Recovery Plan for The California Condor

April, 1996

U.S. Fish and Wildlife Service, Pacific Region

013647

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island Territories under U.S. administration.

013648

CALIFORNIA CONDOR
(*Gymnogyps californianus*)

Third Revision

RECOVERY PLAN
(Original Approved: 1975)
(First Revision Approved: 1979)
(Second Revision Approved: 1984)

Prepared by

Lloyd F. Kiff
Western Foundation of Vertebrate Zoology
Camarillo, California

Robert I. Mesta
U.S. Fish and Wildlife Service
Ventura, California

Dr. Michael P. Wallace
Los Angeles Zoo
Los Angeles, California

for
Region 1
U.S. Fish and Wildlife Service
Portland, Oregon

Approved: Michael J. Spear
Regional Director, U.S. Fish and Wildlife Service

Date: 4/25/96

013649

RECOVERY TEAM MEMBERS

James Carpenter (U.S. Fish and Wildlife Service, Patuxent Wildlife Research Center, Laurel, Maryland): 1986-1989

Cathleen R. Cox (Los Angeles Zoo): 1986-present

Maeton Freel (U.S. Forest Service, Goleta, California): 1988-present

Ronald A. Jurek (California Department of Fish and Game, Sacramento): 1986-present

Lloyd F. Kiff (Western Foundation of Vertebrate Zoology, Camarillo, California): 1986-1993

John C. Ogden (National Audubon Society, Homestead, Florida): 1986-1988

Richard R. Olendorff (Bureau of Land Management, Sacramento, California): 1986-1990

Oliver H. Pattee (U.S. Fish and Wildlife Service, Ventura, California): 1986-1989

Katherine Ralls (Smithsonian Institution, Paso Robles, California): 1990-present

Patrick T. Redig (The Raptor Center, St. Paul, Minnesota): 1993-present

David S. Rimlinger (San Diego Wild Animal Park, Escondido, California): 1992-present

Robert W. Risebrough (Bodega Marine Institute, Berkeley, California): 1990-present

Michael E. Soulé (University of California, Santa Cruz): 1986-1990

William D. Toone (San Diego Wild Animal Park, Escondido, California): 1986-1992

Jared Verner (U.S. Forest Service, Fresno, California): 1986-1991

Brian J. Walton (Santa Cruz Predatory Bird Research Group, University of California, Santa Cruz): 1990-present

Dr. Michael P. Wallace (Los Angeles Zoo): 1986-Present

James W. Wiley (U.S. Fish and Wildlife Service, Grambling, Louisiana): 1989-1992

013650

DISCLAIMER PAGE

Recovery plans delineate reasonable actions that are believed to be required to recover and/or protect listed species. Plans are published by the U.S. Fish and Wildlife Service, sometimes prepared with the assistance of recovery teams, contractors, State agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting parties involved, as well as the need to address other priorities. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service. They represent the official position of the U.S. Fish and Wildlife Service **only** after they have been signed by the Regional Director or Director as **approved**. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and completion of recovery tasks.

013651

Literature Citations should read as follows:

U.S. Fish and Wildlife Service. 1996. California Condor Recovery Plan, Third Revision. Portland, Oregon. 62 pp.

Additional copies may be purchased from:

Fish and Wildlife Reference Service
5430 Grosvenor Lane, Suite 110
Bethesda, Maryland 20814
301/492-3421 or 1-800-582-3421

013652

ACKNOWLEDGMENTS

We are grateful to former USFWS Condor Recovery Program Coordinators Joseph Dowhan and Teresa Nichols, who provided invaluable assistance in preparing earlier drafts of the recovery plan revision, as well as for their contributions to the overall Condor Recovery Program during their respective tenures.

013653

EXECUTIVE SUMMARY
OF THE
RECOVERY PLAN FOR THE CALIFORNIA CONDOR
(*Gymnogyps californianus*)

Current Species Status: The California condor (*Gymnogyps californianus*) is federally listed as an endangered species. The current population is 103, including 86 individuals in captivity at the Los Angeles Zoo, San Diego Wild Animal Park, and the World Center for Birds of Prey, and 17 captive-hatched condors released into Santa Barbara and San Luis Obispo Counties in southern California.

Habitat Requirements and Limiting Factors: California condors require suitable habitat for nesting, roosting, and foraging. The recent range was restricted to chaparral, coniferous forests, and oak savannah habitats in southern and central California. The species formerly occurred more widely throughout the Southwest and also fed on beaches and large rivers along the Pacific coast. Nest sites are located in cavities in cliffs, in large rock outcrops, or in large trees. Traditional roosting sites are maintained on cliffs or large trees, often near feeding sites. Foraging occurs mostly in grasslands, including potreros within chaparral areas, or in oak savannahs. At present, sufficient remaining habitat exists in California and in southwestern states to support a large number of condors, if density independent mortality factors, including shooting, lead poisoning, and collisions with man-made objects, can be controlled. The possibility of eventual genetic problems, resulting from the species' recent perilously low population size, cannot be discounted.

Recovery Priority: 1C

Recovery Objective: Downlist to threatened.

Recovery Criteria: The minimum criterion for reclassification to threatened is the maintenance of at least two non-captive populations and one captive population. These populations (1) must each number at least 150 individuals, (2) must each contain at least 15 breeding pairs and (3) be reproductively self-sustaining and have a positive rate of population growth. In addition, the non-captive populations (4) must be spatially disjunct and non-interacting, and (5) must contain individuals descended from each of the 14 founders.

Actions Needed:

1. Establish a captive breeding program to preserve the gene pool.

2. Reintroduce California condors to the wild.

3. Minimize mortality factors in the natural environment.

4. Maintain habitat for condor recovery.

5. Implement condor information and education programs.

013654

Total Estimated Cost of Recovery

Costs ($1,000's):

Year	Need 1	Need 2	Need 3	Need 4	Need 5
1995	658.0	582.0	83.0	128.0	37.0
1996	643.0	590.0	83.0	193.0	37.0
1997	643.0	895.0	83.0	218.0	237.0
1998	643.0	890.0	83.0	218.0	237.0
1999	643.0	870.0	83.0	148.0	237.0
2000	650.0	850.0	85.0	150.0	50.0
2001	650.0	850.0	85.0	150.0	50.0
2002	650.0	850.0	85.0	150.0	50.0
2003	650.0	850.0	85.0	150.0	50.0
2004	650.0	850.0	85.0	150.0	50.0
2005	650.0	850.0	85.0	150.0	50.0
2006	650.0	850.0	85.0	150.0	50.0
2007	650.0	850.0	85.0	150.0	50.0
2008	650.0	850.0	85.0	150.0	50.0
2009	650.0	850.0	85.0	150.0	50.0
2010	650.0	850.0	85.0	150.0	50.0
Total Costs	10,380.0	13,177.0	1,350.0	2,555.0	1,335.0

Date of Recovery: Downlisting should be initiated in 2010, if recovery criteria are met.

013655

Recovery Plans

1974 California Condor Recovery Plan (U.S. Fish and Wildlife Service 1975): The focus of the first California Condor Recovery Plan was reduction of mortality factors through preservation of habitat. No information existed to indicate that the species' intrinsically low reproductive rate could be increased through multiple clutching techniques. With foresight, however, the potential for studies using Andean condors as surrogates was identified.

Revised California Condor Recovery Plan (U.S. Fish and Wildlife Service 1979): The second edition of the California Condor Recovery Plan, once again focused on habitat preservation as the most effective means of controlling the population decline. However, in 1980 considerable progress had been made in studying the reproductive biology of Andean condors and a directive was given to institute a captive propagation program for California condors. The intent of the program was to capture California condors, breed them in captivity, and release their progeny into the existing wild flock.

Revised California Condor Recovery Plan (U.S. Fish and Wildlife Service 1984): The 1984 Recovery Plan recognized the need for a more intensive management and research program, and called for accelerated productivity by manipulating nesting in wild breeding pairs to induce multiple clutching, securing chicks and eggs produced in the wild for captive incubation, and rearing of captively incubated eggs for reintroduction to the wild. The plan also specified the need for radiotelemetry studies.

Revised California Condor Recovery Plan (U.S. Fish and Wildlife Service 1996): The capture of the last wild California condor in 1987 propelled the recovery program into a new era of management. The 1996 revised recovery plan modifies the previous recovery strategy, that focused primarily on habitat protection, to emphasize the captive breeding program and intensive efforts to reestablish the species in the wild. Important measures are also prescribed for habitat conservation and public education, but these are secondary to the continued development of a captive breeding program and reintroduction of captive-bred California condors.

013656

TABLE OF CONTENTS

Page

Part I. Introduction 1

A. Brief Overview 1

B. Physical Characteristics 1

C. Taxonomy 1

D. Prehistorical Range 2

E. Historical Range 2

F. Life History 2

Nesting 2

Foraging 5

Roosting 7

F. Movements 8

G. Population Trends 9

H. Reasons for Decline 9

I. Population Modeling 12

J. Conservation Measures 13

K. Strategy of Recovery 21

Part II. Recovery 22

A. Objectives and Criteria 22

B. Narrative 22

C. Literature Cited 35

Part III. Implementation Schedule 41

013657

TABLE OF CONTENTS (continued)

Page

Part IV. Appendix

Appendix 1 - Critical Habitat 49

Appendix 2 - Preliminary Population Viability Considerations 57

Appendix 3 - Summary of Comments 60

List of Figures

Figure 1. Range of the California Condor 3

Figure 2. California Condor Population 1982 to 1995 10

013658

CALIFORNIA CONDOR RECOVERY PLAN

I. INTRODUCTION

A. Brief Overview

The California Condor (*Gymnogyps californianus*) was listed as endangered on March 11, 1967, (32 FR 4001) in a final rule published by the U.S. Fish and Wildlife Service (Service). The Service then established critical habitat for the California condor nine years later on September 24, 1976, (41 FR 187).

Long recognized as a vanishing species (Cooper 1890, Koford 1953, Wilbur 1978), the California condor remains one of the world's rarest and most imperiled vertebrate species. Despite intensive conservation efforts, the wild California condor population declined steadily until 1987, when the last free-flying individual was captured. During the 1980s, captive condor flocks were established at the San Diego Wild Animal Park and the Los Angeles Zoo, and the first successful captive breeding was accomplished at the former facility in 1988. Following several years of increasingly successful captive breeding, captive-produced condors were first released back to the wild in early 1992.

B. Physical Characteristics

California condors are among the largest flying birds in the world. Adults weigh approximately 10 kilograms (22 lbs) and have a wing span up to 2.9 meters (9 ½ ft). Adults are black except for prominent white underwing linings and edges of the upper secondary coverts. The head and neck are mostly naked, and the bare skin is gray, grading into various shades of yellow, red, and orange. Males and females cannot be distinguished by size or plumage characteristics. The heads of juveniles up to 3 years old are grayish-black, and their wing linings are variously mottled or completely dark. During the third year the head develops yellow coloration, and the wing linings become gradually whiter (N.J. Schmitt in prep.). By the time individuals are 5 or 6 years of age, they are essentially indistinguishable from adults (Koford 1953, Wilbur 1975, Snyder et al. 1987), but full development of the adult wing patterns may not be completed until 7 or 8 years of age (N.J. Schmitt in prep.).

C. Taxonomy

The California condor is a member of the family Cathartidae or New World vultures, a family of seven species, including the closely related Andean condor (*Vultur gryphus*) and the sympatric turkey vulture (*Cathartes aura*). Although the family has traditionally been placed in the Order Falconiformes, most contemporary taxonomists believe that New World vultures are more closely related to storks (Ligon 1967, Rea 1983, Sibley and Ahlquist 1990).

013659

D. Prehistorical Range

The fossil record of the genus *Gymnogyps* dates back about 100,000 years to the Middle Pleistocene Epoch (Brodkorb 1964). At the Rancho La Brea tar pits in Los Angeles, abundant condor remains occur with many contemporary species, including American Robins (*Turdus migratorius*), Scrub Jays (*Aphelocoma coerulescens*), and Mourning Doves (*Zenaida macroura*) (Howard 1962). Fossil records reveal that the species once ranged over much of the southern United States, south to Nuevo Leon, Mexico and east to Florida (Brodkorb 1964), and two well preserved fossil bones were reported from a site in upstate New York (Steadman and Miller 1987). There is evidence indicating that California condors nested in west Texas, Arizona, and New Mexico during the late Pleistocene (Emslie 1987). The disappearance of the California condor from much of this range occurred about 10,000-11,000 years ago, coinciding with the late Pleistocene extinction of the North American megafauna (Emslie op cit.).

E. Historical Range

By the time of the arrival of European man in western North America, California condors occurred only in a narrow Pacific coastal strip from British Columbia, Canada to Baja California Norte, Mexico (Koford 1953, Wilbur 1978). California condors were observed until the mid-1800s in the northern portion of the Pacific Coast region (Columbia River Gorge) and until the early 1930s in the southern extreme (northern Baja California) (Koford 1953, Wilbur 1973, Wilbur and Kiff 1980). Prior to 1987, California condors used a wishbone-shaped area encompassing six counties just north of Los Angeles, California (Fig. 1). In the 1984 California Condor Recovery Plan, the wishbone-shaped area was designated by the California Condor Recovery Team (Team) as the range of primary concern. It has been used by management agencies and the public for planning purposes.

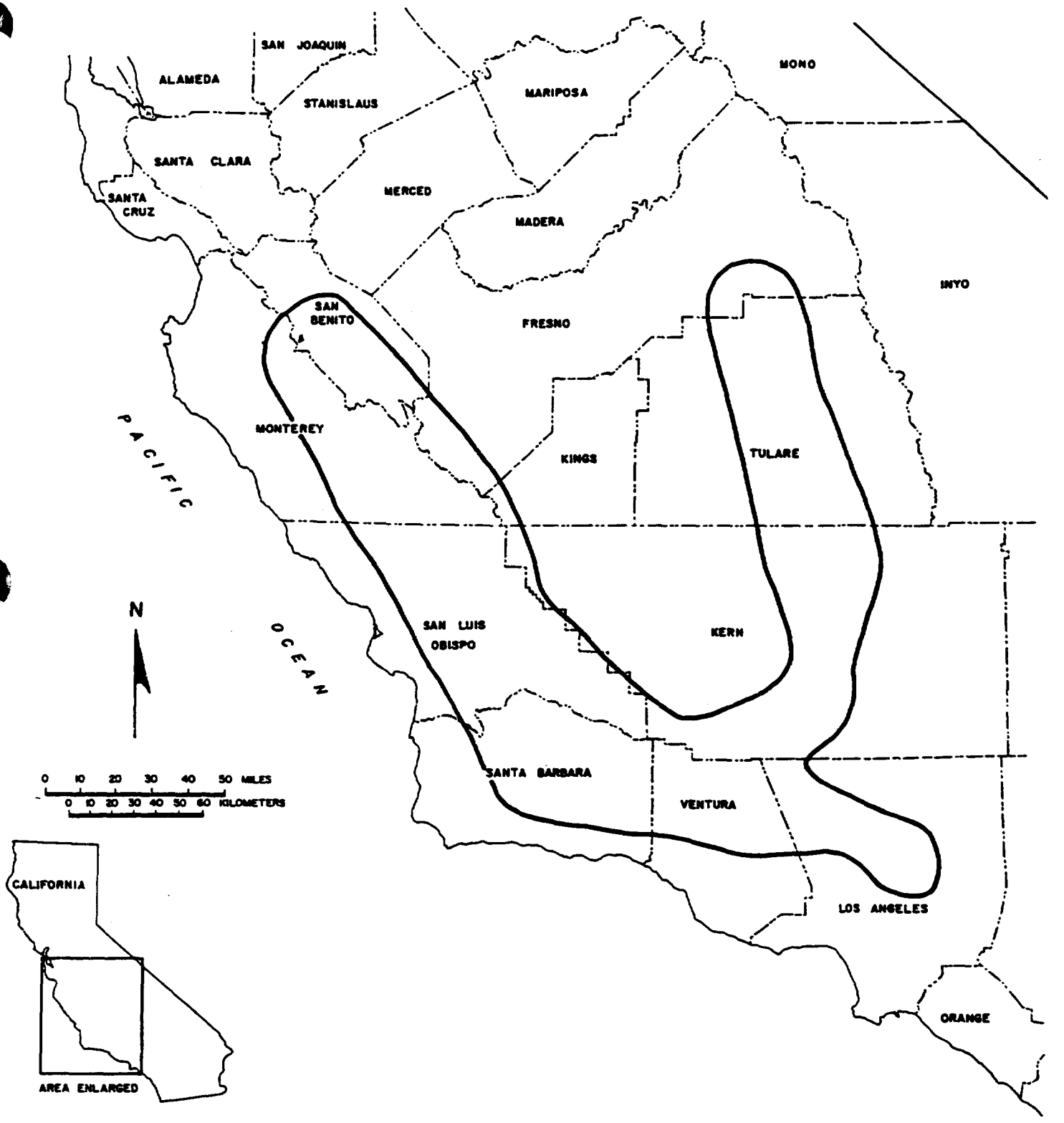
F. Life History

The following details of condor life history are based largely on studies of the wild condor population prior to 1987, principally those of condor biologists Carl Koford (1939-1947), Fred Sibley (1965-1969), Sanford Wilbur (1969-1980), and Noel Snyder and his associates (1980-1985).

California condor life history information can be conveniently categorized into nesting, foraging, and roosting components. The life history section summarizes condor biology, habitat requirements, and range as they relate to each component on a daily basis and over the annual cycle. A concluding discussion summarizing the traditional movement of condors throughout their recent historical range is also provided.

Nesting: Courtship and nest site selection by breeding California condors occur from December through the spring months. Reproductively mature, paired California condors normally lay a single egg between late January and early April. The egg is incubated by both parents and hatches after approximately 56 days. Both parents share responsibilities for feeding the nestling. Feeding usually occurs daily for the first two months, then gradually diminishes in frequency. At two to three months of age condor chicks leave the actual nest cavity, but remain in the vicinity

013660



Range of the California Condor
Figure I

013661

of the nest where they are fed by their parents. The chick takes its first flight at about six to seven months of age, but may not become fully independent of its parents until the following year. Parent birds occasionally continue to feed a fledgling even after it has begun to make longer flights to foraging grounds.

Because of the long period of parental care, it was formerly assumed that successful California condor pairs normally nested successfully every other year (Koford 1953). However, this pattern seems to vary, possibly depending mostly on the time of year that the nestling fledges. If a nestling fledges relatively early (in late summer or early fall), its parents may nest again in the following year, but late fledging probably inhibits nesting in the following year (Snyder and Hamber 1985).

California condors may lay a replacement clutch if their first (Harrison and Kiff 1980) or even second egg is lost (Snyder and Hamber 1985). Whether they lay a replacement egg may depend on the time of year, at what stage of incubation the egg is lost, individual variation, and perhaps genetic or climatic factors. Among Andean condors and other captive cathartid vultures, some females will apparently lay three or even four clutches in a season, while others invariably lay only one or two (M. Wallace, Los Angeles Zoo, in litt.).

Because subadult birds had never been observed in the wild as members of breeding pairs, Koford (1953) concluded that California condors did not breed before six years of age, the time at which the adult plumage is acquired. The only wild California condor (a male) of known age bred successfully in the wild in 1986 at the age of six years. Recent data collected from captive birds, however, demonstrates that reproduction may occur, or at least be attempted at earlier ages. A four-year old male was the youngest California condor observed in courtship display, and the same bird subsequently bred successfully at the age of five years (M. Wallace, Los Angeles Zoo, in litt.).

California condors nest in various types of rock formations including crevices, overhung ledges, and potholes, and, more rarely, in cavities in giant sequoia trees (*Sequoia giganteus*) (Snyder et al. 1986). An evaluation of various nest parameters, including types, elevations, compass orientation, entrance sizes, depths, chamber characteristics, substrates, use of nests by other species, accessibility to predators, presence of porches, and proximity to roost perches and sources of human disturbance, indicated that all surveyed California condor nest sites (n = 72) share the following characteristics:

> (1) entrances large enough for the birds to fit through, (2) a ceiling height of at least 38 centimeters (cm) at the egg position, (3) fairly level floors with some loose surface substrate, (4) unconstricted space for incubating adults, and (5) short distance accessibility to a landing point (Snyder et al. op cit.). The factors influencing the choice of nest sites by condors is poorly understood. The appearance of many nest sites suggests that they have been in long use, perhaps for centuries, whereas other apparently suitable sites in undisturbed areas show no signs of condor use.

The effects of human disturbance on nesting condors have been difficult to evaluate rigorously, and different observers have reached disparate conclusions. Koford (1953) documented numerous accounts of human disturbance at California condor nest sites. He reported that the

013662

responses of nesting birds were highly variable and hypothesized that the nature of the birds' reactions might depend upon the stage of nesting. Koford generally concluded that California condors were keenly aware of intruders, and would alter their behaviors if humans approached in sight within 555 m (500 yd) of a nest. In addition, Koford stated that California condors could be alarmed by loud noises from distances of over 1.6 kilometers (1 mi). Based on these observations, Koford recommended that human disturbance should be restricted within 1.6 km (1 mi) of active nest sites.

Sibley (1969) found a correlation between the location of recently used California condor nest sites and the location and magnitude of human activity. He concluded that the greater the disturbance, either in frequency or noise level, the less likely California condors were to nest nearby. In 1984, a nest site located in a giant sequoia tree within mixed-conifer forest was subjected to a high degree of disturbance during the egg-laying period because it was located on the edge of an active clear-cut timbering operation. Nevertheless, the breeding attempt continued successfully until the half-grown chick was removed from the nest to be added to the captive flock. Based on the variety of historical accounts, Snyder et al. (1986) concluded that tolerance to disturbance by nesting condors is likely to be a highly variable trait individually and that it is prudent to continue the current U.S. Forest Service restriction of human activities within 2.4 km (1.5 mi) of California condor nest sites on Forest Service lands.

Although potential condor nesting habitat still exists over a relatively large portion of the coastal and interior mountains in central and southern California, the recently occupied nesting range was quite limited. After 1910, all recorded nesting sites were located in the Coast, Transverse, and Sierra Nevada mountain ranges (Koford 1953, Meretsky and Snyder 1992). All but one of the nest sites used between 1979 to 1986 were in a narrow belt of chaparral and coniferous forested mountains from central Santa Barbara County across northern and central Ventura County to northwestern Los Angeles County. The sites were located within a total area approximately 90 km (56 mi) from west to east and only about 25 km (15 mi) from north to south. The only nest outside this area was located in a giant sequoia in Tulare County in 1984. It is possible that condors may have been nesting in the latter area over the years since the nest was only a few miles from another giant sequoia nest which was active in 1951. All recent California condor nest sites were located on public lands within the Los Padres, Angeles, and Sequoia National Forests.

Foraging: California condors are opportunistic scavengers, feeding only on the carcasses of dead animals. Typical foraging behavior includes long-distance reconnaissance flights, lengthy circling flights over a carcass, and hours of waiting at a roost or on the ground near a carcass. Seasonal foraging behavior shifts perhaps are the result of climatic cycles or to changes in food availability. Condors maintain wide-ranging foraging patterns throughout the year, an important adaptation for a species that may be subjected to unpredictable food supplies (Meretsky and Snyder 1992). Having located a potential food item, California condors frequently remain in the air circling high above the carcass before landing. As with other scavenging species that are known to feed socially, circling behavior is thought to serve as a signal to other conspecifics, guiding them to available food sources (Houston 1974, Mundy 1982, Wallace and Temple 1987, Meretsky and Snyder 1992). Once on the ground condors may feed immediately or wait passively as other California condors or golden eagles (*Aquila chrysaetos*) feed on the carcass (Wilbur 1978).

013663

Prior to the arrival of European man, condor food items within interior California probably included mule deer (*Odocoileus hemionus*), tule elk (*Cervus elaphus nannoides*), pronghorn antelope (*Antilocapra americana*), and smaller mammals. Along the Pacific shore the diet of the California condor may have included whales, sea lions, and other marine species (Koford 1953, Emslie 1987, U.S. Fish and Wildlife Service 1984). Koford (1953) listed observations of California condors feeding on 24 different mammalian species within the last two centuries. He estimated that 95 percent of the diet consisted of cattle, domestic sheep, ground squirrels (*Spermophilus beechyi*), mule deer, and horses. Over half of the observations Koford reported were of condors feeding on cattle carcasses, and most of those were calves. While beef cattle may be the most available food within the range of the condor, a clear preference for deer over cattle has been observed (Koford 1953, Wilbur 1972, Meretsky and Snyder 1992). California condors appear to feed only one to three days per week, but the frequency of adult feeding is variable and may show seasonal differences.

Most California condor foraging occurs in open terrain of foothill grassland and oak savannah habitats. Although the California condor is not as ungainly on the ground as portrayed in popular literature, it does require fairly open spaces for feeding. This ensures easy take-off and approach and makes finding food easier. As mentioned earlier, mule deer are possibly a "preferred" food, yet deer tend to drift toward canyon bottoms to die (Taber and Dasmann 1958, Blong 1954), where steep terrain and brush interfere with California condor foraging. Carcasses under brush are hard to see, and California condors apparently do not locate food by olfactory cues (Stager 1964).

The principal foraging regions used by California condors from the late 1970s to 1987 were the foothills bordering the southern San Joaquin Valley and axillary valleys in San Luis Obispo, Santa Barbara, Kern, and Tulare Counties. After 1982, most observations of feeding by the small remaining wild population of California condors occurred in the Elkhorn Hills-Cuyama Valley-Carrizo Plain complex, and in the southern San Joaquin Valley (Meretsky and Snyder 1992). The majority of important foraging areas were on private cattle-grazing lands.

The Elkhorn Hills-Cuyama Valley-Carrizo Plain area includes portions of San Luis Obispo, Santa Barbara, and Kern counties. California condors foraged in the eastern part of San Luis Obispo County, generally east of the Los Padres National Forest boundary and west of the Temblor Mountains. Observations of radio-tagged birds along San Juan Creek in the 1980s indicated foraging in the upper drainage, south of Highway 58. Farther south, the Carrizo Plain, Panorama Hills, and the Elkhorn Plain in the region between the Caliente and Temblor Mountains were also commonly used (U.S. Fish and Wildlife Service 1984).

Foraging in Santa Barbara County was mainly to the north in portions of the Cuyama Valley and, occasionally, on potreros along the ridge line of the Sierra Madre Mountains. A nesting pair in Santa Barbara County also foraged in the Santa Ynez Valley to the south, mainly along the northern portions as far west as the Los Olivos area and the Zaca Creek drainage (U.S. Fish and Wildlife Service 1984).

In Kern County, California condors foraged extensively in the foothills adjacent to the northern boundary of Los Padres National Forest, to Reyes Station in the west, to the Pleito Hills west of Interstate Highway 5, and eastward throughout much of the region from the Tehachapi

013664

Mountains north to the slopes of Cummings Mountain (Studer 1983). This entire region, like the similar foraging country in the Carrizo and Elkhorn Plains, is fairly close to traditional nesting sites (U.S. Fish and Wildlife Service 1984).

The San Joaquin Valley foraging region was located in eastern Kern, Tulare, and Ventura counties. An important foraging area in Kern County was the foothill rangelands around Glennville. There, California condors roosted primarily on National Forest lands in the Greenhorn Mountains and foraged daily in the Cedar Creek and upper Pozo Creek drainages as far west as Blue Mountain and the old Granite Station crossroads south of Woody, California. In Tulare County, California condors foraged extensively through the oak savannah and grassland hill country north from the Kern County border and west of the National Forest boundary, including the Tule River Indian Reservation (U.S. Fish and Wildlife Service 1984). As in northern Kern County, important roosting sites were to the east on higher slopes in Sequoia National Forest and on higher peaks within the foraging zone, including Blue Ridge. California condors recently foraged as far north as the Lake Kaweah region, with the White River, Deer Creek, Lake Success, and Yokohl Valley areas being of special importance (U.S. Fish and Wildlife Service 1984).

Although these foraging regions have been identified as being important to California condors since 1980, they should not be considered as all inclusive. Like most scavenging birds, California condors are opportunistic. Through the course of a year they fed on carcasses found in many locations. California condors were known to feed at U.S. Fish and Wildlife Service baiting stations on the Tejon Ranch, the Beard Ranch in Glennville and Hopper Mountain and Bitter Creek National Wildlife Refuges. The birds may be expected to take advantage of local abundance of food almost anywhere within their normal range. California condors were not reported in many areas of that former range after the mid-1980s, especially north in the Coastal Range to Monterey and San Benito Counties, but also east into the San Gabriel Mountains in Los Angeles County.

Roosting: Depending upon weather conditions and the hunger of the bird, a California condor may spend most of its time perched at a roost. California condors often use traditional roosting sites near important foraging grounds (U.S. Fish and Wildlife Service 1984). Although California condors usually remain at roosts until mid-morning, and generally return in mid- to late afternoon, it is not unusual for a bird to stay perched throughout the day. While at a roost, California condors devote considerable time to preening and other maintenance activities. Roosts may also serve some social function, as it is common for two or more California condors to roost together and to leave a roost together (U.S. Fish and Wildlife Service 1984). California condors apparently will tolerate more disturbance at a roost than at a nest. Roosting sites and nesting sites are susceptible to similar disturbance threats, and their preservation requires isolation from human intrusion. There may be adaptive as well as traditional reasons for California condors to continue to occupy a number of widely separated roosts, such as reducing food competition between breeding and non-breeding birds.

Cliffs and tall conifers, including dead snags, are generally utilized as roost sites in nesting areas. Although most roost sites are near nesting or foraging areas, scattered roost sites are located throughout the range.

F. Movements

Data on locations and movements of California condors discussed here are limited mainly to those collected between 1982 and 1987, as summarized by Meretsky and Snyder (1992). These data were obtained primarily from radiotelemetry studies and the analysis of flight photographs of known California condors (Snyder and Johnson 1985, Meretsky and Snyder 1992) and summarized below. For detailed information on historical California condor range, the reader should refer to Koford (1953) and Wilbur (1978).

Studies during the 1980s showed that the last California condors remaining in the wild prior to 1987 comprised a single population of birds occupying a range of 2 million hectares (4,942,000 acres). Insofar as could be determined, every California condor in the wild was familiar with the entire range of the species and was capable of soaring between any two points within the range in a single day. While no difference in movement patterns could be detected between sexes, a difference in the mobility was noted between breeding and nonbreeding condors. Immatures and other unpaired condors seemed to be especially mobile, with the longest recorded flight during a single day by an immature male being 225 km (141 mi). Yearling condors do not venture far from their nest sites until late in their first year, and they gradually increase their distance from their natal area as they mature. Based on the available information, however, it was not possible to ascertain at what age immature condors begin their wide-ranging forays. Paired birds tended to forage most frequently in areas relatively close to their nests, not normally venturing more than 50 km (31 mi) to 70 km (44 mi) from their nest sites; although on one occasion a member of a nesting pair traveled 180 km (113 mi). It should also be noted that during the non-breeding season paired birds tended to expand their home range to encompass more of the available foraging areas.

Seasonal shifts that were noted seemed to be based generally on food availability. For example, condors tended to move to the Tehachapi area during the hunting season where they showed a preference for deer gut-piles and abandoned deer carcasses were preferred over calf carcasses. Furthermore, during the calving season in the San Emigdio area of the San Joaquin Valley foraging region, wild California condors were frequently observed feeding on naturally occurring calf carcasses.

California condors use topography and associated thermal weather patterns for flight. This is best illustrated by observations indicating that almost all flights by California condors, whether covering long distances or not, followed routes over the foothills and mountains bordering the southern San Joaquin Valley. It was rare for a California condor to pass directly over the flat, highly agricultural floor of the Valley. Thus, the usual route for a bird starting from the coastal mountains of Santa Barbara County on its way to foraging grounds in Tulare County was to cross northern Ventura County, pass through the Tehachapi Mountains in southern Kern County, then turn north to pass closely by Breckenridge Mountain, and enter Tulare County somewhere between the Greenhorn Mountains and Blue Mountain. Where flat, agricultural regions are much less extensive, such as the Cuyama Valley in Santa Barbara and San Luis Obispo Counties, California condors freely passed high above enroute to foraging grounds. It has become apparent that California condors are highly dependent on topography since it dictates prevailing wind patterns. (U.S. Fish and Wildlife Service 1984).

013666

G. Population Trends

Condor censusing efforts through the years have varied in intensity and accuracy. That has led to conflicting estimates of historical abundance, but all have indicated an ever-declining California condor population. Koford (1953) estimated a population of about 60 individuals in the late 1930s through the mid-1940s, apparently based on observed flock size. A field study by Eben and Ian McMillan in the early 1960s suggested a population of about 40 individuals, again based in part on the validity of Koford's estimates of flock size (Miller et al. 1965). An annual October California condor survey was begun in 1965 (Mallette and Borneman 1966) and continued for 16 years. The survey effort was typically a two-day simultaneous observation and count of California condors at prominent observation points in areas of known concentration. Interpretation of the results of these surveys was made difficult by variations in weather conditions, number of observers, and other factors from year to year, but the results supported an estimate of 50 to 60 extant California condors in the late 1960s (Sibley 1969, Mailed 1970). Wilbur (1980) continued the survey efforts into the 1970s and concurred with the interpretations of the earlier October surveys. He further estimated that by 1978 the population had dropped to 25-30 individuals.

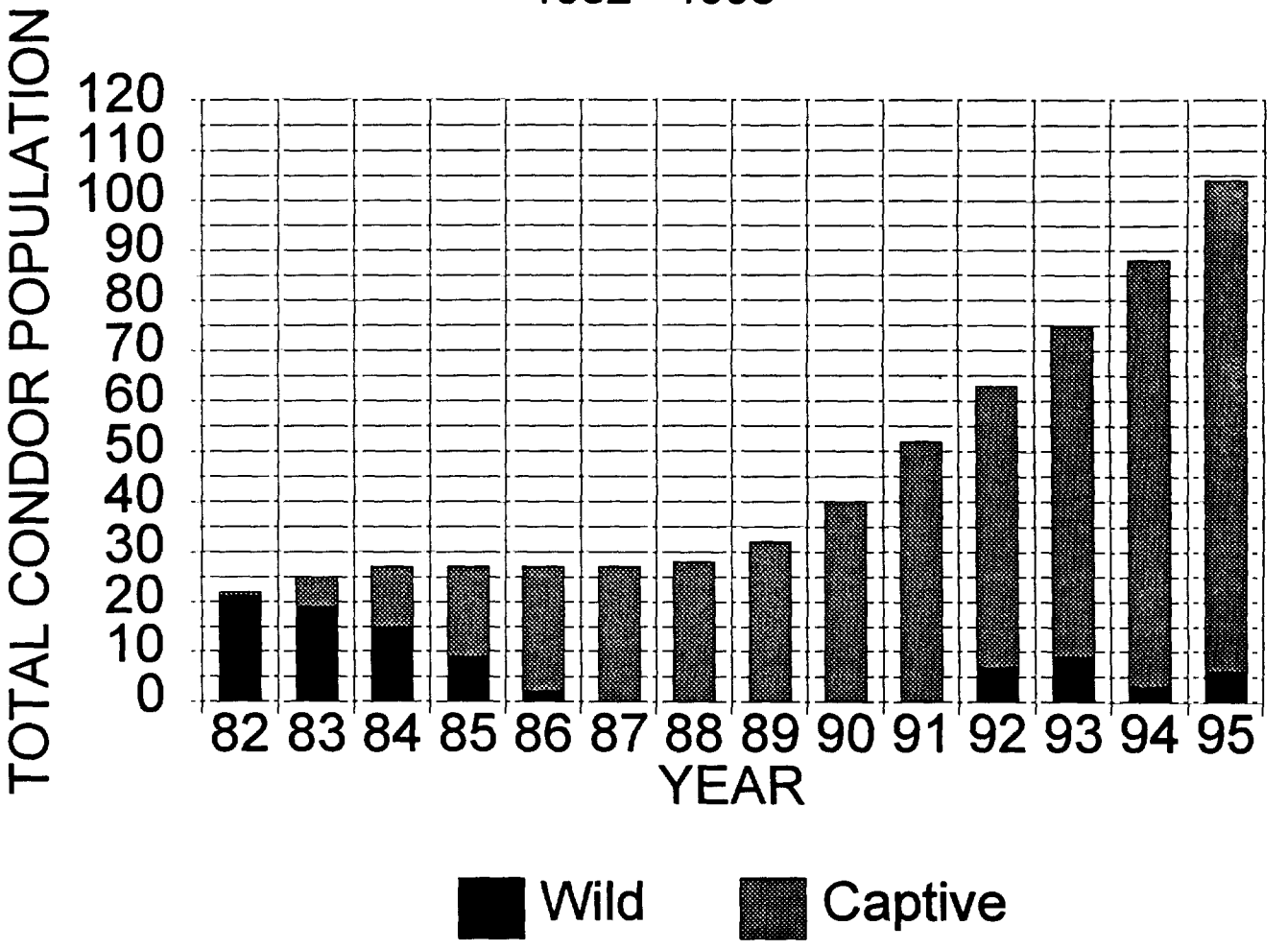
Snyder and Johnson (1985) later reassessed the earlier population estimates of Koford (1953) and Miller et al. (1965) and concluded that they may have underestimated the size of the condor population by a factor of two or three. Regardless of the actual number of birds, the trend toward extinction of the wild condor population was linear and unrelenting. In 1981, the Service, in cooperation with California Polytechnic State University at San Luis Obispo, began census efforts based on individual identifications of condors by photographing flight silhouettes (Snyder and Johnson 1985). Minimum summer counts from these photocensusing efforts showed a steady decline from an estimated minimum of 21 wild condors in 1982, 19 individuals in 1983, 15 individuals in 1984, and 9 individuals in 1985. Although the overall condor population increased slightly after 1982 as a result of double clutching, the wild population continued to decline. By the end of 1986, all but two California condors were captured for safekeeping and genetic security. On April 19, 1987 the last wild condor was captured and taken to the San Diego Wild Animal Park. The population has increased annually since the first successful captive breeding in 1988. The population now stands at 104 individuals, including 86 in the captive flock and 17 in the wild (Fig. 2).

H. Reasons for Decline

Causes of the California condor population decline have probably been numerous and variable through time. However, despite decades of research, it is not known with certainty which mortality factors have been dominant in the overall decline of the species. Relatively few dead California condors have been found, and definitive conclusions on the causes of death were made in only a small portion of these cases (Miller et al. 1965, Wilbur 1978, Snyder and Snyder 1989). Although the information regarding California condor mortality is inconclusive, there is evidence to suggest that two anthropogenic factors, lead poisoning and shooting, have contributed disproportionately to the decline of the species in recent years. Although publicity associated with the condor recovery program has doubtless reduced the likelihood of condors being shot, one person was arrested as recently as July 1992 for shooting at a California condor that was part of a

013667

Fig. 2. California Condor Population
1982 - 1995



reintroduction program, thus indicating the need for continued public education and an enforcement presence to protect the species from wanton shooting.

Post-mortem examinations performed on four California condors found dead since 1983, indicated that three of the birds died from the effects of lead poisoning (Janssen et al. 1986, Wiemeyer et al. (1988), and one died of cyanide poisoning (Wiemeyer et al. op cit.). High lead levels, presumably obtained from the ingestion of fragments of lead bullets in shot mammal carcasses, may be a pervasive problem throughout the historical foraging range of the California condor. For example, Bloom et al. (1989) and Pattee et al. (1990) found elevated levels in one-third of 162 golden eagle blood samples taken in the range of the California condor in 1985-1986, and Wiemeyer et al. (1988) concluded that lead exposure was the major factor having an adverse impact on the wild California condor population between 1982-1986. The possible effects on condors of another highly toxic heavy metal, copper, have not been investigated, but Wiemeyer et al. (1983) reported unusually high copper levels in the liver tissue of an immature condor found dead from unknown causes in 1974.

Cyanide poisoning is considered to be a highly improbable occurrence and is therefore not likely to be a major cause of the decline of the species. Equally improbable was the recent death of a released condor from the ingestion of ethylene glycol, apparently as the result of drinking antifreeze. Deaths from one or more range poisons, including strychnine and various rodenticides, may have occurred historically, but convincing documentation of the occurrence and magnitude of such losses has not been documented.

Kiff et al. (1979) reported severe thinning and ultrastructural abnormalities in California condor eggshells collected in the late 1960s by F. Sibley. They attributed the abnormalities to the probable effects of 1,1-dichloro,-2,2-bis(p-chlorophenyl)etylene (DDE), a breakdown metabolite of the pesticide 1,1,1-trichloro-2,2-bis(p-chloro-phenyl)ethane (DDT). DDT was banned for domestic use in the United States in 1972, and virtually all condor eggshell samples collected after 1975 have exhibited normal thickness (Snyder et al. ms). However, two eggs laid in 1986 by the last female California condor (Stud Book 12) to breed in the wild were very thin (44% thinner than the historical mean thickness) and contained inexplicably high levels of DDE and the parent compound, DDT (Kiff 1989). Indeed, the first-laid of these eggs was crushed, probably by the weight of the incubating bird, before it could be removed for captive incubation. The effect of eggshell thinning on the condor population cannot be accurately assessed now, but it could have been a serious factor during the 1950s-1960s. Significant eggshell thinning has also been reported for the turkey vulture within the region of sympatry with the California condor (Wilbur 1978c, Kiff et al. 1979, Wiemeyer et al. 1986). Organochlorine concentrations were low in four condors analyzed for these contaminants between 1980-86 (Wiemeyer et al. 1988), but the highly contaminated eggs from 1986 indicate that continued monitoring of such compounds in condors and surrogate species is warranted.

One of the Andean condors in an experimental release program died from a collision with a power line near Hopper Mountain National Wildlife Refuge in 1989, and, more recently, four of the 19 California condors released since 1992 were lost from the same cause. At least two deaths from collisions with manmade objects, including power lines, were known historically (Koford 1953). Such deaths suggest that future condor releases should be conducted in areas remote from human settlements with their attendant condor hazards.

013669

Other serious factors formerly contributing to the decline of the species were egg and specimen collecting, capture of live birds for sport or display, Indian ceremonial use, and drowning in uncovered oil sumps. These activities are no longer believed to represent threats to California condors.

Deaths of adult California condors from natural causes are virtually unknown. Rett (1938) reported two adult California condors killed by hail, and he later reported the probable cause of another California condor death as osteomyelitis (Rett 1946). California condor eggs and nestlings are vulnerable to natural predators. According to Snyder (1986), ravens were observed taking two eggs and have been observed attempting to take others. Golden eagles have been observed at least twice attempting to capture condor nestlings, and on one occasion a black bear (*Ursus americanus*) was seen making an unsuccessful attempt to take a nestling (Snyder 1986).

Although not considered a significant factor in the decline of the species, reproductive problems have been noted in recent years. Two pairs, engaged in otherwise normal breeding behavior, failed to successfully copulate on repeated attempts. Based on his observations in the field Snyder (1989) speculated that the pair may have been homosexual; however, one of these birds later paired with another California condor in captivity and reproduced successfully (Cox pers. comm.). One female (Stud Book 10) now deceased produced chicks with morphological abnormalities on several occasions. Another founder female (Stud Book 12) lays unusually small eggs, but continues to reproduce successfully and is well represented by progeny in the captive population. The trait of laying small eggs appears to be heritable through the female line, and her offspring have also laid relatively small eggs (Kuehler et al. 1991). The founder female (Stud Book 12) bird was the last female to breed in the wild.

I. Population Modeling

Verner (1978) constructed a model predicting that a stable California condor population could not be maintained with mortality rates over 9 percent annually in adults coupled with 11 percent annually in immatures, or 7 percent annually in adults coupled with 15 percent annually in immatures. The model employed the following assumptions: (1) age of first breeding is six years, (2) 80 percent of the adults are members of breeding pairs, (3) nesting success is approximately 50 percent, (4) 50 percent of nesting failures occur early enough for renesting, and (5) annual nesting occurs only after early fledging of young. The known mean annual mortality rate for the years 1982 through 1986 was 23.8 percent (24 percent for adults and 23.1 percent for immatures). These percentages clearly indicate the significance of mortality to the decline of the species.

Based on the historical information, the decline of the California condor is more likely attributable to excessive mortality of free-flying birds than to reproductive failure. Review of the available data on recent reproductive success of the California condor does not suggest significant difficulties with reproduction (Snyder and Snyder 1989). Between 1980 and 1985, with a sample of 17 pairs, studies revealed 41 to 47 percent nest success (Snyder and Snyder op cit.). These figures are very similar to historical breeding records of California condors and to that of other cathartid and Old World vultures (Jackson 1983, Mundy 1982). Snyder (1983) suggested that condor reproductive success had held fairly constant through historical times, based upon a comparison of nest success figures from the 1940s (Koford 1953), late 1960s (Sibley 1969), and

013670

Snyder's own data from the early 1980s. However, since the principal causes of nest losses during each period were mostly anthropogenic, directly or indirectly, and apparently specific to each era, it may not be possible to determine "natural" rates of California condor nest success from these data.

J. Conservation Measures

Despite decades of legal protection and extensive conservation efforts, condors continued to decline in numbers in the wild throughout the twentieth century. As a crucial attempt to prevent the extinction of the California condor the decision to capture all remaining wild California condors for safekeeping and genetic security was made by the Service and the California Fish and Game Commission (Commission) in late 1985. That controversial decision was a dramatic shift from previous conservation efforts to recover the species primarily through habitat protection. The following section provides a brief chronology of conservation efforts.

Legal protection was first provided to the California condor by the State of California through a series of avian "protective" laws which were promulgated around the turn of the century (Wilbur 1978). The California condor was protected by the State of California at least as early as 1901. The law was nonspecific, merely prohibiting the taking of any nongame bird or its eggs or nests without a permit. In 1908, a constable was fined $50.00 for shooting a California condor in the San Gabriel Mountains near Pasadena (Finley and Finley 1928). In 1917 an illegally captured California condor was confiscated, but no one was prosecuted (Anonymous 1917). In general, early nongame laws were not strictly enforced, and a number of California condors were shot and eggs were collected until about 1920.

Official concern began to be expressed for the California condor by the mid-1930s. At the urging of Robert O. Easton, a Santa Barbara County rancher, and the National Audubon Society (Audubon), the U.S. Forest Service (Forest Service) established the Sisquoc Condor Sanctuary in 1937. It encompasses 1,198 acres in Santa Barbara County that include an important condor roost, nest site, and bathing pool. Following field studies by Carl Koford between 1939 and 1946, the Sespe Condor Sanctuary was established in 1947 in the Los Padres National Forest in Ventura County. Originally about 35,000 acres, the Sespe Condor Sanctuary was enlarged in 1951 to include approximately 53,000 acres. These two sanctuaries remain under the administration of the Forest Service. The Sisquoc Condor Sanctuary is closed to all non-permitted entry, and the Sespe Condor Sanctuary is also closed to all non-permitted entry with the exception of two narrow travel corridors that allow hikers and horseback riders to pass through the area.

The first specific legal mention of the California condor was in 1953. Section 1179.5 of the California Fish and Game Code stated: "It is unlawful to take any condor at any time or in any manner. No provision of this code or any other law shall be construed to authorize the issuance of a permit to take any condor and no such permit heretofore issued shall have any effect for any purpose on and after January 15, 1954." The California condor was retained in that "fully protected" status with no authority to issue any type of permit for trapping or handling, until 1971. At that time the Fish and Game Code was amended (Stats. 1970, Ch. 1036) to allow issuance of permits for collecting fully protected species when necessary for scientific purposes.

An Audubon-sponsored field survey in 1963-64 resulted in the hiring of an Audubon Society "condor naturalist" in 1965. In the same year, the Service initiated the Endangered Wildlife Research Program, and a research biologist was assigned to study the California condor in 1966. Both Audubon Society and Service positions were occupied until recently. From 1968 to 1973, the Forest Service employed a California condor biologist to prepare a comprehensive California condor habitat management plan for the national forests. The California Department of Fish and Game (Department) maintained a full-time California condor biologist from 1982-1989. Cooperation and assistance from other individuals and agencies have been coordinated through the Service and the Team.

The California condor was recognized by the Federal government as "endangered" in 1967, but the first specific Federal legal protection did not occur until 1972 when the U.S. Migratory Bird Treaty with Mexico was amended to include vultures and certain other families of birds. The passage of the Endangered Species Act of 1973 (Public Law 93-205) made the taking of any endangered species a violation of Federal law.

An important outgrowth of Federal endangered species legislation was the concept of critical habitat. According to Section 7(a)(2) of the Endangered Species Act of 1973, as amended, "each Federal agency shall in consultation with and with the assistance of the Secretary [of Interior] insure that any action authorized, funded, or carried out by such agency... is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary ... to be critical." About 570,400 acres of critical habitat (Section 3(5)(A)) has been determined for the California condor (50 CFR 17./95), in six Southern California counties; Ventura, Los Angeles, Santa Barbara, San Luis Obispo, Kern and Tulare (Appendix 1).

Considerable effort to preserve California condor habitat was made from the late 1960s through the 1980s, yet the species continued to decline rapidly. The Team prepared the first draft "California Condor Contingency Plan" in 1976. That document recommended captive breeding and other intensive recovery efforts. A revised version was approved "in concept" in 1977 by the Service. In 1978, a panel of experts appointed by the American Ornithologists' Union and the Audubon Society prepared a report on the California condor that recommended an aggressive program of trapping condors for captive breeding and radiotelemetry studies (Ricklefs 1978). These reports led to the signing of a Cooperative Agreement in 1979 among the Service, Audubon Society, Department, Forest Service, and U.S. Bureau of Land Management. The purpose of the agreement was to expedite the California condor recovery effort and to cooperate on providing information and education. The Condor Research Center was established in 1980 by the Service and the Audubon Society as a result of the agreement.

In May 1980, Federal and State permits authorizing the capture of a condor for captive breeding and equipping 10 wild condors with radiotelemetry devices were approved. However, the State permit was rescinded in the following month when a condor chick died while being examined by a field team from the Condor Research Center. A permit to capture a condor for captive breeding was renewed in August 1981 by the Commission but a suitable bird could not be found because of the restrictive provisions of the permit.

013672

The Commission also approved the use of patagial-mounted radios in January 1982, and two California condors were captured and equipped with these devices late in 1982. For the first time, photocensusing techniques yielded an accurate estimate of the number of extant California condors (Snyder and Johnson 1985), and it was found that the species had reached an apparent minimum total population size of 22 individuals. In 1982, a wild California condor chick was captured and brought safely into captivity. "Double-clutching" by one of the wild pairs was documented beyond question in 1982 (Snyder and Hamber 1985), and led in 1983 to the issuance of a permit to bring the first-laid eggs of breeding California condors into captivity.

The years 1983 and 1984 were critical ones in the formation of the captive California condor flock at the San Diego Wild Animal Park and Los Angeles Zoo. Two chicks and four eggs were taken from the wild to the San Diego Wild Animal Park in 1983; all eggs hatched successfully. In 1984, six out of eight eggs taken to this facility were hatched successfully. In addition, another chick was captured and added to the captive population in 1984. For the first time in the recorded history of the California condor, the overall population increased in number.

Eventually, nine free-flying California condors were equipped with radiotelemetry devices, and their movements were followed by field technicians. The photocensusing project continued, and it indicated that the wild condor population consisted of 15 individuals in the fall of 1984. Among these birds were five breeding pairs, and it seemed possible that the growing captive flock would soon be able to produce releasable offspring well in sufficient time to forestall the extirpation of the wild population. However, disaster struck during the winter of 1984-85, and six birds were lost from the wild population. The cause of death was determined for only one of the six birds, a condor named Broken Feather that was found sick and on the ground near California Hot Springs. Broken Feather died of lead poisoning while undergoing treatment. Their loss left only one breeding pair of California condors in the wild in the spring of 1985. By April 1985, there was widespread sentiment that all of the remaining wild birds should be brought into captivity in order to ensure the genetic viability of the species and to enhance the chances of success in the captive breeding program. That position was formally endorsed by the Commission and a panel of 10 prominent population geneticists, and it was supported by most of the Team members. An American Ornithologists' Union Committee on the California condor favored the capture of all the wild birds for biological reasons, but recommended that three birds be left in the wild in order to maintain the integrity of habitat preservation efforts and the momentum of the condor recovery program until the captive-reared birds could be released.

In June 1985, the Service recommended the capture of three of the remaining nine wild birds, but (with Audubon backing) also advocated the release of three of the birds then held captive. That proposal became a matter of considerable contention, but the situation was finally resolved in December 1985, when the Service recommended the immediate capture of all remaining wild California condors. Immediately preceding that decision, one of the six remaining wild California condors, a breeding female, was found suffering from lead poisoning and was taken to the San Diego Wild Park, where she died in January 1986.

The Service decision to capture all remaining wild California condors resulted in a lawsuit by Audubon, and a temporary injunction preventing trapping of the remaining wild birds was issued. The matter was not resolved until June 1986, when the court ruled in favor of the Service's position. At about that time administrative responsibility for the California Condor Recovery

013673

Program was transferred from Patuxent Wildlife Research Center (Region 8) to the Service's Region 1 office in Portland, Oregon. There were still five condors in the wild, including one breeding pair. By the end of the summer, all but three of these birds had been captured. The present Team was formed in August 1986, and its first recommendation was to capture the last free-flying condors. One of the birds was taken into captivity before the end of 1986, and another was captured in January 1987. The last individual was captured on Easter Sunday, April 19, 1987.

Other important actions during that period included the acquisition by the Service of the 1,800-acre Hopper Mountain National Wildlife Refuge as a buffer for the Sespe Condor Sanctuary and the 13,500 acre Hudson Ranch (now Bitter Creek National Wildlife Refuge), an important condor foraging area in the southern San Joaquin Valley. DNA "fingerprinting" studies to elucidate the relationship of all living and some recently dead California condors were conducted by Dr. Oliver Ryder at the San Diego Zoo, and they indicated that the captive population contained 14 different founders, representing three "clans." Using these data and the known histories of the captive birds, a computer model was generated to determine the best pairings from a genetic standpoint.

Prior to the beginning of the intense condor management program in the 1980s, the only living captive California condor was a bird ("Topa Topa") that had been captured at the age of 11 months in 1967 and held at the Los Angeles Zoo. In 1983 the decision was made to take into captivity eggs produced by wild California condors, and in that year three eggs from first clutches were collected and hatched at the San Diego Wild Animal Park. Removal of the eggs stimulated the production of replacement clutches in two of the pairs. One of those eggs was also taken and hatched in captivity, and the other was lost to common ravens (*Corvus corax*). In addition, two nestlings were taken into captivity in 1983. In 1984, eight eggs and one chick were taken into captivity. Six of the eggs hatched. The following year, two eggs were taken; both hatched. By 1986 only one breeding pair of California condors survived in the wild, and they produced two eggs, one of which was hatched in captivity. The first successful breeding of California condors in captivity occurred at the San Diego Wild Animal Park in 1988, when a chick, "Molloko," was produced by a pair of wild-caught condors. Four more chicks were produced at the San Diego Wild Animal Park and Los Angeles Zoo in 1989. The number of chicks produced by captive California condors continued to increase annually (Fig. 2), and the captive population grew from 27 birds in 1987 to 86 birds by the spring of 1994.

The Team approved a protocol for the selection of additional condor captive propagation facilities in February 1988, and solicitations were made to candidate zoological institutions for proposals. The two leading proposals were received from The Peregrine Fund, Inc. in Boise, Idaho (World Center for Birds of Prey) and the National Zoo at Front Royal, Virginia. Both institutions were recommended by the Team as sites for additional condor captive propagation facilities in September 1990 with the expectation that the former facility would be in operation first. Twelve condors, genetically selected to form six breeding pairs, were transferred from the two existing condor facilities to the World Center for Birds of Prey on September 23, 1993. Eight more condors were transferred on November 1 and 2, 1994, bringing the total number of pairs at that facility to ten. In addition, the Team recommended in February 1993 that the George M. Sutton Avian Research Center in Bartlesville, Oklahoma be approved as an additional condor captive propagation facility.

013674

In October 1986, the Team recommended criteria to be satisfied before a release of captive-bred California condors could take place. These included having three actively breeding pairs of condors, three chicks behaviorally suitable for release, and retaining at least five offspring from each breeding pair contributing to the release. The Team recommended that all California condors then in captivity should be retained for captive breeding purposes. In June 1989, the Team added a provision to the third criterion to retain a minimum of seven progeny in captivity for founders that were not reproductively active.

Some of the chicks produced in the 1991 breeding season met all three criteria, and two were eventually released to the wild. However, attempting to apply the first criterion to the 1991 chicks also revealed that it would not be practical in the future, because several founders had died without producing five progeny. The Team therefore recommended choosing genetically appropriate chicks for future releases based on pedigree analyses developed for the genetic management of captive populations. These pedigree analyses evolve over time as the results of new research are incorporated. The analyses currently available are described in Ralls and Ballou (1992).

Prior to the capture of the last wild California condor in 1987, the Team recognized that the anticipated future releases of captive-reared California condors would pose the problem of reintroducing individuals of an altricial bird species into habitat devoid of their parents and other members of their own species. Thus, the Team recommended the initiation of an experimental release of Andean condors in southern California. Research objectives for the experimental release were to refine condor release and recapture techniques developed with black and turkey vultures in Florida and Andean condors in Peru, test the criteria being used to select California condor release sites, develop written protocols for the release and recapture of California condors, identify potential problems peculiar to the California environment, field test rearing protocols being used, or proposed for use, to produce California condors suitable for release, evaluate radiotelemetry packages, and train a team of biologists for releasing California condors.

Other benefits of the Andean condor experimental release included identifying environmental hazards associated with selected release sites, and the development and implementation of measures to eliminate, or plans to avoid those hazards prior to the release of California condors. There were also public relations benefits gained from the widespread notice received by the project. Andean condors not only served as a surrogate study species, but the release project also helped maintain momentum for the California condor recovery program and condor habitat protection during the period when California condors were not in the wild.

The project began in August 1988, when a group of three juvenile female Andean condors were released from a fabricated release site on Hopper Mountain National Wildlife Refuge. Later in 1988, four more juvenile female Andean condors were taken to a nearby release site within the Sespe Condor Sanctuary. The birds were reared at each site until they reached fledgling age approximately eight months of age. At that time, the netting was removed from their enclosures, and the birds were allowed to fly. During 1989, six more female Andean condors were added to the experimental release population. The project was continued until December 1991 and resulted in the acquisition of important knowledge about the best procedures for releasing California condors. Following their experimental release in the Sespe area, the Andean condors

013675

were removed gradually from the wild and eventually transported to Colombia and Venezuela, where they were released to the wild.

By the end of the 1991 breeding season several captive-produced chicks met the criteria for release. The Team recommended the release of two individuals into the Sespe Condor Sanctuary (Sanctuary), Los Padres National Forest, Ventura County, California be conducted in the winter of 1991-92. The first release occurred on January 14, 1992, when two captive-produced California condor chicks, "Xewe" (female) and "Chocuyens" (male), were released with two Andean condor chicks at the Arundell Cliffs located in the Sanctuary. The Andean condors were released with the California condors to create a larger social group. The Andean condors were returned to captivity in September 1992, thus marking the end of the 3-year experimental Andean condor release project. The young California condors continued to fare well until Chocuyens was found dead at Pyramid Lake, Ventura County, on October 8, 1992, where he had died from ingesting ethylene glycol, a primary component of antifreeze.

The next release of California condors occurred on December 1, 1992, when six more captive-produced California condors chicks were released at the same Sespe Condor Sanctuary site. Socialization with Xewe, the remaining individual from the first release, proceeded well, and the "flock" appeared to adjust well to wild conditions. However, there was continuing concern over the tendency of the birds to frequent zones of heavy human activity, especially the Pyramid Lake area. Indeed, three of these birds eventually died from collisions with power lines in the release area between late May-October 1993.

Because of the tendency for the remaining birds to be attracted to the vicinity of human activity and man-made obstacles, especially power lines, another condor release site was constructed in a more remote area, Lion Canyon, Los Padres National Forest, near the boundary of the San Rafael Wilderness Area in Santa Barbara County, California. Five juvenile condors were released at the new site on December 8, 1993. In addition, the four condors that had been residing in the Sespe area were also moved to the new site. They were re-released over a period of several weeks in hopes that this approach would reduce the probability that they would return to the Sespe area. Nevertheless, three of these condors eventually moved back to the Sespe-Castaic-Fillmore area in March 1994, where they resumed the high risk practice of perching on power poles. Because of general concern about the tameness of these condors and the possibility that their undesirable behavior would be mimicked by the younger birds, these condors were retrapped on March 29, 1994, and added to the captive breeding population. One of the five condors released on December 8, 1993, died on June 24, 1994, when it collided with a powerline on the north side of San Marcos Pass. A second condor from this group was captured on July 4, 1995, and brought into captivity when it could not be discouraged from frequenting the same area in which the first was killed. On July 4, 1994, this condor died in captivity from cancer.

On February 8, 1995, six of the 14 condors successfully hatched in 1994 were released at Lion Canyon. That group was the first to undergo aversion training in captivity prior to their release. The training was designed to condition these birds to avoid powerlines and approaching humans, hopefully improving their chances of survival in the wild. On March 1, 1995, the three condors remaining in the wild from the December 8, 1993, release were trapped and brought into captivity. This was done so they would not negatively influence the six newly released birds that underwent the aversion training. On August 29, 1995, the remaining eight condors from the 1994

013676

breeding season were released at Lion Canyon. The 1994 release candidates were split into two groups in order to keep the releases at more manageable numbers. Only one unfortunate human interaction threatened this cohort when campers gave one of the condors food and water despite instructions from biologists to the contrary. That left biologists with no choice but to capture the compromised condor and return it to captivity. Despite this one incident, the remaining 13 condors continue to be the best behaved cohort released to the wild. None have been observed landing on power poles, they are avoiding areas of high human activity, and only a few interactions with backcountry hikers have been recorded.

The 1995 breeding season produced 13 condors eligible for release, four of which were parent hatched and reared. At approximately three months of age the four parent hatched and reared condors were transferred to a newly constructed rearing facility at the Hopper Mt. National Wildlfe Refuge. That cohort was released to the wild on February 13, 1996, at the Castle Crags release site located approximately 64 km (40 mi) northwest of Lion Canyon on the western border of San Luis Obispo County. An objective of this release is to determine if parent hatched and reared chicks taken from the Zoo at the earliest possible date and placed in a natural environment to be reared will be more successful in their adjustment to the wild. All 13 condors have undergone aversion training.

To satisfy the objectives of the Plan, at least one subpopulation of non-captive condors must be established in an area disjunct from the subpopulation being reestablished in the recent historical range in California. Following a widely publicized solicitation of suggestions for suitable condor release sites outside of California and the approval of a site selection protocol (March 1987), the Team recommended in December 1991 that California condor releases be conducted in northern Arizona. The remaining 9 condors still in captivity are scheduled to be released at the Vermilion Cliffs in northern Arizona in June of 1996, in an attempt to achieve this primary recovery goal. California condors released into northern Arizona will be designated as a "nonessential" experimental population in acccordance with Section 10(j) of the Act.

Section 10(j) of the Act enables the Service to release individuals of federally listed species into the wild and allows (but does not require) the Service to designate them as "experimental populations". The circumstances under which a designation can be applied are--(1) the population is geographically disjunct from nonexperimental populations of the same species (e.g., the population is reintroduced outside the species' current range but within its historical range); and (2) the Service determines the release will further the conservation of the species. The designation can increase the Service's flexibility to manage a reintroduced population, because under Section 10(j) an experimental population is treated as a threatened species regardless of its designation elsewhere in its range and, under Section 4(d) of the Act, the Service has greater discretion in developing management programs for threatened species than it has for endangered species. Therefore, the experimental designation allows the management flexibility needed to ensure that reintroduction is compatible with current or planned human activities in the reintroduction area and to permit management of the population for recovery purposes.

Experimental populations can be classified as either "essential" or "nonessential". An essential experimental population is a population whose loss would be likely to appreciably reduce the likelihood of the survival of the species in the wild [50 CFR 17.80 (Subpart H-Experimental Populations)]. All other experimental populations are treated as nonessential, if they are not

013677

considered essential to the continued existence of the species. "Nonessential" experimental populations are treated for purposes of Section 7 of the Act as though they are proposed for listing (except on National Wildlife Refuge and National Park Service lands where they will be treated as a species listed as "threatened" under the authority of the Act). A designation of nonessential experimental prohibits the application of Section 7(a)(2) of the Act except on National Wildlife Refuge and National Park Service lands. This ensures that current land uses and activities (such as, but not limited to, forest management, agriculture, mining, livestock grazing, sport hunting and fishing, non-consumptive outdoor recreational activities) will not be restricted.

In March 1995, the Team recommended that a condor release project be undertaken in the Ventana Wilderness on the Big Sur Coast, Los Padres National Forest, Monterey County, California. The recommendation received the Service's concurrence and plans are being made to release condors in this area in November or December of 1996.

In July 1993, the Team recommended that a condor release project be undertaken at Ladder Ranch in New Mexico. That proposal will be pursued after the northern Arizona release has been established. Other areas, including Tehama County in northern California, the Gray Ranch in New Mexico, and the Sierra San Pedro Martir, Baja California Norte, Mexico, have been discussed as possible release sites.

Supplemental feeding is an integral component of the condor release program. Prior to the recent condor management era, Wilbur et al. (1974) and Wilbur (1978b) showed that California condors could easily be attracted to artificial food sites, and "vulture restaurants" have long been in operation in several Old World vulture conservation programs.

Based on the encouraging results of the Andean condor surrogate release experiment, condor field technicians have continued to feed the released California condors on still-born dairy calves, and there has been little evidence that the birds have utilized any other food items. Although it is not expected that free-flying condors will continue to feed on proffered food indefinitely, the supplemental feeding program should continue to reduce the likelihood of deaths of condors from lead or other poisoning insofar as it prevents the birds from feeding on contaminated carcasses. In addition, feeding sites can be strategically located in order to influence movements of the birds. Finally, supplemental feeding can permit the reintroduction and maintenance of condor populations in areas where the supply of natural food resources is too variable to support the birds over the entire annual cycle.

The first two releases took place in the Sespe-Piru Condor Critical Habitat Area, one of nine designated Condor Critical Habitat Areas located in Southern California. The third and fourth releases were conducted approximately 8.1 kms (5 mi) north of the Sisquoc-San Rafael Condor Critical Habitat area. The condors released at that site utilized the Sisquoc-San Rafael and Mt. Pinos Condor Critical Habitat areas. The new Castle Crags release site in San Luis Obispo County is located on the northwest boundary of the Beartrap Condor Critical Habitat area. The original selection of critical habitat areas was based on the documented use of nesting, roosting, and foraging habitat by multiple generations of wild condors. Although recently released captive-hatched condors have no historical bonds to these critical habitat areas, the latter contain the most important habitat components essential to the survival of wild condors still extant. Thus, it is expected that released condors will be drawn to these areas. However, not until we have a larger

013678

number of condors in the wild, including breeding pairs, will we be able to fully evaluate the contribution critical habitat areas will make to the recovery of the California condor.

K. Strategy of Recovery

The recovery strategy for the California condor will focus on (1) increasing reproduction in captivity to provide condors for release, (2) the release of condors to the wild, (3) minimizing condor mortality factors, (4) maintaining habitat for condor recovery, and (5) implementing condor information and education programs.

013679

II. RECOVERY

A. Objectives and Criteria

The primary objective of the California Condor Recovery Plan (Plan) is reclassification of the California condor to threatened status. The plan provides the criteria for reclassification and outlines the requisite actions for the accomplishment of each criterion.

The minimum criterion for reclassification to threatened is the maintenance of at least two non-captive populations and one captive population. These populations (1) must each number at least 150 individuals, (2) must each contain at least 15 breeding pairs and (3) be reproductively self-sustaining and have a positive rate of population growth. In addition, the non-captive populations (4) must be spatially disjunct and non-interacting, (5) must contain individuals descended from each of the 14 founders. When these five conditions are met the species should be reclassified to threatened status. The accomplishment of these objectives will depend upon reducing mortality to the lowest level possible and ensuring the interchange of individuals among the spatially isolated free-living sub-populations and the captive flock. It is recognized that reestablished condor populations in some areas may require continued artificial feeding to supplement natural food resources and/or to protect birds from exposure to contaminated carcasses. However, such management considerations should not preclude reclassification of the species if the above-listed criteria are met.

These reclassification criteria may be revised on the basis of new information. The estimated date of reclassification to threatened is 2010. Reintroduction programs must be successful before reclassification occurs. In addition, productivity must be increased beyond the California condor's intrinsic reproductive rate through a captive breeding program. The long-term population goal of this program is to manage the captive flock to maintain 90 percent of the initial genetic variance of the represented founders for 200 years.

The ultimate size of this population is dependent upon the number of founders, the growth rate of the captive flock, and the generation length of the species. A preliminary estimate of the captive population size is approximately 50 pairs. The short-term population objectives set here are based on preliminary population viability considerations (Appendix 2). The viability factors that have been considered include genetics, demography, and environmental variation, including the possibility of catastrophes and epidemics. The roles and interactions of these factors are set out in Soulé (1987).

B. Narrative

1. Preserve Gene Pool.

Single populations are at higher risks from natural or human-caused disasters than are several sub-populations. Therefore, multiple sub-populations of California condors should be maintained to produce birds for the establishment of viable wild sub-populations.

013680

11. Maintain extensively managed captive breeding programs at a minimum of five zoological institutions.

Captive California condor flocks should be managed to maximize production while optimizing genetic diversity. Optimum pairing strategies for captive birds should be based on genetic information, behavioral data, logistical considerations, and any other pertinent data. In the short term, demographics should be emphasized with the expectation that in the long term, genetic considerations will become increasingly important in managing condor populations.

111. Update standardized management protocols.

Captive breeding/rearing protocols have been developed under the auspices of the Team and are being implemented. Continue to update, revise, and standardize existing protocols for veterinary, husbandry, transport, captive-breeding techniques, and emergency procedures to ensure the health, safety, and productivity of captive condors.

112. Operate existing breeding facilities according to management protocols.

Existing captive-breeding facilities located at the Los Angeles Zoo, San Diego Wild Animal Park, and the World Center for Birds of Prey should be operated in accordance with captive/rearing protocols approved by the Team.

113. Develop additional captive-breeding facilities.

The development of additional captive-breeding facilities is necessary for three reasons, (1) safety - single populations are more susceptible to natural or human-caused disasters than multiple sub-populations, (2) space - additional facilities are necessary to accommodate the growing captive population, and (3) cost - the existing captive breeding facilities cannot be expected to assume the total cost of maintaining the growing captive population. Additional captive-breeding facilities should be developed as needed to accommodate the growing captive population.

12. Manage the captive flock to optimize productivity, maximize genetic diversity, minimize genetic loss, and maintain genetic balance.

Management under the current captive-breeding protocols should continue to emphasize optimal productivity, maximum genetic diversity, minimum genetic loss, and genetic balance.

121. Maintain comparable genetic, age, and sex representation in each facility.

Because of the possibility of a catastrophic loss at one or more captive breeding facilities, each sub-population should be managed to represent as much as possible the captive population as a whole.

122. Offspring and eggs should be exchanged between captive subpopulations to simulate immigration

The exchange of offspring and eggs should be conducted as needed to balance the genetic, age, and sex ratios of the sub-populations.

123. Determine an appropriate genetic balance in the California condor captive flock.

Continue research on the genetic relatedness of the captive flock and generate a computer model to determine an appropriate genetic balance in the captive flock.

124. Establish optimum pairing strategies for the California condor captive flock.

Optimum pairing strategies should continue to be based on the most current genetic and behavioral information, logistical considerations, and any other pertinent data.

125. Maintain a studbook for the California Condor population..

The California condor studbook should be continually updated in order to provide the basic knowledge necessary for assessing population status and for planning management actions.

13. Manage selected California condors for release to the wild.

California condors to be released to the wild whose loss should be genetically affordable, physically and behaviorally healthy, of comparable age, successfully socialized with other release candidates, kept in isolation from humans to prevent taming, and undergo aversion training to condition them to avoid humans and man-made structures. Criteria to identify condors eligible for release should continue to be refined by the Team.

14. Collect and analyze behavioral data on captive California and Andean condors.

Behavioral data on California and Andean condors have been collected and analyzed from the beginning of the captive-breeding program. Collection of such data in a standardized manner should continue, and emphasis should be placed upon publishing summaries of the findings, since they may have relevance to the management of the wild California condor population.

2. Reintroduce California Condors to the Wild.

Establish at least two, preferably more, disjunct wild sub-populations in order to reduce the risks to the overall population and to facilitate their optimal genetic and demographic management.

21. Develop protocols for the releases of California condors.

Draft release protocols were completed in July of 1991, based on data collected during the experimental releases of Andean condors. They should be updated and revised based on data collected from the four releases of California condors.

211. Develop release criteria for California condors.

Criteria to determine eligible release candidates have been developed, but should be reviewed and updated as needed.

212. Develop an annual plan for the release of California condors.

Based on the annual production of release candidates and the physical capacities of the current release site(s), prepare a release plan that would recommend procedures for (1) the selection of release cohorts, (2) the socialization of release cohorts in captivity, (3) the transfer from captive facilities to release sites, (4) veterinary care, (5) feeding schedules, and (6) pre- and post-release monitoring.

22. Establish release sites in California for California condors.

Three California condor release sites have been established. Two releases were conducted in 1992 in the Sespe Condor Sanctuary, Ventura County, one in 1993 and two in 1995 were conducted in Lion Canyon, Santa Barbara County, and one in 1996 at Castle Crags, San Luis Obispo County. Additional release sites should be selected to accommodate any unexpected needs to move the existing release operations, as well as to accommodate an increasing number of releasable birds.

221. Develop criteria for selecting release sites for California condors.

Criteria for selecting release sites have been developed, but should be revised if necessary, based on information collected from the ongoing release operations.

222. Select release sites in accordance with established criteria.

Continue to select release sites as needed utilizing existing release site selection protocols.

223. Prepare release sites based on protocols resulting from the Andean condor experimental release results and information learned from the three recent California condor releases.

Preparation of future release sites should utilize the existing release protocols and incorporate the knowledge gained from past releases of Andean and California condors and revised as new findings become available.

23. Conduct releases in California of California condors into selected habitats

California condor releases should be conducted until the recovery goal is met.

231. Develop a California condor release plan.

A plan outlining the management of releases in California should be developed to project at least five years into the future to ensure adequate support for proposed releases.

232. Release California Condors.

All releases of California condors should be made in accordance with the release plans and established protocols.

233. Monitor California condors held at release sites in accordance with the annual release plan and established protocol.

The specific guidance provided in the plan and existing protocols should be followed to guarantee the health and safety of the birds being held for release.

234. Monitor free-flying condors.

Released California condors should be closely monitored by visual observation and electronic telemetry.

235. Provide protection for released birds.

Protection should be provided by management plans on public lands, volunteer management agreements on private lands, patrolling wildlife authorities, and biologists tracking released birds.

24. Following the procedures outlined in tasks 21 through 23, implement releases of California condors outside California.

The two approved future release sites located outside California should be managed according to the criteria and protocols developed for condor releases in California.

241. Release California condors in northern Arizona.

Release California condors at this approved site in accordance with established release protocols.

242. Release California condors at Ladder Ranch, New Mexico.

Release California condors at this approved site in accordance with established release protocols.

25. Establish rearing facilities in wild lands.

Field rearing facilities should be established to augment zoo rearing and to test whether young condors gain survival advantages.

3. Provide Habitat for Condor Recovery in the Wild.

An important factor in the successful establishment of wild condor sub-populations is the existence of suitable habitat. Therefore, whenever possible or appropriate, a priority for this habitat should include management for condor recovery.

31. Continue to implement management plans to protect known suitable nesting sites on public lands.

Continue the enforcement of adopted Forest Service guidelines that protect known condor nest sites from activities that could adversely modify or destroy them and provide adequate protection against human disturbance.

32. Continue to implement management plans to protect known suitable roosting sites on public lands.

Continue the enforcement of adopted Forest Service guidelines that protect known and potential roost sites from activities that could adversely modify or destroy them, and provide adequate protection against human disturbance.

33. Provide foraging habitat.

The management of existing foraging habitat should include the support of reestablished wild condor subpopulations.

331. Implement strategies for managing condor foraging habitat.

Foraging habitats have been identified and documented through observations and radiotelemetry. Their preservation is necessary to the maintenance of wild populations of California condors. Habitat management plans and volunteer land use agreements on Federal, State, and private lands should be developed and implemented to protect existing foraging habitats.

013685

3311. Encourage land managers and owners to leave dead livestock on rangelands.

Wild California condors traditionally fed on dead livestock found on private and public rangelands. In the future, such carcasses should provide an important food source for released condors. Land managers should be informed of the value of these carcasses, and should be encouraged to leave dead livestock out for condors.

3312. Reestablish extirpated native ungulate populations on historical foraging habitats.

When feasible or appropriate encourage the Department in cooperation with land management agencies to initiate native ungulate reintroduction within the range of the California condor.

332. Preserve key foraging areas near nests and roosts.

The existence of this foraging habitat is necessary, if California condors are to reoccupy these key foraging, roosting, and nesting areas.

3321. Foothills of southwestern Kern County.

The foothills of southwestern Kern County were used by condors throughout the year. Breeding pairs and several individuals fed there year round, and virtually the entire condor population fed there in late summer and fall. The area is principally composed of three large, private cattle ranches in southern Kern County: San Emigdio, Snedden, and Hudson. Dead livestock were the primary food source for condors while feeding in that area. A management plan should be prepared with the consent and participation of all affected land owners to maintain the value of that area for condors.

3322. Carrizo Plain, San Luis Obispo and Elkhorn Plains, Kern County.

The Carrizo and Elkhorn Plains in southeastern San Luis Obispo County and southwestern Kern County, were used by foraging condors year-round with the heaviest use being recorded in late winter and spring. The Bureau of Land Management (BLM) has been able to secure most of that area. It is currently managed by the BLM, The Nature Conservancy, and the Department as the "Carrizo Plain Natural Area." The remaining private inholdings should be purchased.

013686

3323. Tulare County rangelands between Lake Kaweah and White River.

California condors fed in this area throughout the year with heavy use in summer, fall and early winter. It appeared to be an important foraging area for condors, particularly nonbreeders. Efforts should be made to maintain the rural landscape of this area.

3324. Glennville/Woody areas, Kern County.

The feeding area in northern Kern County received use by foraging California condors, particularly between late fall and late spring. Efforts should be made to maintain the rural landscape of that area.

3325. Tejon Ranch area, Kern County.

The Tejon Ranch was an important condor feeding area throughout the annual cycle, but especially in the fall, when there is a high intensity of deer hunting on the ranch. A plan should be prepared with the consent and participation of the affected landowner to maintain its value for condors.

3326. Hopper Mountain Ranch area, Ventura, County.

The Hopper Mountain Ranch area was purchased in 1974 to serve as a buffer against development for the Sespe Condor Sanctuary (Sanctuary) and to provide an area for a condor feeding program. It is now a National Wildlife Refuge and the existing ranch house was used as the headquarters for the condor field program that monitored the wild population of California condors. It should be maintained as a refuge to protect the Sanctuary.

3327. Bitter Creek National Wildlife Refuge, Kern County.

The Hudson Ranch area was purchased in 1986 because it was an important feeding area for California condors, it became the Bitter Creek National Wildlife Refuge. As a refuge, its primary management emphasis should be to support native ungulates as a food source for condors.

3328. San Juan Creek Region, San Luis Obispo County.

Rangelands on either side of the entire San Juan Creek drainage were important as California condor feeding areas. In the early 1980's, foraging flights by radioed condors were recorded in the upper drainage of San Juan Creek south of Highway 58. During this period, a pair of non-radioed breeding condors and, occasionally, non-radioed

single condors were observed there during the summer months. The rural landscape of that area should be preserved.

3329. Elkhorn Hills, Kern County and Caliente Range, Kern County and San Luis Obispo County.

These areas were regular California condor foraging areas. In the future, as the population of wild condors increases, the use of these areas by foraging condors will probably resume. One of the management priorities for these areas should be the reintroduction and maintenance of extirpated ungulate populations.

34. Continue to monitor potential impacts of all surface-disturbing activities (e.g., energy, residential, agricultural, and transportation development projects) within historical condor range.

The pressure to develop land within the recent historical California condor foraging range is increasing. Therefore, investigations to identify, assess, and monitor potential threats should continue in order to develop alternatives that will not negatively affect the survival of the wild condor population.

341. Work with governmental agencies to include information on the condor in land-use planning documents, geographic information systems, and policies.

Routine and close communication should be maintained with appropriate governmental planning agencies (Federal, State, and County), in order to ensure that information on California condor distribution and habitat use is integrated into the land planning documents.

342. Review all plans and land use programs within the condor's range to ensure that the needs of the species are addressed to the extend possible.

An attempt should be made to review all local land-use planning documents and attend all pertinent local government planning meetings to ensure California condor issues are addressed. The goal of these reviews should be to integrate the needs of the condor into all existing or proposed plans and programs, in a manner that is compatible with their purpose.

4. Minimize Mortality Factors in the Natural Environment.

Land management agencies should identify all known condor mortality factors in their land management plans and develop strategies to eliminate them to the extent possible.

41. Assess historical findings.

A review of the historical literature should be conducted to compile information on potential mortality factors. It should be determined if these mortality factors are still a threat. If so, corrective actions should be taken to eliminate them.

42. Provide adequate law enforcement to minimize direct losses of wild condors from shooting.

A cooperative law enforcement program should be developed between the Department, Forest Service, BLM Rangers, and the Service for the patrol of key condor areas.

43. Implement management recommendations and strategies to minimize contaminant-related mortality factors.

Land management agencies should identify all known or suspected sources of contaminants that could poison condors. These land managers should then implement management strategies to eliminate the source, use, or dumping of these contaminants on lands under their jurisdiction to the extent possible.

44. Eliminate or reduce the effects of environmental contaminants on California condor.

Initiate research on known and suspected environmental contaminants using surrogate species to determine their effects on the survival and reproduction of California condors. Based on the findings of this research, management recommendations should be made that would eliminate or reduce these effects on condors.

441. Determine effects of various poisons and contaminants, especially lead and copper, on surrogate species.

Continue to compile information on the effects of various poisons and contaminants on surrogate species, especially the turkey vultures, Andean condor, and golden eagles to provide comparative data of particular relevance to the California condor.

45. Monitor contaminant levels in California condors.

Condor blood, feathers, eggshells, and other tissues will be collected opportunistically and analyzed for heavy metals, pesticides, and other potential contaminants.

451. Sample potential condor food items within historical range to determine seasonal and geographic contaminant loads.

013689

Once California condors find and start feeding on food items other than the carcasses provided to them, those specific items should be tested to determine their contaminant burdens.

452. Sample and analyze blood of surrogate sympatric species in the field to determine seasonal and geographic distribution of contaminant loads throughout the historical condor range.

Blood samples should be taken and analyzed from species (e.g., golden eagle) that are permanent residents within the range of the California condor. Samples should be taken throughout the condor's range and during each season.

46. Minimize mortality due to collisions with man-made structures.

Increasing development within the California condor's range makes it imperative to minimize collisions with man-made structures by developing guidance documents that would eliminate to the extent possible condor deaths due to collisions with man-made structures.

461. Assess avian mortality resulting from collisions with wind turbines, power and transmission lines.

To assess the magnitude of avian mortalities due to collisions with man-made structures, all available information on the subject should be collected, knowledgeable persons interviewed, and further studies conducted if necessary.

462. Advise planning agencies on location of threatening powerlines, wind turbines, and other structures to avoid possible condor mortalities.

In 1966, a California condor was killed when it flew into a power line. In a six-month period from May to October 1993, three juvenile condors died when they collided with powerlines. Death resulting from collisions with man-made structures (e.g., power lines and wind turbines) is avoidable if such structures are designed or retrofitted with hardware that discourages condors from perching on them and also through carefully planned placement. All agencies/companies planning the construction of such structures should be advised on the most favorable location of such structures from the standpoint of the condor, as well as measures that can be implemented that will help avoid possible condor mortalities.

47. Develop strategies for controlling natural potential predators of condor eggs and nestlings in nesting areas.

Studies should be undertaken to develop aversion techniques that would stop or discourage predators such as ravens and golden eagles from preying on California condor eggs and nestlings.

48. Restrict aircraft activity in key condor areas.

Low flying military and civilian aircraft could collide with and cause the death of soaring California condors in certain key areas and could disrupt feeding, nesting, and roosting condors. The Federal Aviation Administration should be persuaded to issue aircraft activity advisories in order to protect the airspace in these areas for condors.

5. Implement Information and Education Programs on Condor Habitat Use and protection Needs.

Information and education programs are currently administered by the Service and all other institutions participating in the California condor recovery effort. These programs should continue in order to respond to frequent requests by students, teachers, reporters, and other interested publics for current information on the condor.

51. Distribute educational material about condor habitat, species identification, and legal protection.

Educational hand-out materials on habitat needs, condor identification, and existing laws protecting condors are useful tools for disseminating information to the public. New material should be developed and existing material should be revised and updated periodically.

52. Provide information to key governmental land managers in condor range.

Written and visual information packets, presentations, and newsletters are currently provided to key governmental land managers. That type of communication should continue in order to meet the informational needs of these land managers.

53. Provide information on condor habitat needs to key private landowners.

Information packets, presentations, and newsletters are currently provided to key private landowners. That level of communication should continue in order to meet the informational needs of these private landowners.

54. Establish observation points and educational facilities at selected sites.

Existing observation points should be rehabilitated, information updated, and new observation sites should be developed within key areas accessible to the public in the range of newly released California condors.

013691

55. Make a video on California condor recovery effort for use as an educational tool by all cooperating agencies and groups.

Continue to prepare video tapes of the California condor field and captive breeding programs to produce up to date visual material for public educational purposes.

56. Provide training sessions on condor biology, ecology, and key use areas to law enforcement agents.

Currently, a condor workshop is conducted once a year to educate law enforcement officers, land managers, biologists, and private citizens that work or live in key use areas. The annual workshop should be conducted as long as condors are being released to the wild.

57. Develop public information about condor recovery programs at zoological institutions.

Existing public information programs at zoological institutions should continue to provide the public important information on the California condor recovery efforts.

571. Provide informational kiosks.

Without California condors on exhibit it is necessary that information on the captive breeding program be displayed using informational kiosks to keep the public informed on the progress of the condor recovery effort. These kiosks should be available to the public at the San Diego Wild Animal Park, Los Angeles Zoo, and World Center for Birds of Prey.

572. Exhibit California condors at zoological institutions.

At selected zoological parks supporting California condor captive breeding facilities, condors should be placed on exhibit to educate the public on the current recovery effort.

573. Continue to provide photos and video tapes of captive-rearing efforts to the press and management agencies of educational use.

The sensitive nature of the captive-rearing program necessitates that it be off-exhibit and closed to the public. It is therefore, important that photos and video tapes be made available to keep the public informed and management agencies supplied with California condor captive-rearing educational information.

58. Maintain and make available a computerized condor information system.

Convert the existing California Condor Program literature archives to a computerized literature-based condor information system.

013692

LITERATURE CITED

Allendorf, F.W., and R.F. Leary. 1986. Heterozygosity and fitness in natural populations of animals. In M. Soulé (ed.). Conservation biology: science of diversity. Pp. 57-76. Sinauer Associates, Sunderland, Massachusetts.

Anonymous. 1917. California condor on exhibition in Golden Gate Park, San Francisco. Calif. Fish and Game. 3:176.

Blong, B. 1954. A south coast deer range. California Department of Fish and Game, Los Angeles.

Bloom, P.H., J.M. Scott, O.H. Pattee, and M.R. Smith. 1989. Lead contamination of golden eagles Aquila chrysaetos within the range of the California condor Gymnogyps californianus. In B.-U. Meyburg and R.D. Chancellor (eds.). Raptors in the modern world. Pp. 481-482. World Working Group on Birds of Prey, London.

Brodkorb, P. 1964. Catalogue of fossil birds. Part 2 (Anseriformes through Galliformes). Bulletin of the Florida State Museum, Biological Sciences 8:195-335.

Conway, W.G. 1980. An overview of captive propagation. In M.E. Soulé and B.A. Wilcox (eds.). Conservation biology: an evolutionary-ecological perspective. Pp. 199-208. Sinauer Associates, Sunderland, Massachusetts.

Cooper, J.G. 1890. A doomed bird. Zoe 1:248-249.

Emslie, S.D. 1987. Age and diet of fossil California condors in Grand Canyon, Arizona. Science 237:768-770.

Finley, W.L., and I. Finley. 1928. Wild animal pets. Charles Scribner's Sons. New York.

Frankel, O.H., and M. E. Soulé. 1981. Conservation and evolution. Cambridge Univ. Press, Cambridge, England.

Franklin, I.R. 1980. Evolutionary changes in small populations. In M.E. Soulé and B.A. Wilcox (eds.). Conservation biology: an evolutionary-ecological perspective. Pp. 135-149. Sinauer Associates, Sunderland, Massachusetts.

Geyer, C.J., O.A. Ryder, L.G. Chemnick, and E.A. Thompson. 1993. Analysis of relatedness in the California condors, from DNA fingerprints. Molecular Biology and Evolution 10:571-589.

Gilpin, M.E. 1987. Spatial structure and population viability. In M.E. Soulé (ed.). Viable populations for conservation. Pp. 124-139. Cambridge University Press, Cambridge, England.

013693

Harrison, E.N., and L.F. Kiff. 1980. Apparent replacement clutch laid by wild California condor. Condor 82:351-352.

Houston, 1974. Food searching in griffon vultures. East African Wildlife Journal 12:63-77.

Howard, H. 1962. A comparison of avian assemblages from individual pits at Rancho La Brea, California. Los Angeles County Museum Contributions to Science 58:1-24.

Jackson, J.A. 1983. Nesting phenology, nest site selection, and reproductive success of Black and turkey vultures. In S.R. Wilbur and J.A. Jackson (eds.). Vulture biology and management. Pp. 245-286. University of California Press, Berkeley and Los Angeles.

Janssen, D.L., J.E. Oosterhuis, J.L. Allen, M.P. Anderson, D.G. Kelts, and S.N. Wiemeyer. 1986. Lead poisoning in free ranging California condors. Journal of the American Veterinary Medicine Association 189:1115-1117.

Kiff, L.F. 1989. DDE and the California condor Gymnogyps californianus: the end of the story? In B.U. Meyburg and R.D. Chancellor (eds.). Raptors in the Modern World. Pp. 477-480. World Working Group on Birds of Prey, Berlin.

Kiff, L.F. 1990. To the brink and back: the battle save the California condor. Terra 28:6-18.

Kiff, L.F., D.B. Peakall, and S.R. Wilbur. 1979. Recent changes in California condor eggshells. Condor 81:166-172.

Kiff, L.F., D.B. Peakall, M.L. Morrison, and S.R. Wilbur. 1983. Eggshell thickness and DDE residue levels in vulture eggs. In S.R. Wilbur and J.A. Jackson (eds.). Vulture biology and management. Pp. 440-458. University of California Press, Berkeley and Los Angeles.

Kimura, M., and J.F. Crow. 1963. The measurement of effective population number. Evolution 7:279-288.

Koford, C.B. 1953. The California condor. National Audubon Society Research Report 4:1-154.

Kuehler, C.M. 1989. California condor (*Gymnogyps californianus*) studbook. San Diego Wild Animal Park, Escondido, California.

Kuehler, C.M., D.J. Sterner, D.S. Jones, R.L. Usnik, S Kasielke. 1991. Report on captive hatches of California condors (*Gymnogyps californianus*): 1983-1990. Zoo Biology 10:65-69.

Lande, R., and G.F. Barrowclough. 1987. Effective population size, genetic variation, and their use in population management. In M.E. Soulé (ed.). Viable populations for conservation. Pp. 87-123. Cambridge University Press, Cambridge, England.

013694

Ligon, J.D. 1967. Relationships of the cathartid vultures. Occasional Paper of the Museum of Zoology, University of Michigan 651:1-26.

Mallette, R.D. 1970. Operational management plan for the California condor. California Department of Fish and Game, Sacramento.

Mallette, R.D., and J.C. Borneman. 1966. First cooperative survey of the California condor. California Fish and Game 52:185-203.

Mallette, R.D., F.C. Sibley, W.D. Carrier, and J.C. Borneman. 1970. California condor Surveys, 1969. California Fish and Game. 56:199-202.

Meretsky, V.J., and N.F.R. Snyder. 1992. Range use and movements of California condors. Condor 94:313-335.

Miller, A.H., I. McMillan, and E. McMillan. 1965. The current status and welfare of the California condor. National Audubon Society Research Report 6:1-61.

Mundy, P.J. 1982. The comparative biology of southern African vultures. The Vulture Study Group, Johannesburg, South Africa.

Pattee, O.H., P.H. Bloom, J.M. Scott, and M.R. Smith. 1990. Lead hazards within the range of the California condor. Condor 92:931-937.

Ralls, K., and J.D. Ballou. 1983. Extinction: lessons from zoos. In C.M. Schoenewald-Cox, S.M. Chambers, B. MacBryde, and W.L. Thomas (eds.). Genetics and conservation. A reference for managing wild animal and plant populations. Pp. 164-184. Benjamin Cummings, Menlo Park, California.

Ralls, K., and J.D. Ballou. 1992. Managing genetic diversity in captive breeding and reintroduction programs. Transactions of the North American Wildlife and Natural Resources Conference vol.57:263-282.

Ralls, K., J. Ballou, and A.R. Templeton. 1988. Estimates of lethal equivalents and the cost of inbreeding in mammals. Conservation Biology 2:185-193.

Rea, A.M. 1983. Cathartid affinities: a brief overview. In S.R. Wilbur and J.A. Jackson (eds.). Vulture biology and management. Pp. 26-54. University of California Press, Berkeley and Los Angeles.

Rett, E.Z. 1938. Hailstorm fatal to California condors. Condor 40:225.

Rett, E.Z. 1946. Record of another condor death. Condor 48:182.

Ricklefs, R.E. (ed.). 1978. Report of the advisory panel on the California condor. National Audubon Society Conservation Report 6:1-27.

013695

Schmitt, N.J. In Prep. A study of the California condor molt.

Senner, S.E. 1980. Inbreeding depression and the survival of zoo populations. In M.E. Soulé and B.A. Wilcox (eds.). Conservation biology: an evolutionary-ecological perspective. Pp. 209-224. Sinauer Associates, Sunderland, Massachusetts.

Sibley, C.G., R.D. Mallette, J.C. Borneman, and R.S. Dalen. 1969. California condor Surveys, 1968. Calif. Fish and Game. 55:298-306.

Sibley, C.G., and J.E. Ahlquist. 1990. Phylogeny and classification of birds. A study in molecular evolution. Yale Univ. Press, New Haven, Connecticut.

Sibley, F. 1969. Effects of the Sespe Creek Project on the California condor. U.S. Fish and Wildlife Service, Laurel, Maryland.

Snyder, N.F.R. 1983. California condor reproduction, past and present. Bird Cons. 1:67-86.

Snyder, N.F.R. 1986. California condor recovery program. In S.E. Senner, C.M. White, and J.R. Parrish (eds.). Raptor conservation in the next 50 years. Raptor Research Report No. 5:56-71.

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

Snyder, N.F.R., and E.V. Johnson. 1985. Photographic censusing of the 1982-1983 California condor population. Condor 87:1-13

Snyder, N.F.R., E.V. Johnson, and D.A. Clendenen. 1987. Primary molt of California condors. Condor 89:468-485.

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

Snyder, N.F.R., and H. Snyder. 1989. Biology and conservation of the California condor. In D.M. Powers (ed.). Current ornithology, Vol. 6. Pp. 175-267. Santa Barbara Museum of Natural History, Santa Barbara, California.

Soulé, M. 1980. Thresholds of survival: maintaining fitness and evolutionary potential. In M.E. Soulé and B.A. Wilcox (eds.). Conservation biology: an evolutionary-ecological perspective. Pp. 151-169. Sinauer Associates, Sunderland, Massachusetts.

Soulé, M. 1987. Viable populations for conservation. Cambridge University Press, Cambridge, England.

Soulé, M. 1986. Conservation biology: the science of scarcity and diversity. Sinauer Associates, Sunderland, Massachusetts.

013696

Stager, K. 1964. The role of olfaction in food location by the turkey vulture (Cathartes aura). Los Angeles County Museum Contributions to Science 81:1-63.

Steadman, D.W., and N.G. Miller. 1987. California condor associated with spruce-pine woodland in the late Pleistocene of New York. Quaternary Research 28:415-426.

Studer, C.D. 1983. Effects of Kern County cattle ranching on California condor habitat. M.S. thesis. Michigan State University, East Lansing.

Taber, R.D., and R.F. Dasmann. 1958. The Black-tailed Deer in the chaparral. California Department of Fish and Game Bulletin 8:1-163.

U.S. Fish and Wildlife Service. 1984. California condor recovery plan. U.S. Fish and Wildlife Service, Portland, Oregon.

Verner, J. 1978. California condors: status of the recovery effort. General Technical Report, PSW-28. U.S. Forest Service, Washington, D.C.

Wallace, M.P., and S.A. Temple. 1987. Releasing captive-reared Andean condors to the wild. Journal of Wildlife Management 351:541-550.

Wiemeyer, S.N., R.M. Jurek, and J.R. Moore. 1986. Environmental contaminants in surrogates, foods and feathers of California condors (Gymnogyps californianus). Environmental Monitoring and Assessment 6:91-111.

Wiemeyer. S.N., A.J. Krynitsky, and S.R. Wilbur. Environmental contaminants in tissues, food, and feces of California condors. In S.R. Wilbur and J.A. Jackson (eds.). Vulture biology and management. Pp. 427-439. University of California Press, Berkeley and Los Angeles.

Wiemeyer, S.N. J.M. Scott, M.P. Anderson, P.H. Bloom, and C.J. Stafford. 1988. Environmental contaminants in California condors. Journal of Wildlife Management 52:238-247.

Wilbur, S.R. 1972. Food resources of the California condor. U.S. Fish and Wildlife Service, Patuxent Wildlife Research Center, Laurel, Maryland.

Wilbur, S.R. 1973. The California condor in the Pacific Northwest. Auk 90:196-198.

Wilbur, S.R. 1975. California condor plumage and molt as field study aids. California Fish and Game 61:144-148.

Wilbur, S.R. 1978a. The California condor, 1966-76: a look at its past and future. U.S. Fish and Wildlife Service, North America Fauna 72:1-136.

Wilbur, S.R. 1978b. Supplemental feeding of California condors. In S.A. Temple (ed.). Endangered birds: management techniques for preserving threatened species. Pp. 135-140. University of Wisconsin Press, Madison.

013697

Wilbur, S.R. 1978c. Turkey vulture eggshell thinning in California, Florida, and Texas. Wilson Bulletin 90:642-643.

Wilbur, S.R. 1980. Estimating the size and trend of the California condor population, 1965-1978. California Fish and Game 66:40-48.

Wilbur, S.R., W. Carrier, and J. Borneman. 1974. Supplemental feeding program for California condors. Journal of Wildlife Management 38:343-346.

Wilbur, S.R., and L.F. Kiff. 1980. The California condor in Baja California, Mexico. American Birds 34:856-859.

Wright, J.M., M. Treadwell, R.K. Nurthen, L.M. Woodworth, M.E. Montgomery, D.A. Briscoe, and R. Frankham. Unpubl. ms. Modeling problems in conservation genetics using Drosophila: purging is ineffective in reducing genetic load.

013698

III. IMPLEMENTATION SCHEDULE

The table that follows is a summary of scheduled actions and costs for the recovery program. It is a guide to meet the objectives of the California Condor Recovery Plan. The table indicates the priority in scheduling tasks to meet the objectives, which agencies are responsible to perform these tasks, a time-table for accomplishing these tasks, and the estimated costs to perform them. Implementing Part III is the action of the plan, that when accomplished, will satisfy the recovery objective. Initiation of these actions is subject to the availability of funds.

Priorities in Column 1 of the following implementation schedule are assigned as follows:

Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.

Priority 2 - An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to provide for full recovery of the species.

Codes used in Implementation Schedule

Ongoing = Task is currently being implemented and will continue until action is no longer necessary for recovery.

* = Lead Agency

Total Cost = Projected cost of task from task start to task completion.

Responsible Parties:

USFWS = U.S. Fish and Wildlife Service
USFS = U.S. Forest Service
USBLM = U.S. Bureau of Land Management
CDFG = California Department of Fish and Game
AGFD = Arizona Game and Fish Department
TNC = The Nature Conservancy
LAZ = Los Angeles Zoo
SDWAP = San Diego Wild Animal Park
PF = Peregrine Fund
CCRT = California Condor Recovery Team
CEC = California Energy Commission

013699

Recovery Plan Implementation Schedule for the California Condor

Need #	Priority #	Task #	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost	Cost Estimates ($1,000)				
							FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
			1: Captive Breeding								
1	1	111	Management Protocol	1	LAZ* SDWAP* USFWS-PF	5	5				
1	1	112	Operate Facilities	Ongoing	LAZ-SDWAP PF	1500	300	300	300	300	300
1	2	113	New Captive Breeding Facilities	Ongoing	CCRT USFWS	10	10				
1	1	12	Manage Captive Flock	Ongoing	LAZ-SDWAP PF	1250	250	250	250	250	250
1	1	121	Maintain: Genetic, Age & Sex Balance	Ongoing	LAZ-SDWAP PF	5	1	1	1	1	1
1	2	122	Offspring & Eggs Exchange	Ongoing	LAZ-SDWAP PF	10	2	2	2	2	2
1	1	123	Determine Genetic Balance	Ongoing	LAZ-SDWAP PF	10	2	2	2	2	2
1	2	124	Develop & Implement Pair Strategies	Ongoing	LAZ-SDWAP PF	10	2	2	2	2	2
1	1	13	Manage Selected Condors for Release	Ongoing	LAZ-SDWAP PF	15	3	3	3	3	3
1	3	14	Behavioral Data	Ongoing	LAZ-SDWAP PF	150	30	30	30	30	30
			1: Subtotal Needs			2965	605	590	590	590	590

013700

Recovery Plan Implementation Schedule for the California Condor

Need #	Priority #	Task #	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost	Cost Estimates ($1,000)				
							FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
5	2	54	Establish Points of Observations & Educational Facilities	Ongoing	USFS USFWS-CDFG USBLM	25	5	5	5	5	5
5	3	55	Videos	Ongoing	USFWS CDFG- USBLM USFS	50	10	10	10	10	10
5	3	56	Training Sessions	Ongoing	USFWS CDFG- USBLM LAZ-SDWAP-PF USFS	10	2	2	2	2	2
5	3	571	Zoo Kiosks	Ongoing	LAZ-SDWAP PF	30	6	6	6	6	6
5	3	572	Zoo Condor Exhibit	3	LAZ-SDWAP PF	600			200	200	200
5	3	573	Provide Photos & Videos	Ongoing	LAZ-SDWAP PF	25	5	5	5	5	5
5	3	58	Maintain Centralized Information Center	Ongoing	USFWS	5	1	1	1	1	1
			5: Subtotal Needs			785	37	37	237	237	237
			TOTAL COSTS			9558	1793	1741	1968	1978	2078

013701

Recovery Plan Implementation Schedule for the California Condor

Need #	Priority #	Task #	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost	Cost Estimates ($1,000)				
							FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
			2: Reintro-ductions								
2	1	21	Develop Release Protocols	1	USFWS CCRT	10	10				
2	2	211	Release Criteria	1	CCRT USFWS	1	1				
2	1	212	Annual Release Plan Release Criteria	Ongoing	USFWS	50	10	10	10	10	10
2	2	221	Release Site Selection Criteria	1	CCRT USFWS	1	1				
2	1	222	Select Release Sites	3	CCRT USFWS	30		10	10	10	
2	1	223	Prepare Release Sites	3	USFWS	30		10	10	10	
2	1	23	Conduct Releases	5	USFWS	2250	450	450	450	450	450
2	1	231	Develop California Release Plan	1	USFWS	5	5				
2	1	232	Release Condors	5	USFWS	50	10	10	10	10	10
2	1	233	Monitor Condors at Site	5	USFWS	250	50	50	50	50	50
2	1	234	Monitor Free-Flying Condors	Ongoing	USFWS	250	50	50	50	50	50
2	1	235	Protect Released Condors	5	USFWS-CDFG USFS	250	50	50	50	50	50

Recovery Plan Implementation Schedule for the California Condor

Need #	Priority #	Task #	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost	Cost Estimates ($1,000)				
							FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
2	1	241	Northern Arizona Release	3	USFWS-PF AGFD	1050	250	200	200	200	200
2	2	242	New Mexico Release	3	USFWS PF	210				10	200
2	1	25	Wild Rearing Facilities	1	USFWS	50	50				
			2: Subtotal Needs			4487	937	840	840	850	1020
			3: Habitat								
3	1	31	Protect Nest Sites	Ongoing	USFWS USBLM-CDFG BIA-USFS	10	2	2	2	2	2
3	1	32	Protect Roost Sites	Ongoing	USFWS USBLM-CDFG BIA-USFS	10	2	2	2	2	2
3	2	331	Manage Condor Foraging Habitat	Ongoing	USFWS USBLM-CDFG BIA-USFS	10	2	2	2	2	2
3	3	3311	Dead Livestock on Rangelands	Ongoing	USFWS USBLM-CDFG USFS-AGFD	26	4	4	6	6	6
3	2	3312	Reestablish Native Ungulates	Ongoing	CDFG USFS-USFWS USBLM	20	4	4	4	4	4

013703

Recovery Plan Implementation Schedule for the California Condor

Need #	Priority #	Task #	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost	Cost Estimates ($1,000)				
							FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
3	1	3321	S.W. Kern Co.	Ongoing	CDFG-CO. USBLM	5	1	1	1	1	1
3	1	3322	Carrizo & Elkhorn Plains	Ongoing	USBLM TNC-CDFG	100	20	20	20	20	20
3	3	3323	Tulare County Grasslands	Ongoing	CDFG-CO.	5	1	1	1	1	1
3	2	3324	Glenville Woody Area	Ongoing	CDFG-CO.	5	1	1	1	1	1
3	1	3325	Tejon Ranch	Ongoing	CDFG-CO.	5	1	1	1	1	1
3	3	3326	Hopper Mtn.	Ongoing	USFWS USBLM-CDFG USFS	100	20	20	20	20	20
3	1	3327	Bitter Creek	Ongoing	USFWS	50	10	10	10	10	10
3	2	3328	San Juan Creek	Ongoing	CDFG-CO.	5	1	1	1	1	1
3	1	3329	Elkhorn Hill & Caliente Range	Ongoing	CDFG-CO.	25	5	5	5	5	5
3	3	341	Land Use Planning	Ongoing	USFWS USFS-CDFG BIA-USBLM	15	3	3	3	3	3
3	3	342	General Plan Review	Ongoing	CDFG USFWS	20	4	4	4	4	4
			3: Subtotal Needs			411	81	81	83	83	83

Recovery Plan Implementation Schedule for the California Condor

Need #	Priority #	Task #	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost	Cost Estimates ($1,000)				
							FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
			4: Mortality								
4	3	41	Assess Historical Findings	Ongoing	USFWS	10	2	2	2	2	2
4	3	42	Law Enforcement	Ongoing	CDFG USBLM-USFS USFWS	25	5	5	5	5	5
4	1	43	Minimize Contaminant Related Mortality	Ongoing	USFWS USBLM-CDFG USFS	25	5	5	5	5	5
4	2	43	Monitor Contaminants	Ongoing	USFWS	10	10				
4	1	441	Determine Effects of Contaminants	3	USFWS	165		55	55	55	
4	3	451	Sample Food for Contaminant Loads	3	USFWS	75			25	25	25
4	3	452	Blood Samples Contaminant Loads	Ongoing	USFWS CDFG	25	5	5	5	5	5
4	1	461	Avian Mortality due to Collisions with Human-made Structures	Ongoing	CEC-USFWS Private Sector	500	100	100	100	100	100

Recovery Plan Implementation Schedule for the California Condor

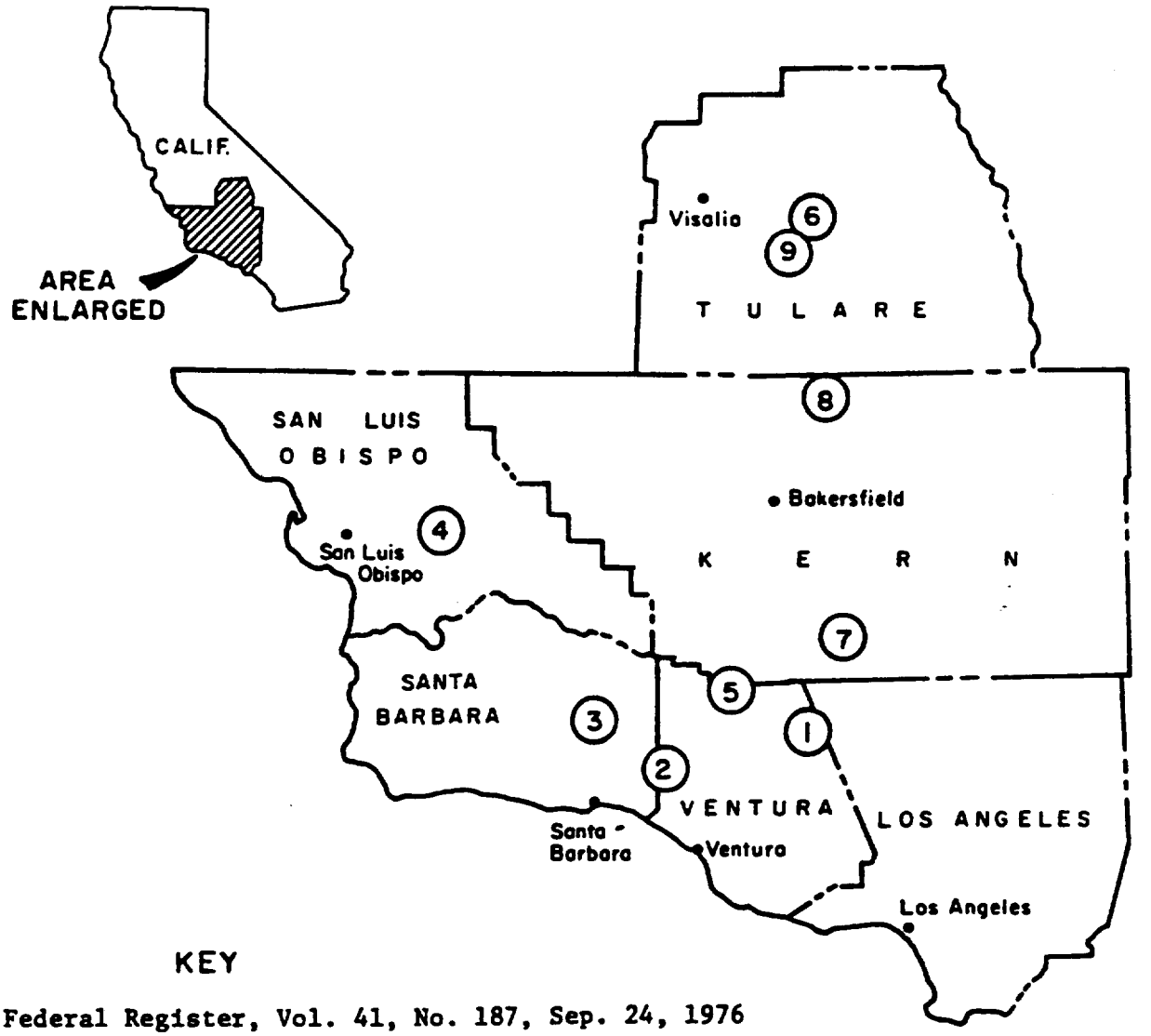
Need #	Priority #	Task #	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost	Cost Estimates ($1,000)				
							FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
4	2	462	Advise Planning Agencies on Location & Mitigation to Avoid Collisions with Human-made Structures	Ongoing	USFWS CDFG	25	5	5	5	5	5
4	3	47	Control Predators	3	USFWS	45		15	15	15	15
4	3	48	Restrict Aircraft in Key Areas	Ongoing	USFWS-FAA	5	1	1	1	1	1
			4: Subtotal Needs			910	133	193	218	218	148
			5: Information & Education								
5	1	51	Distribute Educational Material	Ongoing	USFWS CDFG USBLM LAZ-SDWAP-PF USFS	25	5	5	5	5	5
5	1	52	Provide Information to Land Managers	Ongoing	USFWS CDFG-USBLM USFS	10	2	2	2	2	2
5	1	53	Provide Information to Private Landowners	Ongoing	USFWS CDFG-USBLM USFS	5	1	1	1	1	1

013706

APPENDIX I

Critical Habitat for the California Condor

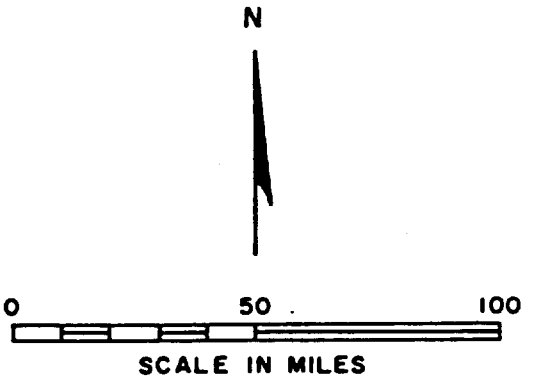
013707



KEY

Federal Register, Vol. 41, No. 187, Sep. 24, 1976
Paragraph 17.64 California Condor
(a)

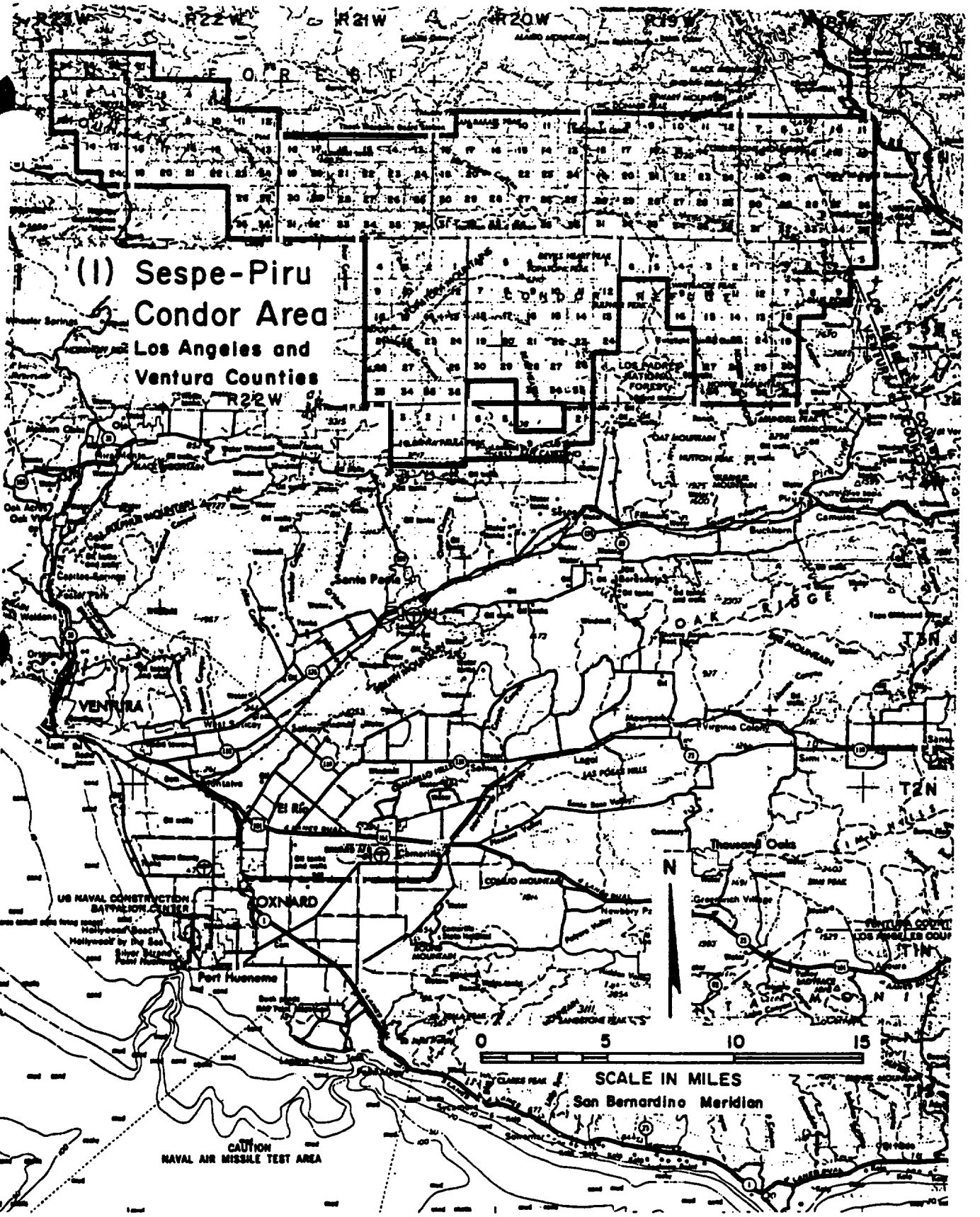
(1) Sespe-Piru Condor Area
(2) Matilija Condor Area
(3) Sisquoc-San Rafael Condor Area
(4) Hi Mountain-Beartrap Condor Areas
(5) Mt. Pinos Condor Area
(6) Blue Ridge Condor Area
(7) Tejon Ranch
(8) Kern County rangelands
(9) Tulare County rangelands



UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

DETERMINATION OF CRITICAL HABITAT
FOR
CALIFORNIA CONDOR

013708
Sheet 1 of 7

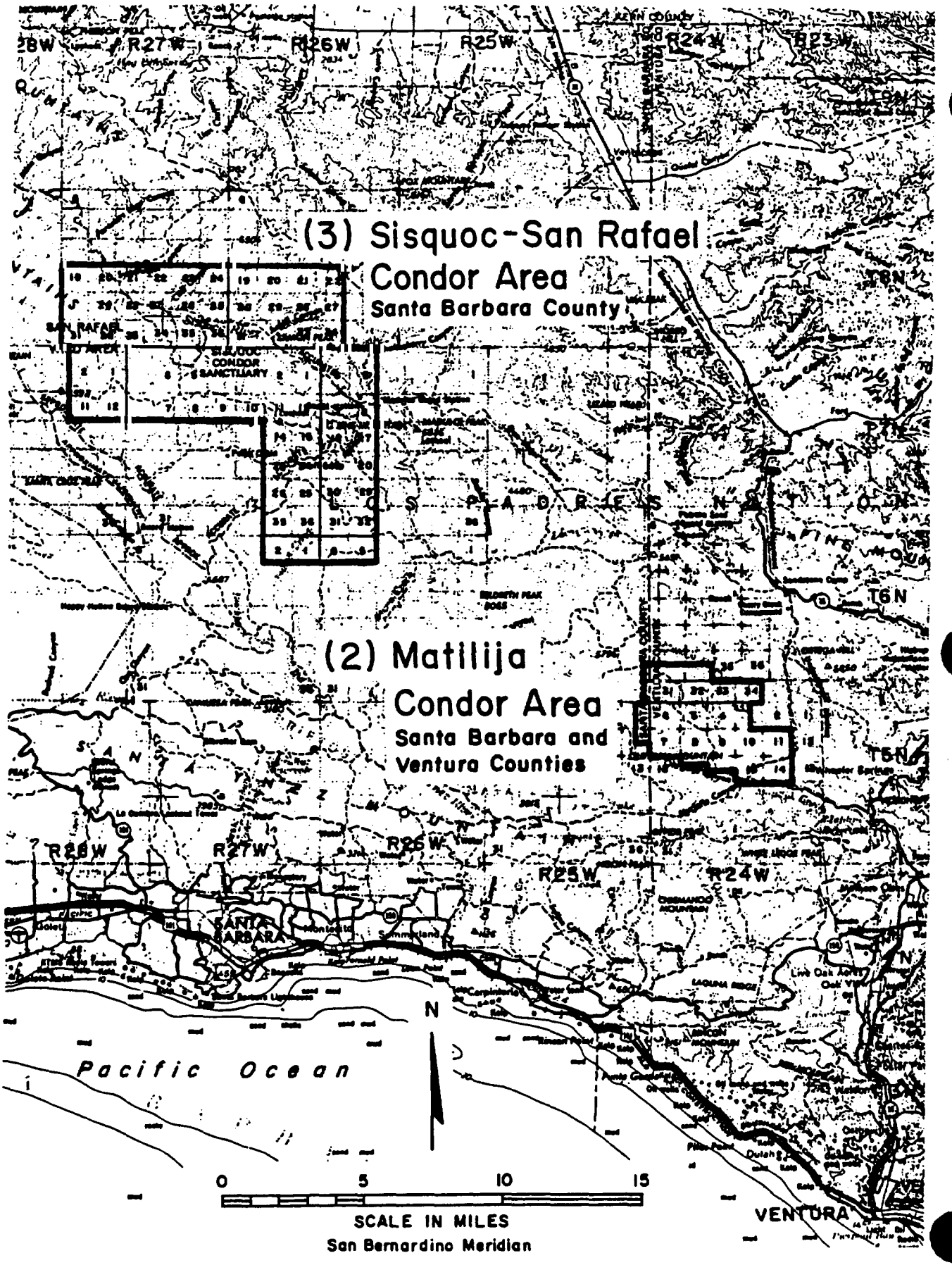


DETERMINATION OF CRITICAL HABITAT FOR CALIFORNIA CONDOR

013709

Reference: Federal Register, Vol. 41, No. 187, Sep. 24, 1976

Sheet 2 of 7

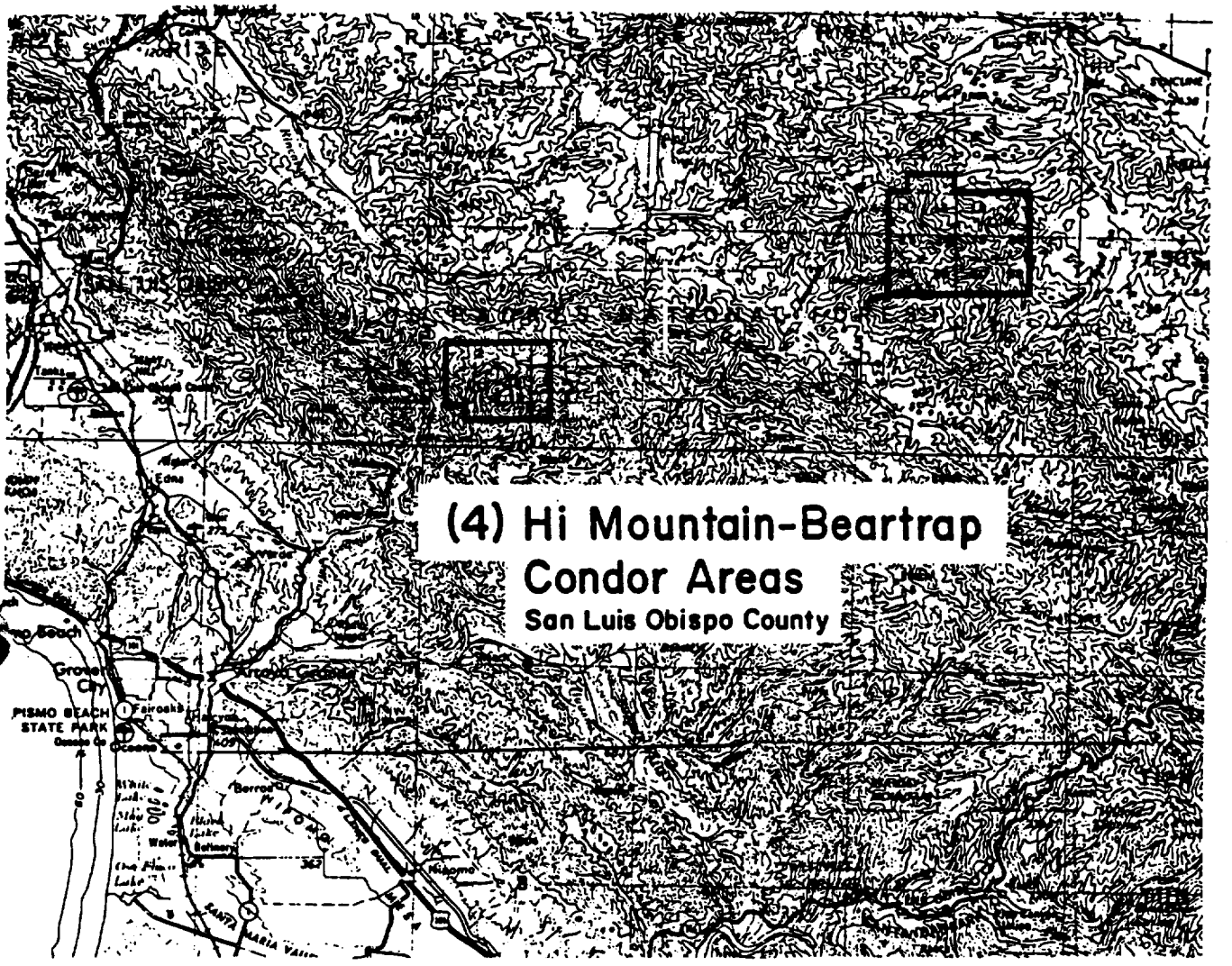


DETERMINATION OF CRITICAL HABITAT
FOR
CALIFORNIA CONDOR

013710

Reference: Federal Register, Vol. 41, No. 187, Sep. 24, 1976

Sheet 3 of 7



N

0 5 10 15

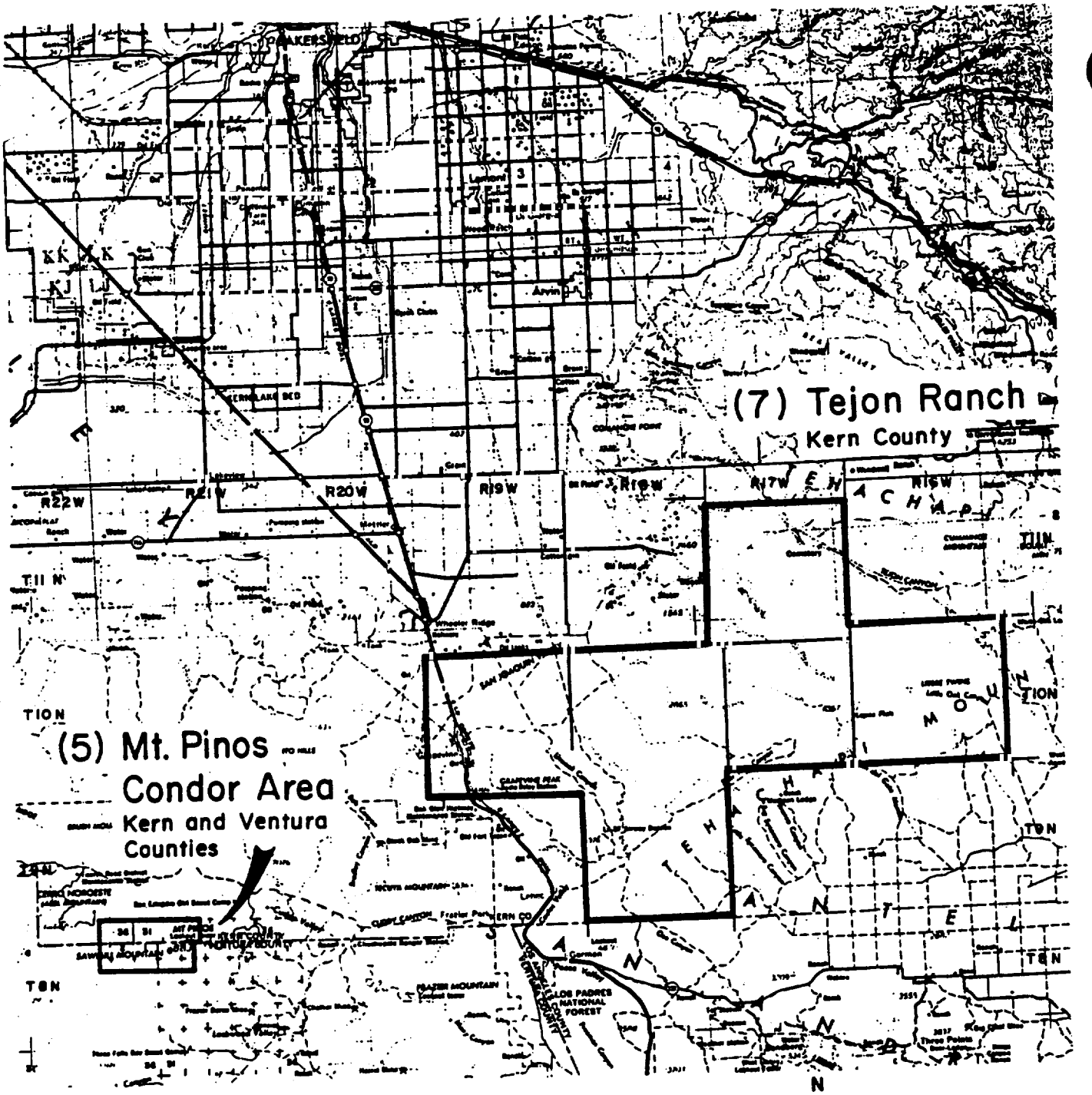
SCALE IN MILES

Mt. Diablo Meridian

DETERMINATION OF CRITICAL HABITAT FOR CALIFORNIA CONDOR

Reference: Federal Register, Vol. 41, No. 187, Sep. 24, 1976

Sheet 4 of 7

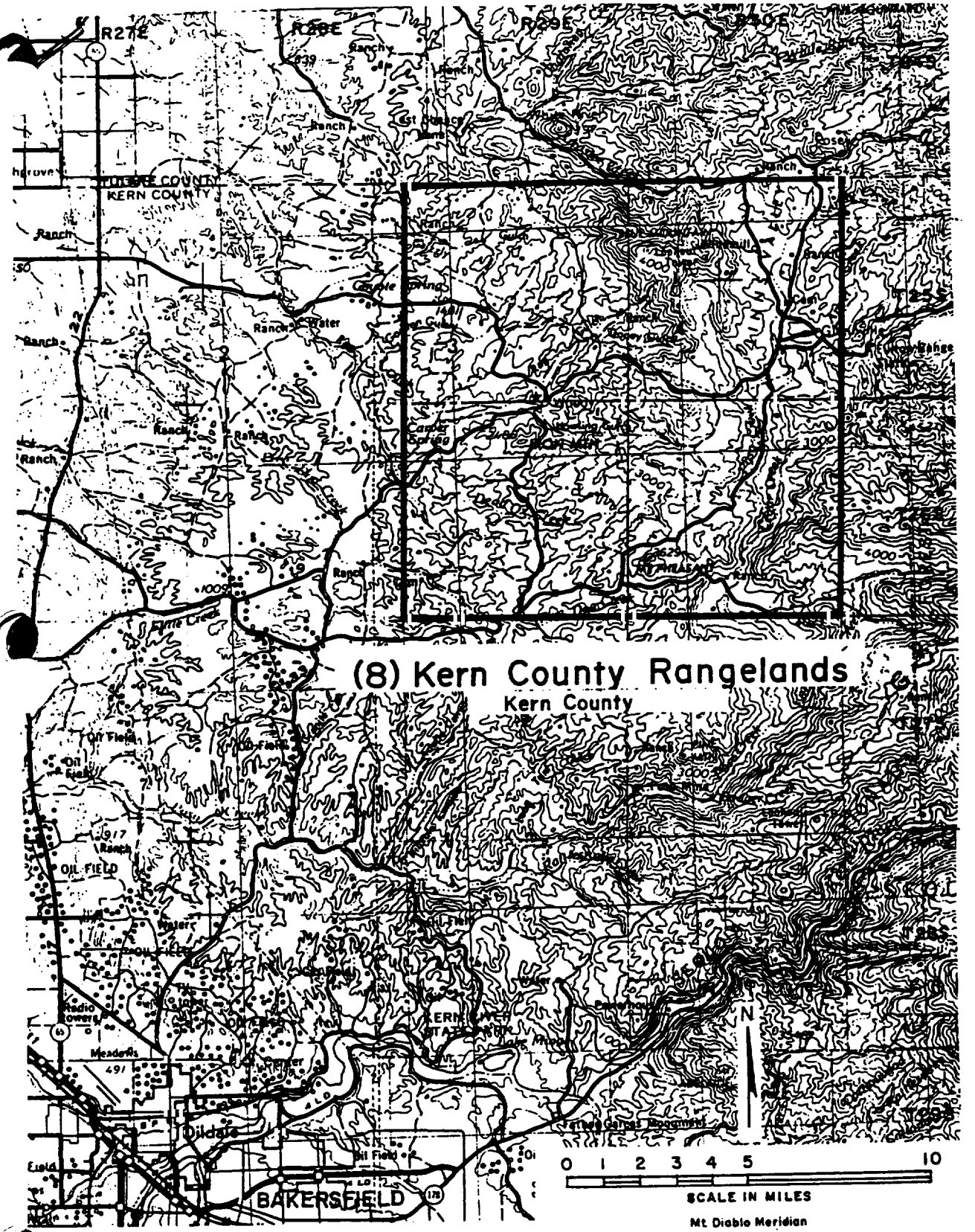


DETERMINATION OF CRITICAL HABITAT
FOR
CALIFORNIA CONDOR

013712

Reference: Federal Register, Vol. 41, No. 187, Sep. 24, 1976

Sheet 5 of 7

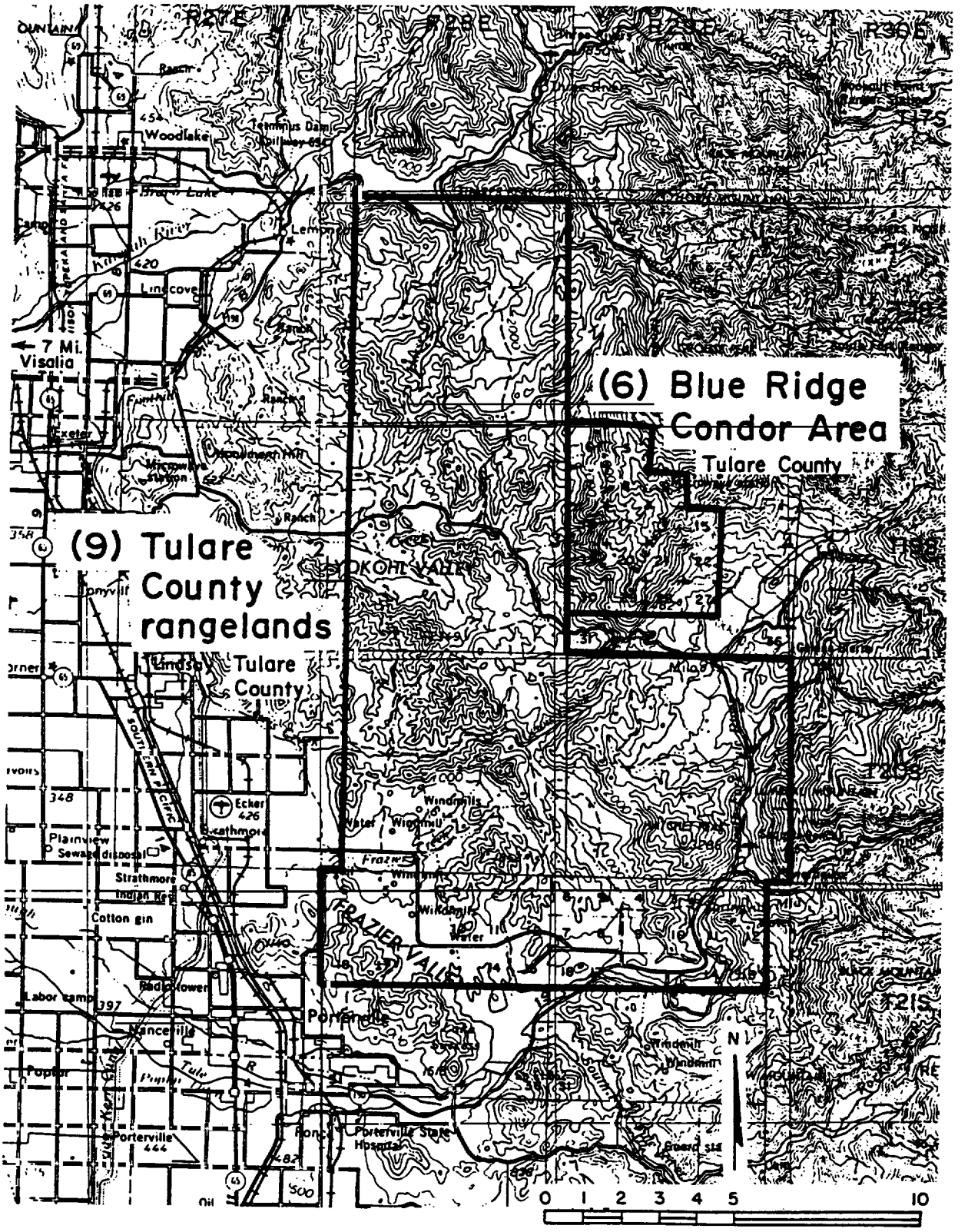


DETERMINATION OF CRITICAL HABITAT
FOR
CALIFORNIA CONDOR

Reference: Federal Register, Vol. 41, No. 187, Sep. 24, 1976

Sheet 6 of 7

013713



DETERMINATION OF CRITICAL HABITAT
FOR
CALIFORNIA CONDOR

013714

Reference: Federal Register, Vol. 41, No. 187, Sep. 24, 1976

APPENDIX II

Preliminary Population Viability
Considerations

013715

In small, closed populations, genetic criteria are thought to be very important. Small populations are more subject to genetic loss than large ones. The number of founders (as for a captive flock in a zoo), however, may have less impact on the loss of genetic variation than does the eventual size of the maintenance population (Senner 1980). For example, a founding group of even ten related individuals will include, on average, about 95 percent of the parent population (Frankel and Soulé 1981), although the level that is maintained for a given time interval depends on several other factors, especially the generation time and the rate of growth of the population following the bottleneck in numbers (Soulé et al. 1986).

The rate of loss of genetic variation depends on the *effective* size of the population. The concept of effective population size N_e, (the "variance effective number" of a population of N individuals, Franklin 1980:138--see Kimura and Crow 1963 and Lande and Barrowclough 1987 for a more detailed explanation), is central to an understanding of the role of genetic drift and inbreeding in the extinction of populations. N_e is rarely if ever equal to N, the number of breeding individuals in the population. Empirical studies show that it is often about 0.5N, but may drop below 0.1N for certain kinds of spatial (metapopulation) structure (Gilpin 1987). Important aspects of N_e related to planning for recovery of the California condor include:

1. N_e is more nearly equal to N in monogamous species, such as the California condor, than in polygamous species (Franklin 1980);

2. N_e is increased (up to twice N) when family sizes approach equality in breeding adults (Franklin 1980);

3. N_e can be as much as doubled by controlling mating to maximize the genetic difference between members of mated pairs (Senner 1980); and

4. Population crashes can substantially reduce the long-term average N_e (Franklin 1980).

Animal breeders have long known that the deleterious consequences of inbreeding (usually referred to as inbreeding depression) may preclude the long-term maintenance of small, closed populations (Conway 1980, Senner 1980). Symptoms of inbreeding depression are (1) lowered viability (failure to live to breeding age), (2) lowered fecundity, and (3) abnormal biases in sex ratios. These are thought to be the combined results of the loss of heterozygosity (reduced heterosis) and the fixation of harmful alleles (Allendorf and Leary 1986). Species differ, however, in this "genetic load" of harmful alleles. It is assumed that the California condor has a genetic load (frequency of bad genes) typical of animals in general. There are two reasons to expect a typical level. First, many large, relatively rare animals have significant levels of inbreeding depression (Ralls and Ballou 1983, Ralls et al. 1987). Second, it is unlikely that the species has been purged of its genetic load by having passed through a population bottleneck (Wright et al. ms.). That is because the current population probably represents the lowest ebb in the numbers during historic and pre-historic time.

The relationship between inbreeding and N_e is critical. The degree of inbreeding in a population, measured by the inbreeding coefficient (F), increases by about $1/2N_e$ per generation (see Lande and Barrowclough 1987 for details). In small populations, the fixation of deleterious genes by

013716

inbreeding and genetic drift cannot be counterbalanced by their selective elimination. The experience of animal breeders shows that a population cannot tolerate more than about 1 to 3 percent inbreeding per generation (Soulé 1980, Franklin 1980). $N_e = 50$, with random mating, will keep the inbreeding below a 1 percent level. However, the homozygosity of such a population will still increase by about 25 percent in 20 to 30 generations (Soulé 1980), assuming an average generation time of 8 years (Verner 1978).

We cannot precisely determine N_e for a population of California condors just from knowledge of the number of breeding adults. Because the species is apparently life-long monogamous and has a uniform clutch size of one (increasing the likelihood that each breeding adult will contribute equally to annual recruitment), its N_e should be nearly equal to N.

The current population of 82 birds represents 14 individual founders. The DNA fingerprinting data indicate that some of the founders are closely related and identify three genetic groups, or "clans" (Geyer et al. 1993). Because all of the breeding individuals are in captivity and matings can be controlled, the level of inbreeding in the population can be controlled. Nevertheless, some loss of genetic variation is inevitable until the population is increased to a total population of 200 to 300 breeding individuals, the size at which mutation is expected to contribute about as much variation for quantitative traits as is lost by random events (Lande and Barrowclough 1987). (The number usually given is 500, but this assumes random mating; because part of the California condor population will be captively bred, the threshold number is lower.)

The principal reasons for requiring the establishment of at least two disjunct populations in the wild are the possibilities of catastrophe and disease. Localized events, including epidemics, might extirpate a single population, but the existence of two, geographically isolated and non-interacting populations will significantly reduce the vulnerability of the species as a whole. Similarly, continuing to maintain several disjunct captive populations is also desirable for the same reasons. The chances that three or more such populations would suffer simultaneous catastrophes are very low.

013717

APPENDIX III

Summary of Comments on
Draft California Condor Recovery Plan

013718

In the September 26, 1994, Federal Register Notice of Availability, the U.S. Fish and Wildlife Service (Service) solicited written comments on the Draft California Condor Recovery Plan (Draft Plan). During the 65 day comment period, 10 responses were received by the Service. Comments were recieved from one Federal Agency, three State governments, two county governments, and four organizations or private individuals. Comments addressing concerns relating to policies and issues of importance to the 10 reviewers and the Service's response to each are listed below. Comments addressing routine editorial and data corrections are not included. Similiar or identical comments mentioned by more than one individual or organization have been grouped.

Comment 1: One of the minimum criterion for reclassification to threatened (Page 22.II.A.) is the requirement that the two non-captive populations must have "sufficient permanently secure habitat". The Draft Plan fails to identify the amount of habitat that would constitute "sufficient secure habitat". If that is to be a criterion for downlisting the Service must quantify an acreage amount which it considers to be sufficient.

Service Response: After reviewing that criterion the Service has determined it is not possible at this time to quantify the specific acreage required for "sufficient secure habitat". Therefore, that requirement has been deleted from the list of criteria to be met before this species can be downlisted.

Comment 2: The Draft Plan establishes supplemental feeding as an integral element of the condor release program, but does not explain how it relates to the downlisting criterion that requires condor populations to be "self-sustaining" (Page 22.II.A.). Is this criterion considered achieved if condors continue to rely on artificial food? A discussion of artificial feeding and how it relates to the downlisting criterion should be included in the final plan.

Service Response: The Service has amended the Objectives and Criteria section of the Draft Plan (Page 22.II.A.), to include the following statement clarifying the Service's position on the dependency of condors on artificial feeding. *It is recognized that reestablished condor populations in some areas may require continued artificial feeding to supplement natural food resources and/or to protect birds from exposure to contaminated carcasses. However, such management considerations should not preclude reclassification of the species if the above-listed criteria are met.*

Comment 3: The Draft Plan states that recently released captive-hatched condors have yet to occupy or use critical habitat and that there are no plans by the Service to utilize critical habitat in the future (Page 21). If this is the case, lands designated as critical habitat no longer satisfy the criteria for critical habitat, therefore, the designation should be removed.

Service Response: The section has been revised to more accurately reflect the current use of critical habitat by newly released condors. The revision reads as follows: *The first two releases took place in the Sespe-Piru Condor Critical Habitat Area, one of nine designated Condor Critical Habitat Areas located in Southern California. The third and fourth releases were conducted approximately 8.1 kms (5 mi) north of the Sisquoc-San Rafael Condor Critical Habitat area. The birds released at this site utilized the Sisquoc-San Rafael and Mt. Pinos Condor Critical Habitat areas. The Castle Crags in San Luis Obispo County which is located on*

the northwest boundary of the Beartrap Condor Critical Habitat area is currently being evaluated as a future release site. Although the use of these critical habitat areas has been limited to date, they do contain habitat components; nest caves, roost trees and foraging grounds necessary to the maintenance of wild condors and expectations are that the released condors will eventually discover these habitats and utilize them. However, until we have a larger number of condors in the wild, including breeding pairs, we will not be able to fully evaluate the effectiveness of critical habitat areas. It is premature at this time to consider the elimination of designated critical habitat areas based on current use.

Comment 4: The Draft Plan calls for all suitable condor habitat to be managed for the recovery of the species (Page 28.B.3.). Making condor management the priority on all land determined by the Service to be suitable condor habitat is neither feasible nor reasonable. Current land uses cannot be ignored and may be considered higher priorities by the individuals and communities that practice them.

Service Response: The Service agrees that current land uses in suitable condor habitat must be considered when planning condor management strategies. The recovery objective was revised to read as follows: *An important factor in the successful establishment of wild condor sub-populations is the existence of suitable habitat. Therefore, whenever possible or appropriate, a priority for this habitat should include management for condor recovery.*

Comment 5: The Draft Plan requires that condor protection plans be developed on private lands for condors and their habitat (Pages 29 and 30). The Service cannot regulate land use on private lands. Any condor protection plan for private lands can only be developed with the consent and cooperation of a willing landowner.

Service Response: The Service agrees with this statement and has changed the wording to read as follows: *A management plan should be prepared with the consent and participation of the affected landowners to preserve its value for condors.*

013720