State of California The Resources Agency Department of Fish and Game Wildlife Management Division

SURVEYS OF BLACK TERNS AND OTHER INLAND-BREEDING SEABIRDS IN NORTHEASTERN CALIFORNIA IN 1997

by

W. David Shuford Point Reyes Bird Observatory

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CONTRACTOR

San Francisco State University Foundation and Point Reyes Bird Observatory

PROJECT ADMINISTRATOR

Dr. Thomas Smith Department of Biology San Francisco State University San Francisco, CA 94132

AUTHOR AND PRINCIPAL INVESTIGATOR

W. David Shuford Point Reyes Bird Observatory 4990 Shoreline Highway Stinson Beach, CA 94970 e-mail: dshuford@prbo.org

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SUMMARY

Surveys of inland-breeding seabirds in northeastern California in 1997, following two wet winters, estimated 1940 pairs of black terns were breeding at 60 sites, 3039 pairs of American white pelicans at 2 sites, 1415 pairs of double-crested cormorants at 7 sites, 12,660 pairs of ringbilled gulls and 5741 pairs of California gulls at 7 sites, 521 to 531 pairs of caspian terns at 5 sites, and 1794 pairs of Forster's terns at 19 sites.

About 59% of the regional black tern population was concentrated at 10 sites, which held over 50 pairs each, and about 70% of the regional population was located in Modoc County. Less than 4% of the regional population was on state or federal wildlife refuges; the remainder was mostly on Forest Service and private lands. Most marshes where black terns bred were dominated by low emergents, primarily spikerush *(Eleocharis* spp.) and *Juncus* spp. Percent cover of emergents (vs. open water) was >80% at about 68% of the 60 breeding sites.

All American white pelicans were breeding at two sites in the Klamath Basin NWR complex: Sheepy Lake in Lower Klamath NWR and Clear Lake NWR. Also, 94% of the regional doublecrested cormorant population was nesting at these two sites and Tule Lake NWR. California and ring-billed gulls were concentrated mostly at 5 sites (2 state wildlife areas, 1 national wildlife refuge, 1 reservoir, and 1 alkali lake), which also supported all the colonies of caspian terns. About 92% of the regional Forster's tern population was concentrated at 8 sites, 2 of which (Goose Lake and Boles Meadow) combined held about 50% of the total. The Klamath Basin NWR complex was the foremost site for inland-breeding seabirds, holding major nesting populations of all species except the black tern. Other sites that held especially large concentrations of breeding gulls and terns were Butte Valley WA, Goose Lake, Big Sage Reservoir, and Honey Lake WA. Boles Meadow and Eagle Lake each had large concentrations of both Forster's and black terns.

Historical knowledge of inland-breeding seabirds is limited and mostly anecdotal making it difficult to assess populations trends. Prior to 1997, single-year region-wide survey data were available only for the American white pelican and ring-billed and California gulls. In the future, the regional white pelican and double-crested cormorant populations should be monitored annually by aerial photographic surveys of nesting sites in the Klamath Basin NWR Complex. Other species should be monitored roughly every three to five years using species-appropriate methods that ensure accurate counts while minimizing survey time and expense.

Priority conservation efforts should be made for the American white pelican, double-crested cormorant, and black tern, three species of recognized management concern. The black tern would benefit most from restoration or enhancement of wetlands used for breeding, whereas the white pelican and double-crested cormorant would be aided by protection and enhancement of breeding sites and foraging habitats and establishment of additional nesting sites. Other species also will benefit from maintenance of isolated breeding sites and enhancement of foraging habitat.

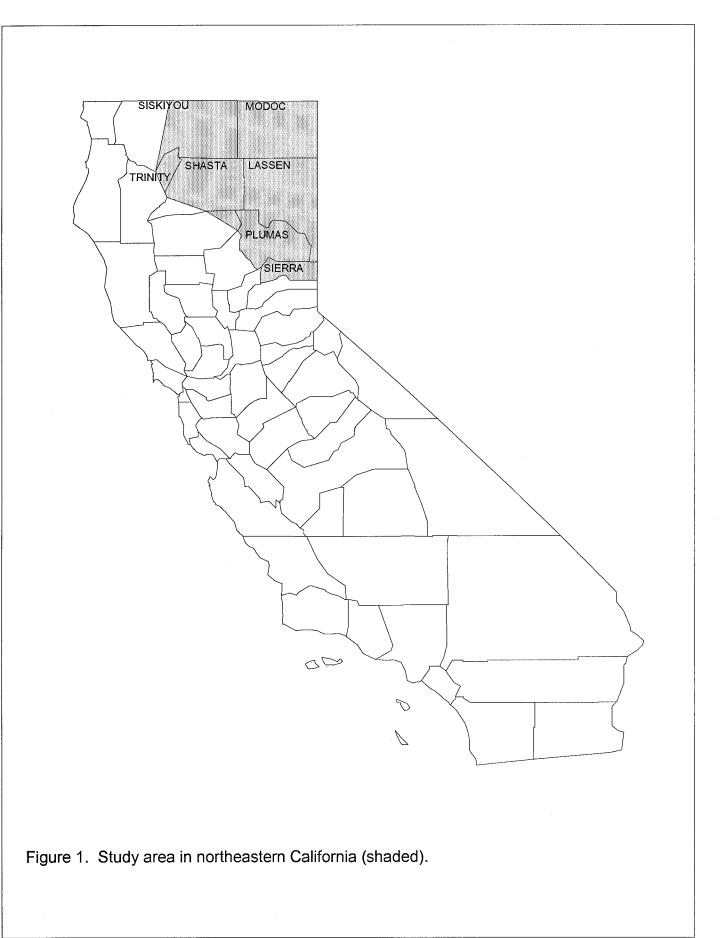
INTRODUCTION

Human threats to seabird breeding colonies in California are greater than anywhere else in the United States (Carter et al. 1995a). Three species have already been listed as threatened or endangered in the state: California brown pelican (*Pelecanus occidentalis californicus*), California least tern (*Sterna albifrons browni*), and marbled murrelet (*Brachyramphus marmoratus*). A primary focus of current efforts to manage for healthy seabird populations in California is to establish baseline data on population sizes and colony locations for evaluating population trends and threats over time. Such information can trigger management actions to help stem or reverse declines in these vulnerable species. To meet this need, comprehensive surveys of all species of seabirds that breed on the California coast have been conducted twice, from 1975 to 1980 (Hunt et al. 1979, Sowls et al. 1980) and 1989 to 1991 (Carter et al. 1992, 1995a). Annual surveys are now conducted of almost all coastal breeding colonies of threatened and endangered species as well as three abundant species, double-crested cormorant (*Phalacrocorax auritus*), Brandt's cormorant (*P. penicillatus*), and common murre (*Uria aalge*) (Carter et al. 1996).

By contrast, no comprehensive statewide surveys have been conducted for seabirds breeding inland in California, despite a historic loss of over 90% of the state's wetlands (Dahl 1990) and strong, though poorly documented, indications of population declines in these species. To establish an accurate baseline, surveys of inland-breeding seabirds were conducted in mountain valleys, the Modoc Plateau, and the Great Basin desert of northeastern California in 1997. Species surveyed included the American white pelican (*Pelecanus erythrorhynchos*), double-crested cormorant, ring-billed gull (*Larus delawarensis*), California gull (*Larus californicus*), caspian tern (*Sterna caspia*), Forster's tern (*Sterna forsteri*), and black tern (*Chlidonias niger*). A special effort was made to survey the black tern because very little information is available on the species' current status in California and its population has declined by about 61% in North America since the 1960s (Peterjohn and Sauer 1997). The black tern currently is a federal Migratory Nongame Bird of Management Concern (USFWS 1995) and a state Species of Special Concern in California (K. Hunting pers. comm.). This report presents the results of these multi-species surveys and makes management recommendations for protection of inland-breeding seabird colonies and their foraging habitats.

STUDY AREA AND METHODS

The primary study area in northeastern California included valleys of the Cascade, Klamath, and Sierra Nevada mountains, the Modoc Plateau, and the Great Basin desert of eastern Siskiyou, northeastern Trinity, eastern Shasta, Modoc, Lassen, Plumas, and Sierra counties (Figure 1). The surveys followed two winters of above average precipitation in the study area, and, hence, water levels were high in most wetlands. Before field work commenced, I searched the published and unpublished literature and contacted various field biologists to identify historic and potential breeding habitats within the study area for all species of inland-breeding seabirds. While in the field, I contacted additional biologists to obtain further information on potential breeding habitat,



particularly for the black tern. The timing and methods of surveys varied among species with respect to their breeding phenology and logistical restraints imposed at their breeding sites:

American White Pelican and Double-crested Cormorant

On 12 and 13 May 1997, I conducted aerial surveys in a Cessna 185 single-winged aircraft to photograph known colonies of the American white pelican and double-crested cormorant and to search for additional colony sites for these and other species. Aerial, rather than ground, surveys were conducted at most sites because of the extreme sensitivity of these species to disturbance at their nesting colonies. Multiple photographs of each colony were taken with a single-lens reflex camera with a 300 mm lens while the plane circled at about 80 to 110 mph at about 120 to 150 m above the colony. This distance above the colonies was selected to obtain the best possible photographs while avoiding flushing birds from their nests. Areas where aerial photographs of pelicans and cormorant colonies were taken were Sheepy Lake at Lower Klamath National Wildlife Refuge (NWR), Siskiyou County; the Lower Sump (1-B) at Tule Lake NWR and Clear Lake NWR, Modoc County; and Pelican Point at Eagle Lake, Lassen County. All areas surveyed by plane, whether photographed or not, are listed in either Table 2 or Appendix 1. Using standardized methods developed for surveying coastal seabird colonies (G. J. McChesney and H. R. Carter in litt.), numbers of nests (= nesting pairs) were counted by projecting aerial photographs (slides) on a large sheet of white paper (27" x 34" easel) and marking nests and birds with a fine marker. Additionally, from 14 to 15 May, agency personnel counted doublecrested cormorant nests at Lake Shastina and Butte Valley Wildlife Area (WA), Siskiyou County, and at Butt Valley Reservoir, Plumas County; counts at the former two sites were taken in conjunction with gull surveys. It was possible to count cormorant nests in trees from a distance at Lake Shastina (by boat) and at Butt Valley Reservoir (from shoreline), thus avoiding disturbance to the colonies.

Ring-billed Gull, California Gull, and Caspian Tern

From 14 to 19 May 1997, ground and boat surveys of gull and tern colonies were conducted at Lake Shastina, Butte Valley WA, and Lower Klamath NWR, Siskiyou County; Clear Lake NWR, Big Sage Reservoir, and Goose Lake, Modoc County; and Honey Lake WA, Lassen County. On 12 May, nesting gulls also were photographed at the otherwise inaccessible Sheepy Lake pelican and cormorant colony. Prior reconnaissance indicated that irregularly occupied islands at Shasta Valley WA, Siskiyou County, Middle Alkali Lake, Modoc County, Eagle Lake, Lassen County, and Lake Almanor, Plumas County, did not have active gull colonies in 1997. Counts of gull nests were made at all active sites, except Clear and Sheepy lakes, by walking through the colonies and marking each nest individually (on the rim or on an adjacent rock or weed) with a dab of spray paint to avoid over- or undercounting. For these colonies, the number of nesting pairs of gulls was estimated as the total number of active nests (with eggs or chicks) counted.

At Clear Lake, one gull colony on an island not inhabited by other colonial nesting species was counted by the above method. Otherwise, to avoid disturbance to sensitive species on islands occupied by multi-species assemblages of nesting seabirds, observers counted all adult gulls while circling the islands in a small motorboat cruising slowly by the colony about 60 m offshore. Numbers of pairs nesting on these islands were estimated by using correction factors developed by Shuford and Alexander (1994) at Clear Lake in 1994. Numbers of gulls were divided by the ratio of adults to nests (1.41 for ring-billed gull, 1.39 for California gull) to obtain numbers of nests or nesting pairs. Numbers of pairs of gulls nesting at Sheepy Lake were also estimated by this method using counts of adults obtained from aerial photographs.

Combining data from the gull surveys described above with data on numbers of California gulls nesting at Mono Lake (22 to 26 May; Kaufmann and Shuford 1997, Jehl 1997), in San Francisco Bay (8 May-24 June; T. Ryan in litt.) and at the Salton Sea (15 May; K. Molina in litt.) enabled me to estimate the statewide breeding population of that species.

For the caspian tern, counts of adults and nests (adults sitting in incubation posture) were taken at a distance from a boat, the nesting islands, or a nearby vantage point. Observers counted with the aid of binoculars or a spotting scope to avoid closely approaching the terns, which would have flushed them from their nests and exposed the contents to possible predation from nesting gulls present at all tern colonies. Counts at Honey Lake on 16 May, early in the egg-laying period, and on 8 June, when most adults had nests with eggs, provided data used to estimate the number of nesting pairs at Clear Lake (14 May), Goose Lake (18 May), and Big Sage Reservoir (15 May), where surveys occurred before most terns had initiated egg laying. The number of nesting pairs at each of the latter sites was estimated by dividing the respective mid-May count of adults by 1.72, the ratio of adults to nests at Honey Lake on 8 June. The caspian tern colony at Butte Valley WA was first discovered on 14 July when chicks of various sizes were present (some not attached to specific nest sites) and some adults still appeared to be incubating eggs or brooding small chicks. The number of pairs that initiated nesting there was arbitrarily but conservatively estimated to be 10 to 20 pairs.

Black and Forster's Tern

From 18 May to 19 July 1997, most potential breeding habitat in the study area was surveyed for black and Forsters's terns. All sites surveyed are listed in either Tables 1 and 5 or Appendix 2. These surveys were conducted mostly on foot and occasionally by kayak. Only a few areas with high potential for supporting nesting terns went unsurveyed. Picnic Grove and Lakeshore reservoirs in the Devil's Garden Ranger District of the Modoc National Forest were not covered because of logistical difficulties in getting to these sites. Additionally, a few private holdings went unsurveyed because permission for access was denied; the largest of these were Steele Swamp, Modoc County, and Dixie Valley, Lassen County.

Black Tern. Early in the season it was possible at many wetlands to count both adult black terns using the wetland and all (or almost all) of their nests. It became clear after a couple of weeks

that it would not be possible to count all nests at every site because of the time required at individual wetlands, the large number of wetlands to be surveyed, and the impossibility of obtaining accurate nest counts once chicks began to hatch and leave their nests (shortly after hatching but long before fledging). Thus, depending on circumstances, three types of survey data were obtained:

(1) Counts of total visible adults (undisturbed) -- taken from the periphery of the wetland or from a vantage point within the wetland where the observer did not attract mobbing adults or flush birds from nests.

(2) Counts of total adults (disturbed) -- taken from within the colony when birds were disturbed by the observer (or occasionally a predator) and all (or almost all) terns present, including incubating or brooding adults, joined a mobbing flock around the intruder. It was not possible to obtain an accurate count of total disturbed adults at large wetlands because of the difficulty of counting (a) large numbers of adults swirling rapidly in various directions around the observer and (b) terns continuously joining or leaving the mobbing flock as they flushed from or returned to their nests in response to the intruder approaching or withdrawing from their "zone of concern."

(3) Counts of total nests from thorough nest searches -- obtained by systematically walking all sections of a marsh and locating all (or almost all) nests by visually scanning areas where terns were agitated, flushing adults from nests, or following terns back to nests. In cases where it was not feasible to make a thorough nest search, partial nest counts were taken; these were not used to estimate numbers of nesting terns but served to document breeding at these sites.

Hence, depending on the type(s) of data available, numbers of pairs of black terns were estimated by three methods, presented here in the order of their apparent reliability in estimation and annotated with regard to their respective biases. When data were available to make more than one estimate, the method of apparent highest reliability is presented.

(1) Nest searches: number of pairs = number of nests from thorough nest searches. This method may underestimate the total number of nests because of the difficulty of finding all nests, particularly in large marshes, and, because of asynchronous egg laying among colonies or sub-colonies, some birds may not have initiated or completed egg laying at the time of surveys.

(2) Counts of adults (disturbed): number of pairs = best count of adults (disturbed) rounded to the nearest even number and divided by two. Throughout the season, this method does not account for adults foraging far from the colony, hence not attracted to mobbing flocks, or, as the season progresses, failed breeders that have dispersed from their breeding wetland. See comments above on the impossibility of using this method at large marshes to obtain accurate counts of adults.

(3) Counts of adults (undisturbed): number of pairs = best count of total adults (undisturbed) divided by 1.27, the mean ratio of undisturbed adult counts to nests for the 10 sites where both types of data were collected (317 total adults, 247 total nests). The primary bias of this method, adjusted by a correction factor, is that it underestimates the total number of adults or pairs because of the difficulty of seeing most incubating and many roosting terns obscured by vegetation or other visual obstructions. This method also does not account for adults foraging

away from the colony. Finally, the number of adults visible probably increases as nests hatch and adults spend more time foraging, but conversely may decrease as nests fail and adults disperse to other wetlands.

To coarsely characterize habitat at each breeding site, observers recorded the dominant species of emergent vegetation and visually estimated the percent cover of both emergent vegetation and open water. These parameters were estimated for the entire wetland, except at managed refuges where they were estimated for just the diked wetland units where black terns were breeding rather than for the entire complex of units.

Forster's Tern. Methods of surveying Forster's terns varied with respect to the stage of nesting phenology, to whether the terns were nesting on islands or in marsh vegetation, and to whether entering colonies would cause undue disturbance. Thorough nest counts were taken at most colonies on islands and at some marsh colonies where adults incubating on floating tule, cattail, or algae mats were visible at a distance. At most other marsh sites, only undisturbed counts of adults were made because it would have been necessary to trample extensive areas of moderately-tall marsh vegetation to enter the colony to count nests or mobbing adults. A count of disturbed adults was taken in the vicinity of nesting islands at Goose Lake; only a partial nest count was possible there because the terns were still laying and because entering colonies on some islands would have caused undue disturbance to other species.

Hence, depending on the type(s) of data available, numbers of pairs of Forster's terns were estimated by three methods, presented here in the order of their apparent reliability in estimation and annotated with regard to their respective biases. When data were available to make more than one estimate, the method of apparent highest reliability is presented.

(1) Nest searches: number of pairs = number of nests from thorough nest searches. This method is very accurate when the terns are nesting on barren or sparsely-vegetated islands, where nests are easily visible, and surveys are timed to coincide with the late incubation period, when the peak number of nests should be present.

(2) Counts of adults (disturbed): number of pairs = best count of adults (disturbed) rounded to the nearest even number and divided by two. Throughout the season, this method does not account for adults foraging far from the colony, hence not attracted to mobbing flocks, or, as the season progresses, failed breeders that have dispersed from their breeding wetland.

(3) Counts of adults (undisturbed): number of pairs = best count of total adults (undisturbed) divided by 1.43, the mean ratio of undisturbed adult counts to nests for the 3 sites where both types of data were collected (78 total adults, 56 total nests). The primary bias of this method, adjusted by a correction factor, is that it underestimates the total number of adults or pairs because of the difficulty of seeing most incubating and many roosting terns obscured by vegetation or other visual obstructions. This method also does not account for adults foraging away from the colony. Finally, the number of adults visible probably increases as nests hatch and adults spend more time foraging, but conversely may decrease as nests fail and adults disperse to other wetlands

RESULTS

Black Tern

Surveys from May to July 1997 estimated about 1940 pairs of black terns were nesting at *60* sites widely scattered in northeastern California (Table 1, Figure 2). About 70.5%, 22.0%, and 7.6% of the population was located in Modoc, Lassen, and Siskiyou counties, respectively. The 10 sites with over 50 pairs of terns, which combined comprised 58.7% of the estimated regional breeding population, were: Barnum Flat Reservoir, Siskiyou County; Weed Valley, Widow Valley, Bucher Swamp, Boles Meadow, Egg Lake, and Taylor Creek wetlands, Modoc County; and Ash Valley (main), Red Rock Lakes complex, and Eagle Lake, Lassen County. Although Tule Lake NWR, Siskiyou and Modoc counties, did not support any nesting black terns in 1997, this area is extremely important to this species as a post-breeding or migratory staging area. Estimates of the number of black terns staging at Tule Lake from 15 July to 4 August 1997 ranged from about 1000 to 6000 birds (J. Beckstrand pers. comm., R. Ryno pers. comm., R. Ekstrom in litt.).

The first nests with eggs were observed at Mud Lake, Modoc County, on 22 May (Table 1) and the first hatched young were recorded at 4 nests at Fletcher Creek Reservoir on 17 June.

Of the 60 breeding sites, 52 had marshes dominated by low (<1 m) emergents and 6 by a mixture of tall (>1 m) and low emergents. At Lower Klamath NWR, black terns nested in shallowly-flooded units dominated by barley stubble, remaining after harvest, and algae mats; these units lacked any significant amount of live emergent vegetation. At Boot Lake, Lassen County, in the southern Warner Mountains at 6560 feet (2000 m), the highest elevation where black terns were documented nesting, breeding habitat was dominated by the floating yellow pond-lily (*Nuphar luteum* ssp. *polysepalum*). Of the 58 sites with emergent vegetation, 50 (86.2%) were dominated or co-dominated by low emergent spikerush (*Eleocharis* spp.) or *Juncus* spp., 7 (12.1%) by a mixture of tall emergents (such as *Scirpus* spp. or *Typha* spp.) and low emergents, and 1 (1.7%) with the low emergent composite *Arnica* spp.

Percent cover of emergent vegetation was >80% at 41 (68.3%) of the 60 breeding sites, between 60% to 80% at 9 (15.0%) sites, 40% to 60% at 3 (5.0%), 20% to 40% at 0 (0%), and 0% to 20% at 7 (11.7%). All of the 7 sites with <20% cover of emergent vegetation, except Lower Klamath NWR, were open-water lakes or reservoirs with fringing marsh vegetation. If vegetative cover estimates had been limited to actual black tern breeding sites, rather than to the entire wetland, the proportion of total sites with >80% cover would have been higher.

Site Name	Survey Date		of Adults" Undisturbed	<u>Number of Nests⁵</u> Total Partial		Estimated Pairs"	
				Total	i ui tiui	i uno	
iskiyou County						_	
Butte Valley WA	14 July	22			2	11 ²	
Butte Valley National Grasslands	14 July	0	2		1	2 ³	
Grass Lake	12 July		28		2+	22 ³	
Orr Lake	30 May		8			6 ³	
11 H	24 & 26 June		6				
Dry Lake (T44N, RIW, S30&31)	12 July		4		2	3 ³	
Lower Klamath NWR							
Unit 4E	18 June	-73	65		3	37 ²	
Unit 4D	18 June		18	12'		12'	
Barnum Flat Reservoir	1 July		68		2+	54 ³	
					Subtotal	147	
Iodoc County							
Dry Lake (T44N, R6E, S4&5)	20 June		12			9 ³	
Fourmile Valley	27 May	38	27	27		27'	
Wild Horse Valley	28 May	6	8	3		3'	
Buchanan Flat	26-27 May	36	29	21		21'	
Weed Valley	3 June		203		6	160'	
Baseball Reservoir	26 May	47	47	42		42'	
Dry Valley Reservoir	25 May	58		30		30'	
Hager Basin (North)	24 May	22	13	14		14'	
Hager Basin (South)	24 May	51	21	18		18'	
Telephone Flat Resv.	31 May	23		7		7'	
South Mountain Resv.	3 1 May-l June	6		2		2'	
Pease Flat	21 May		1	0			
71 FI	17 July		-60			47 ³	
11 11	18 July		19		2'		
Mud Lake (T46N, R12E, S16)	22 May	26	8-10	16		16'	
Crowder Mtn. Resv.	1 June		4 1 ⁺	40		40'	
Whitney Resv.	20 June	10				5 ²	
Hackamore Resv.	20 June	20			4	10 ²	
Spaulding Resv.	21 June	40			10	20 ²	
Beeler Resv.	22 June	26			10	13 ²	
Pinkys Pond	22 June	14			3	7 ²	
Widow Valley	22 June		82		1	64 ³	
Bucher Swamp	22 June		122		5	96 ³	
Six Shooter Tank	23 June	18	12		1	9 ²	
Deadhorse Flat Resv.	23 June		45		1	35 ³	
Surveyors Valley	23 June		35		1	28 ³	
Boles Meadow	7 June		211		15	166 ³	
Fletcher Creek Resv.	16-17 June		48	31		31'	
Jacks Swamp	5 June		64	26		26'	
Dead Horse Resv.	29 May		7+	11		11'	
Jesse Valley	26 June		13		4	10 ³	
Whitehorse Flat Resv.	1 July		37		4+	29 ³	
Egg Lake	30 June-1 July		343		1+	270 ³	
Taylor Ck. wetlands	30 June		128		2	1013	
-					Subtotal	1367	

Table 1 Numbers of adult black terns, nests, and estimated pairs from surveys of wetlands in northeastern California in 1997

Table 1 (continued)

Lassen County						
Muck Valley	2 July		53	-	5	42 ³
Hoover Flat Resv.	3 July		7	-		6 ³
Moll Resv.	27 June	34	20	-	3'	17 ²
FT 11	16 July	13		-		
Okendines Spring	27 June	9	5	-		5 ²
11 11	16 July		0	-		
Ash Valley (main)	27 June		66	-		52 ³
Ash Valley (SE)	19 July		9	-		7 ³
Red Rock Lakes complex	26-27 June		72	-	2+	57 ³
Boot Lake	25-26 June		15	-	8	12 ³
Poison Lake	5 July	76	43	-	2	38 ²
Dry Lake (Grass Valley)	10 June		6	-		5 ³
ff 11 11 11	5 July		0	-		-
Straylor Lake	26 May		11	-		9 ³
11 11	11 July		1	-		
Long Lake (T34N, R8E, S22)	26 May		6	-		5 ³
** **	11 July		0	-		
Ashurst Lake	26 May		7	-		?
11 11	13 June		2	-		2 ³
17 17	10 July		2	-		
Gordon Lake	9 June		12	-		9 ³
11 II	10 July		10	-		-
Pine Creek wetlands	10 June		9	-		7 ³
(T32N, R9E, S28)	10 July		5	-		
McCoy water-pit	9 June		12	-		9 ³
ก ก	10 July		0	-		
Eagle Lake	8-9 July		142	-	3'	112 ³
Willow Creek WA	10 June		13	-		10 ³
Horse Lake	8 July	15	15	-	1'	8 ²
Mtn. Meadow Resv.	7 July	22	20	-		11 ²
Honey Lake N (private)	15 June	5	5	-	1	3 ²
					Subtotal	426
					TOTAL	1940

^a Numbers of adults are from either disturbed or undisturbed counts (see Methods).

^b Numbers of nests from either total or partial counts (see Methods).

^c Numbers of pairs were estimated by three methods listed here in apparent order of reliability; when data were available to make more than one estimate, the estimate from the method of apparent highest reliability is presented (see Methods).

¹ Estimated from numbers of total nests.

² Estimated from best count of total adults (disturbed) rounded up to nearest even number and divided by two.

³ Estimated from best count of total adults (undisturbed) divided by 1.27 (ratio of undisturbed adult counts to nests).

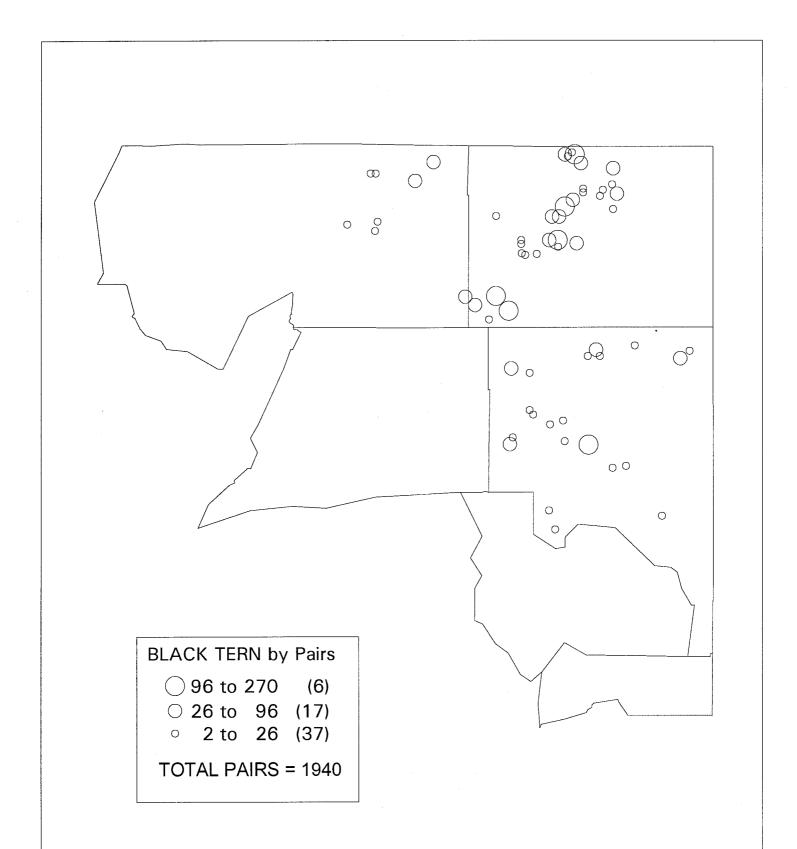


Figure 2. Distribution and relative size of black tern colonies in northeastern California in 1997. See Table 1 for data on individual colonies.

American White Pelican

Surveys in mid-May 1997 estimated about 3039 pairs of pelicans were nesting at Clear Lake NWR (2559 pairs), Modoc County, and at Sheepy Lake (480 pairs) on Lower Klamath NWR, Siskiyou County. At Clear Lake, about 2361 pairs were nesting on a barren to sparsely vegetated low-lying island in the north-central portion of the lake north of "The U" (the large peninsula jutting into the lake from the south shore), 166 pairs on a small low-lying island with tall grass and nettle cover just east of the north end of "The U," and 80 pairs on a small rocky island in the east lobe of the lake. At Sheepy Lake, the pelicans were nesting on two adjoining peat islands.

At most sub-colonies adults were sitting on nests, but at a few sub-colonies medium- to largesized chicks had gathered into creches, indicating they were already about 3 to 5 weeks old (Evans and Knopf 1993, P. Moreno pers. comm.).

Double-crested Cormorant

Surveys in mid-May 1997 estimated 14 15 pairs of double-crested cormorants were nesting at 7 sites in northeastern California (Table 2, Figure 3). Of these, about 94% were concentrated at three sites within the Klamath Basin NWR Complex: Sheepy Lake (69%), Tule Lake Lower Sump (15%), and Clear Lake (9%). Cormorants were nesting on the ground on islands at five sites and in trees surrounded by water at Lake Shastina and Butt Valley Reservoir. At Clear Lake, the only colony where I had close views of a nesting island, many nests had medium-sized chicks.

Ring-billed and California Gulls

Surveys in mid-May 1997 estimated 12,660 pairs of ring-billed gulls and 5741 pairs of California gulls were nesting at 7 sites in northeastern California (Table 3, Figures 4 and 5). All known breeding areas for the ring-billed gull in California are in the study area. For California gulls, in 1997 an additional 24,947 pairs nested at Mono Lake (Kaufmann and Shuford 1997, Jehl 1997), 5076 pairs in San Francisco Bay (the only coastal colony; T. Ryan pers. comm.), and 22 pairs at the Salton Sea (K. Molina in litt.), for a statewide total of 35,786 pairs.

Nesting phenology at Honey Lake appeared to be slightly advanced relative to other gull colonies in northeastern California. At Honey Lake on 16 May, 22.2% of 1858 California gull and 3.1% of 2479 ring-billed gull nests that were checked had small chicks. No chicks were found at any of the other gull colonies that were surveyed from 14 to 19 May.

Site Name	Survey Date	Number of Nests/ Estimated Pairs	Number of Birds	Type of Count ^a	
Siskiyou County					
Lake Shastina	15 May	5		boat	
Meiss Lake, Butte Valley	14 and 15 May	18		boat, ground	
Sheepy Lake, Lower Klamath NWR	12 May	978	1199	aerial	
Modoc County					
Lower Sump (1-B), Tule Lake NWR	12 May	217	435	aerial	
Clear Lake NWR	12 May	133	161	aerial	
Lassen County					
Pelican Point, Eagle Lake	13 May	43	111	aerial	
Plumas County					
Butt Valley Reservoir	14 May	21		ground	
TOTAL		1415			

Table 2 Numbers of pairs of double-crested cormorants breeding at sites in northeastern California in 1997

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^a Surveys conducted by three methods: aerial = numbers of nests and birds counted from aerial photographs; boat = numbers counted in the field from a boat; ground = numbers counted in the field from the nesting island or a shoreline vantage point.

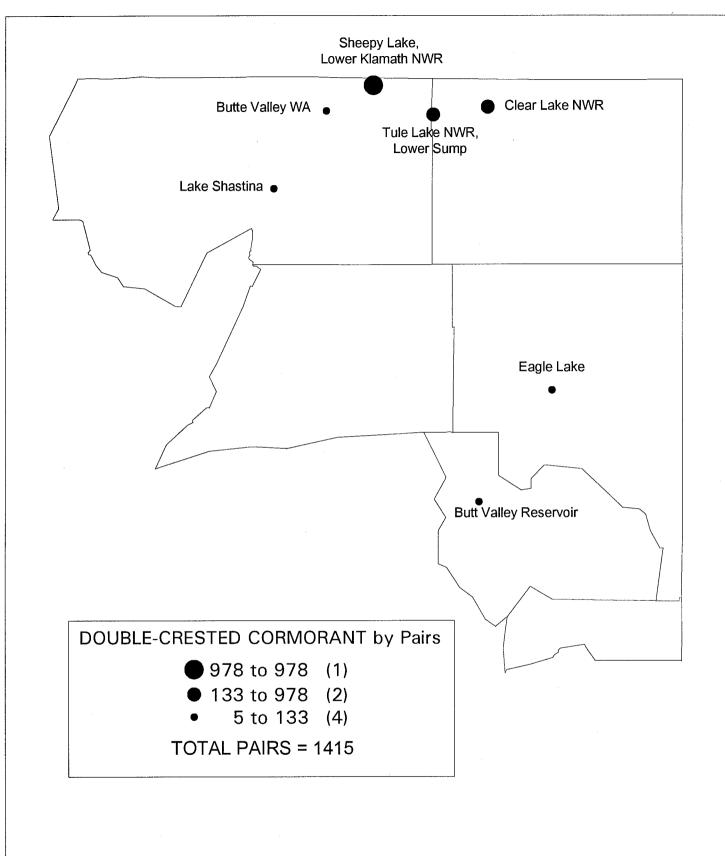


Figure 3. Distribution and relative size of double-crested cormorant colonies in northeastern California in 1997. See Table 2 for data on individual colonies.

Table 3 Numbers of pairs of ring-billed and California gulls nesting at sites in northeastern California, 1994 to 1997

Site	Ring-billed Gull				California Gull ^a			
	1994	1995	1996	1997	1994	1995	1996	1997
Siskiyou County								
Lake Shastina ^b	~15	73	~50	221	~300	151	~103	123
Shasta Valley WA	~15	0	0	0	0	0	0	0
Butte Valley WA	3190	3158	4087	3475	327	1803	1873	2145
Lower Klamath NWR ^c	0	0	0	79	269	52	87	104
Modoc County								
Clear Lake NWR	2868	2942	3747	3680	1175	1769	1488	1355
Goose Lake	0	0	0	1117	0	0	0	73
Big Sage Reservoir	3007	2052	_d	1586	76	11	_d	28
Middle Alkali Lake	0	0	0	0	71	0	0	0
Lassen County								
Pelican Pt., Eagle Lake	0	132	-е	0	0	201	_ ^e	0
Hartson Resv., Honey Lake WA	1931	1961	1727	2502	1247	1317	1510	1913
TOTALS	11,026	10,318	(9611) ^f	12,660	3465	5304	5061	5741

^a Surveys found no nesting gulls at Lake Almanor, where they have bred at least sporadically in prior years. Surveys found no nesting gulls at Tule Lake in 1994 and 1997, and it is unlikely that they nested there in 1995 and 1996, despite irregular occupancy of this site in the past. California gulls also nest in California outside the study area at Mono Lake, Mono County; San Francisco Bay, Santa Clara and Alameda counties; and at the Salton Sea, Riverside and San Bernardino counties (see text).

^b In 1994, counts taken from shore by spotting scope; in 1996, count of total nests made on island, but apportioned to species by ratio found in 1995.

^c In 1997, a small colony of ring-billed (~79 pairs) and California (~8 pairs) gulls was identified at Sheepy Lake via inspection of aerial photographs of the remote American white pelican and double-crested cormorant colony located there. This small gull colony has been active since at least the early 1990s (L. A. Moreno-Matiella pers. comm.), hence the gull numbers attributed here to Lower Klamath NWR were slightly underestimated from 1994 to 1996.

^d No surveys made, but gulls were thought to be nesting.

^e No survey made, and unclear if gulls were nesting.

^f The statewide breeding population of ring-billed gulls in 1996 was probably underestimated by at least 1500 to 2000 pairs by a lack of a survey at Big Sage Reservoir.

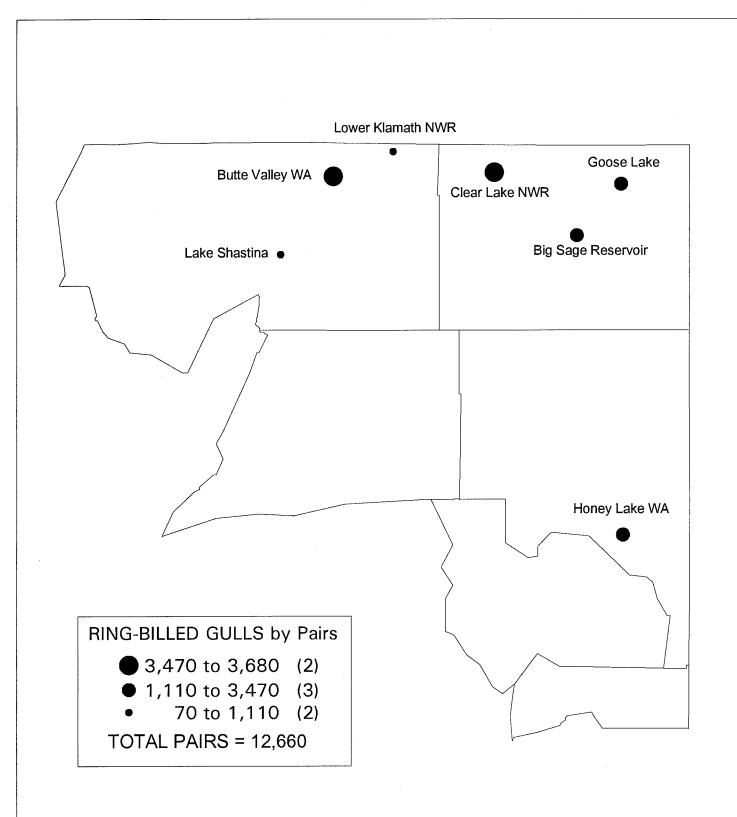


Figure 4. Distribution and relative size of ring-billed gull colonies in northeastern California in 1997. See Table 3 for data on individual colonies.

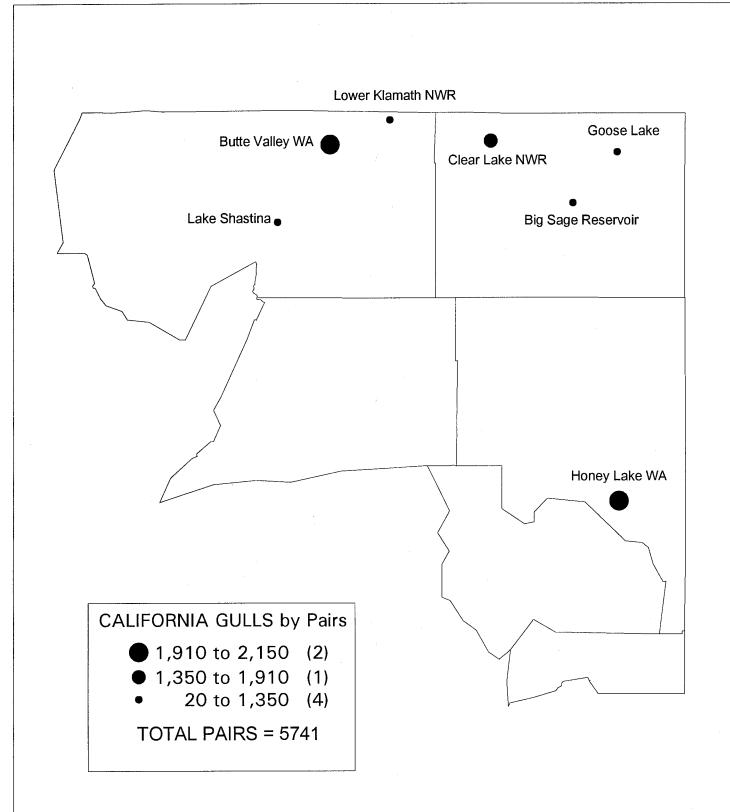


Figure 5. Distribution and relative size of California gull colonies in northeastern California in 1997. See Table 3 for data on individual colonies.

Caspian Tern

Surveys in 1997 estimated about 521 to 531 pairs of caspian terns were nesting at 5 sites in northeastern California (Table 4, Figure 6). The largest colonies were at Clear Lake NWR (168 pairs), Hartson Reservoir at Honey Lake WA (152), and Goose Lake (133). All caspian tern colonies were located on low-lying nesting islands in association with colonies of ring-billed and California gulls (Table 3). The low ratio of nests to adults in mid-May, when most colonies were surveyed, indicated that egg laying was still underway at that time. Some adults appeared to be brooding small chicks at Honey Lake on 8 June.

Forster's Tern

Surveys from May to July 1997 estimated about 1794 pairs of Forster's terns were nesting at 19 sites in northeastern California (Table 5, Figure 7). The terns were nesting on low-lying, sparsely vegetated or barren islands at Boles Meadow, Raker and Thomas Reservoir, Goose Lake, and Leavitt Lake. At 12 other sites they were nesting on the edges of or in openings within marsh vegetation, generally of moderate height (>lm); at Butte Valley WA (and perhaps Prather Ranch) they apparently were nesting both on islands and in marshes.

That mean clutch size at Goose Lake, the first colony surveyed, was 1.79 (n = 258 nests) on 18-19 May versus 2.69 (n = 443 nests) at Boles Meadow on 7 June suggests that egg laying was still very much in progress in mid-May. The first chick was observed on 4 June at Fairchild Swamp, and at Boles Meadow on 7 June 14.2% of the 443 nests checked had at least one chick. Back dating from 4 June, an incubation period of 23-24 days (Ehrlich et al. 1988) indicates that egg laying had commenced by at least 11 May.

DISCUSSION

Regional Importance of Seabird Colonies

Northeastern California supports some of the largest concentrations of inland-nesting seabirds in the state. The study area encompasses most of the historic and all of the current known breeding range of the black tern in California exclusive of the Central Valley (Shuford in press). Northeastern California also currently holds all of California's known breeding colonies of the American white pelican (L. A. Moreno-Matiella pers. corm-n.) and ring-billed gull (Shuford and Alexander 1994); most colonies, though a relatively small proportion of the statewide breeding population, of the California Gull (Shuford and Alexander 1994); and important breeding concentrations of the double-crested cormorant (Carter et al. 1995b), caspian tern (Gill and Mewaldt 1983), and Forster's tern (this report).

Site Name	Survey Date	Number of Adults	Number of Young	Number of Nests ^a	Estimated Pairs^b
Siskiyou County					
Meiss Lake, Butte Valley WA	14 July	41	15		10-20
Modoc County					
Clear Lake NWR	14 May	290		39	168
Goose Lake	18 May	230		57	133
Big Sage Reservoir	15 May	100		5+	58
Lassen County	2				
Hartson Reservoir, Honey Lake WA	16 May	211		81	
	8 June	262	P ^c	152	152
				TOTA	AL ~521-531

Table 4 Numbers of pairs of caspian terns nesting at sites in northeastern California in 1997

^a Nest counts at Clear Lake NWR, Goose Lake, and Big Sage Reservoir were inadequate for estimating the breeding population because they were taken early in the egg-laying period; the survey at Meiss Lake was conducted too late in the season to count nests (see Methods).

^b Numbers of nesting pairs at Clear Lake NWR, Goose Lake, and Big Sage Reservoir were estimated by dividing the number of adults at each site in mid-May by 1.72, the ratio of adults to nests at Hartson Reservoir on 8 June (see Methods). The number of pairs nesting at Meiss Lake was roughly and arbitrarily estimated from the number of adults and chicks present on 14 July.

^c P = Some small chicks appeared to be present under brooding adults.

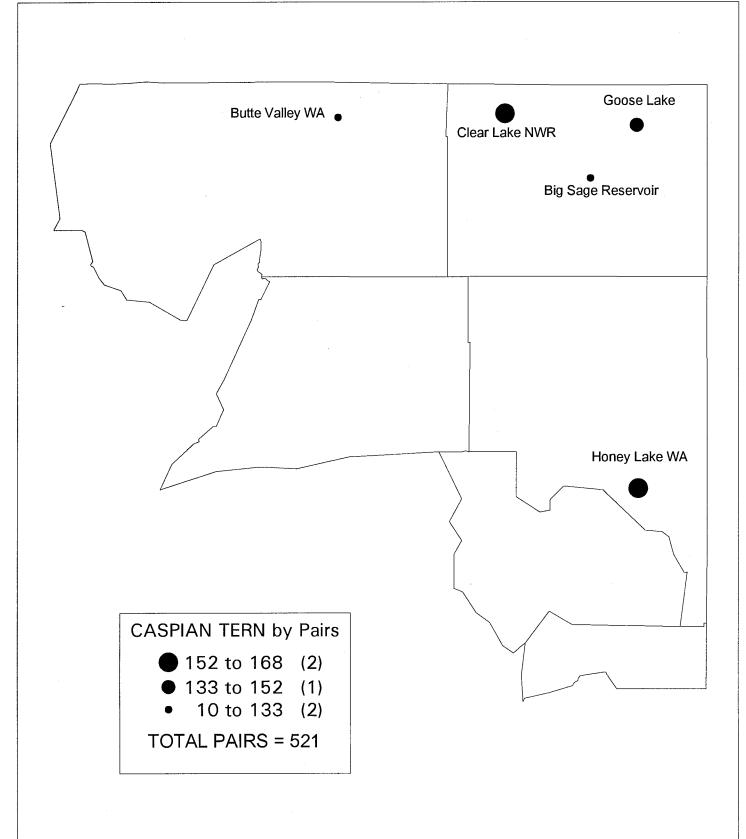


Figure 6. Distribution and relative size of caspian tern colonies in northeastern California in 1997. See Table 4 for data on individual colonies.

		Number of Adults ^a		Number of Nests ^b		Estimated	
Site Name	Survey Date	Disturbed	Undisturbed	Total	Partial ^c	Pairs ^d	
Siskiyou County							
Prather Ranch north ^e	15 July		11		FL	8 ³	
Butte Valley WA	13 July		140		FL, M	98 ³	
Lower Klamath NWR	10 0 41 9		110		12, 10	70	
Unit 3A	19 June		41		2	29 ³	
Unit 4D	18 June		41	18	2	18^{1}	
Unit 4E	18 June			46		46^{1}	
Unit 11B	18 June			63		63 ¹	
Tule Lake Upper Sump (1 -A)	20 June		324		18	226 ³	
Shasta County					10		
Horr Pond	4 July		5+		CF, N	4^{3}	
Modoc County					01,10	-	
Egg Lake	1 July		32		1+	22 ³	
Boles Meadow	7 June	~700		443	T .	443 ¹	
Fairchild Swamp	4 June		166+		3	116 ³	
Raker & Thomas Resv.	30 May	20		8	C	8 ¹	
Goose Lake	18-19 May	916+		-	259	458^{2}	
Lassen County					-07		
Ash Creek WA (Lassen and Modoc cos.)	all summer		~20			~14 ²	
Mtn. Meadows Resv.	7 July		55	-	CF, M	38^{3}	
Eagle Lake	8-9 July		123	-	- 7	86 ³	
Grasshopper Valley	10 July		77	-		54^{3}	
Horse Lake	8 July		27	-	1+	19 ³	
Red Rock Lakes complex	27 June		5	-	1+	4 ³	
Leavitt Lake	8 June	48	39	31		31 ¹	
Honey Lake WA, Fleming Unit	15 June	14	10	7		7^1	
Honey Lake N (private)	15 June	3		2		2^{1}	
· · · · · ·					TOTAL	1794	

Table 5 Numbers of adult Forster's terns, nests, and estimated pairs at sites in northeastern California in 1997

^a Numbers of adults from either disturbed or undisturbed counts (see Methods).

^b Number of nests from either total or partial counts (see Methods). Nests counted based on observations of eggs, small chicks, or adults sitting in incubation posture on obvious nests, except at Egg Lake, Horse Lake, and Red Rocks Lake complex where adults seen to carry fish repeatedly to apparent nest site hidden in marsh.

^c In some cases no actual nests were located, but evidence was observed that indicated a strong probability that nesting was in progress: FL = fledged young, probably restricted to vicinity of nesting areas; CF = adult carrying fish, presumably to feed females during courtship or dependent young at the nest; N = adults at apparent nest site but view obscured by vegetation; M = adults mobbing observer indicating nest(s) or young nearby.

^d Number of pairs estimated from three methods listed in apparent order of reliability; when data were available to make more than one estimate, the estimate from the method of apparent highest reliability is presented (see Methods).

Estimated from number of total nests.

 2 Estimated from best count of total adults (undisturbed) divided by 1.43 (ratio of undisturbed adult counts to nests).

³ Estimated from best count of adults (disturbed) divided by two.

^e Possibly may represent birds that moved from nearby nesting colony at Butte Valley WA.

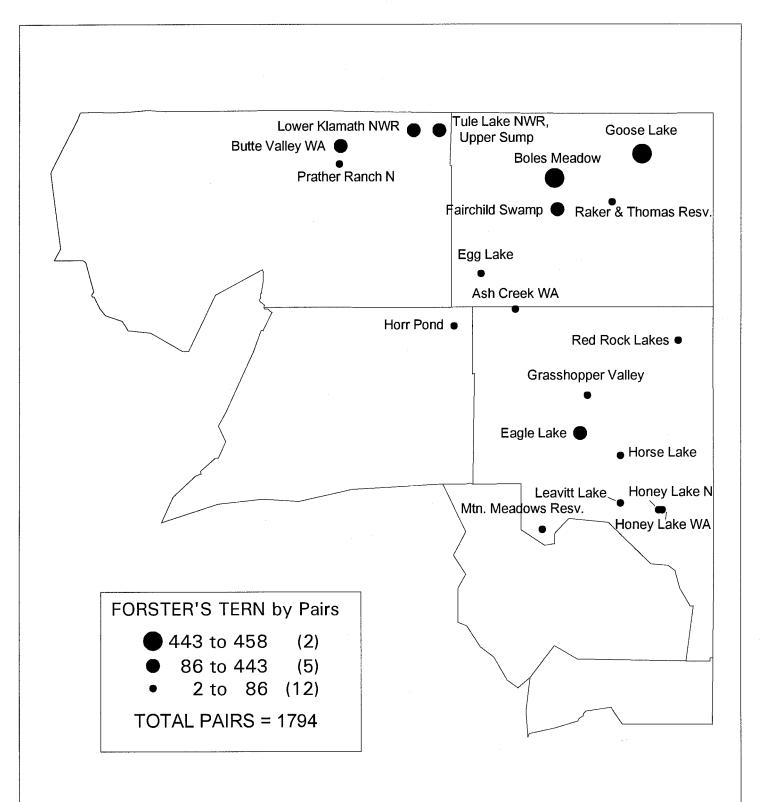


Figure 7. Distribution and relative size of Forster's tern colonies in northeastern California in 1997. See Table 5 for data on individual colonies.

Centers of Abundance and Species Richness of Breeding Seabirds

Several individual sites or complexes of sites hold especially large concentrations of individuals or a high number of species of breeding seabirds. Foremost among these is the Klamath Basin NWR Complex. This refuge system currently supports both of California's remaining white pelican colonies, 94% of the regional double-crested cormorant population, one of the region's largest ring-billed and California gull colonies, the largest regional colony of caspian terns, and one of the region's largest concentrations of Forster's terns (Tables 1-5, Figures 2-7). Other sites having especially large concentrations of breeding gulls and terns are Butte Valley WA, Goose Lake, Big Sage Reservoir, and Honey Lake WA. Boles Meadow and Eagle Lake both had large concentrations of both Forster's and black terns; the latter site also, on a fairly regular basis, supports small colonies of double-crested cormorants and ring-billed and California gulls. The value of these sites should not be judged solely on the basis of their breeding seabird colonies as many of them host large numbers of other breeding waterbirds. For example, Eagle Lake appears to hold California's largest (combined) breeding populations of western (*Aechnophorus occidentalis*) and Clark's (*A. clarkii*) grebes, which also may rank among the largest in the United States (Gould 1974).

Historical Perspective

The amount and quality of knowledge available on historical trends and recent population sizes of seabirds breeding in the study area varies considerably among species. Winkler (1982) conducted the only prior broad scale censuses of nongame aquatic birds in the study area. These surveys, however, were not comparable to those in 1997 because they covered only a subset of the large lakes and wetlands visited in 1997, excluded most of the widely scattered shallow-water marshes where species such as the black tern concentrate, were not always timed to visit nesting colonies during the breeding season, and were conducted in the extreme drought year of 1977. Although it is beyond the scope of this report to review the entire historical record of all species of seabirds breeding in the study area, brief species-specific portrayals of known population trends are presented to provide a context for interpreting the results of the 1997 surveys.

Black Tern. Historical data on the abundance and distribution of the black tern in northeastern California is limited mostly to anecdotal accounts (Grinnell and Miller 1944, Cogswell 1977, Shuford in press). The species' current breeding distribution remains much the same as in the past, and few data are available for comparison of its former and current abundance. Over 100 pairs of black terns formerly bred to the south of the study area at Lake Tahoe, Placer and El dorado counties (primarily at Rowlands Marsh near the mouth of the Upper Truckee River; Orr and Moffitt 1971), but the species no longer nests there because of habitat loss (Cogswell 1977, K. Laves pers. comm.). Estimates of the number of black terns breeding at Eagle Lake have ranged from 300 and 150 in 1970 and 1971, respectively (Gould 1974), to 46 in 1974 (Lederer 1976), to 224 (112 pairs) in 1997 (Table 1 this report). These numbers may reflect year-to-year variation in the size of the nesting population, perhaps

mirroring changing patterns of emergent vegetation in response to lake levels (G. Gould pers. comm.), rather than a population decline followed by recovery. Small's (1994) report of "the largest regular [breeding] concentration (1000+) in northern California" in the Klamath Basin is unsubstantiated. Losses of wetland habitat, particularly in the Klamath Basin, may have been partially offset in the Modoc Plateau by historic increases of habitat from creation of shallow-water reservoirs for livestock grazing and recent efforts to increase waterfowl habitat (T. Ratcliff, G. Studinski pers. comm.).

American White Pelican. The species formerly nested on large lakes scattered throughout the interior of California (Grinnell and Miller 1944). Currently it breeds regularly in the state only in the Klamath Basin region at Sheepy Lake, Lower Klamath NWR, and at Clear Lake NWR (L. A. Moreno-Matiella pers. comm.); breeding is very irregular at Hartson Reservoir, Honey Lake WA (Tait et al. 1978, B. Tatman pers. comm.). Sites in northeastern California where the species formerly bred include Tule Lake and Goose Lake, Modoc County, and Eagle Lake, Lassen County (Grinnell and Miller 1944). Population estimates of pelicans nesting in the Klamath Basin region from 1989 to 1996 have varied from about 600 to 3000 pairs; these estimates include the population at Upper Klamath Lake, Oregon, which numbers up to about 100 pairs (L. A. Moreno-Matiella pers. comm.). The estimate of 3039 breeding pairs at Clear and Sheepy lakes in 1997 was at the upper limit of this range, but it is unclear how comparable prior counts taken with a Questar spotting scope from distant hills are to the 1997 count taken from aerial photographs.

Double-crested Cormorant. Grinnell and Miller (1944) listed three sites in northeastern California -- Tule Lake, Clear Lake, and Eagle Lake -- where double-crested cormorants nested historically. Carter et al. (1995b) listed 11 sites in this region where double-crested cormorants were known to have bred in the period 1977 to 1992. Although all of these colonies were unlikely to have been occupied in a single year, the sum of the population estimates for the 11 sites is 769 to 779 pairs (1538-1558 birds). In 1997, about 1415 pairs of cormorants (2830 birds) were nesting at 5 of these sites plus 2 others (Table 2). Although these data suggest the regional population may have increased in recent years, the lack of rigorous censuses in prior years (most numbers rounded to nearest 10 and no methods described) makes comparisons to the 1997 surveys difficult.

Ring-billed and California Gulls. Historically, ring-billed gulls have nested at 10 sites and California gulls at 11 sites in northeastern California; California gulls also have bred at 4 other sites elsewhere in the state (Grinnell and Miller 1944, Shuford and Alexander 1994, Table 3 this report, D. Shuford unpubl. data). Despite claims that their breeding populations have increased greatly in this century in the West (Conover 1983), historical data for these species appear to be too few to draw valid conclusions regarding population trends in California (Shuford and Alexander 1994). From 1994 to 1997, estimates of the statewide breeding population of the ring-billed gull ranged from about 10,300 to 12,700 pairs (Table 3). For the same period, the population of the California gull breeding in northeastern California ranged from about 3500 to 5700 pairs (Table 3); the regional estimate for 1997 represented about 16% of the statewide

breeding population.

Caspian Tern. Grinnell and Miller (1944) reported Tule Lake as the only area in northeastern California where the species was known to have bred historically. Gill and Mewaldt (1983) estimated 555 to 565 pairs of caspian terns were nesting at 6 sites in northeastern California in 1979, which compares favorably to the estimate of 521 to 53 1 pairs breeding at 5 sites in this region in 1997 (Table 4).

Forster 's Tern. Historical data on the distribution and abundance of the Forster's tern in northeastern California is limited. Grinnell and Miller (1944) considered the Forster's tern a sparse breeder in northeastern California and listed specific nesting locations as Laguna at Willow [Creek] Ranch, Modoc County, Eagle Lake, Lassen County, and Lake Tahoe. At Eagle Lake, J. Moffitt (in Grinnell et al. 1930) found "nearly 100 pairs" nesting near Spaulding's [now Spaulding Tract]. More recent lakewide estimates are about 300 birds in 1970 and 150 in 1971 (Gould 1974), 56 in 1974 (Lederer 1976), and 172 in 1997 (Table 5 this report).

Priorities for Conservation

Although the research conducted in 1997 was the first year of a three-year study to assess the status of inland-nesting seabirds throughout California, it is still valuable at this time to make preliminary recommendations for management actions that will aid the conservation of these species in northeastern California. Because of the variable and generally arid climate in much of the study area, water levels in lakes and marshes may fluctuate greatly from year to year. This has the potential to adversely affect all species by connecting nesting islands to the mainland, thereby allowing access to ground predators, and drying up nesting marshes or foraging areas. Consequently, when possible, water levels should be managed to protect crucial nesting and foraging habitats. In extreme cases, it may be necessary to erect temporary electric fences to deter predators from crossing land bridges to nesting colonies, as has been done in the past at Clear Lake in drought years (J. Beckstrand pers. comm.). Human disturbance can disrupt nesting of all species, but species such as the American white pelican and double-crested cormorant are particularly sensitive to this factor. Barriers that hinder human access to colonies are the most effective means to reduce or eliminate human disturbance, but posting signs may also be helpful if areas are patrolled and regulations enforced. Posting signs, however, should be carefully considered in areas lacking patrols, as signs in such cases sometimes may be counterproductive by attracting attention to colonies.

The following accounts discuss each species' conservation needs and present potentially effective conservation measures.

Black Tern. This species warrants conservation concern because of continent-wide population declines (Dunn and Agro 1995, Peterjohn and Sauer 1997); population declines in California, particularly in the Central Valley (Shuford in press); and its listing as a state Species of Special

Concern (K. Hunting pers. comm.) and a federal Migratory Nongame Bird of Management Concern (USFWS 1995). Although currently a widespread breeder in northeastern California, habitat enhancement in this region likely would benefit the species. Because few black terns were found breeding on state and federal wildlife refuges, it would be worth investigating whether shallow-water wetlands dominated by spikerush (*Eleocharis* spp.), the species' main breeding habitat in the region, could be established and maintained on these areas.

American White Pelican. This species warrants concern because of historic loss of breeding and foraging habitat in California and throughout the West, current concentration of the entire state breeding population at two sites, and its listing as a Species of Special Concern in California (Remsen 1978). The two known California colonies of white pelicans are currently located on islands in lakes remote from human disturbance but within reasonable distance of shallow-water foraging areas. Protection of these breeding sites and the pelicans' foraging habitats are crucial. Current efforts to revitalize Tule Lake and other wetlands in the Klamath Basin (D. Mauser pers. comm.) should address pelican foraging needs in light of recent research conducted on the species by L.A. Moreno-Matiella. If possible, it would be extremely valuable to establish another breeding colony of pelicans in this region at a historic colony site or a site where in recent years pelicans have bred irregularly. Likely prospects would be elsewhere in the Klamath Basin NWR Complex, Hartson Reservoir at Honey Lake WA, or Eagle Lake. Efforts to establish and maintain a colony at the latter site would likely meet the greatest obstacles because of intense recreational use of the lake.

Double-crested Cormorant. This species warrants concern because the vast majority of the regional population is concentrated at only 3 sites (Table 2), the species is considered a Species of Special Concern in California (Remsen 1978), and inland populations probably have been disrupted to a greater extent than coastal ones (Sowls et al. 1980). Like pelicans, cormorants are very sensitive to human disturbance and need remote or inaccessible breeding sites relatively close to suitable foraging areas. Establishment of an additional breeding site for pelicans in the region might also benefit cormorants. One subcolony of cormorants at Butt Valley Reservoir was abandoned in 1996 after nest initiation because the nesting tree was no longer surrounded by water after a draw down was conducted to enable reinforcement of the dam (M. Jenkins, G. Rotta pers. comm.). In mitigation for these effects, wooden nesting platforms were installed on poles in the reservoir and will be monitored in 1998 for cormorant use. Use of platforms might effectively attract nesting cormorants to other unoccupied but otherwise suitable sites.

Other Species. Of the remaining species, the caspian tern appears to warrant the most concern because its small regional population currently is concentrated at only five sites. Both species of gulls have much larger regional populations, but also are concentrated mostly at the same five sites as the caspian tern (Tables 3 and 4, Figures 4-6). Hence, protection of caspian tern colonies, which are more prone to disturbance than are gulls, would also benefit the gulls. Of the species considered, the Forster's tern is the second mostly widely distributed in the region, but it too would benefit from protection and enhancement of nesting wetlands and foraging habitats.

Monitoring and Research Needs

Although it is beyond the scope of this report to provide a detailed monitoring scheme for all species of seabirds, some general recommendations are made below. Every effort should be made to coordinate California surveys with those in other states to establish a broad scale perspective on species' distribution, population trends, and habitat use.

American White Pelican and Double-crested Cormorant. Because these species are sensitive and have declined historically, it would be valuable to monitor their populations on an annual basis. All of the state's white pelican population and most of the regional double-crested cormorant population could be monitored at the Klamath Basin NWR Complex by means of aerial photographs as described above. Even if funds were not available every year to count the photographs, at a minimum it would be valuable to take the photographs, sort them, and archive them for future reference. Excluding the pilot of the airplane, these tasks would take about one day of one biologist's time. The archived photographs could be counted as funds became available; if the photographs are not taken the record of population trends would be lost. Because the white pelican appears to be at the greatest risk of any of the species discussed, it would be valuable to continue more detailed demographic and foraging studies of pelicans in the Klamath Basin.

Other Species. Unless there is further concern for the regional populations of other species of seabirds, it is recommended that they be monitored on a less frequent basis, perhaps every three to five years (more frequently if time allows). Using the methods described above, all colonies of gulls could be surveyed in a short period of time in early to mid-May by a collaboration of biologists from various state and federal agencies, as has been done since 1994. Although caspian tern colonies could be surveyed at the same time as gulls, it would be better to conduct tern censuses in early to mid-June, when the number of nests is at a peak. To avoid disturbance, black terns should be surveyed in mid-June by counts of undisturbed adults taken from the periphery of wetlands or at a site within the wetland where the observer would not attract mobbing terns. To minimize survey time and expense, black tern surveys should be based on a random or stratified sampling of a subset of potential breeding sites; this scheme should take into account the difficulty of reaching some sites. Surveys of Forster's terns might be most effective if they combined a random or stratified sampling regime, as with the black tern, in combination with nest counts where nesting terns concentrate on islands. All monitoring schemes should take into account variable climatic conditions and the likelihood that colonies may shift their breeding locations. Although regularity of monitoring is desirable, surveying in years of extremely low water levels should be avoided or data from such surveys should be very cautiously interpreted.

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APPENDIX 1

Sites surveyed by airplane for breeding seabird colonies on 12 and 13 May 1997. Aerial photographic surveys were made at known American white pelican and double-crested cormorant colonies and searches were made for additional colonies of these and other species, particularly ring-billed and California gulls and caspian terns.

12 May 1997

Trinity County: Trinity Lake.

Shasta County: Whiskeytown Lake, Lake McCloud.

Siskyou County: Lake Siskiyou, Lake Shastina, various small lakes in Shasta Valley, Irongate Reservoir, Copco Lake, Butte Valley WA, Lower Klamath NWR, Tule Lake NWR (part).

Modoc County: Tule Lake NWR (part), Clear Lake, Goose Lake.

13 May 1997

Plumas County: Butt Valley Reservoir, Round Valley Reservoir, Antelope Lake, Frenchman's Lake, Lake Davis.

Lassen County: Eagle Lake, West Valley Reservoir (part), Moon Lake.

 Modoc County: West Valley Reservoir (part), Middle Alkali Lake, Dorris Reservoir, Upper Cummings Reservoir, unknown wetland (W of Wood Flat Resv.), Wood Flat Reservoir, Pretty Juniper Reservoir, Raker and Thomas Reservoir, Dead Horse Reservoir, McGinty Reservoir, Crowder Flat Reservoir, South Mountain Reservoir, reservoir (N of Telephone Flat Resv.), Dry Valley Reservoir, Jones Reservoir, Baseball Reservoir, Dorris Brothers Reservoir, Reservoir C, Reservoir M, Reservoir A, Reservoir N, Fairchild Swamp, Duncan Reservoir, Williams Reservoir, Six Shooter Reservoir, Reservoir F, Beeler Reservoir, Spaulding Reservoir, Mud Lake, Hackmore Reservoir, Whitney Reservoir, Lower Roberts Reservoir.

Shasta County: Horr Pond/Big Lake/McArthur Swamp/Hollenbeck Swamp complex.

APPENDIX 2

Sites in northeastern California surveyed in 1997 at which no breeding black terns were found; see Table 1 for black tern breeding sites. Sites listed by county in chronological order by survey date. Numbers, if any, accompanying survey dates in parentheses represent the number of black terns foraging in or passing over a wetland but apparently not breeding at the site. Nonbreeding status based on noting a lack of seemingly suitable nesting habitat or surveying seemingly suitable habitat and finding no nests or agitated terns.

Siskiyou County: Tule Lake NWR Upper (1-A) Sump (20 June, 15 flybys), Adobe Flat Reservoir (4 July), Wiley wetlands (T39N, R4E, S3) (4 July), Dead Steer Flat (12 July), Antelope Sink (12 July), various wetlands off Dorris-Brownell Rd. and Sheep Creek Rd. (13 July), Mud Lake (T45N, R2W, S16) (13 July), lake S of Juniper Knoll Rd. (T46N, R1W, S16) (13 July), Prather Ranch S (T45N, R2W, S5) (15 July), Prather Ranch N (T46N, R2W, S34) (15 July), Sky Mountain Game Bird Club (T47N, R2W, S10&ll) (15 July), Claes Nilsson wetland (T47N, R1E, S18&19) (15 July).

Modoc County: Everly Reservoir (20 May), Householder Reservoir (21 May), Enquist Reservoir (21 May), Black Reservoir (21 May, 18 July), Sibley Lake (21 May), Oregon Rim Reservoir (21 May), Green Springs Reservoir (22 May), Drift Fence Stock Tank (22 May), Rimrock Valley Reservoir (22 May, 6 carrying food in direction of nearby Mud Lake), Green Tank Reservoir (22 May, 36 of which many flying off toward nearby Mud Lake; 18 July), Lower Roberts Reservoir (23 and 24 May), Lower Cummings Reservoir (24 May), Kelly Reservoir (24 May), Ingall Swamp (24 and 30 May), Hager Basin Reservoir (24 May), Janes Reservoir (25 May), Diamond Reservoir (25 May, 11 -- presumed breeders from Baseball Reservoir on foraging trip), Duncan Reservoir (26 May, 5; 22 June), Reservoir F (26 May, 7; 4 June, numerous flybys), Four-mile Reservoir (27 May), unamed wetland (T47N, R9E, S10) -2.5 mi S of Warm Springs (28 May), Logan Spring (29 May), Layton Spring (29 May), Lauer Reservoir (29 May), Pretty Tree Reservoir (29 May), Raker and Thomas Reservoir (29-30 May), Emigrant Spring (30 May), Wood Flat Reservoir (30 May), Upper Cummings Reservoir (30 May), Indian Valley Reservoir (30 May), Dorris Brothers Reservoir (30 May), Bailey Tank (31 May), Deer Hill Reservoir (31 May), Mosquito Lake (1 June, 1 July), reservoir E end of Widow Valley (1 June, 2 July), Antelope Reservoir (2 June), Jacks Butte Tank (2 June), Mapes Reservoir (2 June), Wild Horse Reservoir (3 June, 1 flyby), Graves Valley (3 June), Williams Valley (3 June), Reservoir C (3 June, 1 flyby), Antelope Plains (2 and 4 June), unnamed reservoir (T44N, Rl0E, SS) S of jct. roads to Boles Meadow and Fairchild Swamp (4 June, 3), Fairchield Swamp (4 June; 5 June, 1 flyby), Dobe Swale Reservoir (6 June, 25), Ash Creek WA (Modoc/Lassen cos.) (~15 June, 2 flybys; none on multiple other summer dates), Avanzino Reservoir (16 June, 3), Reservoir G (16 June), Wilson Valley (21 June), Grohs Brothers wetland (T48N, R9E, S20) (21 June), Kowloski Reservoir and meadow (21 June), unnamed reservoir (T47N, R6E, S2) along Rd. 108 (21 June), Double Head Lake (21 June), Lone Pine Lake (21 June), Werly of 2 lakes E of Double Head Lake (21 June), Pothole Valley (21 June), Pinnacle Lake (21 June), Mud Lake near Spaulding Resv. (21 June), Lost Valley (22 June), Hidden Basin Tank (22 June),

APPENDIX 2 (continued)

Pond 139 E of Pinkys Pond (22 June), Reservoir N (23 June, 6), Reservoir M (23 June), Cowhead Lake (24 June), Big Mud Lake (24 June), Fee Reservoir (24 June), Lake Annie (25 June), Cambron Lake (25 June), Snake Lake (25 June), Sworinger Resv. (part) (25 June), unnamed reservoir (T38N, R17E, S6) E of Sworinger Resv. (25 June), West Valley Reservoir (part) (26 June), Pit River Valley near Likely (27 June), Lyneta Ranch wildrice paddies N of Likely (27 June), Little Egg Lake (30 June and 1 July, min. 3-max. 17 presumed breeders from Egg Lake on foraging trip), Joinen Reservoir (30 June), Upper Roberts Reservoir (30 June), Taylor Reservoir (2 July), Hines Reservoir (2 July), ranch pond N of road to S end Goose Lake W of Davis (17 July, 6 flybys), Modoc NWR (multiple summer dates).

- *Shasta County:* Crystal Lake (6 June), Baum Lake (6 June), Horr Pond/Big Lake/McArthur Swamp/Hollenbeck Swamp complex (8 June, 2 and 4 July), Green Place Resvervoir (2 July), Hopeless Flat wetland (T37N, R3E, corner S15,16,21,22) (4 July), Cornaz Lake (4 July), Bald Mountain Reservoir (4 July), Grassy Lake (4 July), Logan Lake (5 July), Summit Lake (5 July), Shasta Valley WA (multiple summer dates).
- Lassen County: Leavitt Lake (17 May, 8 June), Feather Lake (17 May, 30 June, 5 July), Hog Flat Reservoir (17 May, 10 July), McCoy Reservoir (17 May, 10 July), Grasshopper Valley (17 May, 10 July), Corders Reservoir (26 May, 12 June), Jack's Lake (26 May, 5; 11 July), Smith Reservoir (26 May, 3; 16 July), Said Valley Reservoir (8 June), Mud Lake (T3IN, R9E, S29&32) (8 June), Lake Norvell (8 June), Mahogany Lake (8 June), Colman Lake (8 June), Long Lake just S Hwy 44 (8 June), Papoose Meadows (8 June, 9 July), Summit Lake (9 June), Bullard Lake (9 June), Gordon Valley (9 June), Halls Flat (10 June), Half Cabin Reservoir (10 June), Swains Hole (10 June), Mosquito Flat (13 June), Harvey Valley (13 June), Ashurst Well (13 June), Dakin Unit Honey Lake WA (14 June), Fleming Unit Honey Lake WA (15 June), Mud Flat (15 June), Sworinger Reservoir (part) (25 June), Newland Reservoir (25 June), Newland Springs (25 June), Blue Door Flat (26 June), Mud Lake (T39N, R13E, S24) (26 June), West Valley Reservoir (part) (26 June), wetland W of Madeline at jct. Co. Rd. 527 x Longhorn Rd. (27 June), Fleming Sheep Camp/Holbrook Reservoir (27 June), unnamed wetland (T36N, R9E, Sl) W of Daisy Dean Spring (3 July), Dillon Lake (3 July), Silva Flat Reservoir (3 July), Snider Waterhole (3 July), Snider Lake (3 July), Dry Lake (T37N, RSE, S34) (3 July), Clover Valley (5 July), Craemer Reservoir (8 July), Little Cleghorn Reservoir (10 July), Cleghom Reservoir (10 July), Twin Lakes (11 July), Blue Water (11 July), Pat Morris Spring (11 July), two unnamed lakes (T34N, R9E, S18) (11 July), Big Jack's Lake (11 July, 6 ad. and 4 juv.), Little Jack's Lake (11 July), Schroder Lake (11 July), Bear Valley Reservoir (11 July), Bear Lake (11 July), Little Valley (11 July), Beaver Creek wetlands (11 July), unnamed reservoir (T37N, R12E, S7 and S18) -1.25 mi S of Fleming Sheep Camp (19 July); Jay Dow wetlands S end Honey Lake (multiple summer dates).

Tehama County: Wilson Lake (6 July).

Plumas County: Sierra Valley (11 June), Lake Davis (11 June, 4), Lake Almanor (6 July), Round Valley Reservoir (6 July), Stump Ranch (6 July), Willow Lake (6 July), Fleischmann Lake (6 July).

APPENDIX 2 (continued)

Sierra County: Kyburz Marsh (19 July).

Nevada/Placer Counties: Martis Creek Lake (20 July).