degrees is more usual. Such "triangulated" locations are quite sufficient for starting a closer ground search or to indicate general movements of a bird.

The Condor Research Center staff uses different levels of telemetry tracking effort and accuracy to meet different situations. General movements of birds can be determined by plotting tracking data, triangulation data, and even some single bearing data, which only indicates a direction to a bird. A single bearing from Hudson Ranch often is enough to tell that a bird is probably in the Sierra. This may be sufficient for some research needs. To answer research questions concerning habitat use and foraging activities, visual observations by ground personnel or by the pilot are needed to assure the necessary accuracy. To find dead or injured birds, recent information from all sources is assessed. Weather permitting, immediate tracking is done by plane, which remains the best resource. In bad weather, ground crews concentrate on are of last location and areas of frequent use. The towers are monitored continuously for any signs of a dead bird.

Ground personnel provide visual observations and radio telemetry observations, but they have limited mobility and often limited "hearing" since good observation points are often below the local horizon. The towers provide continual radio telemetry observations in all weather, but have known "black holes" where mountains prevent any of the three towers from "hearing" a bird until it is well up in the air. Since birds fly less often in bad weather, the towers have less opportunity to "hear" them. But the towers do listen constantly and consistently, and if a bird does come out, they are apt to "hear" it. The towers, like ground personnel, can each supply only half of the necessary two bearings for triangulation, but information from two towers can be used when they both "hear" the bird at the same time. The higher a bird flies, the more likely it is that two towers will "hear" it simultaneously. Given high flight, about 75% of condor range can be covered by two towers simultaneously. The pilot provides the most mobile coverage of condor range, and is quite accurate in his locations. However, bad weather can ground him completely for as long as a storm system remains in the area. During such times, ground personnel and towers must fill the vacuum.

All telemetry observations rely on working transmitters. Although the solar-powered and lithium-battery transmitters used in recent years have provided a great deal of valuable information, there have been technical problems with many of the units (Table 4). Currently, the three birds that would not be taken into captivity, AC2, AC3, and IC9 (Santa Barbara pair and Red Rock subadult) have weak, intermittent or dead transmitters. AC2 and IC9 are inaudible to the pilot unless he is directly over them, whether the birds are flying or perched. AC3 originally had a loud but intermittently functioning transmitter. On October 1, 1985 this bird was retrapped and two modified transmitters were attached to her wings, but these, too, may have developed technical problems. CRC staff is now reassessing the telemetry equipment. Of the three birds slated for capture, one has good transmitters, and the other two have transmitters that are loud but only 10-30% active.

The towers have also malfunctioned from time to time. The only recent problem with any tower is being corrected now, and performance is excellent from the other two towers. The main problem with the towers is that complicated solutions can only be had from the tower designer, in Illinois. He is in the process of documenting the system so that Denver Wildlife Research Center can take over on repairs and general assistance.

Despite the problems with radiotransmitters, radioed birds are continuing to provide much valuable information on the habitat use patterns for wild California Condors. The information obtained so far has proven very valuable in efforts to identify roost sites, foraging sites and nest sites. These data have been effectively used by the habitat specialist at the Condor Research Center to identify potential threats to the condor and conveying this information to planning commissions and developers. These data will be used

Table 4. History of transmitters placed on birds since October 1984

Bird	Sex	Battery Type	Date Attached	Date Failed	Days of Full Oper'n	Status
AC3 S.B.	F	S	2 Oct 84	1 Apr 85	183	Replaced
		SB	2 Oct 84	13 Feb 85	136	Missing
		S	1 Oct 85	(status uncertain)		
		B	1 Oct 85	(status uncertain)		
IC4 Sisquoc	M	S	11 Oct 84	10 Apr 85	183	I (captured)
		SB	11 Oct 84	20 Dec 84	72	F
AC5 Sequoia	M	S	9 Oct 84	21 Jan 85	106	I (<10%)
		S	9 Oct 84	9 Oct 84	0	I (<10%)
AC6 Piru	M	S	22 Oct 84	21 Jan 85	93	I (<10%)
		B	22 Oct 84	3 Apr 85	165	I (>90%)
AC7 Pine Mtn.	M	S	7 Nov 84	21 Jan 85	77	I (missing)
		B	7 Nov 84	17 Jan 85	73	I
AC8 Agua Blanca	F	S	12 Oct 84	17 Jan 85	100	I (>80%)
		S	12 Oct 84	23 Mar 85	164	F
IC9 Red Rock	M	B	11 Dec 84	23 Mar 85	102	I (>80%)
		B	11 Dec 84	23 Mar 85	102	I (>80%)

Codes: S - solar
SB - solar/battery
B - lithium battery
I - intermittent signal
F - failed

even more frequently as more developments and changes in land use practices are planned and as we seek to manage for a recovered population of California Condors. Additionally, trapping of California Condors for attachment of transmitters over the years has been done safely, with no known or suspected problems to the birds; also, the transmitters themselves have not presented any problem to the marked condors.

Recommendations

All wild condors currently have radiotransmitters, and every wild condor should continue to be fitted with functioning transmitters for continuing research on movement and behavior patterns and to aid in protecting individual birds. This applies to all young condors released from captivity in the future.

The current radiotransmitter packages that have been designed for condors are being reassessed for possible additional modifications or for replacement by different equipment. Meanwhile, CRC will investigate the suitability and availability of telemetry equipment that has been used successfully on other raptor species. If necessary, major changes in equipment should be made to ensure that units on condors will be adequate for the needs of the program.

Expand the monitoring network of ground crews and aircraft. If necessary make appropriate revisions in the entire monitoring system if different transmitter units will be employed in the future.

USE OF ANDEAN CONDORS TO ASSESS MORTALITY FACTORS

It has been suggested that female Andean Condors released to the wild would provide information on threats to California Condors. This proposal has been seriously considered by USFWS and California Department of Fish and Game, the National Audubon Society, and the Condor Recovery Team. In addition to the political and legal problems posed, none of these groups believed that the information gained would justify the expense and difficulties posed by the release of this non-native endangered species into California. A similar conclusion was reached in May by the California Condor Scientific Advisory Committee of the American Ornithologists Union.

It is our belief that the most relevant information on environmental threats will come from studies of the first groups of released California Condors.

HABITAT PROTECTION

The Problem

The habitat of the California Condor is an area of multiple uses and complex ownership and zoning patterns. Long established land-use practices are being changed, increasing the potential for threats to the condors. Protection of adequate habitat of sufficient quality to sustain a recovered population of California Condors is perhaps the biggest single challenge facing the condor recovery effort.

Actions Taken

California Condor habitat management began with the establishment of the 1,200-acre Sisquoc Condor Sanctuary in 1937, and in 1947, the 35,000-acre Sespe Wild-life Area (later renamed the Sespe Condor Sanctuary and expanded to 53,000 acres), both of which are closed to public use. Since that time, the continued decline of the condor population and increasing concern for its survival have generated a diverse and prolific effort to protect condor habitat (Lehman and Olendorff 1984).

Because it was a major nesting area in the past, the Sespe Condor Sanctuary has been a particular focus of protective management. As a result of enlargement of the sanctuary, moratoria on oil and gas leasing, other protective measures, and public closure, the Sespe Sanctuary remains in a nearly pristine state. However, loss of foraging habitat to the south and encroachment of oil and gas drilling along the southern boundary of the sanctuary may have reduced its current importance to nesting condors.

The development of many agency management and recovery plans since 1952 has also had far-reaching effects on condor habitat management. In recent years, the U.S.F.S. "Emergency Field Procedures for Protection of the California Condor" augmented other plans by establishing protection procedures for condors in emergency situations.

Such plans have gone hand-in-hand with establishment of several committees since 1948. The California Condor Habitat Advisory Committee was established 15 March 1983 to augment the recovery effort by specifically addressing condor habitat issues.

These and other efforts to manage condor habitat have not stemmed the condor decline in the wild, but on public land, at least, they have protected large amounts of habitat for use by current and future condor populations. However, not all habitat requirements of condors can be met on public lands. Foraging areas in particular are almost exclusively privately owned.

Impressive accomplishments have been made in the area of Land Acquisition. Since the mid-1960's many thousands of acres of private land have been purchased by government agencies and private conservation groups. Practically all private lands formerly held in the Sespe Sanctuary are now in public ownership, as are some lands adjacent to the sanctuary and others in outlying nesting areas. The 1,700-acre Hopper Ranch just south of the sanctuary was purchased by the U.S.F.W.S. in 1975. Some 2,000 acres at Blue Ridge roost site in Tulare County have been purchased since 1980. An ambitious habitat management plan for Blue Ridge is being developed by the BLM and cooperating agencies and landowners. Negotiations are currently underway to secure the

14,000-acre Hudson Ranch, an important condor foraging area in the southern San Joaquin Valley foothills. However, in another large roosting and foraging area, the Tejon Ranch in Kern County, efforts to gain condor-use easements have been suspended because the current cooperative management of the ranch is compatible with condor needs.

Many roads, trails, and other areas on the National Forests where disruption of condor activities could occur have been closed to public access, either seasonally or year round. Buffer zones around condor nest and roost sites have been established. Many development projects threatening condor habitat have been restricted or stopped. Road construction and maintenance and campground management on the National Forests are routinely evaluated for possible adverse impacts to the condor. Critical Habitats have been determined for nine "Condor Areas" located throughout the condor range, thereby requiring that government actions not adversely impact condor nesting, roosting and foraging habitats. Sanctuaries, Areas of Critical Environmental Concern, Refuges, and Wilderness Areas have also been established. The San Rafael Wilderness alone protects 145,000 acres of condor habitat with wilderness restrictions. Signing and posting of key condor use areas has been an integral part of condor management to date. However, improvement may be needed in formalizing and systematizing posting, including periodic checks of posted material, since signs are subject to vandalism, and weathering. Finally, fire suppression and pre-suppression activities on the National Forests have been undertaken to reduce the impacts of firebreaks, hand crews, and mechanized equipment on condors (Lehman and Olendorff 1984).

Administrative controls have been instituted to attempt to deal with mortality problems. For example, many restrictions on firearms use have been established on the public lands within condor range. These include firearms closures, such as in the Sespe Sanctuary, and the Piru Gorge. Similarly, certain restrictions on aircraft travel over the Sespe Condor Sanctuary and other nesting areas have been established, including a State law limiting aircraft to at least 3,000 feet over the sanctuary.

It is becoming more difficult for ranchers to survive financially, and the conversion of rangeland to other more lucrative uses is increasing in the condor's foraging range. Subdivision of ranch lands for residential development is one reason condor foraging habitat is being lost; conversion to irrigated agriculture and dry-land farming is another. The long-range effects of this trend could result in grazing lands that are so diminished and fragmented that future condor populations may be unable to find adequate food. Continued research into socioeconomic factors affecting land use and encouragement of programs and tax incentives that benefit ranchers will be required to curtail this trend. Development of new strategies to protect feeding areas may also be necessary.

On private lands, much work remains to be done to resolve conflicts between condor and human use. Protection of private rangelands and of condors using them is extremely important if the species is to survive in the wild, independent of expensive supplemental feeding programs. A condor habitat specialist was added to the Condor Research Center staff in 1980 to primarily study population and development trends in the condor range. This information helps provide input to the land use plans and project proposals.

A preliminary analysis of existing land use decisions which could detrimentally affect future foraging habitat in Tulare County alone since December 1982 revealed that over 30,000 acres have been affected, at least 20,000 acres in critical condor foraging habitat. Although the present use of the land may still be suitable for condor foraging, the decisions have prepared the land for development.

Efforts to assure an adequate amount of safe habitat for a recovered population of California Condors are carried out by staff of the Condor Research Center working cooperatively with members of both public and private agencies. CRC staff provide technical expertise and assistance to other organizations involved in habitat acquisition and management planning. The Hudson Ranch, Carrizo Plain Macropreserve, Blue Ridge Management Plan, and several Nature Conservancy proposals are examples of condor habitat preservation activities.

Strategies for protecting condor habitat by means other than acquisition are more frequently called for but are also more difficult to carry out. The CRC habitat specialist reviews public and private land development proposals being processed by State, Federal, and county governments. Where the proposed actions have the potential to adversely affect significant condor habitat, research information is provided to the governing bodies as part of the NEPA and CEQA processes, to be considered in the land use decision making process. In certain cases, CRC staff members work with developers and planners to mitigate adverse impacts while still allowing development to occur.

Habitat research is an ongoing process, and substantial progress has been made in the last several years toward a better understanding of condor habitat requirements and use patterns. In this regard, processing of a data set spanning nearly 20 years and containing over 5,500 records is nearing completion. While the habitat use information contained within that data set has been used informally in the past to protect particular areas, a comprehensive analysis and application of the data will soon be possible--perhaps by the end of this year. It is the only data set within the Condor Research Center for a population of condors greater than 20, and it is expected to be useful in shaping plans for a recovered population.

Land use and habitat research is directed to identifying the amounts and locations of the different types of habitats that would be necessary to support a recovered population as well as areas that may be hazardous to condors. After that, a system of condor preserves can be identified and key areas protected. It is expected that such a plan will include purchase of at least some properties as the only practical and/or feasible means of protecting some lands.

Additional strategies for habitat preservation to complement those methods already in use will be investigated, including conservation and/or agricultural easements and further legislative incentives to preserve grazing lands.

Recommendations

Acquire Hudson Ranch and implement other land acquisition and management proposals contained in the Condor Recovery Plan. In addition, continue the consultation work conducted by the habitat specialist at the Condor Research Center.

Assess condor movement and habitat use data for use in designing a condor preserve system needed to support a recovered population.

ACQUISITION OF HUDSON RANCH

Hudson Ranch has been identified as an important foraging area for condors and the priority release site for captive-reared birds. The present owner has plans for building 600 homes on this 14,000-acre tract. The U.S. Fish and Wildlife Service has offered to purchase the area to create Bitter Creek National Wildlife Refuge, and Congress has appropriated nine million dollars to acquire the ranch. But the landowner is unwilling to sell his property for the assessed value, and the decision as to whether to proceed with a declaration of take is presently being considered by Secretary of Interior Donald P. Hodel. A final decision on whether the ranch will be acquired may be delayed until 1986; meanwhile, other options to protect the area in the interim are being discussed.

PUBLIC EDUCATION

The Problem

Providing the general public with accurate and timely information on the condor is important. It is believed that a well-informed general public will be more inclined to support the condor recovery effort and less inclined to engage in activities which could prove injurious to its chances for survival.

Actions Taken

Several informational pamphlets on the condor and its habitat have been prepared by National Audubon Society, California Department of Fish and Game, U.S. Fish and Wildlife Service, and U.S. Forest Service. Other efforts are underway, including production of a 1-hour film for network television.

Recommendations

Continue to provide timely and accurate information on the status and biology of the condor to representatives of the media. Distribute the new condor film widely to television stations.

CONCLUDING REMARKS

The task of reducing mortality in the wild population of California Condors is complicated by the wide-ranging habits of this bird. Since 1980 new information has been obtained on possible causes of death and steps taken to reduce exposure to these threats. We will never be able to determine the cause of every condor death, nor will we be able to eliminate unnatural mortality. However, in planning for a recovered population in the future, we need to insure that there is a system of preserves in nesting, roosting and foraging areas which have flight corridors between them which are as hazard-free as possible. By providing contaminant free food in these areas and reducing or eliminating sources of mortality whenever possible, we should be able to significantly reduce unnatural mortality in these areas.

In doing so we must recognize that when condors stray beyond these areas, as they will, that they will be subjected to higher, but probably unavoidable, levels of mortality. The challenge will be in identifying and minimizing mortality sources in the refuges and manipulating the condors' food so that condors spend a significant amount of time in these refuges. The research and management actions identified in this report should help us meet our objectives of significantly reducing mortality of condors in the wild.

Those agencies concerned with the field aspects of the condor recovery effort have made a public commitment to a long-term recovery effort. The anticipated budget for FY 86 for FWS is $790,000. The National Audubon Society has committed $115,000 and California Department of Fish and Game $100,000. Similar funding levels are anticipated in the near future. However, they are subject to re-evaluation as agency needs and priorities change. Insuring funding levels adequate to meet the research and management needs of the Condor Recovery effort may be an area in which the Commission could play a critical role.

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APPENDIX A

Summary of Recent Area and Firearms Closures
and Law Enforcement Actions
(from 1984 Condor Recovery Plan)

Administrative Closures

1. Effective September 27, 1980, the USFS closed Piru Gorge to public use during the condor nest selection period or year round if nesting occurs. Firearm use is prohibited.

2. The USFS restricts motorized activity and blasting within 2.4 km (1.5 mi) of condor nest sites, and limits human use within 0.8 km (0.5 mi) of nests. On March 3, 1975, the courts upheld a USFS-Department of the Interior decision to deny a permit for road access to an oil drilling site near a condor nest site.

3. The USFS closed the vicinity of active nest site #S-353 on Angeles National Forest to public entry.

4. Public use closures of the Sisquoc and Sespe Condor Sanctuaries have been maintained.

5. In 1976 the USFS closed the Mt. Pinos - Mt. Abel trail to motor vehicle use.

6. In 1980 the USFS enacted a firearms closure in the Hardluck area.

7. In 1983 the USFS implemented a patrol of the Pine Mountain area.

Firearms Control and Law Enforcement

1. Patrol and posting of public use closures in the Sisquoc and Sespe Condor Sanctuaries have continued. Signs informing people of the condors' protected status are routinely placed at campgrounds and other public areas. New signs were developed by the USFS in 1981 for this purpose.

2. The Los Padres National Forest and the CDFG have implemented a cooperative law enforcement program whereby CDFG wardens can enforce Federal CFR closures, thereby assisting in patrol of condor use areas.

3. The Angeles National Forest instituted a forest-wide target shooting closure, allowing shooting only at ten designated shooting areas, that are away from condor habitat.

4. To reduce shooting and disturbance threats to condors during the main condor use period in August and September, the California Fish and Game Commission changed the hunting season at Mt. Pinos from the coastal season to the inland season, which begins in late September.

5. Sensitive areas adjacent to the Sespe Condor Sanctuary and its two public access corridors have been closed to firearms use since 1971, including Agua Blanca Creek, Sespe Creek, and Santa Paula Creek.

6. The USFS placed a locked gate on Slide Mountain road, which traverses a ridgetop within 0.8 km (0.5 mi) of the Piru Gorge historical nest site.

7. The USFS closed a spur road located near nest site #135.

8. The USFS annually closes large areas of forest lands to public use during high fire danger seasons, thus indirectly benefitting the condor. Included in such closures is a total of 572,000 acres in Los Padres alone.

9. An aircraft restriction enacted by the California Assembly in 1973 and administered by the Federal Aviation Administration makes it illegal to fly any aircraft less than 3,000 feet above the Sespe Condor Sanctuary, with prescribed exceptions.

10. The USFS has enacted a vehicular closure on Pine Springs road near Bear Trap historical nest site, San Luis Obispo County.

11. In 1971 the USFS enacted a vehicular closure on the last (easternmost) mile of Pine Mountain road, Ventura County, to improve condor nesting and roosting conditions.

APPENDIX B

Condor Program Projects Relating to Wild Population Security

Administering Agency	Project Title (contractor)	Study Duration	Amount
NAS, USFWS	Preserve design for a recovered population	June 1985 - Dec. 1986	$20,000
FWS, Patuxent WRC	Retention, absorption and excretion of lead on vultures and Andean Condors	Oct. 1, 1985 - Sept. 30, 1986	$20,000
DFG	California Condor nest site restoration	Jan. 1 - Sept. 1, 1985	$ 1,500
FWS, Patuxent WRC	Study of pollutant levels in California Condor food items and in condor surrogate species (CDFG, U.C. Santa Cruz)	Sept. 15, 1979 - March 31, 1982	$45,800
CDFG/National Wildlife Federation/ Western Foundation of Vertebrate Zoology	Lead contamination in California Condor egg-shells (R. Ramey)	Sept. 1, 1985 - Jan. 31, 1986	$ 9,000
CDFG	Effects of Compound 1080 on Turkey Vultures (U.C. Davis)	Aug. 1, 1984 - Dec. 31, 1985	$27,081
CDFG	Lead availability in potential condor food (proposed)	1986-87	$12,000 (re-quested)
CDFG	Follow-up work on on-going contaminant studies (proposed)	1986-87	$12,000
FWS, Patuxent WRC	Pesticide, rodenticide and heavy metal levels in potential food of California Condors	Fall 1986-1989	$75,000

APPENDIX B (continued)

Administering Agency	Project Title (contractor)	Study Duration	Amount
USFWS, NAS, LAZ, SDZ, Patuxent WRC	Lead levels in free-flying California Condors	Ongoing	$ 5,000
USFWS, NAS	Lead levels in the blood of Golden Eagles	Ongoing	$ 5,000
USFWS, NAS	Radiotelemetry monitoring	Ongoing	$100,000
DFG	Blue Ridge Ecological Reserve Surveillance, 1986 (BLM)	May 1, Nov. 1, 1986	$ 20,000
FWS Patuxent and cooperators	Review and summarize contaminants in condor samples from 1980-1985	In progress	$ 6,000
USFWS, NAS	Evaluation of potential release sites for California Condors within entire range	Oct. 1985 - Sept. 1987	$ 15,000
USFWS	Acquisition of Hudson Ranch		5.7-9 million
USFWS, NAS	Improve design and performance of radio transmitters	Oct. 1, 1985 - Sept. 30, 1987	$300,000
USFWS, NAS, LAZ, SDZ, CDF, and others	Educational movie		$350,000