

TO: Department of Fish and Game
Wildlife Management Branch
Special Wildlife Investigations

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SUBJECT: Completion Report
Shorebird Research 1968-69^{1/}

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Shorebird Research Conducted By
Point Reyes Bird Observatory, 1968-69^{1/}

Introduction

The Point Reyes Bird Observatory has completed its first year of research under a \$3,200.00 contract with the California Department of Fish and Game Special Wildlife Investigations Project (Pittman-Robertson W54R-1). Main emphasis in the research was placed upon testing the application of shorebird census techniques in the air and on the ground, the analysis of different types of habitat, and the banding and color-marking of birds to further the knowledge and understanding of their movements. In addition, a shorebird literature search was made.

Recommendations arising from this research are not detailed here. They will be set forth in the proposal for research in 1969-70 to be submitted to the Special Wildlife Investigations Department early in July 1969.

Census Techniques

In order to obtain an estimate of the number of shorebirds that winter in California and pass through the coastal and inland areas of the state, it is vital to establish regular censuses in areas used by large numbers of birds. The Point Reyes Peninsula, together with Bodega Bay immediately to the north and Bolinas Lagoon to the south, is a vital area for many shorebird species breeding in Alaska and wintering down the coast of Central and South America to Ecuador and Peru. It forms a vital bridge, being the only major complex of usable habitat along the California coast between San Francisco Bay and Humboldt Bay. It must be assumed that a substantial proportion of birds migrating along the coast use one or more of the areas under consideration as a stopping-off point on their spring or fall journeys or both. How long they stay in the area is one of the questions that the study will help to determine.

Both aerial and ground censuses are being made to monitor the population of shorebirds and other water-dwelling species, game and nongame. One great advantage in censusing Marin County is that only one of the important areas is even as much as a mile wide and therefore they all lend themselves to full coverage by observers without resort to elaborate and time-consuming transect methods.

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Ground Census

Limantour Estero is described in some detail elsewhere in this report. The Point Reyes Bird Observatory began regular censuses of this area in July 1965 and has maintained continuity of coverage since then. Three years of information which backed the 1968-69 study is unparalleled certainly in California and probably in the United States.

For purposes of the ground census, the Estero is divided into the twelve subareas described in detail in the section of this report dealing with Analysis of Micro-habitat. With the exception of the northernmost portions of the bay to the north of the main estuary, all parts of the area are within fairly comfortable view through binoculars or a spotting scope in all but the poorest light conditions. It is therefore possible to maintain a high degree of accuracy both in species identification and in head counts. The twelve subareas are covered in rotation and in each all birds that depend on or have any effect on the environment are counted. In addition, the observer records whether the birds are resting or feeding, whether they are flying through the area, and whether they are making use of deep water, mud, sand or marsh habitat. By correlating these data with essential variables, such as the state of the tide and the area of mudflat exposed, it is possible to determine the population density and degree of use at different times of the day and seasons of the year. Thus, the census becomes much more than a raw population count; it is in a real sense an assessment of the potential of the area reflecting the relative importance of different kinds of habitat. One increasingly significant role of the census observer is to search for color-marked birds and keep track of their number, movements, and flocking behavior.

It is naturally not possible to utilize all the methods employed at Limantour in any given area since the combination of a wide variety of habitat and a population concentrated in a relatively confined space is not commonly encountered. Nevertheless, the general methodology of the Limantour Census could be adapted with great profit to meet the individual requirements of many important areas utilized by shorebirds throughout the state. It is felt that high priority should be given to ground censuses on this model. In terms of knowledge gained on migratory movements and fluctuations, population density, and habitat usage, ground censuses are a most productive use of manpower resources. Without them any program of color-marking birds is virtually meaningless, since dependence only on random sightings would jeopardize the whole project.

Aerial Census

Since the original trial flights in March and April 1968, nine aerial censuses have been made of the West Marin County area. Each flight has started from the Marin County Airport (Gross Field) which is located by Highway 101 just north of Novato. The censuses have covered five assorted locations which are of importance to shorebirds. These are described briefly below.

Tomales Bay

A narrow bay some eight miles long and seldom more than a mile wide in the bottom of the ravine caused by the San Andreas Fault. There are two main areas used by shorebirds: (1) a wide expanse of sandy tidal mudflat adjoining the marsh at the south end of the bay; and, (2) an expanse of Salicornia marsh and mudflat at the mouth of Walker Creek together with sandy mudflats immediately to the north.

On the basis of shorebird numbers, Tomales Bay is the most important area censused.

Abbott's Lagoon

This important shorebird area consists of two lagoons. The lower brackish one is separated from the ocean by a very narrow strip of sandy beach. It receives fresh water outflow from the upper lagoon. The sandy flats on the south and east sides are used by hundreds of shorebirds in the fall though not in the spring.

Drake's Estero

Sharing a common mouth with Limantour Estero, this estuary complex consists of a shallow central expanse with sandbanks exposed at low tide, and four small bays. Of these Schooner Bay and Creamery Bay have expansive feeding areas and support sizeable shorebird populations.

Limantour Estero

This area is described in detail elsewhere. It has been threatened with harmful development under the current master plan for the Point Reyes National Seashore.

Bolinas Lagoon

A tidal lagoon of some 500 acres adjacent to Bolinas Bay. Aside from its great value to shorebirds of the sandpiper type, which may be seen in flocks of over ten thousand on northward migration, this area is the main feeding ground for the Great blue herons and Common egrets nesting at Audubon Canyon Ranch. It is also one of the chief resting places on the California coast for the Brown pelican.

The lagoon has been under constant threat of harmful development in recent years.

All these areas can be adequately censused in one flight of about ninety minutes from Marin County Airport. To cover the same area on the ground would take a week and many parts are inaccessible.

Since no expanse of water on the census route is more than a mile wide and almost all are very much narrower, the census coverage can be made in the simplest, most effective way possible. With an observer sitting on each side of the airplane it is possible to obtain an accurate estimate in each area without resorting to an elaborate and possibly inadequate system of transects.

The widest area, Tomales Bay, has a convenient rectangular shape which makes it easy to cover with two almost straight runs, one parallel to each shore. Drake's Estero with its four arms has the most complex shape; but, straight-forward runs up and down each of its bays provide a good count. The triangular layout of Bolinas Lagoon, together with the population concentration on Kent Island, presents a slight problem, but one small detour is enough to solve it.

Results

The nine full census flights made between August 1968 and May 1969 reflected population changes in shorebirds and other groups of birds, both game and nongame. Although curtailed by adverse weather conditions, with exceptionally prolonged rainfall in December 1968 and occasional very high winds in the early months of 1969, this first program of aerial censuses has provided invaluable information and made possible a preliminary evaluation of the relative merits of several area and habitat types between which there is known to be an interchange of population. It cannot be too strongly emphasized that this is the only way of gathering such a large volume of information about a widely scattered area without enormous and prohibitive expense in terms of manpower and resources.

The following table gives the shorebird totals by area recorded in each area on the 1968-69 counts.

A census made on May 15, 1969, has been excluded from this table because of the low numbers recorded. Shorebirds by this time had largely departed. It appears that the available flight time can be most profitably used between the beginning of August and the first week in May.

TABLE 1

SHOREBIRD TOTALS ON AERIAL CENSUSES 1968-69

	1968					1969			Area Total For Year
	8/9	9/11	10/7	10/30	11/26	1/9	3/19	5/5	
Tomales Bay	906	1165	3441	5684	3069	3772	4991	926	23954
Abbott's Lagoon	904	186	90	29	15	-	-	-	1224
Drake's Estero	638	1807	2062	3151	2702	3322	910	708	15300
Limantour Estero	1219	1612	1856	2772	2360	1240	1803	386	13248
Bolinas Lagoon	838	805	1067	1214	2753	764	784	464	8689
	4505	5575	8516	12850	10899	9298	8488	2484	62415

The sample represented by these figures is not large enough to allow any sweeping conclusions to be drawn, but some comments can be made at this time. As expected, Tomales Bay emerges as the most important area being apparently no less important in the spring than in the fall. Abbott's Lagoon for reasons not yet fully clear, appears to be of importance only in the fall. The evidence from ground census supports this conclusion but also suggests that the paucity of shorebirds recorded on our counts is not typical since flocks of over a thousand sandpipers are not uncommon. Drake's Estero is remarkable in that the proportion of the total West Marin population it supports appears to be more or less constant throughout the year. The interchange of its population with that in Limantour Estero is underlined by the results of the census

on January 9, 1969. It was obvious to the observers on that occasion that the Limantour shorebird population was low as a result of the tide being high (the level was approximately four feet above the low tide datum). It was no accident that the population in Drake's Estero was correspondingly high. This demonstrates the advisability of making the census when the tide is at about the middle of its range as the normal practice has been, thus ensuring a more even distribution of population. Bolinas Lagoon emerges as an area of obvious importance although it is felt that the sample size may not have done it full justice. Flocks of up to 12,000 sandpipers can be observed on northward migration in April. As indicated in the initial summary, the Brown pelican appears in larger numbers in Bolinas Lagoon than anywhere else in the area. On September and October counts over 220 were recorded.

Table 2 gives the average count of shorebirds in each location with the percentage of the overall population for the area. As suggested above, these figures can only be taken as a general indication of the relative importance of each area.

TABLE 2
AVERAGE COUNTS AND PERCENTAGE OF TOTAL POPULATION IN EACH AREA

	<u>Average Count</u>	<u>Percentage of Total Population</u>
Tomaes Bay	2994	38.4%
Abbott's Lagoon	153	2.0
Drake's Estero	1913	24.5
Limantour Estero	1656	21.2
Bolinas Lagoon	1086	13.9

Evaluation

In evaluating this table it should be borne in mind that the wintering population of shorebirds does not build up in a steady progression. The experience of the Observatory, clearly borne out by other observers in California, notably Recher (1966) and Storer (1951) is that successive groups of birds migrate into and out of an area. It is most unusual, for instance, for any of the birds color marked as part of the Limantour Estero study to be seen in the Estero more than about three weeks after capture and marking. Some of the apparent inconsistencies in Table 1 are easily explained. The ground census at Limantour Estero on September 20 was taken when the tide was going down from a high level (5.1 feet). Under these conditions it is likely that many shorebirds were flying into the estuary from high tide resting areas while the censuser was on the ocean beach, thus the total figure is probably too low. The shorebird total for Abbott's Lagoon on September 3 includes a flock of 600 Northern Phalaropes resting on migration.

In general, it is clear that the present accuracy of the censuses is quite sufficient for Department of Fish and Game purposes and that more experience on the part of the censusers will make the totals even more accurate. There is little difficulty in estimating numbers of large shorebirds such as godwits which occur in easily countable numbers. The problem is greatest in the case of the small sandpipers which almost always flock, often in many hundreds. The commonest shortcoming on the part of an aerial censuser seems to be a tendency to make occasional wrong estimates of large flocks, usually erring on the high side.

Limantour Estero Study

Description

Limantour Estero is an estuary adjacent to Drake's Estero and sharing with it a common mouth through which they discharge into Drake's Bay. For most of its two-and-a-half mile length it is less than five hundred feet wide, although one large bay approximately one mile long by a third of a mile wide adjoins it midway.

It was threatened with development as a "multiple-use" recreation area under the Point Reyes National Seashore Master Plan in 1965. The plan, which is technically still in effect, provides for a spill dam near the mouth of the bay to the north and parking and other public facilities on the spit separating the estero from Drake's Bay. Drake's Estero was also earmarked in the plan as a "multiple-use" area. The provision of a dam in Limantour Estero would irreversibly damage all the areas at the east end, which are the most important for shorebirds, by maintaining the water at a level corresponding to that of a high tide, thereby making the mud and sandflats uninhabitable to the invertebrates on which the birds depend for their food.

The Point Reyes Bird Observatory's study at Limantour began in 1965 with a contract from the National Park Service to document the importance of the region to shorebirds and waterfowl. The technique of censusing evolved since the inception of the study is described in the census section. A major feature of the study has been the identification and analysis of microhabitat for census and other study purposes. The twelve areas used consistently in gathering data since June 1967 (Figure 1) can be described as follows:

AREA 1

(Muddy Hollow Pond) A freshwater pond artificially created by a dam to the northeast of the main estuary. Although much used by waterfowl, it is not important to shorebirds.

AREA 2

A freshwater pond more or less surrounded by marsh according to season. Before the fall rain it has flats which are particularly attractive to Long-billed dowitchers.

Key Species: Long-billed dowitcher, Least sandpiper, Common snipe.

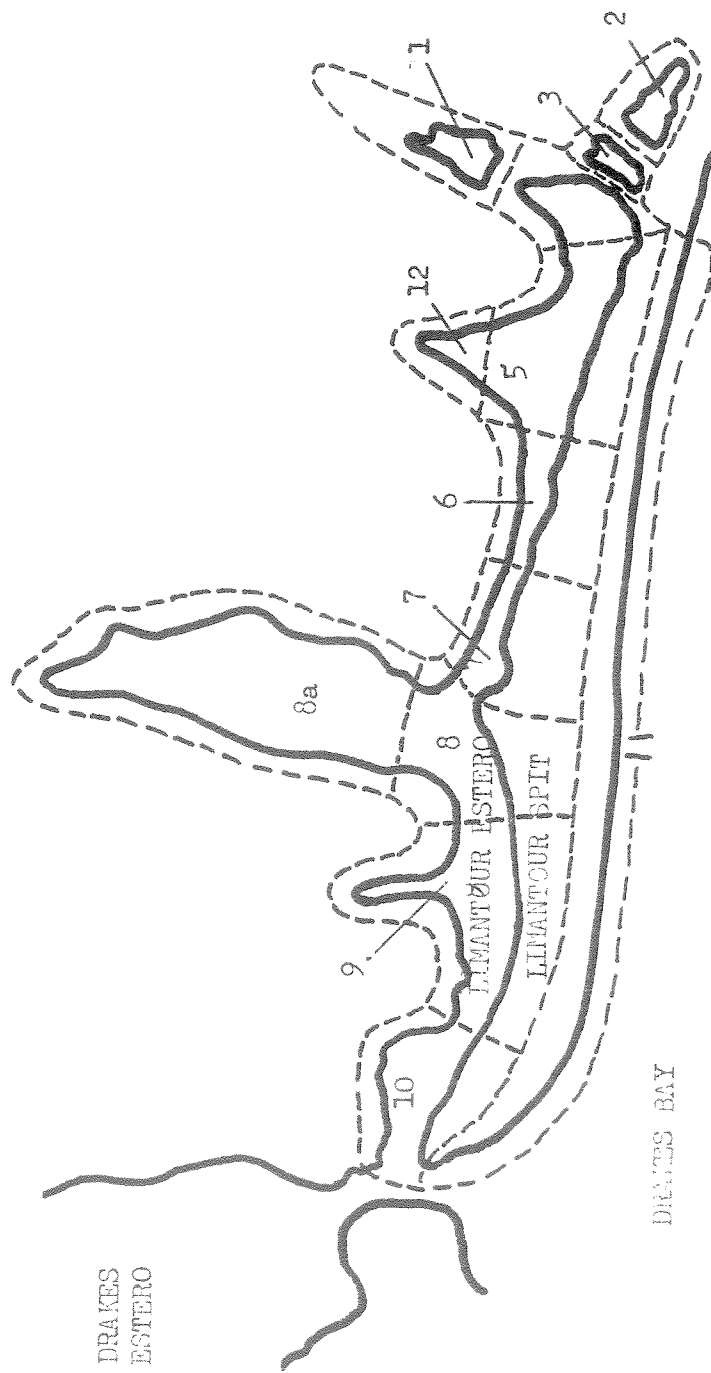


FIGURE 1
LIMANTOUR CENSUS AREAS

AREA 3

A small expanse of marsh between Area 2 and the main part of the estuary, of minimal importance.

AREA 4

Some 1,200 by 400 feet, mudflat fringed with Salicornia marsh. The mud is exposed until the tide is about 3.5 feet above the datum. Nearly all the shorebird species recorded at Limantour use this area, which often supports over 2,000 birds at one time. Much used also by herons and egrets.

Key Species: Western sandpiper, Dunlin, Least sandpiper, Willet, Semipalmated plover, Black turnstone.

AREA 5

An area of sandy mudflat adjoining the main channel. The food supply is the richest and most varied; the sandy substrate has many polychaetes, amphipods and small bivalves while the large expanse of Salicornia adjacent to the flats is abundant in insects and small crabs. It is in this area that the capture and marking program has been carried out.

Key Species: Dunlin, Western sandpiper, Willet, Marbled godwit, Least sandpiper, Black turnstone.

AREA 6

Physically similar to Area 5 but with a narrower strip of Salicornia marsh and a less rich and slightly coarser substrate.

Key Species: Generally the same as Area 5.

AREA 7

In this area the substrate slopes more steeply into the main channel and there is no Salicornia marsh. Its importance therefore is as a resting area rather than a feeding area.

Key Species: Black-bellied plover, American golden plover.

AREA 8

A broad expanse of sandy flat opposite the mouth of the north bay. Much used by most shorebird species both for feeding and resting.

Key Species: Dunlin, Western sandpiper, Willet, Marbled godwit, Sanderling, Snowy plover, Black-bellied plover.

AREA 8A

The large shallow bay to the north of the estuary. Surrounded by flats which often support large sandpiper flocks. The main feeding ground for Great blue Herons and Common egrets. Imperfectly known because of lack of immediate access from the ground.

AREA 9

A wide sandy flat adjoining deeper water to the west of the bay mouth. Used for feeding on rising tides especially by Dunlins. The dune area back from the water's edge is much used by sandpipers for resting, particularly at higher tides when other areas are covered.

Key Species: Dunlin, Western sandpiper, Sanderling, Snowy plover.

AREA 10

The area near the mouth of the estuary including a small embayment. This is used chiefly as a stopping-off area by birds on their way from Limantour to Drake's Estero but sizeable flocks of feeding sandpipers can be found at certain stages of the tide. A rocky area by the mouth is much used by turnstones.

Key Species: As in Area 9, with the addition of Black turnstone.

AREA 11

The wide sandy ocean beach. The preferred habitat of Sanderlings and much used also by Willets for feeding. The higher portions are used by resting sandpipers and small plovers.

Key Species: Sanderling, Willet, Black-bellied plover, Snowy plover, Semipalmated plover, Western sandpiper, Dunlin, Least sandpiper.

The range of habitat types within a relatively small self-contained area at Limantour Estero gives added value to the censuses made there, since it gives an idea of the characteristics and potential of each in terms of species, carrying capacity, and seasonal fluctuation.

Analysis of Micro-Habitat

Various habitats at Limantour, as established for census purposes, are being analyzed in several different respects. A study of the particle size of the substrate in each area was made by taking samples at regular intervals along the whole shore of the estero and running them through a series of standard sieves. The correlation between particle size and distance from the mouth of the estero is more complex than might have been supposed. It is clear that this factor--when considered in connection with tidal action, drainage, and the feeding habits and stratification of the invertebrates consumed by birds--offers a basis of explanation for relative bird numbers using each area.

The data from substrate invertebrate analysis are being analyzed to determine several basic parameters affecting the use of each area. It has been found that there is a considerable seasonal variation in the total invertebrate

population and also within each order. For each area the relative abundance of each order and the total biomass per square meter are being established.

Continuing analysis of the invertebrate fauna will determine their stratification and, hence, their accessibility and usefulness to birds of different bill and leg lengths and modes of feeding.

The Observatory has hitherto done its own analysis, but is now collaborating with the Fish and Game Department's Food Habits Laboratory. The stomach of five shorebirds that were net casualties in a banding session have been sent to the Laboratory for analysis. Further specimens will be collected and sent to the Laboratory. It should be noted here that existing studies have been few and mostly based on very few specimens. In this connection, the work done in 1964-65 by the Food Habits Laboratory, involving an analysis of the stomachs of 118 shorebirds, will be of the utmost value.

Data Processing

Valuable assistance has been provided by the Forest and Range Experiment Station, U. S. Department of Agriculture in Berkeley, to process data gathered over the last four seasons of the Observatory's study of Limantour Estero. Data reduced to the form recommended by consultants at the USDA has been processed by the Department's Marine Resources Operation at Terminal Island. Over 12,000 punch cards have been tabulated for entry into a computerized program. The Observatory feels that utmost priority should be given to this aspect of the study. Development of a data processing system will be of enormous importance in determining the future use and development of estuaries throughout the state. It cannot be overemphasized that the Limantour study offers the unique source for such data.

Banding and Color-Marking

During the 1968-69 season, six banding and color-marking sessions were held at Limantour Estero. The capture results are summarized below with totals for recaptured birds given in parentheses after the figure for first-time captures.

The situation of Limantour Estero, running east-west and backed by hundred-foot cliffs, unfortunately forms a natural wind funnel and the high winds of the past winter forced many scheduled banding operations to be cancelled, and sudden heavy rain cut short activity on the night of November 24th. Nevertheless, the results obtained have been useful. One particularly valuable feature has been the high proportion of recaptures. Of a total of 378 birds netted, 29 (7.7%) were recaptures. This figure compares with 0.4% for Humboldt Bay.

In the Least sandpiper the recapture percentage was a striking 18.6% (13 out of 70), while in the Western sandpiper, clearly a less sedentary species, the percentage is only 3.2% (4 out of 125). Information of this kind is vital in assessing how long shorebirds stay in a given area and ultimately in arriving at a realistic estimate of the total population for a large area or even for the state.

TABLE 3

SHOREBIRD CAPTURES AT LIMANTOUR ESTERO 1968-69

	1968					1969		
	8/24	9/28	10/26	11/24	3/8	3/29		
Least sandpiper	17	18(3)	10(4)	8(3)	4(3)			70
Western sandpiper	12	10	16(1)	5	44(2)	34(1)		125
Dunlin		5	100(2)	28(5)	17(3)	13(2)		175
Short-billed dowitcher	3							3
Long-billed dowitcher		1		1				2
Black turnstone		1						1
Semipalmated plover		1	1					2
	32	39	134	50	73	50		378

The first sighting of color-marked birds from Humboldt Bay was made on February 7, 1969, when two Western sandpipers were seen at Inverness in Tomales Bay. It seems likely that these birds were banded in December 1968. This sighting demonstrates that there is still some southerly movement down the coast after December. It is quite clear that many more sightings of this kind will be needed to establish patterns of migration movement. Regular observations by competent observers in a coordinated program are essential to the success of the banding and color-marking operation. Plans for such a program will be outlined in the proposal for the 1969-70 season which will be presented early in July 1969.

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