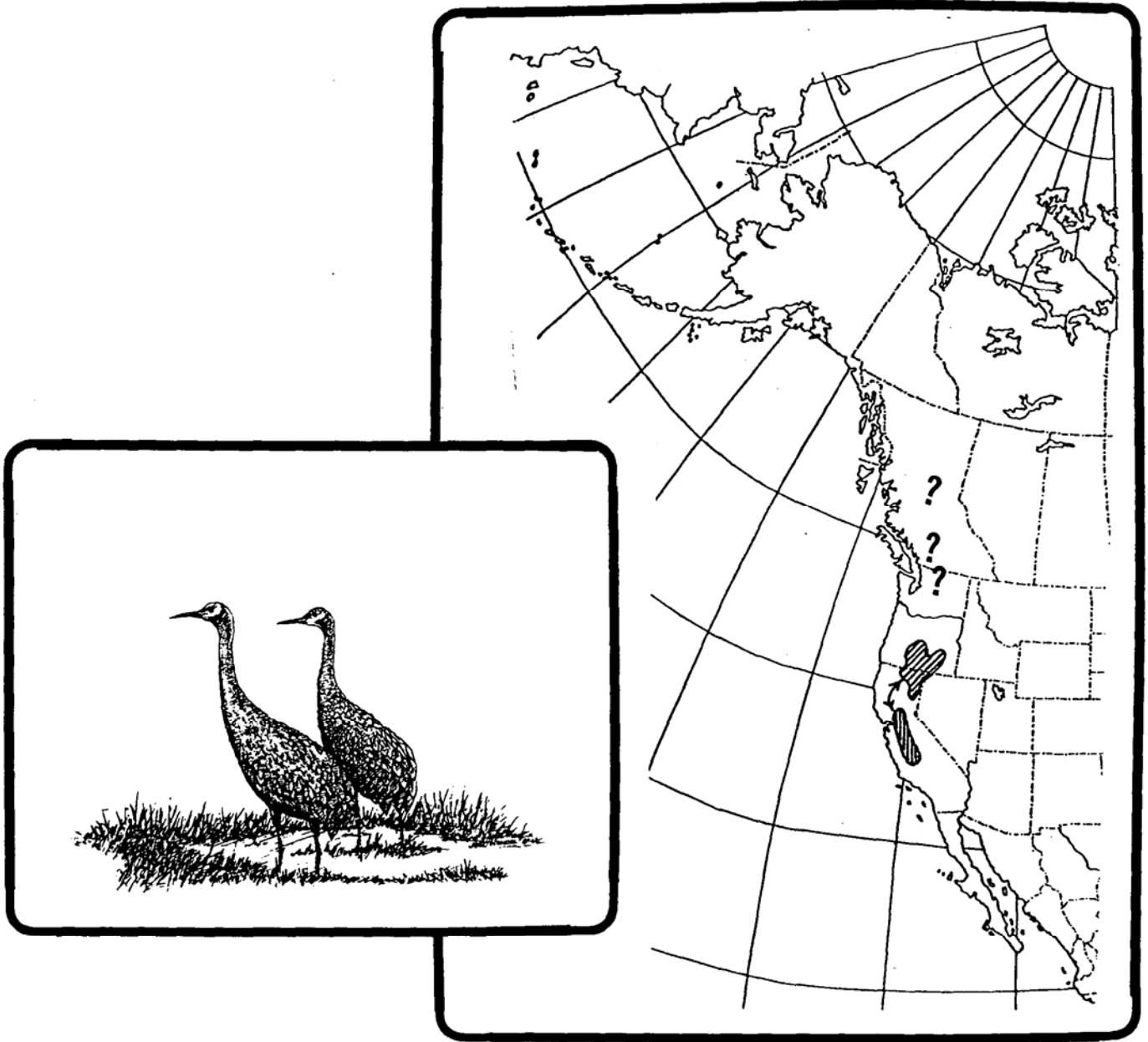


Central Valley Population of Greater Sandhill Cranes



PACIFIC FLYWAY MANAGEMENT PLAN

FOR THE

CENTRAL VALLEY POPULATION OF


GREATER SANDHILL CRANES

Prepared for the:

Pacific Flyway Council
Canadian Wildlife Service
U.S. Fish and Wildlife Service

by the

Pacific Flyway Study Committee July 1997

Approved by:  July 1997

Chairman, Pacific Flyway Council

Date

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I. INTRODUCTION

Five greater sandhill crane (*Cms canadensis tabida*) populations are presently recognized, breeding from the Pacific states and British Columbia, eastward to the Great Lakes Region. These five populations are the Eastern (sometimes referred to as the Great Lakes Population), Prairie, Rocky Mountain, Lower Colorado River Valley, and Central Valley (Braun et al. 1975, Orewien and Lewis 1987). The Central Valley Population (CVP) is the westernmost, breeding in two separate regions; in British Columbia, and in Washington, Oregon, Nevada and California (Littlefield et al. 1994).

The CVP is the third most abundant. Pogson (1990) estimated that the population contained from 6000 to 6800 individuals which were concentrated at eight winter geographical sites in California. About 3400 individuals occupy the southern segment of the population's range in central and eastern Oregon, northeast California, northwest Nevada, and south-central Washington. An undetermined, but substantial number breed in the southern half of British Columbia, and these birds represent the northern segment. The entire population winters in the California Central Valley (Littlefield and Thompson 1979).

Declines of breeding cranes in portions of their range, particularly at Malheur National Wildlife Refuge (NWR), Harney County, Oregon, and breeding habitat losses in both Oregon and California, resulted in the population being classified as a Washington endangered species in 1981, a U. S. Fish and Wildlife Service, Region I, sensitive species in 1982, a California threatened species in 1983, an Oregon sensitive species in 1989, and a sensitive species in British Columbia in 1993. In Oregon and California, of 1223 greater sandhill crane breeding pairs recorded in 1986 and 1988, 878 (72%) were on private land, 247 (20%) on U.S. Fish and Wildlife Service refuges, 49 (4%) on state wildlife areas, 40 (3%) on U.S. Forest Service lands, and 9 (<1%) on Bureau of Land Management lands (Littlefield et al, 1994). Land ownership and use status of breeding greater sandhill cranes in British Columbia remains mostly undetermined.

This plan is a revision of the March 1983 CVP Management Plan. Its purpose is to establish overall guidelines for managing CVP *G. c. tabida* based upon the most current information available. The plan reviews habitats (breeding range, autumn and spring staging and

traditional stopover areas, migration route, wintering areas), status, current management, and problems associated with the population.

II. GOALS AND OBJECTIVES

The goals of this management plan are to maintain the Central Valley Population of greater sandhill cranes and to provide opportunities for its increase and expansion. Such goals would preclude the population from becoming either "endangered" or "threatened", thus providing for the public's maximum nonconsumptive enjoyment of them, while contributing to the general welfare of the subspecies in the Pacific states and British Columbia.

Objectives of this plan are:

- A. Increase the population to a minimum of 7,500 cranes, measured by counts on wintering areas or fall staging areas.
- B. Through specific management actions, restore, enhance and maintain breeding, migration, and wintering habitats to meet population objectives. Protect important greater sandhill crane habitats at risk from developments through means such as easements, agreements, joint venture plans, or acquisition, if necessary.
- C. Increase birding, photographic, educational, and scientific opportunities using CVP cranes, particularly on public lands such as national wildlife refuges, state wildlife areas, and national forest lands, when such activities do not interfere with the general welfare of the cranes.
- D. Protect habitats in major greater sandhill crane use areas in the Pacific states through easement, agreement, joint ventures or if necessary, acquisition.

III. STATUS

Numbers and Distribution

Breeding Areas

Littlefield et al. (1994) found breeding greater sandhill cranes at 120 Oregon sites (Table I) in 14 counties (947 pairs) and at 58 California sites (Table 2) in six counties (276 pairs). In Oregon, the majority occurred in Lake (40%), Harney (39%), and Klamath (12%) counties (Figure 1). The two largest Oregon breeding concentrations occurred in the Malheur NWR-Silvies River Floodplain, Harney County (251 pairs), and Sycan Marsh, Lake County (126 pairs). Other major nesting concentrations occurred in the Warner Basin, Lake County (61 pairs), Klamath Marsh-Klamath Forest NWR, Klamath County (51 pairs), Upper Chewaucan Marsh, Lake County (44 pairs), and Lower Chewaucan Marsh, Lake County (41 pairs). Sixty-two percent of the breeding cranes in Oregon occurred at these six sites. In addition, there were 10 sites of secondary importance having 10 or more breeding pairs - in Harney County at Diamond, Catlow, and Warm Springs valleys, and Alvord Basin; in Lake County at Summer Lake and Goose Lake basins, Big Valley, and Paulina Marsh; in Grant County at Bear Valley; and in Klamath County at Klamath River Floodplain. Additionally to the above, V. Coggins (ODFW, Enterprise) reported from Wallowa County, a pair in the Maxwell area since 1991, a pair at Thompson Meadows in 1993, and, a pair in Olsen Meadows in 1993. With the exception of Bear Valley and Klamath River Floodplain, all major breeding areas were within the northern Great Basin.

The greatest number of *G. c. tabida* breeding pairs in California was recorded in Modoc County, with 59% of all pairs recorded. Lassen County was second in importance with 27%, followed by Siskiyou County (11%) and Plumas County (3%) Shasta and Sierra counties each had a single pair. However, four pairs recorded in eastern Fall River Valley nested in Lassen County, but often fed in Shasta County (Littlefield 1989)

Table 1. Location and number of greater sandhill crane breeding pairs in Oregon - 1986.

| <u>Harney County</u> | | <u>Lake County</u> | | <u>Klamath County</u> | | <u>Grant County</u> | | <u>Jackson County</u> | |
|--------------------------|-----|-----------------------|-----|--------------------------|-----|-------------------------|----|-------------------------|-----|
| Catlow Valley: | | Sycan Marsh | 126 | Klamath Wildlife Area | 2 | Crane Prairie | 1 | Willow Lake | 1* |
| Threemile Ranch | 4 | Paulina Marsh | 12 | Klamath River | 10 | Silvies Valley | 8 | Owens Pit | 1 |
| Home Creek Ranch | 7 | Summer Lake | 17 | Wood River | 2 | Bear Valley | 22 | Deadwood Junction | 1 |
| Roaring Springs Ranch | 4 | Upper Chewaucan Marsh | 44 | Upper Klamath NWR | 2 | Fox | 1 | Howard Prairie | 1* |
| Sixmile Creek | 2 | Lower Chewaucan Marsh | 41 | Klamath Forest NWR | 21 | Logan Valley | 5 | Skeeter Swamp | 1* |
| | | Silver Lake | 1 | Solman Flats | 5 | Summit Prairie | 1 | Willow Prairie | 1* |
| Malheur-Ninemile Slough | 2 | Crooked Creek Valley | 3 | Klamath Marsh | 25 | | | | |
| Barton Lake Valley | 4 | Lake Abert | 1 | Dry Prairie | 2 | GRANT COUNTY TOTAL | 38 | JACKSON COUNTY TOTAL | 6 |
| Happy Valley | 9 | Antelope Flat | 1 | Wilson Flat | 1 | | | | |
| Diamond Valley | 34 | Quartz Creek | 1 | Swan Lake | 5 | | | | |
| Drewsey Valley | 2 | Thompson Reservoir | 2 | Langell Valley | 5 | <u>Malheur County</u> | | <u>Wasco County</u> | |
| Pine Creek Valley | 2 | Goose Lake | 18 | Round Lake #1 | 1 | Crowley | 1 | Camas Prairie | 1 |
| Stinkingwater Pond #1 | 1 | Camas Prairie | 7 | | | Cow Creek | 1 | | |
| | | Bull Prairie | 2 | Gerber Reservoir: | | Danner | 3 | | |
| Alvord Basin: | | Big Valley | 11 | Noble Reservoir | 1 | Batch Lake | 1 | <u>Union County</u> | |
| Mann Lake Ranch | 8 | Warner Basin | 61 | Big Adobe | 1 | | | | |
| Comegy's Slough | 1 | Hart Mountain NWR | 3 | Gerber Potholes | 1 | MALHEUR COUNTY TOTAL | 6 | Ladd Marsh WMA | 3 |
| Alvord Ranch | 9 | Burnt Creek | 1 | | | | | | |
| Kuney Ranch | 2 | Abramson Ranch | 1 | Big Marsh | 6 | | | | |
| Colony Ranch | 1 | Camp Creek | 1 | Alkali Lake/Yonna Valley | 7 | <u>Crook County</u> | | <u>Linn County</u> | |
| Pueblo Slough | 1 | Drews Valley | 1 | Beatty | 1 | G.I. Ranch | 4 | Lava Lake | 1 |
| | | Dog Lake | 2 | Bly/Sprague River | 9 | Big Summit Prairie | 7 | | |
| Silvies River Floodplain | 70 | Lower Thomas Creek | 1 | Round Lake #2 | 1 | Merwin Reservoir | 1 | | |
| Cross Ranch | 1 | Long Valley | 1 | Barnes Valley | 3 | Humphrey Ranch | 4 | <u>Clackamas County</u> | |
| Silvies Valley | 5 | Strawberry Reservoir | 1 | Bear Valley | 22 | | | Salmon River Meadows | 1* |
| Skull Creek | 2 | Yocum Valley | 2 | Aspen Lake | 2* | CROOK COUNTY TOTAL | 16 | Big Meadow | 1 |
| Damon Ranch | 1 | Cox Valley | 1 | | | | | Little Crater Meadows | 1* |
| Crane Creek Ranch | 1 | Murphy Ranch | 1 | KLAMATH COUNTY TOTAL | 115 | <u>Deschutes County</u> | | Dry Meadow | 1* |
| Silver Creek Valley | 1 | Shoestring Meadow | 1 | | | Clover Meadow | 1 | CLACKAMAS COUNTY TOTAL | 4 |
| Warm Springs Valley | 15 | Augur Creek | 1 | <u>Baker County</u> | | Crane Prairie Reservoir | 1 | | |
| Sealoft Springs | 1 | Lee Thomas Meadows | 1 | Baker Valley | 1 | Davis Lake | 1 | <u>Lane County</u> | |
| | | | | Phillips Reservoir | 1 | Lava Lake | 1 | | |
| Malheur NWR | | LAKE COUNTY TOTAL | 373 | Whitney Valley | 4 | Winopee Lake | 1* | Wildcat Swamp | 1 |
| Double-O Unit | 27 | | | Hereford | 1 | | | | |
| Blitzen Valley | 154 | | | BAKER COUNTY TOTAL | 7 | DESCHUTES COUNTY TOTAL | 5 | OVERALL TOTAL | 947 |
| HARNEY COUNTY TOTAL | 371 | | | | | | | | |

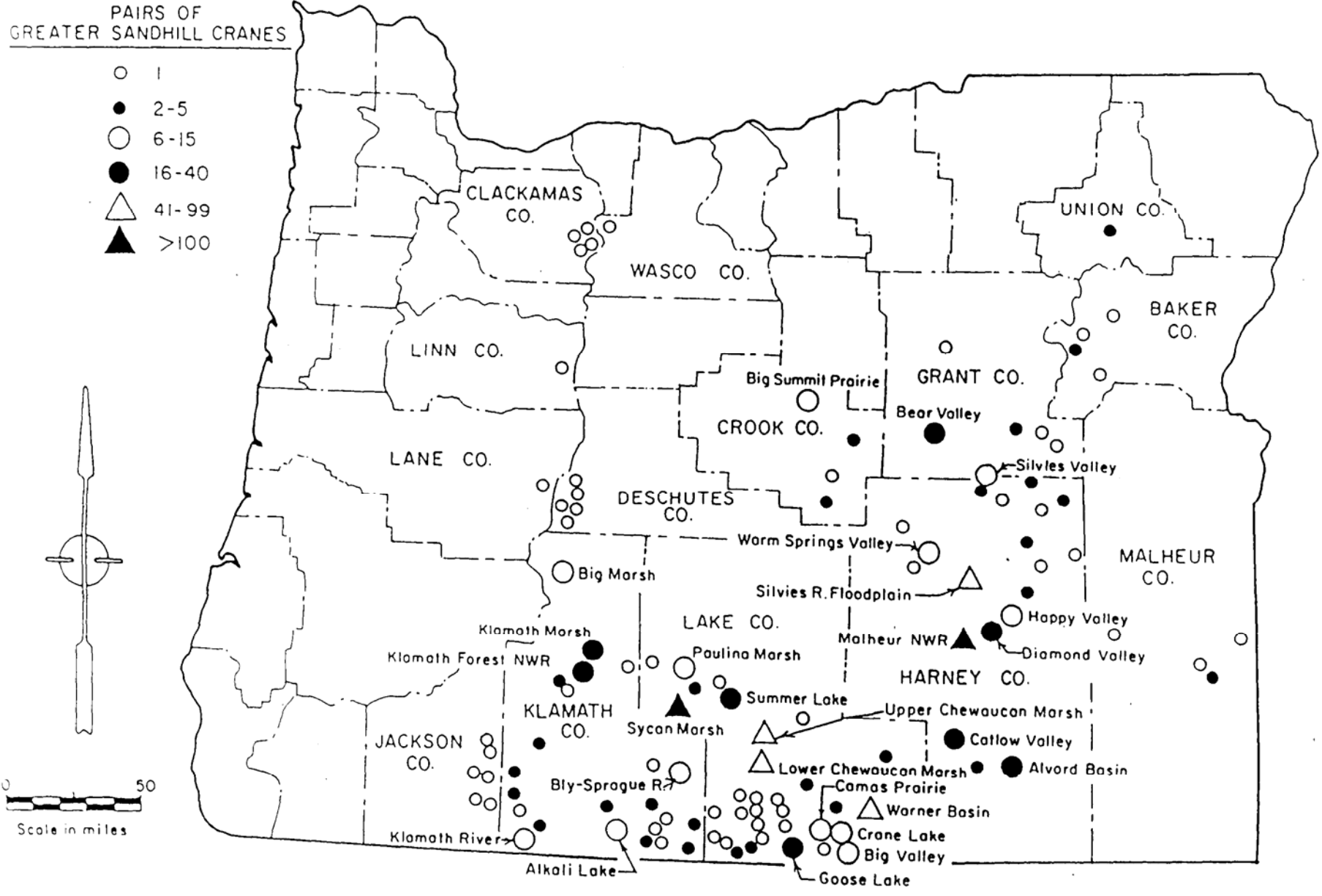
* denotes isolated pairs discovered between 1987-1991.
(Littlefield et al., in press)

Table 2. Location and number of greater sandhill crane breeding pairs in California - 1988.

| <u>Modoc County</u> | | <u>Lassen County</u> | | <u>Siskiyou County</u> | |
|---------------------------|-----------|---------------------------|----------|------------------------|------------|
| Goose Lake | 15 | Dixie Valley | 3 | Tulelake NWR | 1 |
| Davis Creek | 1 | Big Valley (SE of Beiber) | 1 | Prather Ranch | 1 |
| Alturas area | 7 | Ash Creek WA (Big Valley) | 22 | Montague area | 5 |
| Surprise Valley | 56 | Fall River Valley | 4 | Grenada | 1 |
| Cow Head Valley | 1 | Madeline Plains | 2 | Big Springs | 1 |
| Canby area | 5 | Clarke's Valley | 1 | Orr Lake | 1 |
| Jess Valley | 9 | Red Rock Lake | 3 | Red Rock Lakes | 1 |
| Likely area | 12 | Susan Valley Ranch | 1 | Grass Valley | 5 |
| Pit Valley (N. of Beiber) | 1 | Honey Lake WA | 5 | Oklahoma Flat | 2 |
| Ash Creek WA (Big Valley) | 8 | Willow Creek Valley | 6 | Lower Klamath NWR | 10 |
| California Pines | 1 | Horse Lake | 1 | Butte Valley WA | <u>1</u> |
| Egg Lake | 4 | Grasshopper Valley | 1 | SISKIYOU COUNTY TOTAL | 29 |
| Hackamore Reservoir | 1 | Ash Creek Valley | 17 | | |
| Beeler Reservoir | 1 | Papoose Meadow | 1 | <u>Plumas County</u> | |
| Ingell Swamp | 1 | Little Harvey Valley | 2 | Sierra Valley | 5 |
| Hager Basin | 1 | Ashurst Lake | 1 | Indian Valley | 1 |
| Weed Valley | 1 | Pine Creek Reservoir | 1 | Chester area | <u>1</u> |
| Steele Swamp | 1 | Gray's Valley | 1 | PLUMAS COUNTY TOTAL | 7 |
| Sweringer Reservoir | 1 | Bullard Lake | 1 | | |
| Fairchild Swamp | 1 | Feather Lake | <u>1</u> | <u>Sierra County</u> | |
| Buchanan Flat | 1 | LASSEN COUNTY TOTAL | 75 | Sattley | 1 |
| Wildhorse Valley | 1 | | | | |
| White Horse Flat | 3 | <u>Shasta County</u> | | | |
| Modoc NWR | <u>30</u> | Fort Crook | 1 | | |
| MODOC COUNTY TOTAL | 163 | | | OVERALL TOTAL | <u>276</u> |

(Littlefield et al., in press)

Figure 1. Distribution of greater sandhill cranes in Oregon
(Littlefield, et al. 1994).



Surprise Valley, Modoc County, had 56 pairs in 1988 for the greatest local number in California. Other important nesting locations were Big Valley, in Modoc and Lassen counties (32 pairs), Modoc NWR, Modoc County (30 pairs), Lakeshore Ranch, near Goose Lake, in Modoc County (12 pairs), Ash Creek Valley, in Lassen County (17 pairs), and Lower Klamath NWR, in Siskiyou County (10 pairs). These seven areas accounted for over 62% of the pairs nesting in California (Littlefield et al., 1994). Breeding distribution of greater sandhill cranes in California is presented in Figure 2.

Cranes are extremely scarce in summer in northwestern Nevada. Single pairs have been reported at Catnip Reservoir within Sheldon NWR and at the IXL Ranch on the Oregon-Nevada border in Washoe County (G. Herron, pers. comm.) Four pairs have recently been reported breeding within the boundaries of Sheldon NWR (FWS pers. comm.). In Washington, at least one pair has summered on Conboy Lake NWR, Yakima County, since 1975, and cranes have been observed on Yakama Indian Reservation since 1989 (Table 3).

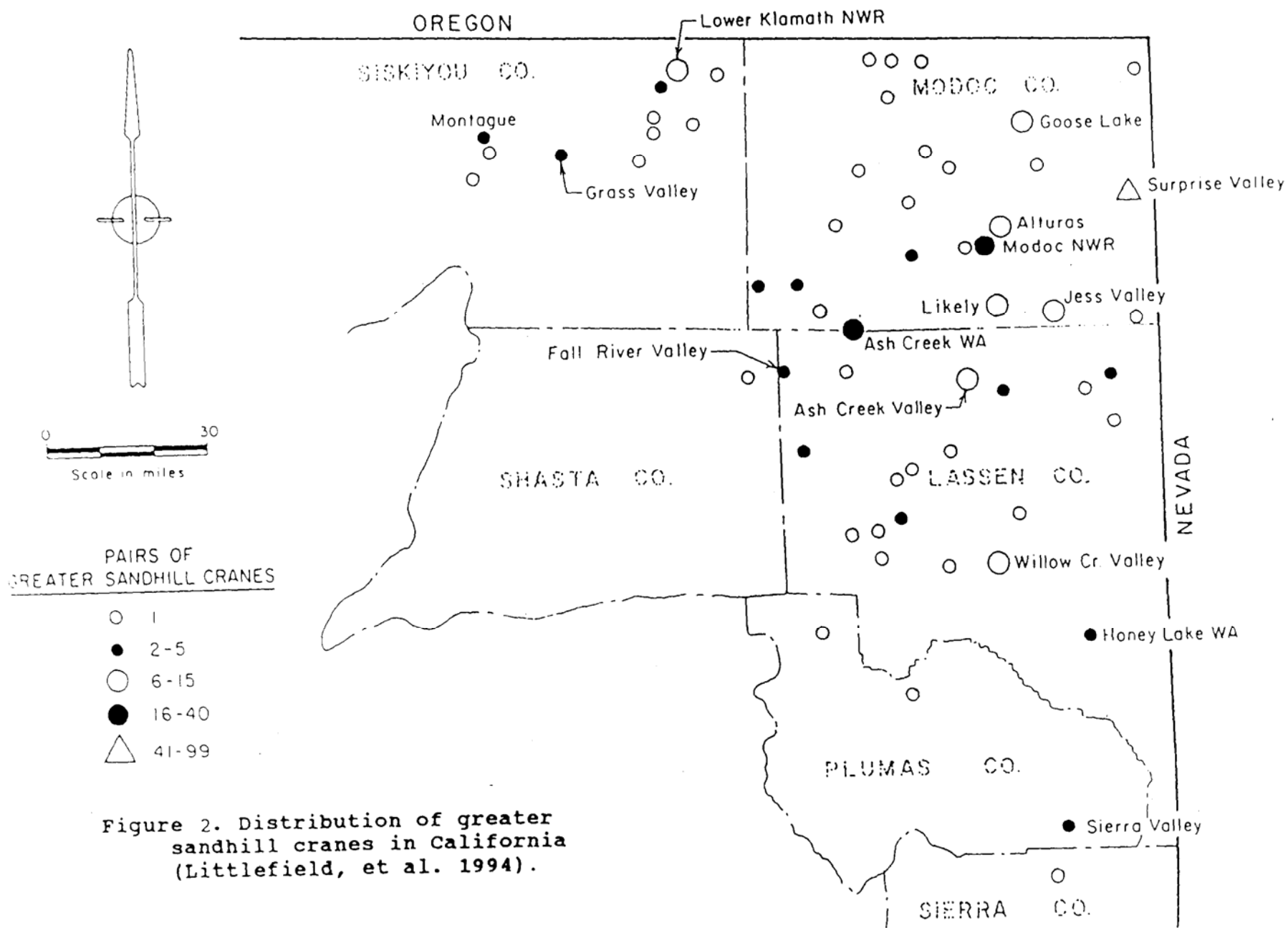


Figure 2. Distribution of greater sandhill cranes in California (Littlefield, et al. 1994).

Table 3. Recent Sandhill Crane breeding records for Washington, compiled by Washington Department of Fish and Wildlife, July 17, 1995 (Scott Richardson). Table shows maximum number (estimates in parentheses) of adults seen in spring, summer, and fall; confirmed nests; indication of nest success; total number of young, number to reach flight stage, number known to have migrated; and a source.

Conboy National Wildlife Refuge and adjacent lands.

| Year | Sp | Su | Fa | Nest | Success | Yg | Fl | Mig | Source |
|------|----|----|---------|------|---------|----|----|-----|---|
| 1995 | | 18 | | 6(7) | Y | 4 | | | J.D. Engler, in litt. |
| 1994 | 4 | 8 | | 3(4) | Y | 2 | | | H. Cole, pers. comm., E. Anderson, in litt. |
| 1993 | | 6 | 12(18+) | 3 | Y | 2 | 2 | | H. Cole, pers. comm. |
| 1992 | | 6 | | 3 | Y | 3 | 3 | | Conboy NWR Narrative Report, p. 40 |
| 1991 | | 6 | | 3 | Y | 4 | 1 | | Conboy NWR Narrative Report, pp. 35-36 |
| 1990 | | 6 | | 4 | Y | 6 | 1 | | Conboy NWR Narrative Report, pp. 23-24 |
| 1989 | 4 | 4 | | 2 | Y | 1 | 1 | 1 | H. Cole, memorandum |
| 1988 | 4 | 4 | | 3 | Y | 2 | 1 | 1 | H. Cole, memorandum |
| 1987 | | 2 | | 1 | Y | 2 | | | H. Cole, memorandum |
| 1986 | 4 | 4 | | 1 | Y | 1 | 1 | | H. Cole, memorandum |
| 1985 | | 2 | | 1 | Y | 1 | 1 | 1 | H. Cole, memorandum |
| 1984 | | 2 | 1 | 1 | Y | 2 | 2 | 2 | H. Cole, memorandum |
| 1983 | 5 | 3 | | 1? | N | | | | H. Cole, memorandum |
| 1982 | | 4 | 4 | 1? | N | | | | H. Cole, memorandum |
| 1981 | | 3 | | 1 | N | | | | H. Cole, memorandum |
| 1980 | | 3 | | 1? | N | | | | H. Cole, memorandum |
| 1979 | | 2 | | 1 | Y? | | | | H. Cole, memorandum |
| 1978 | | 2 | | 1 | N | | | | H. Cole, memorandum |
| 1977 | | 2 | 2 | | N | | | | H. Cole, memorandum |
| 1976 | 4 | 2 | | | Y | | 1 | 1 | H. Cole, memorandum |
| 1975 | 6 | 4 | | 1 | Y | | 1 | 1 | H. Cole, memorandum |
| 1974 | | 6 | | | N | | | | H. Cole, memorandum |
| 1973 | | | | | | | | | |
| 1972 | | | 2 | | N | | | | H. Cole, memorandum |

Yakama Indian Reservation

| Year | Sp | Su | Fa | Nest | Success | Yg | Fl | Mig | Source |
|------|----|------|----|------|---------|----|----|-----|--------------------------------------|
| 1995 | | 2 | | 1 | Y | 2 | | | R. Leach, pers. comm. |
| 1994 | | 2 | | 1 | Y | 1 | | | R. Leach, in prep |
| 1993 | | 2 | | | | | | | R. Leach, in prep |
| 1992 | | 1 | | | | | | | R. Leach, in prep |
| 1991 | | 1 | | | | | | | R. Leach, in prep |
| 1990 | | | | | | | | | |
| 1989 | | 1(2) | | | | | | | E. Hansen, WDFW files, H. Cole, memo |
| 1988 | | 0 | | | | | | | H. Cole, memorandum |
| 1987 | | 0 | | | | | | | H. Cole, memorandum |

Little is known on the number and distribution of CVP cranes breeding in British Columbia. Their status and range have been generally described as an uncommon to fairly common local breeder along the coast, very rare summer visitant and breeder to the north Okanagan, becoming fairly common in the Cariboo-Chilcotin area. The south coast breeding population is now apparently restricted to the Pitt Meadows area and one site near Fort Langley. The last breeding record for Lulu Island was in July 1946, and breeding birds have not been found on Vancouver Island since June 1941. Breeding birds have recently been located in the northern Okanagan at Mara Meadows near Enderby (R. W. Campbell, et al. 1990). Additional records are from near 70 Mile House, Williams Lake, Soda Creek, Hanceville, and Horsefly River (M. McNall to S. Thompson, pers. comm., T. Pogson, pers. comm.), but status of the subspecies in south-central British Columbia is generally unknown. Losses of habitat and human disturbance during the nesting season were reported as the major causes of recent declines in British Columbia *G. c. tabida* (Weber 1980). This has been particularly well documented in the southwest portion of the province by Robinson (1978, 1980).

Distribution of Spring Nonbreeders

Large groups of non breeding (mostly subadults) cranes were frequently encountered at major Oregon breeding areas during surveys in 1986, with the largest concentration recorded in Diamond Valley, Klamath Marsh-Klamath Forest NWR area, Warner Basin, Sycan Marsh, and Chewaucan marshes (Stern et al. 1987). In total, 606 nonbreeding *G. c. tabida* were recorded in Oregon in 1986 (Table 4). Northeast California supported fewer nonbreeders, with 159 recorded in 1988 (Littlefield 1989). Surprise Valley was the most important California area used by nonbreeders (Table 5). In 1994, 35 to 38 nonbreeding cranes began using Modoc NWR for the first time, and this area may become an important use-area in future years (D Johnson, pers. comm.).

In the two states, Diamond Valley, Oregon was the most important area used by nonbreeders. Traditionally, Diamond Valley has a large number of nonbreeding greater sandhill cranes in early May, with few thereafter. It is suspected that many of these birds are

using the valley as a traditional stop-over site before migrating north to British Columbia (Littlefield et al., 1994) Other than some nonbreeder use in the vicinity of Fox, Grant County (71 on 3 April 1986), no known crane stop over sites are presently known north of Harney County, Oregon. However, some birds probably do stop and use cereal grain fields in eastern Washington during migration.

Table 4. Locations and numbers of non-breeding greater sandhill cranes in Oregon - Spring 1986.

| LOCATION | NUMBER | DATE |
|------------------------|------------|-----------|
| Harney County: | | |
| Diamond Valley | 296 | 19 March |
| Alvord Basin | 11 | 30 March |
| Sixmile Creek | 2 | 18 March |
| Foster Flat | 1 | 12 May |
| Warm Springs Valley | 1 | 24 March |
| Princeton area | 1 | 30 March |
| Lake County: | | |
| Sycan Marsh | 25 | April |
| Paulina Marsh | 25 | 30 April |
| Upper Chewaucan Marsh | 29 | 14-15 May |
| Lower Chewaucan Marsh | 24 | 16 May |
| Warner Basin | 45 | 21-22 May |
| Goose Lake | 18 | 18 May |
| Summer Lake | 17 | 12-14 May |
| Hart Mountain | 1 | 30 May |
| Klamath County: | | |
| Klamath Marsh | 48 | 9 May |
| Klamath Forest NWR | 27 | 12 June |
| Swan Lake | 17 | 12 June |
| Mallory Reservoir | 3 | 6 May |
| Alkali Lake | 11 | 6 April |
| Union County: | | |
| Ladd Marsh WA | 1 | 4 April |
| Malheur County: | | |
| Danner | 1 | 9 April |
| Crook County: | | |
| Big Summit Prairie | 1 | 16 May |
| Grant County: | | |
| Galena | 1 | April |
| TOTAL: | 606 | |

Table 5. Locations and numbers of non-breeding greater sandhill cranes in California - spring 1988.

| LOCATION | NUMBER | DATE |
|------------------------|--------|----------|
| <u>Modoc County</u> | | |
| Surprise Valley | 35 | 25 May |
| Davis Creek | 71 | 27 March |
| Likely | 8 | 28 March |
| <u>Lassen County</u> | | |
| Big Valley | 6 | 30 March |
| Honey Lake WA | 5 | 6 April |
| Ash Creek Valley | 10 | 25 April |
| <u>Siskiyou County</u> | | |
| Grass Lake | 19 | 21 May |
| Lower Klamath NWR | 5 | 22 May |
| TOTAL | 159 | |

Premigration Staging and Migration Stopover Areas

Four autumn staging and migration stopover areas are currently known. The most important is Malheur NWR, Oregon when cereal grain crops are available. Over 3400 individuals were counted there in 1979 (Table 6), as both local and British Columbia migrants congregated from late July into November. This site has been used for at least several decades, and peak numbers from 1935 through 1984 are presented in Littlefield (1986).

Table 6. Year and autumn peak numbers of greater sandhill cranes on Malheur National Wildlife Refuge, Oregon.

| YEAR | NUMBER | YEAR | NUMBER |
|------|--------|------|--------|
| 1970 | 2929 | 1982 | 2502 |
| 1971 | 2711 | 1983 | 2295 |
| 1972 | 974 | 1984 | 2720 |
| 1973 | 1319 | 1985 | 1292 |
| 1974 | 563 | 1986 | 513 |
| 1975 | 2056 | 1987 | 836 |
| 1976 | 1651 | 1988 | 319 |
| 1977 | 2855 | 1989 | 933 |
| 1978 | 2614 | 1990 | 442 |
| 1979 | 3408 | 1991 | 2899 |
| 1980 | 2157 | 1992 | 473 |
| 1981 | 2179 | 1993 | 1915 |
| | | 1994 | 512 |

The second most important staging area is on Lower Klamath NWR (Table 7). Migrant crane arrive in late August and feed in large barley fields in the southern portion of the refuge. Night roosting occurs in shallowly flooded wetlands containing limited emergent growth and in shallowly flooded burned areas in seasonal wetlands. Although no formal surveys have been conducted, flocks appear to be 80-90% greater sandhill cranes (D. Mauser, pers. comm.).

Table 7. Peak sandhill cranes numbers, Lower Klamath NWR, California, 1985-1994.

| YEAR | DATE | NUMBER |
|------|-------|--------|
| 1985 | 10/24 | 425 |
| 1986 | 10/29 | 240 |
| 1987 | 10/22 | 440 |
| 1988 | 11/04 | 360 |
| 1989 | 11/03 | 730 |
| 1990 | 10/10 | 920 |
| 1991 | 10/18 | 590 |
| 1992 | 10/22 | 820 |
| 1993 | 9/22 | 260 |
| 1994 | 10/21 | 1090 |

The third most important staging area occurs in Klamath County in southern Langell Valley, near the town of Bonanza. The majority of birds from the western portion of Oregon are believed to use this site in autumn. Marked birds from Sycan Marsh have been recorded in both spring and autumn at this site (M Stern, pers comm) Numbers sometimes approach 700 individuals (Table 8), although no concerted effort has been made to count these birds all a regular basis

Table 8. Date and autumn numbers of greater sandhill cranes at Langell Valley, Oregon.

| DATE | NUMBER | SOURCE |
|----------------|--------|----------------|
| Mid Sept. 1976 | 472 | C. Littlefield |
| 27 Sept. 1985 | 676 | M. Stern |
| 16 Sept. 1986 | 229 | M. Stern |
| 13 Aug. 1988 | 0 | C. Littlefield |
| 28 Sept. 1990 | 350 | M. Stern |

The fourth staging area is on and near Modoc NWR, near Alturas, Modoc County, California. Birds using this site are mostly those which nest on the refuge and in surrounding wetland habitats (D. Johnson, pers comm.). Upwards of 300 birds generally congregate there in autumn (Table 9)

Table 9. Date and peak autumn numbers of greater sandhill cranes at Modoc NWR, California.

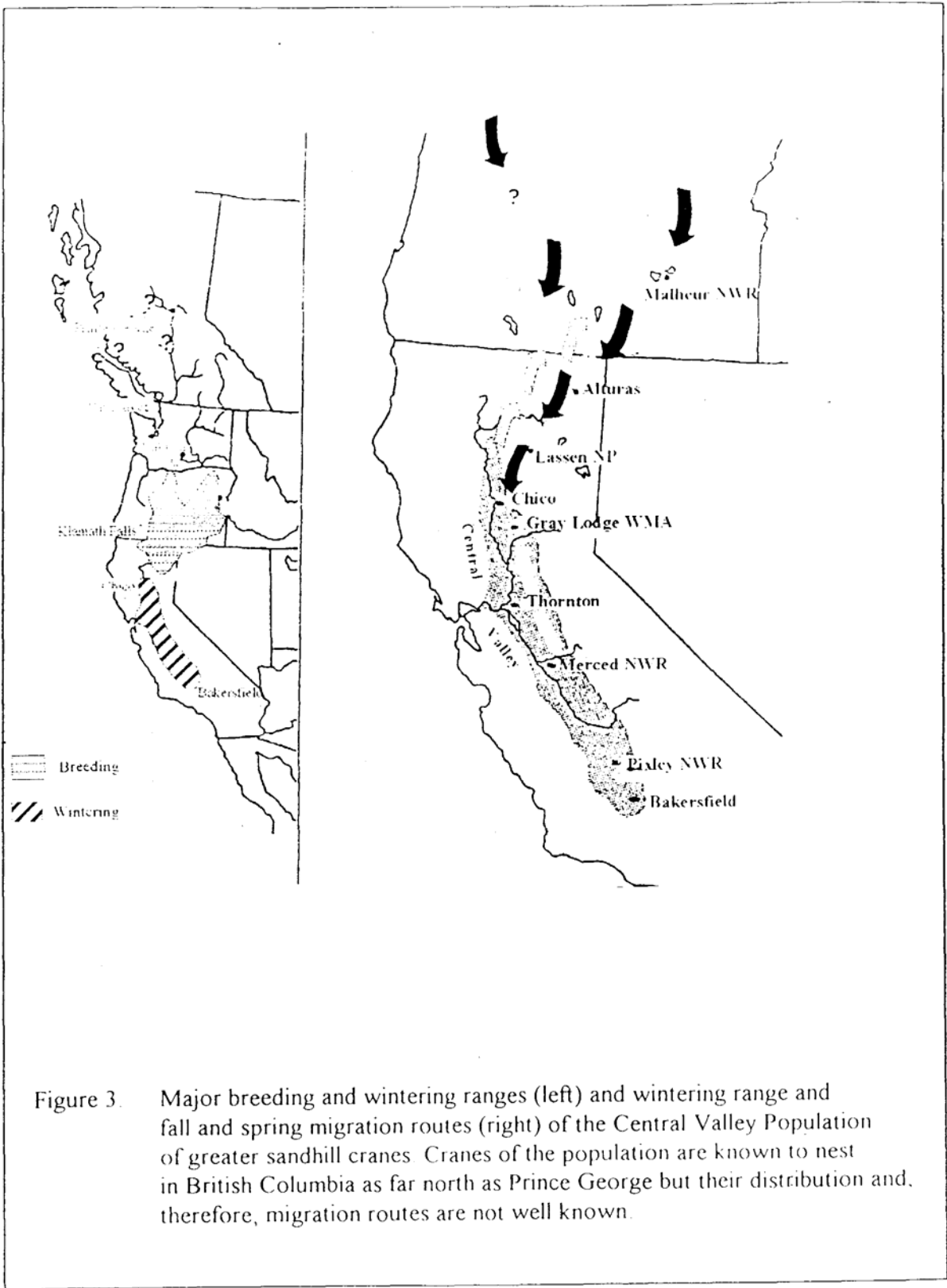
| YEAR | PEAK NUMBER |
|------|-------------|
| 1983 | 302 |
| 1984 | 109 |
| 1985 | 335 |
| 1989 | 281 |
| 1991 | 697 |
| 1992 | 243 |
| 1993 | 258 |
| 1994 | 289 |

(D. Johnson, pers. comm.)

Other congregation sites occur along the migration corridor but these are usually temporary and not consistently used. When autumn water and feeding sites are available, several hundred *G. c. labida* concentrate on the Silvies River Floodplain, near Burns, Harney County, Oregon, but generally by mid-October these birds have moved onto Malheur NWR.

After migrating from Malheur NWR, greater sandhill cranes fly southeast between Beatty Butte and Hart Mountain, and enter the southeast corner of the Warner Valley. From Warner Valley birds fly south into Surprise Valley, California. Near Cedarville, Modoc County, California they turn west-southwest and cross the Warner Mountains, Alturas, and Round, Big, and Fall River valleys. At the west end of Fall River Valley, cranes fly south to the vicinity of Lassen Volcanic National Park and continue until they enter the California Central Valley near Chico, Butte County (Littlefield and Thompson 1979, Figure 3). Birds from the Modoc NWR site likely use this same migration route, while the route used by birds staging at Langell Valley is not known.

In spring, the same migration corridors are used, but use areas along the route change. Generally, breeding pairs do not linger at these sites, but instead make a direct and rapid flight to their breeding territories (c. Littlefield, pers. observ.). However, subadults occasionally linger from March well into May. From surveys conducted in Oregon in 1986 and California in 1981 and 1988, subadult flocks were frequently encountered at major breeding areas. In Oregon, greatest concentrations were noted in Diamond Valley, Klamath Marsh-Klamath Forest NWR area, Warner Basin, Sycan Marsh, and Chewaucan marshes (Stern et al. 1987), and in California, at Surprise Valley, Big Valley, and near Davis Creek, Modoc County. Some migrant pairs also occasionally use these same areas, particularly if grounded by inclement weather.



Wintering Areas

All members of the CVP winter in the California Central Valley (Figure 3), from about 13 km southwest of Chico, south and east to near Delano, Tulare County (Littlefield and Thompson 1979). In 1983-84, ninety-five percent of the population wintered from the Sacramento Valley south to the San Joaquin - Sacramento Rivers Delta (Delta Region). Over one-half of the population used the Butte Sink region of the Sacramento Valley during October-November, while from December through January, the Thornton and Consumnes region (San Joaquin County) had 56-76% of the population (Pogson and Lindstedt 1991). Counts in the Butte Sink region in the winters of 1991-92 and 1992-93 showed 5880 CVP cranes in December 1991, 5223 in January 1992, 4614 in February 1992, 6532 in December 1992, 5546 in January 1993 and 6078 in February 1993 (Littlefield 1993a). No surveys were conducted in October and November 1991; however, in October and November 1992, 4971 and 6832 greater sandhill cranes were recorded in this region, respectively. In both winters, cranes were noted migrating from the Butte Sink region in December and early January. Unfortunately, no surveys were conducted at other Central Valley crane use-areas in 1991-92 and 1992-93.

Assuming CVP cranes continued to winter in substantial numbers in the Delta and San Joaquin Valley, the 6000 to 6800 individuals estimated by Pogson may be conservative, and the number which actually comprise the population will likely exceed the peak count of 6832.

With only about 3400 greater sandhills summering in Oregon and California, more than one-half of the population is presumed to be summering in British Columbia.

Recorded wintering greater sandhill crane numbers and locations are presented in Appendix A.

Habitat

Breeding Areas

Greater sandhill cranes of the CVP typically nest in wet meadow and marsh habitats within the northern Great Basin and mountainous regions of Oregon and California. Nesting habitat varies, with most pairs using wet-open meadows; however, in some regions nesting occurs more commonly in marshes. Most nests examined in California in 1988 were located in open meadow habitat (62.5%)(Littlefield 1989), while at Sycan Marsh, Oregon 82.0% were in wet meadows (Stern et al. 1987). At Malheur NWR, where marshes are important, 90.3% were found in emergent vegetation compared with only 9.7% in wet-open meadow habitats (Littlefield and Ryder 1968).

In British Columbia, breeding habitat has been described as isolated bogs, marshes, and meadows from near sea level to 1220 m (R.W. Campbell, et al. 1990).

Autumn Premigration Use Areas

The Malheur NWR autumn use-area has been described by Littlefield (1986), but throughout the subspecies' Pacific states range, use-areas are similar. Cereal grain fields, associated with favorable roosting and loafing sites are the principal components. Cereal grains which have been recorded at use-areas are oats, rye, wheat, and barley, with barley being the most important because of its availability. However, waste wheat appears to be preferred (Littlefield 1986, Sugden and Clark 1988). Favorable roosting sites are small to medium sized open water bodies and reservoirs, with preferred depths ranging from 3 to 8 cm. Probably similar autumn habitat is used in British Columbia

Spring Migration Stopover Areas

Spring use-areas consist of the same as those used in autumn, but mowed-recently flooded meadows are also an important habitat in spring. Greater sandhill cranes in Diamond Valley, Oregon use this meadow habitat exclusively; however, in other regions meadow use is supplemented by use in harvested cereal grain crops. Duration of use in spring is somewhat limited, as most breeding birds rapidly move to breeding territories.

Wintering Areas

Within the California Central Valley, greater sandhill cranes winter in regions with extensive cereal grain production in close proximity with small open ponds and wetlands which are used for loafing and roosting. In the Sacramento Valley, harvested rice fields are used extensively for feeding. During the winters of 1991-92 and 1992-93, use of rice fields accrued 71.4% of the recorded feeding use-days in the Upper Butte Basin (Littlefield 1993a). However, unharvested corn plots on the Little Dry Creek Unit of the Upper Butte Basin Wildlife Area (W.A.), in Butte County, received substantial crane feeding use during the winter of 1992-93 (Littlefield 1993 b).

Further south, in the Delta and San Joaquin Valley, waste corn was the most important food source, particularly in the Thornton area (Pogson 1990). Greater sandhill cranes used milo fields and grasslands extensively in the early 1970's on and near the Faith Ranch, west of Modesto, Stanislaus County (Littlefield and Thompson 1979), while in Merced County, they were recorded in corn and barley fields, but most birds spent considerable time on wetlands within the Merced NWR. The few cranes which have been recorded at Pixley NWR were noted using waste corn and new plant growth in fallow fields on and adjacent to the refuge (c. Littlefield, pers observ.)

Irrigated pastures and wetlands are present at greater sandhill crane wintering use-areas in

the California Central Valley. Birds loaf and feed during mid-day on these uncultivated habitats, and such sites are probably important for obtaining certain minerals and essential amino acids which are not present in cereal grains (Reinecke and Krapu 1979).

Human Use

Sandhill cranes of the Pacific Coast, excluding Alaska and Mexico, are not hunted. There is considerable interest in sandhill cranes among birders, photographers, and other nonconsumptive users of wildlife resources in the Pacific States. At Malheur NWR, Oregon for example, about 70% of the estimated 65,000 public visitors annually, specifically inquire about cranes (D. Staller, pers. comm.). Many people interested in viewing cranes visit concentration areas throughout the breeding and wintering range. Bird enthusiasts enjoy watching cranes at the important wintering areas near Thornton, California.

Management

Management directed specifically at or in part toward the CVP has included: (1) controlled livestock grazing; (2) planting of cereal grain crops for food; (3) delayed mowing of meadows and marshes used for nesting; (4) delayed dewatering from nesting and roosting areas; (5) placement of warning markers on powerlines; (6) control of predators; (7) acquisition of winter and summer crane use areas; and (8) conducting surveys to monitor population status. These practices, as well as other management procedures, are listed in Section V "Recommended Management Procedures"

IV. PROBLEMS

Major problems confronting CVP cranes throughout their range are: (1) poor recruitment of young birds into the adult segment of the population, primarily because of high predation rates; (2) loss of habitat; and (3) mortality from illegal shooting and by accidental collisions with powerlines.

Problems confronting cranes on and near Malheur NWR and Sycan Marsh may be typical of those elsewhere in Oregon. At Malheur NWR, from 1966-85, nesting success (at least one egg per clutch hatched) ranged from 20 to 67% and averaged 47% (Table 10). Predation of eggs by common ravens, raccoons, and coyotes was the primary factor for low nesting success, especially in years of low precipitation, although flooding, desertion, and infertility also contributed to clutch losses (C. Littlefield, unpubl. data). At Sycan Marsh, nesting success was 29.8% from 1981-84 (Stem et al. 1987), and predation of eggs by coyotes was the primary factor limiting nesting success.

In California, nesting success at Modoc NWR has ranged from 40 to 100%, and averaged 65.1% for 15 years between 1979 and 1993 (Modoc NWR files). However, nesting success was only 37.5% at various sites in northeast California in 1988. Thirty of 56 clutches were destroyed by predators, with coyotes taking 17 (30.4%), common ravens six (10.7%), raccoons five (8.9%), and unknown predators two (3.6%) (Littlefield 1989). Only limited data are available on nest success for cranes in British Columbia or Washington.

Mortality of young cranes from the time of hatching to fledging has also been high. Predation in particular, and brood strife, disease, starvation, mowing, and livestock grazing all contribute to losses of young cranes. At Malheur NWR, Oregon, coyotes are important predators of young cranes. When coyotes were numerous in 1973 and 1974, only two young each year were known to have fledged from 235 pairs of breeding cranes (Littlefield 1976). After coyotes naturally declined, 17 young cranes were fledged in 1975, and 27 were produced in 1977 by 219 pairs (Table 11). Between 1970 and 1985, percent mortality of unfledged colts from all causes ranged from 66 to 98%, and averaged 86.1% (C Littlefield, unpubl data).

Table 10. Greater sandhill crane nest fates recorded on Malheur NWR, Oregon: 1966-1985 (% in parentheses) .

| YEAR | No. | Hatched | Abandoned | Flooded | Infertile | Depredated | Raven | Raccoon | Coyote | Unknown |
|-------|-----|----------|-----------|---------|-----------|------------|-------|---------|--------|---------|
| 1966 | 51 | 18 (35) | 7 (14) | 0 (00) | 0 (00) | 26 (51) | 9 | 6 | 4 | 7 |
| 1967 | 59 | 25 (42) | 1 (02) | 0 (00) | 0 (00) | 33 (56) | 13 | 14 | 0 | 6 |
| 1969 | 88 | 52 (59) | 3 (03) | 1 (01) | 0 (00) | 32 (36) | 10 | 12 | 1 | 9 |
| 1970 | 86 | 44 (45) | 4 (05) | 0 (00) | 0 (00) | 38 (50) | 17 | 9 | 1 | 11 |
| 1971 | 83 | 44 (53) | 0 (00) | 0 (00) | 0 (00) | 39 (47) | 16 | 10 | 1 | 12 |
| 1973 | 49 | 10 (20) | 1 (02) | 0 (00) | 1 (02) | 37 (76) | 20 | 4 | 5 | 8 |
| 1974 | 50 | 18 (36) | 2 (04) | 0 (00) | 0 (00) | 30 (60) | 14 | 2 | 7 | 7 |
| 1976 | 52 | 35 (67) | 0 (00) | 0 (00) | 1 (02) | 16 (31) | 4 | 6 | 0 | 6 |
| 1977 | 50 | 23 (46) | 0 (00) | 0 (00) | 1 (02) | 26 (52) | 9 | 6 | 3 | 8 |
| 1978 | 55 | 19 (34) | 1 (02) | 10 (18) | 1 (02) | 24 (44) | 7 | 5 | 5 | 7 |
| 1980 | 30 | 16 (53) | 1 (03) | 2 (07) | 0 (00) | 11 (37) | 4 | 2 | 1 | 4 |
| 1981 | 31 | 15 (48) | 0 (00) | 0 (00) | 2 (07) | 14 (45) | 5 | 2 | 0 | 7 |
| 1982 | 81 | 54 (67) | 2 (02) | 0 (00) | 1 (01) | 24 (30) | 8 | 2 | 3 | 11 |
| 1983 | 60 | 38 (63) | 3 (05) | 3 (05) | 1 (02) | 15 (25) | 2 | 5 | 5 | 4 |
| 1984 | 67 | 23 (34) | 2 (03) | 5 (07) | 3 (05) | 34 (51) | 8 | 5 | 8 | 13 |
| 1985 | 50 | 24 (48) | 1 (02) | 0 (00) | 0 (00) | 25 (50) | 7 | 1 | 0 | 17 |
| Total | 942 | 458 (47) | 28 (03) | 21 (02) | 11 (01) | 424 (46) | 153 | 91 | 43 | 137 |

Table 11. Mortality and recruitment rates for greater sandhill crane young on Malheur NWR, Oregon: 1970-85.

| YEAR | % Mortality | No of Young Fledged | % Recruitment |
|--------|-------------|---------------------|---------------|
| 1970 | 66.5 | 68 | 12.5 |
| 1971 | 80.7 | 46 | 8.9 |
| 1972 | ---- | 43 | 8.3 |
| 1973 | 98.0 | 2 | 0.4 |
| 1974 | 98.8 | 2 | 0.4 |
| 1975 | ---- | 17 | 3.5 |
| 1976 | 84.6 | 47 | 9.1 |
| 1977 | 85.5 | 27 | 5.8 |
| 1978 | 70.1 | 43 | 8.9 |
| 1979 | ---- | 39 | 8.1 |
| 1980 | 84.9 | 34 | 7.1 |
| 1981 | 88.7 | 23 | 5.0 |
| 1982 | 90.1 | 25 | 5.5 |
| 1983 | 84.8 | 39 | 8.4 |
| 1984 | 93.8 | 8 | 1.8 |
| 1985 | 92.6 | 9 | 2.4 |
| Means: | 86.1 | 30 | 6.0 |

1970-74, Littlefield 1976.
 1975-85, C. Littlefield, unpubl. data.
 1986-93, see Table 13.

At Sycan Marsh, Oregon, annual recruitment was 00%, 31%, 67%, and 80% in 1981, 1982, 1983, and 1984, respectively (Stern et al. 1987). In California, 224 pairs were surveyed in 1988, of which 20 young fledged. This yielded a recruitment rate of 4.5% (Littlefield 1989). Between 1970 and 1985, recruitment rates at Malheur NWR have ranged from 0.4% to 12.5%, and averaged 6.0% (C. Littlefield, unpubl. data). General recruitment rates for the CVP at a staging/traditional stopover area in southeast Oregon between 1975 and 1987 averaged 6.3% (c. Littlefield, unpubl. data), while at the same location in 1990 and 1991, recorded recruitment rates were 3.5% and 7.1%, respectively (G. Ivey, pers. comm). Surveys conducted by R. Schlorff in the California Central Valley in the winter of 1975, and all winters between 1979 through 1986 ranged from 4.1% to 84%, and averaged 5.6% recruitment (Drewien et al. 1995). Possible reasons for high predation rates at large breeding locales such as Malheur NWR and Sycan Marsh are discussed by Littlefield et al. (1994).

Brood strife is an important mortality factor, and has been recorded from both Sycan Marsh and Malheur NWR Oregon. One chick becomes dominant shortly after both young have hatched, and if food supplies are limited, one chick will drive the submissive chick away from the parents. On rare occasions the dominant chick will kill its sibling and in some instances adults may have killed their own young, possibly related to extreme drought and stress (Stern et al., 1986).

In June and July, water shortages and reduced flows into crane brooding areas will often reduce food for colts. On private lands, irrigation water is drained before mowing begins in early July. On Malheur NWR, stream flows often become reduced in early summer and meadows begin to dry. Young cranes, which depend mostly on invertebrate foods during their first 5 or 6 weeks, sometimes starve when invertebrate populations decrease with water levels. Also, it is not uncommon during this period for both members of a brood to disappear because of intensified strife. In addition, coyotes readily move into these drying meadows, resulting in the loss of many young (Littlefield and Lindstedt 1992).

Young greater sandhill cranes are vulnerable to meadow mowing because they hide in vegetation when threatened, and sometimes remain hidden until destroyed by mowing equipment. Spring and summer livestock grazing may cause losses of both nests and young because of nest desertion and trampling of young (Littlefield 1989), as can winter livestock grazing reduce nesting success by eliminating residual nesting cover (Littlefield and Paullin 1990).

Although loss of crane nesting habitat in the Pacific States has been somewhat stabilized in recent years, wintering habitat is presently being eliminated by conversion of grasslands and cereal grain fields to vineyards in the San Joaquin-Sacramento Rivers Delta (Delta) (T. Pogson, pers. comm.), and flooding, plowing, and burning of harvested rice stubble in the Sacramento Valley (Littlefield 1993a). At the present time ample winter feeding habitat is available, but some agricultural practices may have a detrimental impact on wintering greater sandhill cranes in the future.

Although illegal shooting appears to have declined in the past decade, powerlines continue to kill several cranes annually throughout their summer and winter ranges.

V. RECOMMENDED MANAGEMENT PROCEDURES

Since release of the first CVP Management Plan in March 1983, several management procedures have been initiated. These include land acquisitions on both breeding and wintering areas, predator management programs, habitat enhancement, surveys, and mortality reduction programs. However, several procedures have not been implemented, while others which have been initiated should continue. The following management procedures are recommended even though the degree and timing for their implementation by the agencies involved will be influenced by fiscal, and other constraints. Whenever possible, management procedures in this plan should be coordinated and incorporated into those procedures recommended in plans for other species and populations of-Pacific Flyway birds.

HABITAT

A. Habitat Protection

California

1. Privately owned areas which support breeding greater sandhill crane pairs should be protected by means such as easements, agreements, joint venture plans or acquisition. Priorities for protection include important areas in Surprise Valley, Warm Springs Valley, South Fork Pit River Valley, Egg Lake, Whitehorse Flat, Fall River Valley, Ash Creek Valley, Indian Valley, and Sierra Valley (for legal description of areas cf. Littlefield 1989).

Lead Agencies:

California Dept. of Fish & Game

U.S. Fish & Wildlife Service

Priority: I Schedule Ongoing

- 2 Protect wintering and migrational staging areas, roosting sites, loafing sites, and feeding areas in California to ensure adequate greater sandhill crane habitat. Autumn roosting habitat (large isolated wetlands, secure from human disturbance) should be maintained at Modoc and Lower Klamath NWRs, and Ash Creek Wildlife Area.

Lead Agencies: U.S. Fish & Wildlife Service
California Dept. of Fish & Game
Priority: 1 Schedule: Ongoing.

3. Continue acquisition of the San Joaquin River NWR. Continue the effort in pursuing acquisition of the Grasslands Wildlife Management Area (including additions to the Merced and Arena Plains NWRs), Merced County, and protect through fee title and perpetual conservation easement. Expand the acquisition boundaries if additional, unprotected crane use areas are identified.

Lead Agency: U.S. Fish & Wildlife Service
Priority: 2
Schedule: Ongoing.

Oregon

1. Protect important crane breeding areas, roosting sites, loafing areas and feeding areas through means such as easements, agreements, joint venture plans or acquisition, when necessary. Not only interested agencies, but conservation organizations, groups and individuals are encouraged to participate in this effort. Priorities should be determined by immediate threats to habitat.

Lead Agencies/Groups: U.S. Fish & Wildlife Service
Oregon Dept. of Fish & Wildlife Oregon
Natural Heritage Program
Bureau of Land Management
U.S Forest Service

Priority I
Schedule: As necessary

- 2 Provide up to 400 acres of cereal grain production on Malheur NWR for food of staging cranes. Autumn roosting habitat (large isolated wetlands, secure from human disturbance) should be maintained at Malheur NWR and Summer Lake Wildlife Area.

Lead Agencies: U.S. Fish & Wildlife Service
Oregon Dept. of Fish & Wildlife

Priority: I
Schedule: Ongoing.

Washington

1. Considering Conboy Lake NWR and vicinity, and the Yakama Indian Reservation are the only known greater sandhill crane breeding areas in the State of Washington, efforts should continue to support this isolated segment of the CVP. Therefore, protection of important wetlands adjacent to or near the Conboy Lake NWR through means such as easements, agreements, joint venture plans, or acquisition, if necessary, should continue.

Lead Agencies: U.S. Fish & Wildlife Service
Washington Dept. of Fish & Wildlife

Priority: 1
Schedule: Ongoing.

2. Efforts should be continued to determine the status of greater sandhill cranes on the Yakama Indian Reservation, and the extent of crane nesting habitat on the reservation. Efforts to protect this habitat should be encouraged.

Lead Agencies/Groups: Yakama Tribal Council
U.S. Fish & Wildlife Service
Washington Dept. of Fish & Wildlife
Bureau of Indian Affairs

Priority: 2
Schedule 1996 and ongoing

B. Habitat Management

I. Breeding Habitat

- a. Seek easements with private landowners to delay haying and livestock grazing on crane nesting areas to at least August 1, or as local data indicates.
- b. On public lands encompassing crane nesting or brooding habitat, land management agencies should eliminate harmful livestock grazing practices. In general, summer livestock grazing on crane nesting habitat may be detrimental to crane production, and winter grazing may reduce cover and possibly result in lower nesting success. Land management agencies should consider the effects of grazing on sandhill crane productivity when planning economic uses.
- c. To prevent mower mortality, hay mowing should be delayed on designated portions of public lands before 10 August (or a date based on the best local data) to prevent the loss of young cranes. Mowed hay should be removed because "moldy" hay from the proceeding year's growth provides favorable conditions for aspergillosis, which has been known to infect young cranes.
- d. Encourage public and private land managers to keep meadows wet through July if possible. Rapid drying of meadows while young are dependent on invertebrates can result in death by starvation.
- e. Where possible, remove internal fences and powerlines on National Wildlife Refuges and other federal and state lands on greater sandhill crane use-areas. Sandhill cranes are occasionally killed by fences and powerlines.
- f. Discourage the construction of dams that would inundate or dewater crane breeding habitat

- g. Restore degraded wet meadow and other wetland habitat areas by plugging drains, removing dams, etc. where feasible. Avoid converting natural wetlands, which are important to cranes, into artificial wetlands, managed to benefit other species. Discourage the construction of dams that would inundate or dewater crane breeding habitat.

Lead Agencies: Subcommittee

All agencies

Priority: 1

Schedule: 1996 and ongoing.

2. Wintering Habitat

- a. Preferred greater sandhill crane feeding habitat in Butte, northern Sutter, and eastern Colusa counties in the Sacramento Valley of California is in unaltered harvested rice fields (Littlefield 1993a). However, presently rice stubble is being altered rather extensively by burning, flooding, or plowing, all of which may affect crane food sources. The status of feeding areas should be monitored.

- b. Encourage agency land managers to plant, but not harvest corn plots on National Wildlife Refuges and State Wildlife Areas in the California Central Valley. Experimental corn plots were established on the Little Dry Creek Unit of the Upper Butte Basin Wildlife Area, Butte County, California in 1991 and 1992. Standing corn received considerable crane feeding use during the winters of 1991-92 and 1992-93, particularly in 1992-93 (Littlefield 1993b). For example, over 3400 greater sandhill cranes were feeding on these plots in January 1993. Additional plots should be planted on other state and federal lands, preferably in screened (trees) areas protected from human disturbance.

- d. Some wetlands on state and federal lands which support cranes in the California

Central Valley should be flooded in September to provide roosting and loafing sites for early arriving greater sandhill cranes. Presently, many of the wetlands in the Sacramento Valley are not watered until mid-October, which could result in a deficiency of adequate roost sites during the early crane wintering period.

Lead Agencies: U.S. Fish & Wildlife Service
California Dept. of Fish & Game

Priority: 2

Schedule: 1996 and ongoing.

C. Habitat Enhancement

The value to CVP cranes on lands owned by individuals, corporations and Indian tribes, or managed by various public agencies can be increased through cooperative ventures or extension education, regarding certain land-use activities. Specific measures that lead agencies should employ to effect habitat enhancement include, but are not limited to:

1. Recommending to private landowners, tribal land managers, and public agencies (e.g. Fish and Wildlife Service, Soil Conservation Service, Agricultural Stabilization and Conservation Service, U.S. Forest Service, Bureau of Land Management, Bureau of Indian Affairs, Corps of Engineers, Bureau of Reclamation) practices that would help, rather than harm cranes, including:
 - a. Minimize road and foot travel when it is closer than one-quarter mile of nesting, loafing, and roosting cranes in order to reduce disturbance.
 - b. Reducing or curtailing logging operations during the crane nesting season (1 April - 10 August) when the activity is closer than one-half mile to the breeding territory, in order to reduce human and mechanical disturbance.
 - c. Seeking early assistance in planning and siting utility corridors that would avoid

primary crane use-areas.

- d. Installing line markers or other devices on transmission lines where they pose aerial hazards to cranes. Recent studies in Colorado demonstrated mortalities could be reduced by as much as 91 % with yellow spiral damper line markers (Brown and Drewien 1995).
2. Carefully review water projects (dams, irrigation channels, etc.) which could adversely alter water levels on habitats important to cranes.

Lead Agencies: All agencies.
Participating: Yakama Indian Tribe
Priority: 1
Schedule: Ongoing.

D. CVP Greater Sandhill Crane Life History and Habitat Manual

A manual should be written which provides specific information for land management agencies on life history requirements, habitat components, nesting and brooding chronology, best management practices etc., for the CVP of Greater Sandhill Cranes. This information should be summarized in a leaflet describing good/optimum CVP crane nesting and brood-rearing habitats, and available methods for creating and maintaining such habitats to increase public awareness of CVP cranes and will include written and pictorial information on the life history of these cranes, and on the nature and necessity for a cooperative management program. This material would be provided to State, Provincial, and Federal agencies, schools and citizen groups for use, in part, to develop interpretive programs that include cranes.

Lead Agency: U.S. Fish and Wildlife Service
Priority: 1
Schedule 1996

PRODUCTIVITY

Sandhill cranes are a long-lived species, with inherent low productivity. To maintain this population, it is important to maintain productivity at a level high enough to result in the population's increase or at least its stability. In certain greater sandhill crane breeding areas low productivity caused by predators is a problem.

1. Predator Management Programs.

If predators are determined to be a significant problem by limiting productivity of CVP cranes in management areas, predator management programs should be considered on Federal and State lands.

Lead Agencies: All agencies

Priority: 1

Schedule: Ongoing and as necessary.

2. Malheur NWR, Oregon Predator Management Program.

The predator management program on Malheur NWR should continue, as this project is important to the welfare and subsequent expansion of the subspecies in southeast Oregon. After declining from a peak of 236 nesting pairs on the refuge about 1975 to 186 pairs in 1985, a predator control program was initiated in 1986. Since then, the refuge population had increased to 243 pairs in 1995 (G. Ivey, pers. comm.). Even though nesting success and productivity has fluctuated annually (Tables 12 and 13), the program has been successful. Once breeding territories have become occupied on the refuge, it is anticipated that new pairs will expand from the refuge onto surrounding unoccupied breeding habitat

The Malheur Refuge staff should continue to monitor predators and depredation rates on crane eggs and young. Future predator management should continue to focus on predator species which are limiting crane productivity on the refuge

Table 12. Greater sandhill crane nest fates recorded on Malheur NWR, Oregon, with predator management: 1986-1993 (% in parentheses) .

| YEAR | No. | Hatched | Abandoned | Flooded | Infertile | Depredated | Raven | Raccoon | Coyote | Unknown |
|-------|-----|----------|-----------|---------|-----------|------------|-------|---------|--------|---------|
| 1986 | 60 | 40 (67) | 2 (03) | 0 (00) | 2 (03) | 16 (27) | 2 | 2 | 1 | 11 |
| 1987 | 61 | 35 (57) | 2 (03) | 0 (00) | 3 (05) | 21 (34) | 4 | 4 | 0 | 13 |
| 1988 | 67 | 51 (76) | 3 (05) | 0 (00) | 1 (01) | 12 (18) | 4 | 1 | 0 | 7 |
| 1989 | 70 | 43 (61) | 2 (03) | 0 (00) | 2 (03) | 23 (33) | 9 | 4 | 3 | 7 |
| 1990 | 60 | 50 (83) | 4 (07) | 0 (00) | 1 (02) | 5 (08) | 2 | 2 | 0 | 1 |
| 1991 | 77 | 39 (50) | 0 (00) | 9 (12) | 10 (13) | 19 (25) | 1 | 0 | 4 | 14 |
| 1992 | 57 | 38 (67) | 3 (05) | 0 (00) | 5 (09) | 11 (19) | 3 | 1 | 4 | 3 |
| 1993 | 63 | 52 (83) | 1 (02) | 2 (03) | 3 (05) | 5 (08) | 0 | 1 | 0 | 4 |
| Total | 515 | 348 (68) | 17 (03) | 11 (02) | 37 (05) | 112 (22) | 25 | 15 | 12 | 60 |

Table 13. Mortality and recruitment rates for greater sandhill crane young on Malheur NWR, Oregon during predator management program: 1986-93.

| YEAR | % Mortality | No of Young Fledged | % Recruitment |
|--------|-------------|---------------------|---------------|
| 1986 | 77.6 | 50 | 12.1 |
| 1987 | 78.4 | 43 | 10.6 |
| 1988 | 97.0 | 6 | 2.1 |
| 1989 | 75.0 | 49 | 12.7 |
| 1990 | 87.7 | 22 | 5.8 |
| 1991 | 92.6 | 15 | 3.4 |
| 1992 | 94.2 | 16 | 4.0 |
| 1993 | 89.1 | 40 | 8.0 |
| Means: | 86.4 | 30 | 7.3 |

(G. Ivey and C. unpubl. data)

PUBLIC ENJOYMENT OF CRANES

1. Interpretive Program.

Observing greater sandhill cranes is an important pastime throughout the subspecies' range. Increasing the opportunities for this activity and providing for an increased understanding of these cranes are an integral part of this plan. Along with the life history manual, the subcommittee will develop written and pictorial information on the life history of these cranes, and on the nature and necessity for a cooperative management program. This material would be provided to State, Provincial, and Federal agencies, schools and citizen groups for use, in part, to develop interpretive programs that include cranes.

Lead Agencies/Group: Subcommittee, All agencies

Priority: 2

Schedule Ongoing

SURVEYS

1. Fall Population Survey.

The fall population index of CVP cranes throughout Oregon and California is the primary means of measuring the population status relative to the objective of this plan. The survey will involve counting adults and young, documenting brood size and recruitment for CVP cranes. Procedures for the survey are to be designed by the subcommittee, and the surveys are to be implemented by the lead agencies.

| | |
|----------------|---|
| Lead Agencies: | Design the survey: Subcommittee Conduct the survey: U. S. Fish & Wildlife Service Oregon Dept. of Fish & Wildlife California Dept. of Fish & Game |
|----------------|---|

Priority: 1 A

Schedule: Design the survey by August 1996. Conduct the survey beginning in the fall of 1996, thereafter biannually.

2. Range wide survey of Summering Populations.

Conduct on a 10-year basis the range wide breeding pair surveys like those completed in 1986 in Oregon and 1988 in California, to determine changes in breeding pair status (cf Littlefield et al., 1994). Expand survey efforts to include pairs in northwest Nevada, Washington, and British Columbia. Determine the population status and distribution of greater sandhill cranes summering in British Columbia through postal questionnaires, inquiries to conservation agents and birders, ground and aerial surveys, etc.

| | |
|----------------------|--|
| Lead Agencies/Group: | U.S. Fish & Wildlife Service Oregon Dept. of Fish & Wildlife California Dept. of Fish & Game Washington Dept. of Fish & Wildlife Canadian Wildlife Service British Columbia Wildlife Branch |
|----------------------|--|

Priority 1 B

3. Productivity and Production.

Information on nesting and fledging success of cranes on Malheur, Modoc, Lower Klamath NWR's, in Warner, Surprise, Sierra, Big, Chewaucan valleys, Sycan Marsh, and the Malheur-Harney Lakes Basin (off Malheur NWR) should be collected annually.

Lead Agencies/Groups: U.S. Fish & Wildlife Service
California Dept. of Fish & Game
Oregon Dept. of Fish & Wildlife
Oregon Natural Heritage Program

Priority: 1 C

Schedule: Begin in 1996 at all areas.

RESEARCH

As needed, the subcommittee shall encourage, develop or review research projects for Federal, State, Provincial, or other sources of funding.

RECOMMENDED RESEARCH:

1. Evaluation of Agricultural Changes and Crane use in the San Joaquin Valley, the Delta Region, and Sacramento Valley.

In recent years agricultural practices in the California Central Valley have been changing. An evaluation of these changes is needed to determine if such changes are having or will have a negative impact on crane feeding areas. If conversions (e.g. cereal grains to vineyards, rice to orchards) continue, crane feeding sites may become a limiting factor.

Lead Agencies: California Dept. of Fish & Game
U.S. Fish & Wildlife Service

Priority: 1 Schedule: Begin in 1996.

2. Relationship of Predation and Recruitment.

Assess the impacts of predators upon nesting cranes and recruitment of young birds to the population, and recommend management practices on both public and private lands that would minimize losses where the problem is deemed serious.

Lead Agencies:
All. Priority: 2
Schedule:
Ongoing.

3. Distribution and Migration.

The migration routes and the summer and winter distributions of certain segments of greater sandhill cranes need to be ascertained. This information would be obtained by marking cranes at the locations noted below, and by conducting extensive searches for the marked birds throughout their suspected range. Specific marking or telemetering efforts should include, but not be limited

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- a. Cranes wintering at Upper Butte Basin W.A., California, - Priority 1A.
- b. Ten or more migrating large sandhill cranes from Sauvies Island, Oregon, - Priority 1B.
- c. Cranes summering in Washington and British Columbia, - Priority 1 C
- d. Cranes summering in Baker, Clackamas, Wasco, Union, and Malheur counties, Oregon, Alvord Basin, Oregon, and Washoe County, Nevada - Priority 2.

Lead Agencies: Appropriate State, Federal, Provincial and non-government agencies cooperatively mark cranes. All agencies participate in collecting sightings of marked cranes.

Priority: Noted above.
Schedule: Begin in 1996.

4. Subadult survival and distribution.

Through radio-telemetry (providing a transmitter can be developed which will function for 4 years) and color marking of juvenile CVP cranes, subadult survival rates should be investigated. This study, in conjunction with nesting and fledging success studies could be used to develop a model for determining recruitment rates needed to maintain the population. In addition, information on subadult summering areas could possibly be obtained during the course of these studies.

Lead Agencies: U.S. Fish & Wildlife Service
California Department of Fish &
Game Oregon Department of Fish &
Wildlife
British Columbia Wildlife Branch

Lead Agency/Group: Subcommittee
Priority: 1
Schedule: Ongoing

ANNUAL REVIEW OF PLAN

The subcommittee shall meet annually or as needed to measure progress toward achieving the goal and objectives of this plan, and to recommend revisions. For the subcommittee to be most effective as a management entity, representatives should report to the subcommittee local issues on problems as they arise, which may pose a threat to the population, or its important habitats. The subcommittee shall report on accomplishments and shortcomings the progress of the cooperative management efforts to the Pacific Flyway Council (through the Western Migratory Upland Gamebird Committee), those states and federal agencies having management responsibilities, and those agencies and organizations either interested in or cooperating in the management of cranes.

Lead Agency/Group: Subcommittee

Priority: 1

Schedule: Annually (March meeting of the WMUGBTC) or as needed.

VI. LITERATURE CITED

- Braun, C.E., R.C. Drewien, C.D. Littlefield, and L.H. Walkinshaw. 1975. Conservation committee on status of sandhill cranes. *Wilson Bull.* 87(2):297-302.
- Brown, W.M. and R.C. Drewien. 1995. Marking powerlines to reduce crane and waterfowl collision mortality. *Wildl. Soc. Bull.* 23(2):217-227.
- Campbell, R.W., N.K. Dawe, I. McTaggart-Cowan, J.M. Cooper, G.W. Kaiser, and M.C.E. McNall. 1990. The birds of British Columbia. Royal British Columbia Mus., Vol. 2, Victoria, British Columbia, Canada.
- Drewien, R.C., W.M. Brown and W.L. Kendall. 1995. Recruitment in Rocky Mountain Greater Sandhill Cranes and comparison with other crane populations. *J. Wildl. Manage.* 59(2):339-356.
- Drewien, R.C. and J.C. Lewis. 1987. Status and distribution of cranes in North America. Pages 469-477 in G.W. Archibald and R.F. Pasquier, eds, Proc. 1983 Int. Crane Workshop, Int. Crane Found., Baraboo, Wise.
- Littlefield, C.D. 1976. Productivity of greater sandhill cranes on Malheur National Wildlife Refuge, Oregon. Pages 86-92 in J.C. Lewis, ed., Proc. Int. Crane Workshop, Oklahoma State Univ. Publ. and Printing, Stillwater, Okla.
- Littlefield, C.D. 1986. Autumn sandhill crane habitat use in southeast Oregon. *Wilson Bull.* 98: 131-137.
- Littlefield, C.D. 1989. Status of greater sandhill crane breeding populations in California, 1988. Calif. Dept. Fish and Game Nongame Bird and Mammal Section Report, Sacramento, Calif.
- Littlefield, C.D. 1993a. Greater sandhill crane assessment in the Upper Butte Basin, California 1991-93. Calif. Dept. Fish and Game draft report, Rancho Cordova, Calif.
- Littlefield, C.D. 1993b. Annual assessment and monitoring report for greater sandhill cranes and other threatened and endangered species on the Little Dry Creek Unit, California (October 1992 - February 1993). Calif. Dept. Fish and Game draft report, Rancho Cordova, Calif.
- Littlefield, C.D. and S.M. Lindstedt. 1992. Survival of juvenile greater sandhill cranes at Malheur National Wildlife Refuge, Oregon. Pages 21-31, in D.A Wood, ed, Proc. 1988 North American Crane Workshop, Fla. Game and Fresh Water Fish Comm., Nongame Wild I. Prog. Tech Report # 12.

- Littlefield, C.D. and D.G. Paullin. 1990. Effects of land management on nesting success of sandhill cranes in Oregon. *Wildl. Soc. Bull.* 18:63-65.
- Littlefield, C.D. and R.A. Ryder. 1968. Breeding biology of the greater sandhill crane on Malheur National Wildlife Refuge, Oregon. *Trans. N.A. Wildl. Conf.* 33: 444-454.
- Littlefield, C.D. and S.P. Thompson. 1979. Distribution and status of the Central Valley Population of greater sandhill cranes. Pages 113-120 in J.C Lewis, ed., *Proc. 1978 Crane Workshop*. Colorado State Univ. Print. Serv., Ft. Collins, Colo.
- Littlefield, C D., M.A. Stern, and R.W. Schlorff. 1994. Summer distribution, status, and trends of greater sandhill cranes in Oregon and California. *Northwest Nat.* 75: 1-10.
- Pogson, T.H. 1990. Distribution, abundance, and behavior of greater sandhill cranes (*Crus canadensis tabida*) wintering in California's Central Valley. M.S. Thesis, Univ. of Alaska, Fairbanks, Alaska.
- Pogson, T.R. and S.M. Lindstedt. 1991. Distribution and abundance of large sandhill cranes (*Crus canadensis tabida*) wintering in California's Central Valley. *Condor* 93: 266-278.
- Reinecke, K.J. and G.L. Krapu. 1979. Spring food habits of sandhill cranes in Nebraska. Pages 13-19 in J.C. Lewis, ed., *Proc. 1978 Crane Workshop*, Colorado State Univ. Print. Serv., Fort Collins, Colo.
- Robinson, W. 1978. Progress and the sandhill crane. *Discovery* 7: 26-27.
- Robinson, W. 1980. The greater sandhill crane. Pages 183-185 *in* R. Stace Smith, L. Johns, and P. Joslin, eds., *Threatened and Endangered Species and habitats in British Columbia and the Yukon*. British Columbia Ministry of the Environment, Fish and Wildl. Branch, Victoria, B.C
- Stern, M.A., G.J. Pampush, and R.E. Del Carlo. 1987. Nesting ecology and productivity of greater sandhill cranes at Sycan Marsh, Oregon. Pages 249-256 in J.C Lewis, ed., *Proc 1985 Crane Workshop*, Platte River Whooping Crane Maintenance Trust, Grand Island, Nebr.
- Stern, M.A., G.J. Pampush, K. Kristensen and R.E. Del Carlo. 1986. Survivorship, causes of mortality, and movements of juvenile sandhill cranes at Sycan Marsh, Oregon 1984-1985, Oregon Dept. of Fish and Wildlife Nongame Program, unpubl. report. Portland, Oreg.
- Sugden, L.G. and R.G. Clark. 1988. Small grain selection by captive sandhill cranes. *J. Wildl. Manage.* 52: 263-265.
- Weber, WC 1980. A proposed list of rare and endangered bird species for British Columbia Pages 160-182 in R. Stace-Smith, L. Johns, and P. Joslin, eds, *Threatened and Endangered Species and habitats in British Columbia and the Yukon* British Columbia Ministry of the Environment, Fish and Wildl. Branch, Victoria, BC.

APPENDIX A. SELECTED GREATER SANDHILL CRANE WINTERING NUMBERS AND LOCATIONS IN THE CALIFORNIA CENTRAL VALLEY. PAGE 1 OF 2

| LOCATION | DATE | NUMBER OF CRANES | SOURCE | LOCATION | DATE | NUMBER OF CRANES | SOURCE |
|---------------------------|-------------------------------------|------------------|---------------------|-------------------------------|-----------------|------------------|----------------|
| Sacramento Valley: | | | | Sacramento Valley: | | | |
| Llano Seco, Butte Co. | 6 Dec. 1969 | 655 | C. Littlefield | Gray Lodge W.A., Butte Co. | 6 Dec. 1968 | 448 | C. Littlefield |
| | 8 Nov. 1970 | 506 | C. Littlefield | | 6 Nov. 1970 | 606 | C. Littlefield |
| | 1976 | 651 | J. Snowden | | 17-19 Oct. 1983 | 702 | T. Pogson |
| | 20 Oct. 1983 | 216 | T. Pogson | | 19-20 Dec. 1983 | 630 | T. Pogson |
| | 21-22 Nov. 1983 | 681 | T. Pogson | | 12 Oct. 1990 | 691 | B. Deuel |
| | 20 Dec. 1983 | 786 | T. Pogson | | 24 Oct. 1990 | 560 | B. Deuel |
| | 23-24 Jan. 1984 | 1123 | T. Pogson | | 4 Nov. 1990 | 481 | B. Deuel |
| | 3 Dec. 1991 | 1577 | C. Littlefield | | 18 Nov. 1990 | 469 | B. Deuel |
| | 13 Jan. 1992 | 1589 | C. Littlefield | | 7 Dec. 1991 | 661 | C. Littlefield |
| | 8 Feb. 1992 | 1591 | C. Littlefield | | 29 Dec. 1991 | 911 | C. Littlefield |
| | Oct. 1992 | 1108 | C. Littlefield, FWS | | 5 Jan. 1992 | 714 | C. Littlefield |
| | Nov. 1992 | 1715 | C. Littlefield, FWS | | 9 Feb. 1992 | 123 | C. Littlefield |
| | Dec. 1992 | 2017 | C. Littlefield, FWS | | 19 Oct. 1992 | 449 | C. Littlefield |
| | Jan. 1993 | 2130 | C. Littlefield, FWS | | 1 Nov. 1992 | 711 | C. Littlefield |
| | Feb. 1993 | 2053 | C. Littlefield, FWS | 20 Dec. 1992 | 756 | C. Littlefield | |
| | Little Dry Creek Area, Butte Co. | 20 Dec. 1983 | 688 | T. Pogson | 28 Dec. 1992 | 804 | C. Littlefield |
| | | 24 Jan. 1984 | 233 | T. Pogson | 14 Feb. 1993 | 116 | C. Littlefield |
| 19 Oct. 1990 | | 1122 | B. Deuel | Brady Ranch, Sutter Co. | 21 Jan. 1976 | 544 | C. Littlefield |
| 28 Oct. 1990 | | 2244 | B. Deuel | | 17-19 Oct. 1983 | 1168 | T. Pogson |
| 5 Dec. 1991 | | 1520 | C. Littlefield | | 21-22 Nov. 1983 | 2246 | T. Pogson |
| 26 Dec. 1991 | | 2357 | C. Littlefield | | 19-20 Dec. 1983 | 469 | T. Pogson |
| 4 Jan. 1992 | | 1839 | C. Littlefield | | 26 Jan. 1984 | 231 | T. Pogson |
| 18 Jan. 1992 | | 1423 | C. Littlefield | | 1 Dec. 1991 | 737 | C. Littlefield |
| 4 Feb. 1992 | | 1254 | C. Littlefield | | 8 Dec. 1991 | 810 | C. Littlefield |
| 14 Feb. 1992 | | 1123 | C. Littlefield | | 25 Dec. 1991 | 523 | C. Littlefield |
| 25 Feb. 1992 | | 732 | C. Littlefield | | 6 Jan. 1992 | 862 | C. Littlefield |
| 24 Oct. 1992 | | 2117 | C. Littlefield | | 23 Jan. 1992 | 685 | C. Littlefield |
| 14 Nov. 1992 | | 2422 | C. Littlefield | | 1 Feb. 1992 | 754 | C. Littlefield |
| 29 Dec. 1992 | | 2482 | C. Littlefield | | 24 Feb. 1992 | 166 | C. Littlefield |
| 19 Jan. 1993 | | 3065 | C. Littlefield | | 22 Oct. 1992 | 640 | C. Littlefield |
| 4 Feb. 1993 | | 3413 | C. Littlefield | | 5 Nov. 1992 | 1182 | C. Littlefield |
| 14 Feb. 1993 | | 1524 | C. Littlefield | 26 Nov. 1992 | 970 | C. Littlefield | |
| | | | | 10 Dec. 1993 | 664 | C. Littlefield | |
| | | | | 7 Jan. 1993 | 141 | C. Littlefield | |
| | | | | 3 Feb. 1993 | 50 | C. Littlefield | |
| | | | | 14 Feb. 1993 | 28 | C. Littlefield | |

APPENDIX A. SELECTED GREATER SANDHILL CRANE WINTERING NUMBERS AND LOCATIONS IN THE CALIFORNIA CENTRAL VALLEY.

| LOCATION | DATE | NUMBER OF CRANES | SOURCE | LOCATION | DATE | NUMBER OF CRANES | SOURCE | |
|---|-----------------|------------------|----------------|---|--|------------------|----------------|----------------|
| Sacramento Valley: | | | | San Joaquin - Sacramento Rivers Delta: | | | | |
| Butte Basin Farm, Colusa Co. | 17-19 Oct. 1983 | 509 | T. Pogson | Staten Island, San Joaquin Co. | 24 Oct. 1983 | 813 | T. Pogson | |
| | 19-20 Nov. 1983 | 934 | T. Pogson | | 29 Nov. 1983 | 845 | T. Pogson | |
| | 19-20 Dec. 1983 | 60 | T. Pogson | | 9 Dec. 1983 | 595 | T. Pogson | |
| | 4 Dec. 1991 | 125 | C. Littlefield | | 28 Jan. 1984 | 1634 | T. Pogson | |
| | 11 Dec. 1991 | 250 | C. Littlefield | Consumnes, San Joaquin Co. | 26 Oct. 1983 | 65 | T. Pogson | |
| | 19 Dec. 1991 | 317 | C. Littlefield | | 3 Nov. 1983 | 197 | T. Pogson | |
| | 14 Jan. 1992 | 68 | C. Littlefield | | 7 Dec. 1983 | 238 | T. Pogson | |
| | 22 Feb. 1992 | 78 | C. Littlefield | | 29 Jan. 1984 | 1390 | T. Pogson | |
| | 23 Oct. 1992 | 260 | C. Littlefield | | San Joaquin Valley: | | | |
| | 31 Oct. 1992 | 524 | C. Littlefield | | Faith & Mapes Ranch, Stanislaus Co. | 27 Oct. 1969 | 72 | C. Littlefield |
| | 22 Nov. 1992 | 423 | C. Littlefield | | | 14 Nov. 1969 | 203 | C. Littlefield |
| | 14 Dec. 1992 | 214 | C. Littlefield | | | 12 Dec. 1969 | 298 | C. Littlefield |
| | 22 Dec. 1992 | 326 | C. Littlefield | 3 Feb. 1970 | | 287 | C. Littlefield | |
| | 4 Jan. 1993 | 91 | C. Littlefield | 18 Feb. 1971 | | 253 | C. Littlefield | |
| | 26 Jan. 1993 | 32 | C. Littlefield | 26 Jan. 1976 | | 184 | C. Littlefield | |
| 10 Feb. 1993 | 27 | C. Littlefield | 5 Oct. 1983 | 80 | T. Pogson | | | |
| Butte Farms (Bean Patch), Colusa Co. | 17-19 Oct. 1983 | 1500 | T. Pogson | 29 Oct. 1983 | 128 | T. Pogson | | |
| | 11 Dec. 1991 | 430 | C. Littlefield | 28 Dec. 1983 | 226 | T. Pogson | | |
| | 31 Dec. 1991 | 62 | C. Littlefield | Merced NWR, Merced Co. | 26 Nov. 1969 | 23 | C. Littlefield | |
| | 1 Feb. 1992 | 257 | C. Littlefield | | 8 Dec. 1969 | 41 | C. Littlefield | |
| | 8 Feb. 1992 | 402 | C. Littlefield | | 27 Jan. 1970 | 63 | C. Littlefield | |
| | 2 Nov. 1992 | 397 | C. Littlefield | | 1 Feb. 1970 | 90 | C. Littlefield | |
| | 3 Dec. 1992 | 759 | C. Littlefield | | 15 Feb. 1971 | 110 | C. Littlefield | |
| | 14 Dec. 1992 | 462 | C. Littlefield | | 1 Mar. 1971 | 98 | C. Littlefield | |
| | 4 Jan. 1993 | 170 | C. Littlefield | 27 Jan. 1976 | 47 | C. Littlefield | | |
| | 10 Feb. 1993 | 101 | C. Littlefield | 1 Jan. 1984 | 32 | T. Pogson | | |
| San Joaquin - Sacramento Rivers Delta: | | | | Pixley NWR, Tulare Co. | 22 Nov. 1969 | 68 | C. Littlefield | |
| Woodbridge Road Area, San Joaquin Co. | 14 Dec. 1969 | 994 | C. Littlefield | | 7 Feb. 1971 | 7 | C. Littlefield | |
| | 8 Feb. 1970 | 723 | C. Littlefield | | 3 Jan. 1984 | 14 | T. Pogson | |
| | 12 Nov. 1970 | 301+ | C. Littlefield | | | | | |
| | 19 Feb. 1971 | 997 | C. Littlefield | | | | | |
| | 24 Jan. 1976 | 933 | C. Littlefield | | | | | |
| | 22-28 Oct. 1983 | 959 | T. Pogson | | | | | |
| | 27-30 Nov. 1983 | 1223 | T. Pogson | | | | | |
| Grand Island, San Joaquin Co. | 11 Dec. 1983 | 2204 | T. Pogson | | | | | |
| | 28 Jan. 1984 | 2195 | T. Pogson | | | | | |
| | 16 Dec. 1983 | 675 | T. Pogson | | | | | |