

CALIFORNIA SHOREBIRD STUDY

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Abstract. A shorebird research program was conducted in California from 1968 to 1973. Studies included trapping and banding of shorebirds at selected sites and a statewide censusing program, the California Shorebird Survey. Trapping methods were developed, and 10,207 shorebirds were banded and color marked. From one to four years of census data were collected at 57 sites by more than 200 observers, mostly volunteers.

INTRODUCTION

Coastlines and wetlands in California support millions of migrating and resident shorebirds through the year. Forty-nine species have been recorded in the State (Table 1). Ten species nest here, while the others appear as migrants, winter visitants, or sporadic or accidental visitors.

Shorebirds are classified as game birds. They were hunted heavily in North America in the late 1800's, a period of unregulated sport and market hunting. On the east coast the Eskimo curlew population was extirpated and golden plovers and other shorebirds nearly became extinct. In California, populations of common snipe, marbled godwit, willet and long-billed curlew were greatly depleted (Grinnell, Bryant and Storer, 1918). Concern for the future of game and nongame bird populations in the nation led to protective measures in the early 1900's. By 1917, hunting of all shorebirds except common snipe was prohibited in California.

Today, the greatest threat to shorebird populations in California is degradation and destruction of shorebird habitat. Economic development of California wetlands, particularly along the coast, has resulted in an alarming reduction in suitable shorebird habitat. Since the turn of the century approximately 67 percent of coastal habitats of high wildlife value have been destroyed by dredging, land fills, harbor development and pollution.

Increasing concern for continued existence of shorebird habitats and populations in California prompted a major shorebird research effort directed by California Department of Fish and Game. Studies were conducted from July 1968 to June 1973. Funding was provided by Federal Aid in Wildlife Restoration, Project W-54-R, and by the Accelerated Research Program for Shore and Upland Migratory Game Birds. Research activities were coordinated by the Special Wildlife Investigations unit of the Department.

Objectives of shorebird research in California were to: (1) develop shorebird trapping methods; (2) develop shorebird survey methods; (3) identify shorebird habitats and habitat requirements; (4) determine shorebird seasonal and geographic occurrence and movement patterns; and (5) determine current status of shorebird populations in the State.

The author wishes to express his gratitude to Mr. Howard R. Leach who supervised the project since its inception in 1968. Grateful acknowledgement is extended to the six members of the Shorebird Advisory Committee who provided the needed expertise in formulating the goals, scope and direction of the shorebird program. These members were Dr. Howard L. Cogswell, Dr. Mary Erickson, Dr. Stanley Harris, Dr. Joseph R. Jehl, Dr. L. Richard Mewaldt, and Dr. Frank Pitelka. Valuable information on shorebird ecology, census methods and trapping techniques were contributed by many individuals under contract by the Department or hired as seasonal aids. Without the dedicated cooperation of more than 200 volunteer observers and State and Federal wildlife biologists, the California Shorebird Survey would not have been possible. Many other volunteers assisted in shorebird trapping operations. The Operations Research Branch of the Department of Fish and Game provided invaluable assistance in programming shorebird census data.

METHODS

Studies included a trapping and banding program and a statewide survey program, the California Shorebird Survey. Techniques for trapping, banding, color marking and censusing were developed in 1968 and 1969 by contract personnel and Department seasonal aids.

During 1968-69, Point Reyes Bird Observatory, Bolinas, was contracted to conduct shorebird censuses, evaluate ground and aerial census methods, identify shorebird habitat requirements, develop trapping methods, and band and color mark shorebirds at Point Reyes Peninsula, Marin County. Ron Gerstenberg, graduate student at Humboldt State University, was hired as a Department seasonal aid to conduct similar studies at Humboldt Bay, Humboldt County.

In 1969-70, Point Reyes Bird Observatory continued shorebird studies under contract. At Humboldt Bay, seasonal aids Gerstenberg and Nevin Holmberg, also a graduate student at Humboldt State University, continued studies at Humboldt Bay with emphasis on development and comparison of shorebird trapping methods. Under Department contract with San Diego Natural History Museum, Alan Craig, under supervision of Dr. Joseph Jehl, conducted shorebird surveys and banding studies in the San Diego Bay area.

From 1969 to 1972 seasonal aids were hired to conduct shorebird trapping and banding operations at Woodland Sugar Ponds, Yolo County. Banders were Bob Burks, Steve Speich and Dean Greenberg.

During the course of the study, publicity efforts were directed to increasing public awareness of the importance of protecting shorebird habitat. This was done by means of lectures and through newspaper and television coverage of banding operations. Through lectures, special mailings and notices in bulletins and periodicals, bird watchers throughout the State were informed of shorebird banding and color marking studies.

Literature searches carried out during the program were compiled in 1972 (Gerstenberg and Jurek, 1972).

Capture and Banding Program

Types of shorebird trapping equipment used were: (1) mist net; (2) rocket net; (3) night light; and (4) drift trap.

Mist nets used were black, brown and gray nylon nets in 9 and 12 meter (30 and 42-foot) lengths. Single and double tier nets were utilized in addition to standard four tier nets. Since mist nets selectively capture the small and medium size shorebirds, 30 mm, 36 mm and 61 mm mesh sizes were most frequently used. Mist nets were positioned to capture birds in flight at feeding or resting sites, or more commonly where they were moving to or from feeding areas. Trapping strategies varied greatly from one area to another.

Rocket netting was conducted chiefly at Humboldt Bay. The projecting net measures 18 by 12-meters (60 by 40-feet) and was constructed of nylon netting in a 3-cm (1 1/4-inch) square mesh. The net was launched by three recoilless cannons. Trap sites were selected at coastal locations where the larger species of shorebirds regularly formed dense roosting flocks at high tide. The net was positioned so that cross winds or head winds would not interfere with its flight, where high tides would not flood equipment, and where birds would not be trapped on wet or muddy substrates.

Nightlighting was attempted at several locations. The nightlight consisted of a high intensity spotlight powered by a portable electric generator that was mounted on a pack frame. Trapping crews consisted of two or three people--one carrying the generator and light, and one or two carrying long-handled nets. Crews walked rapidly across marsh, upland or other habitats spotlighting shorebirds on the ground. Birds that did not flush when approached closely were netted.

Two types of drift traps were tested. Clover-leaf drift traps were used on tidal mud flats at Humboldt Bay and in a freshwater marsh at Woodland Sugar Ponds. Since these traps failed to capture shorebirds, two modified Modesto traps (Feltas 1936, Rogers 1946) were built and used at Woodland Sugar Ponds in April 1972. These latter traps were positioned so that birds feeding along a shoreline were funneled into the trap by guide fences.

Captured birds were brought to a banding station near the trap site. Each bird was banded with a numbered Fish and Wildlife Service aluminum leg band. In accordance with color marking schedules, birds were marked to indicate area and date of capture. This information was conveyed by color of dye on breast feathers, positions on legs of the Service numbered band and, in many cases, an additional unnumbered aluminum band, and color of plastic adhesive tape over each leg band. Information was collected on age, sex and body measurements.

California Shorebird Survey

California Shorebird Survey consisted of a statewide network of shorebird census sites. Sites were established in areas where large numbers of shorebirds were known to occur or where information was needed on shorebird occurrence, abundance, species composition and habitat use.

Censusers, mostly volunteer observers, counted shorebirds at their respective sites periodically throughout each fiscal year and submitted reports to the Department. Censusers were provided with instructions and a supply of census forms. Counts of each species were recorded in columns designating the habitat where birds were observed. Observers also recorded weather

conditions, water level or tidal phase, and sightings of other selected water birds, such as brown pelicans, clapper rails and herons.

Survey reports for the period July 1969 to June 1972 were programmed for computer processing and tabulation. In June 1972, printouts of data in the form of summary sheets were produced. For each fiscal year count data were tabulated by census site and by species.

RESULTS AND DISCUSSION

Capture and Banding Program

From July 1968 to November 1972, 10,207 shorebirds of 26 species were banded in California (Table 2). Western sandpipers, least sandpipers and dunlins accounted for 68 percent of the banding total.

Of all trapping methods used, mist netting was most adaptable to the various trapping conditions encountered in coastal and inland habitats. It was the method most frequently used at all banding stations. Nearly 86 percent of all shorebirds banded were captured by mist netting. Most of these were western sandpipers, least sandpipers and dunlins.

The rocket net was set up 22 times, and ten successful firings netted 1,350 shorebirds. The first five successful attempts netted an average of 257 birds per firing. A maximum of 581 shorebirds was captured on one attempt. This method was best suited for the capture of medium and large shorebirds (e.g., dowitchers and willets).

Nightlighting attempts resulted in mixed success. Some attempts gave promising results. However, on the final five attempts from October 1970 to September 1971, the equipment was used a total of six hours and only 15 shorebirds were caught. Best success generally resulted on dark, moonless nights in areas where city lights were not visible on the horizon. In efforts at Point Reyes Peninsula, conditions of overcast sky or light mist enhanced catch success.

Use of the modified Modesto drift traps gave encouraging results at Woodland Sugar Ponds. In 12 sessions of trapping in April 1972, 142 shorebirds, mostly western sandpipers, were trapped. Least sandpiper, dunlin, long-billed dowitcher and (in November) common snipe were other species captured in these traps. Drift traps and mist nets were operated concurrently during April. High winds hampered many mist net operations but did not appear to reduce the effectiveness of the drift traps.

Shorebird mortality rates from each of the four trapping methods were compared. No mortality resulted from trapping with nightlight or drift trap. At Humboldt Bay, mortality from 17 mist netting sessions from June to September 1969 was 1.2 percent of the 677 shorebirds captured. Mortality from rocket net attempts, with one exception, ranged from 0 to 2.1 percent. On the first rocket net firing not enough banders and holding facilities were available to handle the tremendous number of birds caught. Thus, a high bird mortality of 10.7 percent resulted. In later attempts banders were better prepared, and on the subsequent nine firings shorebird mortality rate averaged 1.0 percent.

Banding studies were useful chiefly in gathering data on shorebird use in the vicinity of each banding location. Two hundred and thirty-two shorebirds of eight species were recovered or recaptured more than one day after being banded. All but three of these returns were recovered or recaptured within 32 kilometers (20 miles) of the original banding location. More than 2,000 reports of color marked shorebirds were received. As with band returns, nearly all reports were of birds known or presumed to have been

banded locally. No banded shorebird was sighted or recovered farther than 362 kilometers (225 miles) from the banding site. A possible exception was a western sandpiper sighted at San Diego Bay in March 1970. This bird appeared to have yellow dye on the breast indicating that it was color marked at Humboldt Bay; however, viewing conditions were such that the observer was unable to determine if the bird was banded.

Data indicate little, if any, population interchange of migrants between one banding area and another. However, at each banding site, recaptures, recoveries and sighting reports of color marked birds demonstrate that individuals of many shorebird species display a strong predilection for returning to the same migration stops or wintering grounds each year.

Detailed accounts of banding activities were reported by Gerstenberg (1972), Sibley (1970), Jehl and Craig (1971) and Jurek (1973).

CALIFORNIA SHOREBIRD SURVEY

Surveys were conducted at 57 shorebird census sites (Table 3). Nine sites were surveyed all four years of the program, while 14 others were covered three of the years. More than 200 censusers participated in the program.

Census effort by survey year is tabulated below:

<u>Survey Period</u>	<u>No. of Sites</u>	<u>No. of Counts</u>
July 1969-June 1970	34	463
July 1970-June 1971	24	446
July 1971-June 1972	42	750
July 1972-June 1973	29	442

Survey data have been summarized in greater detail by Jurek (1973).

The California Shorebird Survey has provided valuable population data on shorebirds over a vast area. Information was obtained on shorebird seasonal and geographic distribution, seasonal and yearly population changes, and habitat use. Long-term counts have proven useful in documenting wildlife values at many census sites, and this information has been used in many impact reports and resource evaluations. The data also serve as baseline information for comparison with future survey programs to determine long-range population trends.

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Table 2

SHOREBIRD BANDING SUMMARY BY AREA, 1968-1972

Area	Period	Banding Total
Humboldt Bay	July 1968 - April 1972	4,482
Point Reyes Peninsula	August 1969 - April 1970	1,770
San Diego Bay	September 1969 - August 1970	1,741
Woodland Sugar Ponds	August 1969 - November 1972	1,500
San Francisco Bay	October 1970 - April 1972	492
Anaheim Bay	October 1970 - February 1971	173
Other areas	April 1971, November 1971	49
TOTAL		10,207

TABLE 1
CHECKLIST OF SHOREBIRDS OF CALIFORNIA

Family	Species			Status ^{3/}	
	Common Name ^{1/}	Scientific Name ^{1/}	Nomenclatural Changes ^{2/}		
Haematopodidae	American oystercatcher	<u>Haematopus palliatus</u>		I	
	Black oystercatcher	<u>Haematopus bachmani</u>		C ^o	
Charadriidae	Semipalmated plover	<u>Charadrius semipalmatus</u>		C	
	Piping plover	<u>Charadrius melodus</u>		I	
	Snowy plover	<u>Charadrius alexandrinus</u>		C ^o	
	Wilson's plover	<u>Charadrius wilsonia</u>		I	
	Killdeer	<u>Charadrius vociferous</u>		C ^o	
	Mountain plover	<u>Spoda montana</u>	<u>Charadrius montanus</u>	U	
	American golden plover	<u>Pluvialis dominica</u>		P	
	Black-bellied plover	<u>Squatarola squatarola</u>	<u>Pluvialis squatarola</u>	C	
	Surfbird	<u>Aphriza virgata</u>)	C	
	Ruddy turnstone	<u>Arenaria interpres</u>) Moved from Charadriidae	C	
	Black turnstone	<u>Arenaria melanocephala</u>) to Scolopacidae	C	
Scolopacidae	American woodcock	<u>Philohela minor</u>	Experimental Introduction		
	Common snipe	<u>Capella gallinago</u>		C ^o	
	European jacksnipe	<u>Lymanocryptes minimus</u>		I	
	Long-billed curlew	<u>Numenius americanus</u>		C ^o	
	Whimbrel	<u>Numenius phaeopus</u>		C	
	Upland plover	<u>Bartremia longicauda</u>	Upland sandpiper	I	
	Spotted sandpiper	<u>Actitis macularia</u>		C ^o	
	Solitary sandpiper	<u>Tringa solitaria</u>		P	
	Wandering tattler	<u>Heteroscelus incanus</u>		C	
	Willet	<u>Catoptrophorus semipalmatus</u>		C ^o	
	Greater yellowlegs	<u>Totanus melanoleucus</u>	<u>Tringa melanoleucus</u>	C	
	Lesser yellowlegs	<u>Totanus falvipes</u>	<u>Tringa falvipes</u>	P	
	Knot	<u>Calidris canutus</u>	Red knot	C	
	Rock sandpiper	<u>Erolia ptilocnemis</u>	<u>Calidris ptilocnemis</u>	P	
	Sharp-tailed sandpiper	<u>Erolia acuminata</u>	<u>Calidris acuminata</u>	I	
	Pectoral sandpiper	<u>Erolia melanotos</u>	<u>Calidris melanotos</u>	P	
	White-rumped sandpiper	<u>Erolia fuscicollis</u>	<u>Calidris fuscicollis</u>	I	
	Baird's sandpiper	<u>Erolia bairdii</u>	<u>Calidris bairdii</u>	P	
	Least sandpiper	<u>Erolia minutilla</u>	<u>Calidris minutilla</u>	C	
	Curlew sandpiper	<u>Erolia ferruginea</u>	<u>Calidris ferruginea</u>	I	
	Dualin	<u>Erolia alpina</u>	<u>Calidris alpina</u>	C	
	Short-billed dowitcher	<u>Limodromus griseus</u>		C	
	Long-billed dowitcher	<u>Limodromus scolopaceus</u>		C	
	Stilt sandpiper	<u>Micropalama himantopus</u>		P	
	Scapillated sandpiper	<u>Ereunetes pusillus</u>	<u>Calidris pusilla</u>	I	
	Western sandpiper	<u>Ereunetes sauri</u>	<u>Calidris sauri</u>	C	
	Buff-breasted sandpiper	<u>Tryngites subruficollis</u>		I	
	Marbled godwit	<u>Limosa fedoa</u>		C	
	Bar-tailed godwit	<u>Limosa lapponica</u>		I	
	Ruff	<u>Philomachus pugnax</u>		I	
	Senderling	<u>Crocethia alba</u>	<u>Calidris alba</u>	C	
	Recurvirostridae	American avocet	<u>Recurvirostra americana</u>		C ^o
		Black-necked stilt	<u>Himantopus mexicanus</u>		C ^o
Phalaropodidae	Red phalarope	<u>Phalaropus fulicarius</u>		C	
	Wilson's phalarope	<u>Steganopus tricolor</u>		C ^o	
	Northern phalarope	<u>Lobipes lobatus</u>		C	

^{1/} A.O.U. 1957

^{2/} A.O.U. 1973

^{3/} Status codes:

Common - Species whose population levels are compatible with existing habitat and are currently secure because essential habitats are not severely threatened by environmental degradation.

Uncommon - Species or subspecies is not immediately threatened with extinction but is vulnerable because it exists in such small numbers or is so restricted throughout its distribution, that its existence may become endangered if its total population declines or if environmental conditions deteriorate.

Peripheral - Species extends into California but is at the edge of its geographic distribution. Although it may occur in low numbers in California, it is not in danger of extinction or uncommon in its distribution as a whole.

Irregular - Species has been recorded, but a population does not regularly occur in the State each year.

Table 3

CALIFORNIA SHOREBIRD SURVEY
CENSUS SITES, 1969-1973

<u>County</u>	<u>Site</u>	<u>Census Period</u>	<u>No. of Counts</u>
Alameda	Alameda, South Shore, S. F. Bay	Nov. 1969-Jun. 1973	64
	Bay Bridge Toll Plaza-Emeryville		
	Crescent, S. F. Bay	Sep. 1969-Jun. 1973	39
	Golden Gate Fields, S. F. Bay	Oct. 1969-May 1973	78
Del Norte	Lake Earl and Lake Tnlawa	Jul. 1970-Jun. 1971	14
Glenn	Sacramento National Wildlife Refuge	Nov. 1969-May 1973	33
Humboldt	Gillespie Ranch, Humboldt Bay	Sep. 1969-Jun. 1970	8
	South Spit, Sand Beach, Humboldt Bay	Sep. 1969-Jan. 1972	16
	South Spit, Sand Flat, Humboldt Bay	Aug. 1969-Mar. 1972	23
	McDaniel Slough, Humboldt Bay	Sep. 1969-Mar. 1970	10
	Emmerson's Mill, Humboldt Bay	Oct. 1969-Apr. 1970	7
Imperial	Salton Sea National Wildlife Refuge	Jul. 1971-Jun. 1973	48
Kern	Kern National Wildlife Refuge	Oct. 1969-Apr. 1973	47
Los Angeles	Palos Verdes Peninsula	Nov. 1969-Feb. 1973	61
Marin	Walker Creek, Tomales Bay	Sep. 1969-Mar. 1973	109
	Seminary Cove and DeSilvas Lagoon, S. F. Bay	Jul. 1969-Jun. 1972	43
Mendocino	MacKerricher State Park	Aug. 1971-Jun. 1973	39
Merced	Moffit Field, San Luis N. W. R.	Apr. 1970-Aug. 1971	14
	Sprig Lake, Kesterson N. W. R.	Apr. 1970-Jun. 1971	9
	Glory Hole, Merced N. W. R.	Apr. 1970-Aug. 1971	13
	San Luis Wasteway Wildlife Area	Sep. 1970-May 1971	13
	San Luis National Wildlife Refuge	Feb. 1970-Sep. 1972	42
	Kesterson National Wildlife Refuge	Feb. 1970-Sep. 1972	43
	Merced National Wildlife Refuge	Feb. 1970-Mar. 1972	39
Volta Wildlife Area	Aug. 1971-Sep. 1972	16	
Modoc	Modoc National Wildlife Refuge	Oct. 1971-Jun. 1972	16
	Clear Lake National Wildlife Refuge	Jul. 1971-Jun. 1972	21
Mono	Mono Marina, Mono Lake	Jul. 1971-Jun. 1973	28
	South Boat Ramp, Mono Lake	Jul. 1971-Jun. 1973	20
	Alkali Lake, Crowley Area	Sep. 1971-May 1973	15
Monterey	Jetty Road, Elkhorn Slough	Aug. 1970-Jun. 1973	62
	Salt Flats, Elkhorn Slough	Aug. 1970-Jun. 1973	62
	Kirby Park, Elkhorn Slough	Aug. 1970-Jun. 1973	61

<u>County</u>	<u>Site</u>	<u>Census Period</u>	<u>No. of Counts</u>
Orange	Bolsa Bay	Oct. 1969-Dec. 1971	34
	Upper Newport Bay	Jul. 1969-May 1970	16
	Anshein Bay	Jul. 1970-Jun. 1971	35
San Luis Obispo	Cuesta-by-the-Sea, Morro Bay	Nov. 1969-May 1973	89
	Carrizo Flain	Nov. 1971-Feb. 1973	12
Santa Barbara	El Capitan Beach	Jul. 1969-June 1973	63
	Goleta Slough	Oct. 1969-Feb. 1972	18
	Carpinteria Marsh	Sep. 1969-Mar. 1970	15
Santa Clara	Palo Alto Marsh, S. F. Bay	Oct. 1969-May 1972	73
	Palo Alto Flood Basin	Nov. 1969-Apr. 1971	25
San Diego	South San Diego Bay Salt Ponds	Oct. 1969-Oct. 1970	27
	San Elijo Lagoon	Jan. 1970-Jun. 1972	32
	Batiquitos Lagoon	Dec. 1969-Jun. 1972	57
	Buena Vista Lagoon	Dec. 1969-Apr. 1971	20
	San Diego River Flood Control Channel	Jan. 1970-Jun. 1973	66
	Santa Margarita River Estuary	Apr. 1971-Jun. 1973	55
	Imperial Salt Ponds, San Diego Bay	Aug. 1971-Jun. 1972	21
San Mateo	Glorietta Bay, San Diego Bay	Aug. 1972-Aug. 1973	26
	Belmont Slough, S. F. Bay	Jul. 1971-Sep. 1972	26
Siskiyou	Faber Tract, S. F. Bay	Nov. 1971-May 1973	19
	Tule Lake National Wildlife Refuge	Jul. 1971-Jun. 1972	25
Solano	Lower Klamath National Wildlife Refuge	Jul. 1971-Jun. 1973	49
	Joice Island	Aug. 1969-May 1973	30
Yolo	Grizzly Island	Oct. 1971-May 1973	24
	Woodland Sugar Ponds	Jul. 1969-Jun. 1973	129