STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF FISH AND GAME
WILDLIFE MANAGMENT DIVISION
NONGAME BIRD AND MAMMAL SECTION

STATUS OF GREATER SANDHILL CRANE BREEDING POPULATIONS IN CALIFORNIA, 1988

by

Carrol D. Littlefield
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ABSTRACT

A total of 227 Greater Sandhill Crane pairs was recorded during the survey. The largest number was in Modoc County, with 164 pairs. Lassen County had 75 pairs, followed by Siskiyou County, with 29, Plumas County, with 7 and single pairs in both Shasta and Sierra counties. Pairs increased 32% between 1981 and 1988 at 11 traditional nesting locations. During the study, 56 crane nests had a success rate of 37.5%. Nesting success ranged from 0.0% in Ash Creek Valley, Lassen County, to 66.7% near Goose Lake, Modoc County. Coyotes were the most important predator, consuming 30.4% of the clutches. Common Ravens were the second most important predator, destroying 10.7% of all clutches. Of 37 crane pairs monitored through the nesting season at Surprise Valley, 64.9% never attempted to nest because of extremely dry conditions. Only 20 young fledged from 224 crane pairs surveyed in July and August for a recruitment rate of 4.5%.

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RECOMMENDATIONS

The contractor makes the following recommendations with which the Department concurs:

1. Retain the Greater Sandhill Crane on the California Threatened Species List.

2. Continue to monitor crane pair numbers at key nesting areas.

3. The need for predator control, particularly for coyotes and Common Ravens, should be evaluated in certain crane nesting areas.

4. Monitor wetland areas to detect land use changes and potential threats.

5. Continue to acquire key crane nesting habitats.

6. Conduct nesting studies in selected areas periodically.

7. Federal wetlands, particularly on U.S. Forest Service lands, should be fenced and protected from summer livestock grazing.

8. Continue to seek protection for wetlands in northeast California.

INTRODUCTION

The California nesting population of Greater Sandhill Cranes *(Grus canadensis tabida)* was first systematically studied in 1971 and again in 1981. Inasmuch as the subspecies was designated a Threatened bird by the California Fish and Game Commission in 1983, another survey was proposed for 1988 to update the breeding status. Major objectives included: 1) repeat of the 1981 survey to document range, population, habitat, and impacts; 2) assess the impact of livestock grazing on the population, particularly on U.S. Forest Service and other public lands; 3) assess the impact of land conversions on the population and habitat on private lands; 4) identify habitat for possible acquisition; 5) examine the impact of predation on a sample of the population on both private and public lands; 6) gather reproductive information on a selected number of nests on private land with a variety of nongrazing and grazing impacts, and public lands with and without grazing impacts; and 7) document mortality rates of young cranes and attempt to determine sources of mortality.

Unfortunately, nesting studies were somewhat limited in 1988 because of the extremely dry conditions which persisted throughout the reproductive period. Drought was particularly evident in Lassen, Plumas, Siskiyou, and Shasta counties, but some relief in Modoc County occurred in late April and early May. Over 7.0 cm of rainfall occurred during this period in some regions, particularly in the vicinity of Alturas. Elsewhere within the six county study area little or no precipitation was recorded. This resulted in many crane pairs making no effort to nest in 1988. Naylor et al. (1954) reported similar behavior for Greater Sandhill Cranes in California in the late 1940s and early 1950s.

Of the five Greater Sandhill Crane populations presently recognized, the Central Valley Population (CVP) is the only one known to be declining in portions of its nesting range. However, the status of two of these populations has not been determined. The remaining two have increasing numbers. The CVP is confined to the Pacific States and British Columbia. About 3200 individuals occur in south-central and eastern Oregon, and northeast California. The number nesting in Washington and British Columbia is presently unknown (Littlefield and Thompson 1979). Of the Oregon and California nesting segment, the majority occur in Oregon (approximately 950 pairs) and it is there that major declines have occurred. In California, minor declines have been noted in the southern portion of their range, while increases have been noted in the northern portion, particularly in Modoc and Siskiyou counties.

In the early 1980s, above normal precipitation occurred in northeast California, providing improved nesting and brooding habitat. This was probably a major contributing factor for the increase in nesting pairs between 1981 and 1988. However, if drought conditions, as occurred in 1988, persist for an extended period, decreases can be expected over much of the Greater Sandhill Crane breeding range in the future. Also, alfalfa prices increase dramatically with prolonged drought. With alfalfa price increases, more land can be expected to be converted from wet-meadow to alfalfa. Wet-meadows are the major crane nesting habitat within the state.

STUDY AREA

The study area encompassed six counties in northeast California (Figure 1).

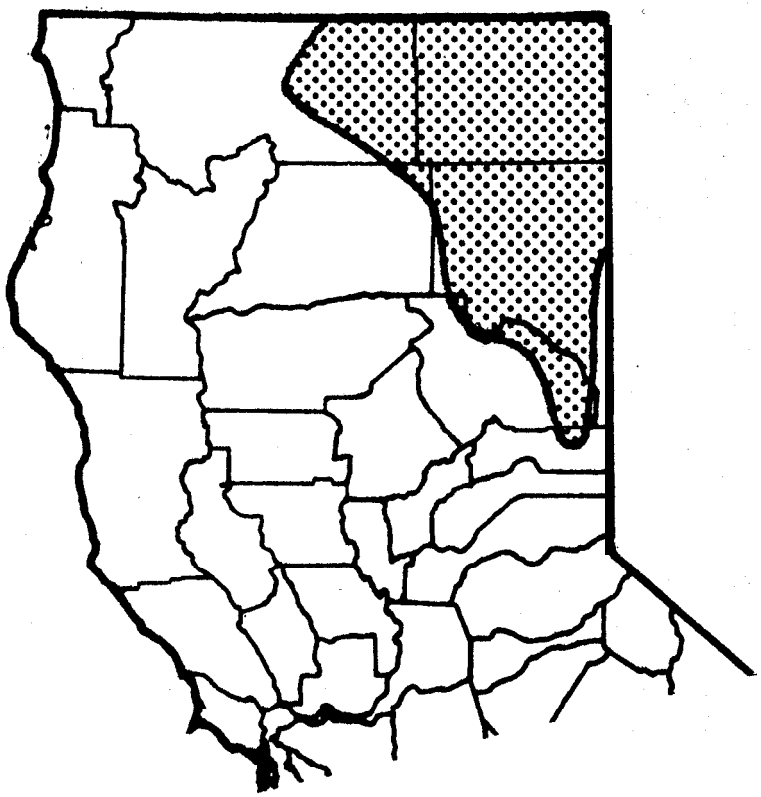

Figure 1. Nesting distribution (shaded area) of Greater Sandhill Cranes in California.

It was bound on the west by Montague, Siskiyou County, north to the Oregon Border, east to Nevada, and south to Sierraville, Sierra County. Most known Greater Sandhill Crane nesting habitat was surveyed within this area. In Modoc County, nesting studies were conducted in Surprise and Jess valleys, near Likely, Goose Lake, Modoc National Wildlife Refuge (NWR), and Ash Creek Wildlife Area (WA), and in Lassen County at Ash Creek WA and Ash Creek Valley. Brood counts were conducted in the same areas as well as in Lassen National Forest (NF), Lassen County, Honey Lake WA, Lassen County, Willow Creek Valley, Lassen County, Madeline Plains, Lassen County, Sierra Valley, Plumas County, and Lower Klamath NWR, Siskiyou County. In addition, brood counts were conducted throughout Siskiyou County by Richard Johnstone. Fall River Valley, in Shasta and Lassen counties, was not examined for broods as no water had been received in the nesting marshes by mid-June. Major study emphasis was in Lassen and Modoc counties.

MATERIALS AND METHODS

The study was initiated on 12 March 1988 and completed on 11 August 1988. Pair surveys were conducted between 12 March and 15 June, nesting studies between 28 April and 18 June, and production surveys between 15 July and 11 August. All known or suspected sites were examined with 7 X 35 binoculars and a 20X spotting-scope. Areas were surveyed from a vehicle when possible, but inaccessible site surveys were conducted on foot. Meadow habitats at Gray's Valley and Bullard Lake, Lassen County, were not investigated because of impassable roads; however, L. Schultz (pers. comm.) reported that each had a crane pair and these have been added to the survey total. The western portion of Siskiyou County was examined by R. Johnstone. The staff at Modoc NWR was responsible for pair surveys on the Refuge. When a crane pair was located its nesting territory was documented to the nearest one-sixteenth Section.

Measurements taken at each nest included vegetative type and height, water depth, egg sizes, nest measurements, and concealment (i.e., cover). Concealment was classified as poor, fair, good, or excellent, depending on the distance from which the incubating bird could be seen. Land management regimes were recorded as hayed, idle, or grazed by cattle. Grazing refers to winter grazing, as no nests were located in areas of summer grazing. Upon locating an active nest, eggs were floated to determine incubation state (Westerskov 1950, and modified by R. Drewien and C. Littlefield for cranes). After the normal 30 day incubation period nests were revisited and the fate of the eggs determined. If loss of reproduction was suspected due to predation, predator identity was determined primarily by the condition of egg remains.

Selected nesting areas were surveyed and the number of fledged young were recorded in August. Young cranes are usually still within the general area of the breeding territory as they are incapable of long-distance flight at this time. In an effort to monitor the chronology of both successful and unsuccessful pairs, two transects were established in Surprise Valley. The transect routes ran from Fort Bidwell southward to Lake City and from 3.2 km northeast of Eagleville to 4.8 km east of Eagleville. Thirty-seven pairs were located along these routes. Seven surveys were conducted between 25 May and 9 August 1988.

Approximately 22,000 km were driven during the study.

RESULTS

Historically, Greater Sandhill Cranes were recorded in the northeastern plateau region, west to Siskiyou County, northeastern Shasta County, and south to Honey Lake. Nesting sites were known from Fort Crook, Shasta County, in 1860, Fort Bidwell in 1878, near Eagleville in 1912 and 1924, near Alturas in 1926, and Jess Valley in 1931 (cf. Grinnell and Miller 1944). For a brief historical account of Greater Sandhill Cranes in California see Littlefield (1982).

Cranes presently occupy these same general areas and have increased since the 1940s. Walkinshaw (1949) estimated that only three to five pairs were nesting in California in 1944. This estimate was similar to numbers nesting earlier in the century as Dawson (1923) reported that if there were any breeding cranes left in the state, there were probably no more than six. However, the intensity of these earlier investigations does not compare with the 1971, 1981 and 1988 studies. Currently the subspecies is widely distributed and relatively dense in portions of the northeast California nesting range, particularly in Modoc County.

1988 Distribution, Abundance, and Habitat

A total of 277 Greater Sandhill Crane pairs was recorded during the 1988 survey (Table 1, Appendix A). The largest number was in Modoc County with 59.2% of all pairs. Lassen County was second in importance with 27.1% of all pairs, followed by Siskiyou County with 10.5% and Plumas County with 2.5%. Both Shasta and Sierra counties had single pairs. This was the first survey record for Sierra County; but James (1977) had previously reported on a nesting pair near Sierraville. Four additional pairs were recorded in Fall River Valley, Lassen County; however, these pairs were near the Shasta County line and often fed in that county.

Surprise Valley had 56 pairs for the largest number of any California area. Other important nesting locations were Big Valley, Modoc and Lassen counties 32 pairs, Modoc NWR 30 pairs, Lakeshore Ranch, near Goose Lake 15 pairs, Ash Creek Valley 17 pairs, near Likely 12 pairs, and Lower Klamath NWR 10 pairs. All of these areas have shown pair increases since the last survey in 1981. These seven areas presently account for 62.1% of the pairs which nest in California. Of the 277 pairs located in 1988, 185 (66.8%) were on private land and 92 (33.2%) were recorded on state and federal lands. Of those recorded on public lands, 41 pairs were on NWRs, 36 on State Wildlife Areas and 15 on U.S. Forest Service lands.

Modoc County

Greater Sandhill Cranes were found at 24 locations in Modoc County in 1988. Of the 164 pairs, 56 (34.2%) were in Surprise Valley. Major concentrations in the valley were north and east of Eagleville (21 pairs), north and northeast of,Lake City (16 pairs), south of Fort Bidwell (7 pairs), and at the southern extremity on the Bare Ranch at the south end of Surprise Valley, (5 pairs). Most Surprise Valley pairs were found in wet-meadow habitat; however, east of Eagleville, extensive stands of hardstem bulrush *(Scirpus acutus)* were present. Therefore, in the valley as a whole, most nesting occurred in wet-meadow habitat. Nesting in Surprise Valley was limited in 1988 because of dry conditions. Of 15 pairs located east of Eagleville, only four were believed to have nested.

Table 1. Geographical location and numbers of Greater Sandhill Crane pairs in California - 1988

LOCATION	NUMBER
Modoc County	
Goose Lake	15
Davis Creek (8.4 km S.)	1
Alturas area	7
Surprise Valley	56
Cow Head Lake	1
Canby area	5
Jess Valley	9
Likely area	12
Big Valley (not on WA)	1
Ash Creek WA	8
California Pines	1
Egg Lake	4
Hackamore Reservoir	1
Beeler Reservoir	1
Ingell Swamp	1
Hager Basin	1
Weed Valley	1
Steele Swamp	1
Sweringer Reservoir	1
Fairchild Swamp	1
Buchanan Flat	1
Wildhorse Valley	1
White Horse Flat	3
Modoc NWR	30
Subtotal	164
Lassen County	
Big Valley (not on WA)	1
Ash Creek WA	22
Fall River Valley	4
Madeline Plains	2
Clark's Valley	1
Red Rock Lake	3
Susan Valley Ranch	1
Honey Lake WA	5
Willow Creek Valley	6
Horse Lake	1
Grasshopper Valley	1
Ash Valley	17
Papoose Meadow	1
Little Harvey Valley	2
Ashurst Lake	1
Pine Creek Reservoir	1
Gray's Valley	1
Bullard Lake	1
Feather Lake	1
Subtotal	75

LOCATION	NUMBER
Siskiyou County	
Tule Lake NWR	1
Prather Ranch	1
Montague Area (3.6 km E.)	5
Grenada	1
Big Springs	1
Orr Lake	1
Red Rock Lakes	1
Grass Valley	5
Oklahoma Flat	2
Lower Klamath NWR	10
Subtotal	29
Plumas County	
Sierra Valley	5
Indian Valley	1
Chester area	1
Subtotal	7
Shasta County	
Fort Crook	1
Subtotal	11
Sierra County	
Sattley	1
Subtotal	1
California	
Total	277

Modoc NWR had 30 pairs and nesting conditions appeared suitable after a period of precipitation in April and May. Most nesting occurred in wet-meadow habitat and all pairs were believed to have nested. Although extensive stands of common cattail *(Typha latifolia)* occurred on the west portion of the Refuge little nesting occurred there. Seven other pairs nested in the vicinity of Alturas. These were mostly in wet-meadow habitat. One nest along the Pit River, west of Alturas, was flooded in April (C. Bloom, pers. comm.).

Twelve pairs were present on 29 March 1988 west and northwest of Likely. Territories *were* primarily in wet-grazed meadows; however, a few isolated stands of cattails and hardstem bulrush were present in some territories. Nine pairs were recorded in Jess Valley (Figure 2). Eight pairs remained in the southern one-half of the valley, while one pair moved to the northern portion during the nesting season. Considerable spring use occurred along the edge of a flooded peat mining operation at the southern end of the valley; however, during the nesting season all but one pair moved north and nested in open wet-grazed meadows.

Along the south shore of Goose Lake most pairs occupied territories on the Lakeshore Ranch (northeast of Davis Creek). Summer cattle grazing occurred throughout the ranch except in a fenced marsh in the northeast portion. Other than in this marsh, little nesting apparently occurred although much of the ranch had some water throughout the breeding season. Five pairs had territories about 2.5 km west of the ranch headquarters in an emergent vegetation covered bay of Goose Lake. Unfortunately, this bay had dried by mid-June, eliminating the habitat for about one-third of the local nesting pairs. First located in 1971, a nesting territory about 12 km south of Davis Creek was still occupied in 1988. Little water was available in the nesting meadow through the season and the pair never nested.

Five pairs were located in the vicinity of Canby. In 1981, most pairs were southwest of Canby, but in 1988 pairs had shifted to the east. Only one pair was present southwest of Canby while four were located to the southeast. All crane pairs were in mowed and winter grazed meadows. This eastward shift might be related to intensive year-long livestock grazing which has occurred southwest of Canby (P. Roush, pers. comm.). South of the Pit River, and southwest of California Pines, a single pair was located in a winter-grazed meadow on 5 April. Little water was in the meadow; however, several cattail stands were present in a series of small ponds to the south. This was probably the pair which has been seen occasionally at California Pines Reservoir.

In Big Valley, nine pairs were located in Modoc County, while 23 pairs were south of the Lassen County border (Figure 3). Some pair shifting appeared to have occurred in the valley during the study period. This was apparently related to drought conditions. For example, the pair which was originally located along Willow Creek (west of Adin) moved northwest to nest on Ash Creek WA and several pairs that have nested in the central portion of Ash Creek WA moved south and north where water was available. This shifting made it difficult to determine the exact number of pairs using the valley and it is possible that 34 pairs used the area instead of the 32 recorded during the study. Of these pairs, 30 occupied territories on Ash Creek WA, but under normal or above normal water conditions this number might vary.

Photo by C.D. Littlefield

Figure 2. Greater Sandhill Crane nesting habitat in Jess Valley, Modoc County. Nine pairs presently nest in the valley.

Photo by C. D. Littlefield

Figure 3. Big Valley, Modoc and Lassen Counties supported 32 Greater Sandhill Crane pairs in 1988.

North and west of Big Valley, crane pairs were located at both Egg Lake and Whitehorse Flat. Four pairs were at Egg Lake on 27 April, but all meadow habitat was dry except some water was present in the extensive bulrush stands. One nest was seen on an aerial survey in May (B. Deuel, pers. comm.). Three pairs, including one with two chicks, were noted at Whitehorse Flat on 15 June. The flat contained excellent crane habitat in the north portion, with the potential for additional habitat in the south. The southern portion was mostly dry and being grazed by livestock in June, but water was adequate in the north. Pairs were seen in a few isolated stands of bulrushes among the rushes. Aerial surveys in May indicated that there may have been more pairs present, as B. Deuel (pers. comm.) observed two pairs, four singles, and two nests.

Other private lands in Modoc County had single crane pairs at widely scattered localities. A single pair was recorded for the first time at Cow Head Lake Valley north of Surprise Valley. The meadows had water through much of the nesting season and a few isolated stands of bulrush and broad-fruited burreed *(Sparganium eurycarpum)* were scattered among the meadows. The area had been heavily winter-grazed, and on 27 March the pair was standing beneath a powerline which bisects the meadow habitat. The pair was not seen after March, although habitat appeared favorable. Northwest of Alturas, three other privately owned wetlands had Greater Sandhill Crane pairs. Ingell Swamp had a single pair on 12 May. At this time the meadows were dry, but spring fed wetlands in the west portion provided adequate habitat. One pair was at Steele Swamp on 20 May (about 8km E. of Clear Lake NWR). Habitat was similar (but drier) to that recorded on the 1981 survey. Water was present in the sloughs in the south portion and the pair was feeding along the western edge of the meadow. Meadows had been either mowed or winter-grazed. Also, northwest of Alturas, a pair was recorded at Hager Basin which has been a traditional site since at least 1981. Habitat had not changed in 1988; however, cattle were grazing on the nesting site that was active in 1981. No cranes were noted on 12 May but they were present on 13 June 1988. A pair was located at Sweringer Reservoir southwest of Eagleville, on 24 May. Here, habitat was in good condition but cattle were beginning to congregate on the area. Extensive meadows on the west side of the reservoir had ample water as several streams from the Warner Mountains flowed through the area. T. Melanson (pers. comm.) reported that this pair was also present in 1987.

Seven pairs were located on Modoc N.F. lands. Three pairs were in isolated wetlands near the Oregon border, three pairs were north of Canby, and one northwest of Alturas. Along the Oregon border, one pair with two 3 to 4 week old chicks was located on 13 June at Buchanan Flat. Extensive stands of bull rushes were present and water did not appear insufficient except in the southern portion of this approximately 10 ha wetland. The pair and both chicks were still present on 13 July. West of Buchanan Flat, one pair was recorded on 13 June at Wild Horse Valley. Water was limited in June, particularly in the northwest portion, and cattle were present throughout the wetlands in July. Another pair was at Weed Valley, but as was the case with the Wild Horse Valley pair, deficient water likely resulted in a failed reproductive effort. Cattle were grazing in the wetlands by mid-July. Near Canby, pairs were present at Beeler and Hackamore reservoirs, and Fairchild Swamp. A nest was seen at Beeler Reservoir during an aerial survey in May (B. Deuel, pers. comm.), but this attempt was apparently unsuccessful as the pair had no young on 14 July. Habitat at Beeler Reservoir has improved since 1981 as the area has now been fenced and protected against cattle grazing. Rushes

are now becoming well established along the shoreline and several meadows extend into the surrounding ponderosa pine *(Pinus ponderosa).* No cattle were noted at Hackamore Reservoir and favorable crane habitat was present along the south shore, but the pair was not seen after 5 May. Excellent wetland habitat has been created behind a dike at the western portion of Fairchild Swamp, and on 5 June a crane pair was located in the wetland. Open water, with a fringe of Baltic rush *(Juncus balticus)* and isolated stands of cattails, characterized the area. The crane pair had no chicks. Cattle were present in portions of the wetland habitat on 5 June, but little degradation had occurred. Northwest of Alturas, one pair nested in a small pond near Reservoir C. Flooded western juniper *(Juniperus occidentalis)* snags, with isolated stands of rush were present. Extensive grasslands occurred south of the site. After the eggs hatched, the pair was not seen again; however, a pair seen on the Antelope Plains (South of the nest site) during an aerial survey (B. Deuel, pers. comm.), could have been the same pair.

With the abnormally dry conditions in portions of Modoc County in 1988, some Greater Sandhill Cranes apparently dispersed in search of more favorable nesting habitat. Both Baseball Reservoir and Boles Meadow were examined from the ground in May and no cranes were recorded. However, some crane use did occur in these areas as B. Deuel (pers. comm.) later observed single birds during aerial surveys at both of these locations. In addition, two pairs were observed from the air at Deadhorse Flat. Whether the latter birds were wandering individuals or territorial pairs was undetermined since no ground surveys were conducted in the area.

Of the 164 Greater Sandhill Crane pairs recorded in 1988 in Modoc County, 119 (72.6%) were on private land, 30 (18.3%) were on a National Wildlife Refuge, eight (4.9%) were on a State Wildlife Area, and seven (4.3%) were on U.S. Forest lands. Of the 110 pairs recorded in the 1981 in the County, 80.9% were on private land, 18.2% on a National Wildlife Refuge, and 0.9% on U.S. Forest Service lands (Littlefield 1982).

Lassen County

Greater Sandhill Cranes were located at 19 sites in Lassen County in 1988. Of the 75 pairs recorded,. Big Valley had the largest number with 23 (30.2%), of which 22 were near Bieber on Ash Creek WA. Second in importance was Ash Creek Valley where 17 pairs were recorded. Most of these pairs were in the east portion of the valley on the Stone Ranch where eight nests were located in 5 ha of burreed. Other isolated stands of emergent vegetation were present throughout the valley. Only five pairs were present on the meadow habitat west of the Stone Ranch headquarters. The entire area had been winter-grazed and a few meadows west of the county road were still being grazed on 25 April. No crane pairs were present in these meadows.

Willow Creek Valley supported six pairs; three on the winter-grazed meadows south of the Horse Lake Road and three in the marsh-agricultural areas north of the road. Honey Lake WA had five pairs, four on or adjacent to the Fleming Unit and one on the Dakin Unit. Two of the Fleming Unit pairs were feeding in an irrigated mowed-grazed meadow on private land, while the other two were in Wildlife Area grain fields. The Dakin Unit pair was east of Hartson Reservoir in a diked pond with stands of hardstem bulrush.

Habitat in the Lassen County portion of Fall River Valley remained dry throughout the nesting season. Four pairs were present on 26 April, feeding primarily in agricultural fields in neighboring Shasta County. Nesting habitat consists of wet meadows interspersed with cattails. Southeast of Fall River Valley, Dixie Valley continued to be severely degraded by livestock overgrazing; however, three pairs were using the meadow habitat on 26 April. These birds probably nested in the deeper water areas which had extensive bulrush stands. These stands appeared to have been spared the intensive grazing pressure which characterized the meadows and surrounding uplands. With livestock removal, this valley has the potential for providing habitat for at least 15 Greater Sandhill Crane pairs.

East of Madeline, Clark's Valley had a crane pair feeding in a spring-fed, moist winter-grazed meadow on 6 April. Immediately east of Clark's Valley, Red Rock Lake had three pairs (Figure 4). This lake was rapidly drying on 6 April and it is doubtful any nesting occurred as extensive mudflats separated open water from the dry Baltic rush nesting habitat. During normal precipitation years this area probably provides ideal nesting habitat. Two pairs were present on winter-grazed meadow habitat about 4 and 5 km west of Madeline. Neither was apparently successful as water in the area was limited. There was a report that one egg set was removed illegally at this location in 1988, but details are presently lacking. Single pairs were present on privately owned lands at Horse Lake, Susan Valley Ranch, and Grasshopper Valley. The Horse Lake area consisted of winter-grazed meadows, but little water was present in early April except in the Horse Lake playa. Swan Valley Ranch (about 20 km ENE of Termo) had a single pair of Greater and eight Lesser Sandhill Cranes *(G.* c. *canadensis)* along the south shore of a reservoir immediately south of the ranch headquarters. No water was on the grazed meadow habitat to the south as irrigation water from the reservoir had not been released by 6 April. One pair was in the northwest portion of Grasshopper Valley on 8 April, feeding in a winter-grazed dry meadow. Unless this pair moved southward about 5 km to a few isolated springs in the southwest portion of the valley, it is doubtful that nesting occurred.

On Lassen N-F., five pairs were located during the 1988 survey and an additional three pairs were reported by Forest Service personnel (L. Schultz, pers. colnm.). Two pairs were in Little Harvey Valley but little water was present in this extensive valley on 8 May. Conditions had deteriorated by mid-July as cattle were concentrated in the limited wetland habitat. Similar conditions were noted at Pine Creek Reservoir and Papoose Meadows, but single pairs in both areas apparently nested. Each was unsuccessful. Ashurst Lake had a pair present on 8 May. At that time emergents were flooded, but adjacent meadows were mostly dry. The lake was completely dry by mid-July. This was one of the few wetlands examined in Lassen N.F. which did not have cattle in July. The three additional pairs reported by Forest Service personnel were located at Bullard and Feather lakes, and Gray's Valley. Both Bullard Lake and Gray's Valley were inaccessible during the May survey, but Feather Lake was examined in both May and July. Water was present in a hardstem bulrush stand in May, but by mid-July the lake was mostly dry and being heavily grazed by cattle. No cranes were seen during both visits.

Of the 75 known Greater Sandhill Crane pairs recorded in Lassen County, 40 (53.3%) were on private land, eight (10.7%) on U.S. Forest Service lands, and 27 (36.0%) were on or adjacent to a State Wildlife Area. This compares with 80.3% on private lands, 9.8% on U.S. Forest Service land, 8.2% on state land, and 1.7% on Bureau of Land Management (BLM) land in 1981 (Littlefield 1982).

Photo by C.D. Littlefield

Figure 4. Three Greater Sandhill Crane pairs occupied territories at Red Rock Lakes, Lassen Co., in 1988, but drought conditions likely prevented any nesting attempts.

Siskiyou County

Much of Siskiyou County was surveyed for nesting cranes by Richard Johnstone in 1988. Exceptions were Lower Klamath and Tule Lake NWRs, and Oklahoma Flat which I examined in May and August. Pairs in Siskiyou County were widely dispersed and no large concentrations occurred except at Lower Klamath NWR and Grass Lake. Ten pairs were present on Lower Klamath NWR on 22 May, including one pair with a less than one week old chick. Some pairs could have been using the Refuge for feeding purposes only, as four pairs were recorded on recently planted grain fields. The remaining pairs were in grasslands or fallow fields. Since lands in Oklahoma Flat, and southward along Willow Creek, had deficient water, some pairs present on the Refuge could have moved from these two areas. Five pairs were occupying territories at Grass Lake (Figure 5). Cranes were first noted at the lake in 1979, indicating the subspecies has increased in Siskiyou County in recent years. The lake consists of an extensive stand of rush, bordered by meadows and grass-covered uplands. Nesting occurs among the rushes and young cranes are fed primarily in the meadows and uplands. One chick was killed after colliding with a truck in 1986 as it was apparently being moved to a favorable feeding area (Klamath NWR files).

Three pairs nested in close proximity on the Hart Ranch (about 8 km ESE of Montague). Interestingly, the local landowner reported that cranes also wintered on the ranch. Habitat consists of an interspersion of lakes surrounded by meadows. Two pairs were recorded at Oklahoma Flat on 21 May. Both pairs were feeding in dry-mowed meadows in areas not being grazed by cattle.

The remaining cranes recorded in Siskiyou County consisted of single pairs at nine widely scattered locations. One pair continues to inhabit hardstem bulrush stands and agricultural fields east of Tule Lake NWR headquarters. Another pair was seen on the Prather Ranch about 6 km south of Macdoel. Nesting was in progress on 21 May in a water impoundment with extensive stands of rushes. Wet meadow habitat was located immediately east of the reservoir. West of Macdoel, at Butte Valley WA, a single bird was seen and heard giving a unison call about 0.8 km WNW of Wildlife Area headquarters on 21 May. Territorial calling indicated this was a pair member, perhaps nesting in an extensive stand of rushes in the southwest portion of the Wildlife Area.

One pair has nested at Davis Cabin since 1979, but, because of the dry conditions in both 1987 and 1988, the pair has not been seen recently. Since the early 1980s, one pair has been occupying a territory at Red Rock Lakes (about 14 km E of Macdoel). The pair fledged a single chick in 1988 (R. Johnstone, pers. comm.). Meadows south of the lakes provide feeding habitat, and it was here that the chick was fledged. Another pair normally nests near Orr Lake about 1.2 km northeast of Bray, but dry conditions prevented nesting in 1988. Emergent vegetation occurs around the lake and meadows adjacent to Butte Creek provide feeding habitat. This pair was first recorded on 2 July 1984 with one chick, but nesting efforts have apparently been unsuccessful since 1986 (Klamath NWR files).

Two pairs occupy territories east of Montague. One pair nests about 3.2 km east and was first discovered in 1984. Habitat is primarily spikerush *(Eleocharis sp.),* adjacent to the Little Shasta River. Records of this pair indicate that it has never nested successfully, and did not even attempt to nest in 1988 (R. Johnstone, pers. comm.). The second pair nests near Table

Photo by C.D. Littlefield

Figure 5. Grass Lake, Siskiyou County, supported five pairs of Greater Sandhill Cranes in 1988 after first being recorded there in 1979.

Mountain about 14 km east of Montague. First discovered in 1985, the pair may have fledged a single chick in 1987, but did not attempt to nest in 1988. One pair has been present since the 1960s southeast of Montague. They appear to alternate between Salt Lake and Cedar Lake, in the Lava Lakes Wildlife Sanctuary on state land. Even though emergents surround the lakes, the pair nested in open grass-rush meadow in 1988. In 1987, two young were fledged and in 1988 one young was fledged (R. Johnstone, pers. comm.). Another pair occurs in the Big Springs - Gazelle area. In years with above normal water, nesting occasionally occurs near Gazelle, otherwise the nest site is near Big Springs. One small chick was trampled by cattle at this location in 1987. The pair was seen near Big Springs in 1988, but made no effort to nest. In 1986, a pair with two large young was observed feeding near the same site in a harvested grain field (R. Johnstone, pers. comm.). These observations suggest that only one pair normally occurs in this region, but two pairs occasionally may be present.

Of the 29 pairs of Greater Sandhill Cranes occupying territories in Siskiyou County, 16 (55.2%) occur on private land, 11 (37.9%) on National Wildlife Refuges, and two (6.9%) on state lands. Of the 12 known pairs in 1981, 41.7% were on private land and 58.3% on National Wildlife Refuges (Littlefield 1982).

Plumas County

Greater Sandhill Cranes occupied three areas in Plumas County in 1988: 1) southeast of Portola, in the northwest portion of Sierra Valley; 2) southeast of Greenville, in Indian Valley; and 3) north of Lake Almanor near Chester. Five pairs were present in Sierra Valley. Dry conditions likely contributed to an unsuccessful reproductive season; however, three pairs were known to have nested. Two pairs had territories in open meadow habitat. The other three were in areas with an interspersion of meadows and cattails. Meadows had been or were being grazed by cattle and little water was available during the nesting and brooding periods. Some water was available in the deeper ponds and sloughs, allowing pairs which had territories in this habitat to nest. One pair was present about 6 km southeast of Greenville. Cattail stands, surrounded by grazed meadows, provided nesting habitat for this pair. North of Lake Almanor, numerous springs provided excellent habitat along the eastern edge of a large marsh. A crane pair was present on 7 May, but no nest or young were found. Similar to other areas in California, water was limited in most parts of Plumas County in 1988. In both 1981 and 1988, all crane pairs nesting in Plumas County were on private land.

Sierra County

One pair was located on private land in the Sierra County portion of Sierra Valley about 2.2 km northeast of Sattley (Figure 6). Habitat was mostly wet meadows which had been winter grazed. Although this area was surveyed in 1981, no cranes were recorded. However, James (1977) reported on a nest found in this general area in late May 1976.

Shasta County

A Greater Sandhill Crane egg set was collected near Fort Crook in 1860 (Grinnell and Miller 1944), and interestingly, a crane pair was in this same general area in 1988. The site was about 14 km NNW of Fall River Mills, adjacent to Fall River. Unlike in 1860, cattle were grazing among the

Photo by C.D. Littlefield

Figure 6. The southern extremity of the Greater Sandhill Crane's nesting range in California was near Sattley, Sierra County.

emergents and meadows in 1988. In addition to this pair, four pairs occasionally feed in the county, but their nesting areas are located in Lassen County in the extreme eastern portion of Fall River Valley.

Distribution of Non-breeders in 1988

Northeast California continued to be an important area for subadult Greater Sandhill Cranes in 1988. Generally, subadults were seen in the same areas as recorded in 1981; however, Big Valley, which was an important area in earlier surveys, declined in importance in 1988 (Figure 7). Only six cranes were seen on 30 March 1988, compared to 87 in 1981. Reports indicated large numbers of cranes were present in mid-March, but had departed before surveys were initiated. Habitat was still present, particularly in the vicinity of Nubieber.

Surprise Valley was also important for subadults and numbers were almost identical to those recorded in 1981. The area east and north of Lake City had most use, but small groups were recorded between 13 March and 4 July from the southwest extremity of the valley to Fort Bidwell. The most nonbreeding cranes recorded was 35 on 25 May. Many subadults moved onto grain fields and a reservoir southeast of Davis Creek. Fifty-four birds were using the area on 12 March, increasing to 71 on 27 March. Crane numbers had declined to seven by 11 April. Perhaps this group of subadults was that which had been seen earlier in Big Valley.

In addition to the larger concentrations at traditional sites, several other subadult flocks were noted in 1988. The totals were: eight near Likely on 28 March; five at Honey Lake WA on 6 April; 10 in Ash Creek Valley on 25 April; five at Lower Klamath NWR on 22 May; and 19 at Grass Lake on 21 May.

Subadult flocks were monitored in Surprise Valley from 13 March through 8 August. On the first survey in March, 19 were recorded, with 35 on 25 May, 16 on 1 June, 15 on 7 June, 9 on 18 June, and 0 on 4 July. Subadults had returned to the valley by 9 August. Attempts to locate subadults in the state in July were unsuccessful and it is still unknown where these birds concentrate in early summer.

Trends in the Number of Breeding Pairs in 1971, 1981, and 1988

In 1988, survey dates were intended to correspond with the survey dates in 1971 and 1981 (Table 2). However, this was not always possible and some were nearly 2 months later than those of earlier years.

From 1971 to 1981, Greater Sandhill Crane pairs increased in California and this upward trend in population growth has continued from 1981 to 1988 (Table 3). From 11 traditional nesting locations examined during all three surveys (1971, 1981, 1988) pairs increased 15% between 1971 and 1981 (Littlefield 1982), and 32% between 1981 and 1988 (Table 4). Between 1971 and 1988, crane pairs increased 52% at these 11 sites. Several additional nesting locations were examined in 1981 which were not included in the 1971 survey. A 31% increase occurred at these 19 new areas between 1981 and 1988, similar to the 32% increase noted at the 11 traditional sites.

At the 11 traditional sites, increases between 1971 and 1981 occurred at Modoc NWR (87.5%), Jess Valley (28.6%), Madeline (100% - from one Pair to two),

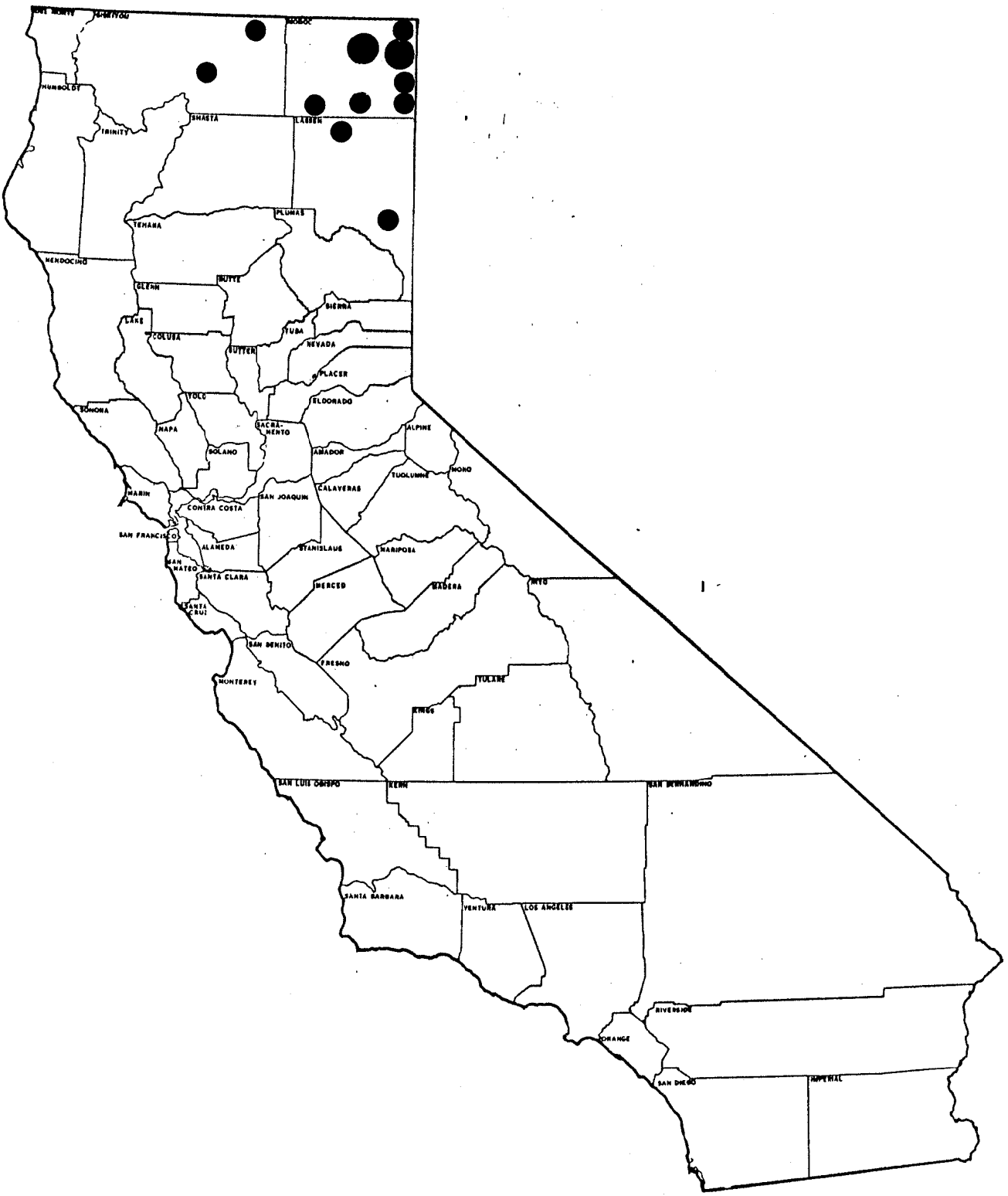

Figure 7. Locations of subadult Greater Sandhill Cranes seen in California in 1988.

Table 2. Dates and locations of Greater Sandhill Crane surveys in northeast California in 1971, 1981, and 1988.

Location	1971	1981	1988
Modoc NWR	26 March	4 April	*
Jess Valley	26 March	3 April	29 March
Likely	26 March	4 April	29 March
Madeline	26 March	3 April	6 April
Goose Lake	27 March	25 April	12 March
Surprise Valley	28 March	24 April	13 March to 10 April
Canby	28 March	29 March	28 March
Round Valley	28 March	29 March	**
Big Valley	28 March	29 March	29 March to 25 April
Fall River Valley	28 March	22 April	26 April
Honey Lake WA	30 March	3 April	6 April

*Modoc NWR staff conducted the survey during the summer of 1988.

**Three surveys conducted in March and April 1988.

Photo by C.D. Littlefield

Figure 8. Most California Greater Sandhill Crane nests located in 1988 were in open areas.

Table 3. A comparison of nesting Greater Sandhill Crane pairs in northeast California in 1971, 1981, and 1988.

Location	1971	1981	1988
Modoc NWR	16	21	30
Jess Valley	7	7	9
Likely	14	9	12
Madeline	1	1	2
Goose Lake	2	7	15
Surprise Valley	42	44	56
Canby	2	6	5
Round Valley	2	2	0
Big Valley	21	24	32
Fall River Valley	2	2	4
Honey Lake	3	6	5
	112	129	170

Table 4. A comparison of Greater Sandhill Crane pairs at 19 northeast California sites between 1981 and 1988.

Location	**1981**	**1988**
Cow Head Lake	0	1
Egg Lake	2	4
Ingell Swamp	0	1
Hager Basin	1	1
Weed Valley	1	1
Steele Swam	1	1
Tule Lake NWR	1	1
L. Klamath NWR	6	10
Grass Lake	2	5
Sierra Valley	6	6
Red Rock Lake	2	3
Willow Creek Valley	7	6
Eagle Lake	1	0
Horse Lake	2	1
Grasshopper Valley	1	1
Ash Valley	13	17
Dixie Valley	1	3
Ashurst Lake	1	1
Pine Creek	1	1
	49	64

Goose Lake (650%), Surprise Valley (33.3%), Big Valley (52.4%), and Fall River Valley (100%). Decreases were noted at Canby, Round Valley, and Honey Lake WA. Pairs decreased between 1971 and 1981 at Likely, but then increased between 1981 and 1988.

At sites first examined in 1981, substantial increases in pairs were noted at Egg Lake (l00%), Lower Klamath NWR (66.7%), Red Rock Lake (50%), Grass Lake (150%), Dixie Valley (200%), and Ash Creek Valley (30.8%). Pairs were located for the first time at Cowhead Lake Valley and Ingell Swamp in 1988, even though these two areas were examined in 1981.

Greater Sandhill Crane Nesting Biology and Ecology in 1988

Fifty-six Greater Sandhill Crane nests were examined in northeast California in 1988. Twenty-two nests were located on Modoc NWR, 14 at Ash Creek WA, eight in Ash Creek Valley, four in Jess Valley, three near Goose Lake, two near Likely, and single nests were examined in Surprise Valley, near Reservoir C, and near Alturas.

Most nests examined in California in 1988 were located in open habitat (Figure 8). Of 48 nests where surrounding vegetation was determined, 21 (43.8%) were in rushes *(Juncus spp.),* nine (18.8%) in burreed, five (10.4%) in grasses, four (8.3%) in sedges, and three (6.3%) in hardstem bulrush. The remaining six nests were in various vegetation types, with a single nest in each. Of nests for which measurements were taken, the basal diameter averaged 90 cm, crown diameter 52 cm, bowl diameter 26 cm, bowl depth 3.1 cm, nest height 11.2 cm, and vegetative height surrounding the nest 29.6 cm. Forty-five (80.4%) nests were poorly concealed, while 10 (17.9%) had fair concealment, and one (1.8%) was well concealed. Water depth at nest sites ranged from dry to 33.5 cm, and averaged 4.6 cm.

Clutch size was determined for 42 nests, of which 36 had two eggs, five had one egg, and one had three eggs. Average clutch size was 1.91 eggs. Egg sizes ranged from 96.9 x 62.2 mm for the largest egg to 94.2 x 62.3 mm for the smallest. The smallest eggs were found in Jess Valley. Here eggs averaged 90.7 x 62.1 mm, while the largest average egg size was near Goose Lake with dimensions of 98.6 x 61.3 mm. The two largest eggs recorded in 1988 were 106.4 x 59.2 mm (Modoc NWR), and 92.7 x 67.5 mm (Modoc NWR), the two smallest were 82.5 x 61.6 mm (Modoc NWR), and 89.8 x 54.9 mm (Ash Creek WA). A larger percentage (53.3%) of the California eggs were light brown in coloration when compared with those of other Greater Sandhill Cranes nesting in the Pacific states. Another 24.5% were of other shades of brown, while the remainder had olive coloration. Considering individual female cranes lay specifically colored eggs throughout their life, this high incidence of brown coloration indicates that many of these females are closely related.

Nesting Success

Total nesting success (ratio of nests in which at least one egg hatched to all known nests) for all sites within the study area was 37.5% (Table 5). A total of 30 nests were destroyed by predators, with coyotes *(Canis latrans)* (Figure 9) taking 17 (30.4%), Common Ravens *(Corvus corvax)* six (l0.7%), raccoons *(Procyon lotor)* five (8.9%), and unknown predators two nests (3.6%). Success rates varied between study sites and are discussed individually.

Photo by C.D. Littlefield

Figure 8. Most California Greater Sandhill Crane nests located in 1988 were in open areas.

Table 5. Fates of Greater Sandhill Crane nests in California in 1988.

Fate	No.	Percent
Successful	21	37.5
Unsuccessful		
Coyote	17	30.4
Common Raven	6	10.7
Raccoon	5	8.9
Unidentified Predators	2	3.6
Infertile	3	5.4
Abandoned	2	3.6
	56	100.0

Photo by C.D. Littlefield

Figure 9. Coyotes were the number one predator on Greater Sandhill Crane nests in California, destroying 30.4% of the examined clutches in 1988.

Modoc NWR - Of the 22 nests located on Modoc NWR in 1988, 11 (50.0%) had eggs which hatched. Raccoons were the most important predator in this region, destroying four (18.2%) clutches. Common Ravens and unidentified predators each destroyed two (9.1%) clutches. Two clutches were infertile (9.1%) and one (4.6%) was abandoned. The 50% nesting success was lower than expected.

Ash Creek WA - Ash Creek WA had a 35.7% (5 of 14 nests examined) nesting success rate. Water available for WA use was limited in 1988, and probably contributed to the low nesting success. Coyotes destroyed seven (50.0%) nests. Coyote predation was most evident in the southwest portion of the WA, while nests in the north portion had no nests lost to predation. In addition to coyote predation, one (7.1%) clutch was destroyed by a Common Raven and another was found to be infertile.

Ash Creek Valley - Ash Creek Valley had limited water and the eight nests examined were all unsuccessful. All eight nests were crowded into a winter-grazed burreed stand which was only 10 ha in size. Nests were poorly concealed and could be clearly seen from 1.6 km away. Water depths averaged 6.2 cm, and coyotes apparently had little difficulty in destroying six (75.0%) clutches. A Common Raven consumed one (12.5%) clutch and another clutch was abandoned. Two coyotes were seen near the nesting marsh in May, indicating a den was nearby.

Jess Valley - Although all four crane nests located in Jess Valley were poorly concealed, two (50.0%) clutches hatched. The remaining two were destroyed by coyotes. Water depths at the nest sites averaged only 1.3 cm. W. Flourney (pers. comm.), who owns a major percentage of the valley, reported nest losses in the past were primarily attributable to flooding. He also reported that there were some coyotes and raccoons, but few ravens. However, one raven pair was noted in May and June.

Goose Lake - Only three nests could be located on the Lakeshore Ranch in May; however, another pair with a single chick was seen in June. The three nests examined were within a fenced, idle marsh about 0.8 km south of Goose Lake. Two were located over deep water and both (66.7%) hatched. The third was among rushes where water had recently receded to 1.8 cm. This nest was destroyed by a coyote. Two additional pairs apparently nested within the marsh, but their nests could not be located.

Likely - Two nests were located about 3.0 km WNW of Likely. One was in an open meadow over 4.1 cm of water. Vehicle tracks were noted within 3 m of the site, but the nest was lost to a coyote. One coyote was seen within 0.4 km of the nest on 19 May. The second nest was in a stand of hardstem bulrush over 29.3 cm of water, and it was destroyed by a raccoon. On 19 May, most meadow habitat in the Likely area was dry. Four additional pairs were seen, but no nesting activity was noted.

Surprise Valley - Only one nest was located in Surprise Valley. About 15 pairs occupied territories about 3.2 km east of Eagleville, but few of these nested in 1988. Although the nest was never located, one pair was nesting in a hardstem bulrush stand when cattle were turned into the marsh. The nest was abandoned within 6 hours after cattle entered the marsh. The nest which was examined was in a hardstem bulrush stand over 9.5 cm of water, and it was lost to predation by a Common Raven.

Reservoir C - One pair nested about 0.8 km south of Reservoir C near a U.S. Forest Service road. The pair was successful in hatching both eggs, but were not seen thereafter. They could have moved into Antelope Flat, as a pair was seen there during an aerial survey in May (B. Deuel, pers. comm.). The nest was composed of rushes and was placed over 20.0 cm of water.

Alturas - The first nest located in 1988 was about 3.0 km west of Alturas. Unfortunately, one member of the pair died after colliding with a powerline. The nesting site was in a small stand of cattle-trampled cattails, with little or no water. Upon reexamination, a Common Raven was present and the eggs had been consumed by this species. This was the only nest located in cattails during the study.

Pair Chronolosy in Surprise Valley - 1988

All pairs in Surprise Valley were located in March and April before transect routes were established on 25 May. Transect surveys were conducted from 25 May through 9 August (Table 6). Several pairs had already abandoned their territories before 25 May, particularly those east of Eagleville (Pairs 25-37). North of Lake City (Pairs 9-231, pairs lingered longer and most were still present through June. Four of these pairs had chicks. Near Fort Bidwell (Pairs l-8), two pairs remained through the duration of study, and one of these had a chick (Pair 6). Of the 37 pairs known to occur along the route, 29 were present on 25 May and nine were still on their territories through 9 August. Twenty-four pairs were recorded on 1 June, with 23 on 7 June, 15 on 18 June, nine on 4 July, and 10 on 16 July.

Of those pairs which had chicks during the survey period, four of their six chicks survived. Pair 10 still had two chicks through 16 July, but before 9 August one had been lost. Pair 11 had a nearly fledged chick on 4 July, but it had disappeared by 16 July. Known nesting efforts by Pairs 15, 21, 25, and 28 were unsuccessful, and Pair 37 (E of Eagleville) apparently nested successfully, but no young were ever seen and were probably were lost shortly after hatching. There was no indication that the remaining pairs (64.9%) ever attempted to nest because of the extremely dry conditions which persisted through the 1988 reproductive period.

Impacts of Livestock Grazinq

Of the 56 Greater Sandhill Crane nests examined in 1988, 31 (55.4%) were on winter-grazed habitat, 20 (35.7%) on idle, and five (8.9%) on hayed only lands. Of those in grazed areas, 16 were on private land and 15 on federal lands. Those located on idle lands included three on private, three on federal, and 14 on state. All five nests in mowed only habitat were located on federal lands (Modoc NWR). Nesting success on both grazed private and federal lands is presented in Table 7.

All federal lands where winter livestock grazing occurred were on Modoc NWR where active predator management was practiced. Nesting success on the Refuge in grazed habitat was 40.0%, compared to 12.5% on private lands. No nests were lost to coyotes on Modoc NWR, while 56.3% were lost to this species on private land.

Lands which had only been mowed had a nesting success of 80%. One nest (20.0%) was lost to a Common Raven. Few areas on private land had idle or

Table 6. Pair chronology in Surprise Valley, Modoc Co., California - 1988. (X = date checked, - = date not checked)

Pair No.	25 May	1 June	7 June	18 June	4 July	16 July	9 August
1	x	-	-	-	-	-	-
2	x	*	x**	x	-	-	x**
3	x	-	-	-	-	-	-
4	x	x	x	x	-	-	-
5	x	x	x	-	-	-	-
6	x	-	x	-	x	x	x
7	x	-	-	-	-	-	-
8	x	x	x	x	x	-	x
9	x	x	x	x	x	-	-
10	x***	x***	x***	x	x***	***	x**
11	x	x**	x	-	x**	-	-
12	x	x**	x**	x	x**	x	x**
13	x	x	x	-	-	-	x
14	x	x	x	x	-	x**	x**
15	x	x*	x*	x	-	x	-
16	x	x	x	x	-	x	-
17	x	x	x	x	-	-	-
18	x	-	x	x	-	-	-
19	x	x	x	x	-	-	-
20	x	x	x	x	-	-	-
21	x*	x*	x*	x	-	x	x
22	x	x	x	-	-	x	-
23	x	-	-	-	-	-	-
24	x	-	x	-	-	-	-

Table 6-contd.

Pair No.	25 May	1 June	7 June	18 June	4 July	16 July	9 August
25	x*	x*	-	-	x	x	-
26	x	x	-	-	-	-	-
27	x	-	x	-	-	-	-
28	x*	x*	x*	x	x	-	-
29	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-
31	-	x	-	-	-	-	-
32	-	x	-	-	-	-	-
33	x	-	-	-	-	-	-
34	-	-	-	-	-	-	-
35	-	x	-	-	-	-	-
36	-	-	x	-	-	-	-
37	-	x	-	-	x	x	x

*Incubating

**One chick

***Two chicks

Table 7. Greater Sandhill Crane nesting success on grazed federal and private lands, northeast California - 1988.

	Federal		Private	
Fate	No.	Percent	No.	Percent
Successful	6	40.0	2	12.5
Unsuccessful				
Coyote	-	--	9	56.3
Raccoon	4	26.7	1	6.3
Common Raven	1	6.7	3	18.8
Unidentified Predators	1	6.7	-	--
Infertile or addled	2	13.3	-	--
Abandoned	1	6.7	1	6.3
	15		16	

mowed only habitat. An exception was on the Lakeshore Ranch where three nests were located in an idle marsh. Of these, two (66.7%) hatched and one was destroyed by a coyote. On federal lands, a similar success rate (66.7%) was recorded as one of three nests was lost to an unknown predator on Modoc NWR. All 14 nests on idle state lands were at the Ash Creek WA. Of these, five (35.7%) hatched, seven (50.0%) were lost to coyotes, one (7.1%) to a Common Raven, and one (7.1%) was infertile.

Young Survival

Brood surveys were conducted at selected nesting areas of northeast California between 8 and 11 August, while additional sites in Lassen and Modoc National Forests were examined in mid-July. Surveys were completed in areas where 224 crane pairs had been present during pair counts in March, April, and May. A total of 20 young was recorded yielding a recruitment rate of 4.5%. Of the 18 broods recorded, two (11%) consisted of two chick broods and 16 (89%) contained a single chick. The two-young broods were located on Modoc and Lower Klamath NWRs.

Broods were noted at Modoc NWR (10 young, C. Bloom, pers. comm.), Surprise Valley (four young), Likely area (one young), Jess Valley (one young), Lower Klamath NWR (two young - J. Hainline, pers. comm.), and elsewhere in Siskiyou County (two young). In addition, one pair at Buchanan Flat had two well developed chicks in mid-July, but it is not known if these fledged. One chick less than 3-weeks old was found on 9 August near Likely.

Although 1987 was also a dry year, recruitment rates appeared much higher than in 1988. Schlorff (1987) surveyed several nesting areas in 1987, and recorded 10 young in Surprise Valley, two near Likely, two at Goose Lake, and one in Big Valley, for a total of 15 young in these four areas. Only five young were found at these same locations in 1988.

Land Conversion

No major land conversions have occurred in California crane nesting areas sine 1981. However, had not the California Wildlife Conservation Board purchased a large percentage of the crane nesting habitat in Big Valley in 1985, much of this area would now be planted to alfalfa. Conversions from wetlands to alfalfa have declined in recent years because of declining alfalfa prices (Schlorff 1987). In both 1987 and 1988, drought conditions persisted in northeast California and if these conditions continue, alfalfa prices are expected to increase. With this increase land conversions are also expected to surge. In fact, approximately 2,430 ha of meadow habitat on the Bare Ranch (in southern Surprise Valley) may be drained and converted to alfalfa in the near future (R. Schlorff, pers. comm.). Five crane territories will be lost if this conversion occurs.

Should drainage occur in other portions of Surprise Valley, near Likely, Jess Valley, Sierra Valley, Ash Creek Valley, Canby area, or Lakeshore Ranch, Greater Sandhill Crane populations in California would be greatly reduced. Crane nesting areas should be closely monitored and actions taken to prevent losses of extant habitat.

Key Habitats for Acquisition

Any area which has Greater Sandhill Crane nesting pairs should be acquired if the wetland becomes available for purchase or becomes threatened by drainage. However, at the present time, major efforts to purchase key nesting areas should be initiated. Priorities for acquisition are presented in Appendix B.

DISCUSSION

The 1988 Greater Sandhill Crane study in northeast California revealed at least three trends that were most encouraging: 1) pair numbers have continued to increase in most of the study area; 2) relatively little crane nesting habitat has been destroyed since the last survey in 1981; and 3) major crane nesting areas in Big Valley have now been purchased by the state, after efforts to drain the wetlands in the mid-1980s were halted. Presently, 30 Greater Sandhill Cranes pairs occupy territories, and after water control structures and other developments have been repaired or constructed, the Ash Creek WA should become a very important crane production area. The Modoc NWR continues to have both high nesting and fledging success. In addition, a few wetlands in Modoc NF have now been fenced and protected from livestock grazing and some of these now have nesting crane pairs. Despite these favorable trends, some potential threats to crane survival became evident during the 1988 survey.

Increases in Greater Sandhill Crane pairs in California can be attributed to the same factors which existed in 1971 and 1981 - lack of high densities of coyotes, raccoons, and Common Ravens, and reduced conversions from wetlands to agricultural crops. In addition, above normal precipitation from 1982 through 1986 probably contributed to higher nesting success and brood survival. However, this upward trend is likely to change in the future. Predator populations are increasing substantially throughout the subspecies' California nesting range. Where few ravens were noted in the 1981 survey, the species was seen at virtually all areas examined in 1988. They were particularly abundant in Surprise Valley, and the only crane nest examined there in 1988 was destroyed by a raven. Common Ravens were also obvious at Sierra Valley, Lower Klamath NWR, Canby area, and Big Valley. Coyotes were observed throughout the study area and were particularly common in Sierra, Ash Creek, and Big valleys, as well as Lower Klamath NWR. Of 22 crane nests located in Ash Creek and Big valleys, 13 were lost to coyotes. Although the animals are rarely seen by day, raccoon tracks were evident at both Modoc NWR and Big Valley, and crane nests were lost to this species at both Modoc NWR and near Likely. Unless predator control is initiated in the near future, this upward trend in predator populations is expected to continue as it has in Oregon.

Summer livestock grazing continues to have a detrimental impact on both Greater Sandhill Crane nesting habitat and success. In 1988, this activity depressed crane nesting attempts; however, in years with above normal precipitation, summer livestock grazing may have less influence. One pair was known to have deserted its nest once cattle entered the nesting marsh in May 1988. At this site, nesting habitat was in a dense hardstem bulrush stand. If a nest were in the open, as most California nesting sites are, there would be little chance for survival even in above normal precipitation years if cattle were turned into a meadow. Even if eggs successfully hatched there remains the potential for the young being trampled by cattle. Chicks have been known to have been trampled in both California and Idaho. Little can be

done to alleviate these losses on private land, but potential losses on public lands can be avoided by fencing the wetlands inhabited by crane pairs. Both Modoc and Lassen NFs presently allow summer grazing on some wetlands, particularly in Lassen NF. All crane areas examined on Lassen NF in July 1988 were being intensively grazed by cattle except at Ashurst Lake.

Hopefully, the upward trend of Greater Sandhill Crane pairs in California will continue. However, this is unlikely if: 1) predator populations continue to increase; 2) spring and summer livestock grazing persists; 3) land conversions from wetlands to agricultural crops increase; and 4) drought conditions continue for an extended period. Cranes should continue to increase if the state continues to purchase major crane nesting areas, the U.S. Forest Service continues to improve wetlands, predator management is expanded, and the 1973 amendments to the Federal Water Control Act of 1972 are strictly enforced. Until these actions are implemented or expanded, the subspecies should be monitored on a regular basis, and continue to be listed on both the State's threatened and U.S. Fish and Wildlife Service's sensitive species lists. It should also be added to the U.S. Forest Service's sensitive species list and appropriate management must be applied to reduce impacts of livestock grazing.

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LITERATURE CITED

Dawson, W.L. 1923. The birds of California. South Moulton County, San Diego, Los Angeles, San Francisco. 2121 pp.

Grinnell, J. and A.H. Miller. 1944. The distribution of the birds of California. Cooper Ornith. Club 27. 608 pp.

James, A.H. 1977. Sandhill cranes breeding in Sierra Valley, California. Western Birds 8:159-160.

Littlefield, C.D. 1982. The status and distribution of Greater Sandhill Cranes in California, 1981. Calif. Dept. Fish and Game Admin. Report 82-1. 27 pp.

_____ and S.P. Thompson. 1979. Distribution and status of the Central Valley Population of Greater Sandhill Cranes. Proc. Int. Crane Workshop 2:113-120.

Naylor, A.E., A.W. Miller, and M.E. Foster. 1954. Observations on sandhill cranes in northeastern California. Condor 56:224-227.

Schlorff, R.W. 1987. Sandhill crane research and management. Calif. Dept. Fish and Game, Proj. No. W-65-R-4. 15 pp.

Walkinshaw, L.H. 1949. The sandhill cranes. Cranbrook Instit. Sci., Bloomefield Hills, Mich. 202 pp.

Westerskov, K. 1950. Methods for determining the age of game bird eggs. J. Wildl. Manage. 14:56-67.

APPENDIX A

LEGAL DESCRIPTION OF GREATER SANDHILL CRANE TERRITORIES
LOCATED IN CALIFORNIA, 1988

MODOC COUNTY

Goose Lake area

T45N,R13E,Sec. 2,SE¼ of NW¼
T45N,R13E,Sec. 9,SE¼ of SE¼
T45N,R13E,Sec. 9,NE¼ of NE¼
T45N,R13E,Sec.l3,NE¼ of NE¼
T45N,R13E,Sec.l3,NE¼ of SW¼
T45N,R13E,Sec.l5,NE¼ of SE¼
T45N,R13E,Sec.l5,NE¼ of SE¼
T45N,R13E,Sec.l6,SW¼ of NE¼
T45N,R14E,Sec. 5,SW¼ of SE¼
T45N,R14E,Sec. 6,SE¼ of SE¼
T45N,R14E,Sec.l7,NW¼ of NE¼
T45N,R14E,Sec.l7,NE¼ of SE¼
T45N,R14E,Sec.l8,SE¼ of NW¼
T45N,R13E,Sec.36,SE¼ of SE¼
T45N,R14E,Sec,31,SE¼ of SE¼

South of Davis Creek

T44N,R14E,Sec.l8,NE¼ of SW¼

Alturas area

T41N,R12E,Sec.25,SW¼ of SE¼
T41N,R13E,Sec.28,SE¼ of SW¼
T42N,R12E,Sec. 8,NE¼ of SW¼
T42N,R13E,Sec. 8,SW¼ of NW¼
T42N,R13E,Sec.l8,SE¼ of NE¼
T42N,R13E,Sec.22,NW¼ of NW¼
T42N,R13E,Sec.X,SE¼ of SE¼

Surprise Valley

T38N,R17E,Sec. 3,SW ¼ of SW¼
T38N,R17E,Sec. 4,NW ¼ of NW¼
T39N,R17E,Sec. 8,NE ¼ of NW¼
T39N,R17E,Sec. 8,SW ¼ of SE¼
T39N,R17E,Sec. 8,SW ¼ of SE¼
T39N,R17E,Sec. 8,SW ¼ of SE¼
T39N,R17E,Sec. 8,SW ¼ of SE¼
T39N,R17E,Sec. 8,SW ¼ of SE¼
T39N,R17E,Sec. 8,SW ¼ of SE¼
T39N,R17E,Sec.20,NE ¼ of SW¼
T39N,R17E,Sec.28,SE ¼ of NW¼
T39N,R17E,Sec.34,SW ¼ of SW¼
T40N,R16E,Sec. 1,SE ¼ of SW¼

Surprise Valley-cont.

T40N,R16E,Sec. 1,NW¼ of SE¼
T40N,N16E,Sec. l,SW¼ of NE¼
T40N,R16E,Sec.l2,SW¼ of NE¼
T40N,R16E,Sec.l2,NE¼ of NW¼
T40N,R16E,Sec.l2,NE¼ of SW¼
T40N,R16E,Sec.l3,NE¼ of NW¼
T40N,R17E,Sec.20,SW¼ of NW¼
T40N,R17E,Sec.28,SW¼ of SW¼
T40N,R17E,Sec.29,NE¼ of SE¼
T40N,R17E,Sec.29,NW¼ of SE¼
T40N,R17E,Sec.29,NE¼ of SW¼
T40N,R17E,Sec.30,NE¼ of SE¼
T40N,R17E,Sec,31,NE¼ of SE¼
T40N,R17E,Sec.31,NE¼ of NW¼
T42N,R16E,Sec. 8,NE¼ of SE¼
T42N,R16E,Sec. 9,SE¼ of NE¼
T42N,R16E,Sec.34,NW¼ of NW¼
T42N,R16E,Sec.34,SW¼ of SE¼
T42N,R16E,Sec.34,SW¼ of SW¼
T42N,R15E,Sec. l,SE¼ of NW¼
T44N,R15E,Sec.l2,NE¼ of SE¼
T44N,R15E,Sec.l3,SE¼ of NE¼
T44N,R15E,Sec.24,SW¼ of NW¼
T44N,R15E,Sec.24,NW¼ of SE¼
T44N,R16E,Sec. 6,SW¼ of SW¼
T44N,R16E,Sec. 6,NW¼ of SW¼
T44N,R16E,Sec.l9,SW¼ of NE¼
T44N,R16E,Sec.l9,NE¼ of SW¼
T44N,R16E,Sec.l9,NE¼ of SE¼
T44N,R16E,Sec.30,NE¼ of SW¼
T44N,R16E,Sec.31,NE¼ of NW¼
T44N,R16E,Sec. 8,SW¼ of SW¼
T44N,R16E,Sec.l7,NW¼ of SW¼
T44N,R16E,Sec.30,SW¼ of SE¼
T44N,R16E,Sec.31,NE¼ of SW¼
T44N,R16E,Sec.20,NW¼ of SE¼
T44N,R16E,Sec.20,SE¼ of NE¼
T44N,R16E,Sec,20,SE¼ of SE¼
T44N,R16E,Sec.20,NE¼ of SW¼
T44N,R16E,Sec.20,NE¼ of SE¼
T44N,R16E,Sec.22,NW¼ of SW¼
T44N,R16E,Sec.29,NE¼ of NE¼
T44N,R16E,Sec.29,NW¼ of NW¼

Cow Head Lake

T47N,R17E,Sec.l6,SE¼ of NW¼

APPENDIX A-cont.

Canby area

T41N,R 9E,Sec. 1,SW¼ of NW¼
T4lN,Rl0E,Sec. 1,SW¼ of SW¼
T4lN,Rl0E,Sec. 3,SW¼ of NW¼
T4lN,Rl0E,Sec.l0,SE¼ of NW¼
T42N,RllE,Sec.32,NE¼ of SE¼

Jess Valley

T39N,R14E,Sec.ll,NE ¼ of SW¼
T39N,Rl4E,Sec.l3,NW ¼ of SW¼
T39N,Rl4E,Sec,ll,NE ¼ of SW¼
T39N,R14E,Sec.ll,SE ¼ of NW¼
T39N,Rl4E,Sec.ll,SW ¼ of SE¼
T39N,R14E,Sec.ll,NE ¼ of NW¼
T39N,Rl4E,Sec.ll,SW ¼ of NW¼
T39N,Rl4E,Sec.ll,NW ¼ of SW¼
T39N,Rl4E,Sec.ll,SW ¼ of SW¼

Likely area

T39N,R12E,Sec. l,NE¼ of SE¼
T39N,R12E,Sec.l2,NW¼ of NE¼
T39N,Rl2E,Sec.l2,SE¼ of NW¼
T39N,R12E,Sec.l2,NE¼ of SW¼
T39N,Rl3E,Sec. 6,NE¼ of SE¼
T39N,Rl3E,Sec. 7,NE¼ of SW¼
T39N,Rl3E,Sec.l8,SE¼ of NW¼
T40N,Rl2E,Sec.24,NW¼ of SW¼
T40N,Rl2E,Sec.25,SW¼ of NW¼
T40N,Rl2E,Sec.25,NE¼ of SW¼
T40N,Rl3E,Sec.30,SW¼ of NW¼
T40N,Rl3E,Sec.3l,SE¼ of NW¼

Big Valley

T39N,R 7E,Sec.22,SE¼ of NW¼
T39N,R 7E,Sec,25,SE¼ of SE¼
T39N,R 7E,Sec.25,NW¼ of SE¼
T39N,R 8E,Sec.26,SE¼ of NW¼
T39N,R 8E,Sec.27,SE¼ of NE¼
T39N,R 8E,Sec.27,SE¼ of SW¼
T39N,R 8E,Sec.28,SE¼ of NE¼
T39N,R 8E,Sec.29,NE¼ of SE¼
T39N,R 9E,Sec.29,SE¼ of NW¼

Big Valley

T39N,R 7E,Sec. 2,SE¼ of NW¼
T39N,R 7E,Sec.25,SE¼ of SE¼
T39N,R 7E,Sec.25,NW¼ of SE¼

Big Valley-cont.

T39N,R 8E,Sec.26,SE¼ of NW¼
T39N,R 8E,Sec.27,SE¼ of NE¼
T39N,R 8E,Sec.27,SE¼ of SW¼
T39N,R 8E,Sec.28,SE¼ of NE¼
T39N,R 8E,Sec.20,NE¼ of SE¼
T39N,R 9E,Sec.29,SE¼ of NW¼

California Pines

T4lN,RllE,Sec.2l,SW¼ of SW¼

Egg Lake

TI0N,R 6E,Sec. 9,NW¼ of NE¼
T40N,R 6E,Sec.lO,NW¼ of NW¼
T40N,R 6E,Sec.lO,SW¼ of NW¼
T40N,R 6E,Sec.lO,NE¼ of SW¼

Hackamore Reservoir

T43N,R 7E,Sec.23,SW¼ of NE¼

Beeler Reservoir

T42N,R 8E,Sec. 6,SW¼ of NW¼

Reservoir C

T44N,Rl0E,Sec.l3,SW¼ of NW¼

Ingal Swamp

T44N,RllE,Sec. 3,SW¼ of NW¼

Weed Valley

T48N,Rl0E,Sec.33,SE¼ of SE¼

Steele Swamp

T47N,R 9E,Sec.30,SE¼ of NW¼

Sweringer Reservoir

T38N,RlGE,Sec. 1,SW¼ of SE¼

Fairchild Swamp

T43N,R 9E,Sec. l,NE¼ of NE¼

APPENDIX A-cont.

Hager Basin

T46N,Rl0E,Sec.36,SE¼ of NW¼

Buchanan Flat

T48N,Rl0E,Sec.28,SW¼ of SW¼

Wild Horse Valley

T48N,R 9E,Sec.36,NE¼ of SW¼

White Horse Flat

T40N,R 5E,Sec.l7,SW¼ of NW¼
T40N,R 5E,Sec.l8,SW¼ of NW¼
T40N,R 5E,Sec.l8,SE¼ of SW¼

Modoc NWR

T4lN,Rl2E,Sec. l,SE¼ of SW¼
T42N,Rl2E,Sec.l3,SW¼ of SW¼
T42N,Rl2E,Sec.l3,SW¼ of SW¼
T42N,Rl2E,Sec.23,NW¼ of NE¼
T42N,Rl2E,Sec.24,SW¼ of SW¼
T42N,R12E,Sec.24,NW¼ of SW¼
T42N,R12E,Sec.24,SE¼ of NE¼
TK?N,R12E,Sec.25,NW¼ of SW¼
T42N,Rl2E,Sec.25,SE¼ of NW¼
T42N,Rl2E,Sec.25,NE¼ of SW¼
T42N,Rl2E,Sec.25,NW¼ of NE¼
T42N,Rl2E,Sec.36,SE¼ of NW¼
T42N,Rl2E,Sec.36,NW¼ of NW¼
T42N,Rl2E,Sec.36,SW¼ of NW¼
T42N,Rl3E,Sec.l9,SW¼ of SE¼
T42N,Rl3E,Sec.l9,NW¼ of SW¼
T42N,Rl3E,Sec.l9,NE¼ of NW¼
T42N,Rl3E,Sec.28,NW¼ of SW¼
T42N,Rl3E,Sec.29,NE¼ of SE¼
T42N,Rl3E,Sec.29,NE¼ of SW¼
T42N,Rl3E,Sec.29,SW¼ of NW¼
T42N,Rl3E,Sec.29,NE¼ of SW¼
T42N,R13E,Sec.29,SW¼ of NW¼
T42N,Rl3E,Sec.30,NE¼ of NW¼
T42N,Rl3E,Sec.30,SE¼ of NE¼
T42N,Rl3E,Sec.30,SE¼ of SE¼
T42N,Rl3E,Sec.30,SW¼ of NW¼
T42N,Rl3E,Sec.30,SE¼ of NW¼
T42N,Rl3E,Sec.30,NW¼ of NW¼

LASSEN COUNTY

Big Valley

T37N,R 7E,Sec. 2,NE¼ of SW¼
T38N,R 7E,Sec. l,SE¼ of SW¼
T38N,R 7E,Sec. 1,SW¼ of NE¼
T38N,R 7E,Sec. l,SE¼ of NE¼
T38N,R 7E,Sec. 3,SE¼ of NE¼
T38N,R 7E,Sec. 3,SE¼ of NE¼
T38N,R 7E,Sec.l0,SE¼ of NE¼
T39N,R 7E,Sec,35,SE¼ of NE¼
T38N,R 8E,Sec. 5,NE¼ of SE¼
T38N,R 8E,Sec. 5,NW¼ of NE¼
T38N,R 8E,Sec. 5,SW¼ of NW¼
T38N,R 8E,Sec. 5,SW¼ of SW¼
T39N,R 8E,Sec.3l,NE¼ of NE¼
T39N,R 8E,Sec.3l,SW¼ of SW¼
T39N,R 8E,Sec.3l,SE¼ of NW¼
T39N,R 8E,Sec.32,NW¼ of NW¼
T39N,R 8E,Sec.32,SE¼ of NW¼
T39N,R 8E,Sec.32,NW¼ of NE¼
T39N,R 8E,Sec.33,SW¼ of SW¼
T39N,R 8E,Sec.33,NE¼ of NW¼
T39N,R 8E,Sec.33,SE¼ of NW¼
T39N,R 8E,Sec.33,SW¼ of NE¼
T39N,R 8E,Sec.34,NW¼ of NW¼

Clark's Valley

T37N,Rl5E,Sec.22,SW¼ of NW¼

Red Rock Lake

T37N,Rl6E,Sec.30,NW¼ of SE¼
T37N,Rl6E,Sec.30,SE¼ of SE¼
T37N,Rl6E,Sec.32,NE¼ of NW¼

Madeline Plains

T37N,Rl2E,Sec.l3,NW¼ of NE¼
T37N,Rl3E,Sec.l8,NE¼ of SW¼

Susan Valley Ranch

T35N,Rl5N,Sec.l2,NE¼ of SW¼

Honey Lake W.A.

T28N,R15E,Sec.11,SW¼
T29N,R15E,Sec.28,NE¼
T29N,R15E,Sec.28,NE¼

Honey Lake W.A.-cont.

T29N,R15E,Sec.28,SE¼
T29N,R15E,Sec.28,SE¼

Willow Creek Valley

T3lN,Rl2E,Sec.l0,SE¼ of NW¼
T3lN,R12E,Sec.l0,NE¼ of SE¼
T3lN,Rl2E,Sec.l4,NE¼ of NW¼
T31N,Rl2E,Sec.24,SE¼ of SE¼
T31N,Rl2E,Sec.24,NE¼ of SW¼
T3lN,R12E,Sec.25,SE¼ of NE¼

Grasshopper Valley

T34N,RllE,Sec.22,SE¼ of NW¼

Ash Creek Valley

T37N,RllE,Sec. 2,SW¼ of NW¼
T37N,RllE,Sec. 2,NW¼ of NW¼
T37N,Rl E,Sec. 3,SE¼ of NE¼
T37N,Rl E,Sec. 3,NW¼ of NE¼
T37N,Rl E,Sec. 3,SE¼ of NW¼
T37N,Rl E,Sec. 3,Nw¼ of NW¼
T37N,Rl E,Sec. ll,NE¼ of SW¼
T37N,Rl E,Sec. ll,NW¼ of SE¼
T37N,RllE,Sec.ll,SE¼ of SE¼
T37N,RllE,Sec.l2,SE¼ of SW¼
T38N,RllE,Sec.32,SE¼ of NE¼
T38N,RllE,Sec,33,SE¼ of SE¼
T38N,RllE,Sec.33,SW¼ of NW¼
T38N,RllE,Sec.34,SE¼ of NE¼
T38N,RllE,Sec.35,SW¼ of SW¼
T38N,RllE,Sec.35,SE¼ of SW¼
T38N,RllE,Sec.35,NE¼ of SW¼

Fall River Valley

T37N,R 5E,Sec.6,NW¼ of NW¼
T38N,R 5E,Sec.25,NW¼ of SE¼
T38N,R 5E,Sec.36,NE¼ of NE¼
T38N,R 5E,Sec.36,SW¼ of NW¼

Dixie Valley

T35N,R 8E,Sec.2l,SE¼ of SW¼
T35N,R 8E,Sec.22,SE¼ of NW¼
T35N,R 8E,Sec.23,SW¼ of NW¼

Papoose Meadow

T3lN,RllE,Sec.29,NE¼ of NW¼

Little Harvey Valley

T32N,R 9E,Sec. 4,NW¼ of SW¼
T32N,R 9E,Sec. 5,SW¼ of NE¼

Ashurst Lake

T34N,R 9E,Sec. 4,SW¼ of SE¼

Pine Creek Reservoir

T32N,R 9E,Sec.28,NW¼ of SE¼

Gray's Valley

T32N,R 7E,Sec.l3,SW¼ of NE¼

Bullard Lake

T34N,Rl0E,Sec,3l,NW¼ of NW¼

Feather Lake

T3lN,R 8E,Sec.24,NE¼ of NE¼

SISKIYOU COUNTY

Tule Lake NWR

T47N,R 4E,Sec. 4,SE¼ of NW¼

Prather Ranch

T46N,R 2W,Sec.34,SE¼ of NW¼

Butte Valley W.A.

T46N,R 2W,Sec. 9,NW¼ of SW¼

Montague area

T44N,R 5W,Sec.l0,SW¼ of NW¼
T44N,R 5W,Sec.lO,NW¼ of SE¼
T44N,R 5W,Sec.lO,SW¼ of SE¼
T45N,R 4W,Sec.l9,SW¼ of SW¼
T45N,R 5W,Sec.30,NW¼ of NW¼

Grenada

T44N,R 5W,Sec.20,NW¼ of SW¼

Big Springs

T43N,R 5W,Sec. 9,NE¼ of SW¼

Bray

T44N,R lW,Sec.20,NE¼ of NE¼

Red Rock Lakes

T46N,R lE,Sec.23,SE¼ of NE¼

Grass Lake

T44N,R 3W,Sec.l5,SE¼ of SW¼
T44N,R 3W,Sec.2l,SE¼ of NE¼
T44N,R 3W,Sec.22,NE¼ of SW¼
T44N,R 3W,Sec.22,SE¼ of NE¼
T44N,R 3W,Sec.23,SW¼ of NE¼

Oklahoma Flat

T46N,R lE,Sec.23,SE¼ of SE¼
T48N,R lE,Sec,33,NE¼ of NE¼

Lower Klamath NWR

T47N,R 2E,Sec. l,SE¼ of NW¼
T47N,R 2E,Sec. 3,NW¼ of SE¼
T47N,R 2E,Sec. 5,NW¼ of SW¼
T47N,R 2E,Sec.l2,SE¼ of SE¼
T47N,R 2E,Sec.l2,SE¼ of SE¼
T47N,R 2E,Sec.l3,SE¼ of NE¼
T47N,R 3E,Sec. 5,SE¼ of SW¼
T48N,R 2E,Sec.l9,NE¼ of NE¼
T48N,R 2E,Sec.25,NE¼ of SE¼
T48N,R 2E,Sec.3l,SW¼ of NE¼

PLUMAS COUNTY

Chester area

T29N,R 7E,Sec.26,SW¼ of NW¼

Sierra Valley

T22N,Rl5E,Sec.l7,SW¼ of NW¼
T22N,Rl5E,Sec.l8,SW¼ of NE¼
T22N,Rl5E,Sec.20,SE¼ of NW¼
T23N,Rl4E,Sec.35,NW¼ of SE¼
T23N,Rl4E,Sec.35,SE¼ of SE¼

Indian Valley

T26N,R1OE,Sec.5,SW¼ of SE¼

SIERRA COUNTY

Sierra Valley

T2lN,Rl4E,Sec.34,NE¼ of NW¼

SHASTA COUNTY

Ft. Crook

T38N,R 4E,Sec.29,NE¼ of SW¼

APPENDIX B

KEY GREATER SANDHILL CRANE NESTING
AREAS IN CALIFORNIA TO BE CONSIDERED FOR LAND AQUISITION

Surprise Valley, Modoc County

South and east of Ft. Bidwell

T46N,R16E,Sec.20
T46N,R16E,Sec.21

North and east of Lake City

T44N,R16E,Sec.30,W½
T44N,R16E,Sec.19
T44N,R16E,Sec.18,SW¼
T44N,R16E,Sec.13,NE¼

East of Eagleville

T40N,R17E,Sec.19,W½
T40N,R17E,Sec.20,NW¼
T40N,R17E,Sec.17,SW¼
T40N,R17E,Sec.18,E½

Bare Ranch

T39N,Rl7E,Sec.28
T39N,R17E,Sec.29,NE¼
T39N,R17E,Sec.20

Egg Lake, Modoc County

T40N,R6E,Sec.9
T40N,R6E,Sec.l6,N$

Whitehorse Flat, Modoc County

T40N,R5E,Sec.17
T40N,R5E,Sec.18
T40N,R5E,Sec.20
T40N,RSE,Sec.7

Fall River Valley, Lassen County

T38N,R5E,Sec.36
T38N,R5E,Sec.25

Willow Creek Valley, Lassen County

T31N,Rl2E,Sec.24
T31N,Rl2E,Sec.25,NE¼
T31N,Rl2E,Sec.l0
T31N,R12E,Sec.14

Ash Creek Valley, Lassen County

T37N,RllE,Sec.2,W½
T37N,RllE,Sec.l4,NE¼
T37N,RllE,Sec.3,NW¼
T37N,RllE,Sec.l3,NW¼
T37N,RllE,Secy.33,S½

Indian Valley, Plumas County

T26S,Rl0E,Sec.5

Sierra Valley, Plumas County

T22N,R15E,Sec.17
T23N,R14E,Sec.35
T23N,Rl4E,Sec.35,E½
T23N,R14E,Sec.20