

Report on the Tomales Bay Shorebird Project:

1989-90 Winter and Spring
Shorebird Abundances
on Tomales Bay, California,
and notes on the Movements
of Shorebirds within Tomales Bay

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INTRODUCTION

This is the first annual report on the Tomales Bay Shorebird Project. The results contribute to an understanding of wildlife values in the wetlands of Tomales Bay. A large number of ecological studies have been conducted on Tomales Bay (e.g., see ANATEC Laboratories 1983, Smith and Hollibaugh 1989). Studies on the use of Tomales Bay wetlands by Shorebirds have been limited to four years of monthly surveys of Walker Creek Delta (Jurek 1973) and the annual Audubon Christmas Bird Count (National Audubon Society). Other data on the occurrence of shorebirds on Tomales Bay were collected monthly at Walker Creek Delta and Cypress Grove Preserve during most years between 1973 and 1987 (Audubon Canyon Ranch, unpublished data). These studies were helpful in designing the Tomales Bay Shorebird Project. Previous studies suffer from large amounts of variation associated with undersized study areas and unstandardized methods. The census results reported here are the first standardized estimates of shorebird abundances covering all of the Tomales Bay wetlands.

A primary goal of the Tomales Bay Shorebird Project is to estimate seasonal abundances of shorebirds within 9 count areas that represent most of the available shorebird habitat in Tomales Bay. We estimate early and late season levels of wintering populations, and attempt to record peak numbers of fall and spring migrants. (This report does not include the fall 1989 season.) A considerable amount of effort is required to obtain seasonal estimates of shorebird abundances. The success of each count depends on the commitments of experienced trained volunteer field observers and recorders.

A second goal of the project is to delineate the movements of wintering shorebirds among wetlands within Tomales Bay area. This report summarizes preliminary observations that will be used to establish methods for a multi-year study of winter shorebird movements. The extent to which wintering shorebirds depend on groups of two or more wetland areas within Tomales Bay to find food during different times of day, tides, and weather conditions is not known. Similarly, little is known about the extent to which shorebirds wintering on Tomales Bay depend on other wetlands outside Tomales Bay (Peter Connors, Bodega Marine Laboratory, and Gary Page, Point Reyes Bird Observatory, personal communication). Field reconnaissance suggests that there could be some restriction of movement of wintering flocks between the northwest and southeast ends of the bay. Knowledge about the broad or narrow use of available habitat areas by shorebirds could be used to evaluate the possible impact of habitat loss on winter shorebird populations.

METHODS

Tomales Bay is divided into 9 count areas censused simultaneously by teams of observers (Figure 1). The count areas were selected to allow observers to complete each count within 60-90 minutes. This reduces the chance of counting the same shorebirds in more than one area.

We conducted all counts during rising tides at tide levels between 2.5 and 4.0 feet (above mean low low water at Blake's Landing). This allowed the most reliable counts because birds using large tidal flats are not too distant, have not begun to depart for alternate feeding or roosting areas, and are moving slowly toward the observers. Field reconnaissance suggested that numbers of feeding shorebirds are as great or greater during these tides as during other periods of the tidal cycle.

We obtained three counts, treated as replicates, within each of three census periods: early winter (21 November, 7, 19 December), late winter (31 January, 15 February, 1 March), spring migration (16, 23, 26 April). The scheduling of spring counts was based in part on peak numbers in surveys conducted at Walker Creek Delta between 1975 and 1987 (Audubon Canyon Ranch, unpublished data). Winter count schedules were coordinated to coincide as closely as possible (on the same day or within a few days) to counts conducted at Bolinas Lagoon, Limantour Estero, Drake's Estero, and Abbott's Lagoon (Gary Page, Point Reyes Bird Observatory, personal communication), and at Bodega Harbor and Estero Americano (Peter Connors and John Maron, Bodega Marine Laboratory, personal communication).

Counts were conducted on days with favorable weather for using telescopes and identifying shorebirds. Each count area team included at least one counter who was experienced in shorebird identification and census methods. To increase accuracy, recorders were included wherever possible to allow observers to make uninterrupted observations of flocks. We used multiple observers or observer/recorders whenever possible to provide opportunities for obtaining average team estimates of large flocks.

Observers attempted to identify all shorebirds (Scolopacidae and Charadriidae) to species. Incidental observations of White Pelicans, raptors (Falconiformes), and herons (Ciconiiformes) were also recorded. Unidentified species were recorded in species groups, such as dowitcher spp., or Least/Western Sandpiper. These groups were used to adjust abundance estimates by allocating pooled species groups to single species groups in proportion to the number of identified birds of each species in each count area on each day (Stenzel and Page 1988). Pooled groups of two species were allocated to single species groups only if the total number of identified individuals was greater than 50 and exceeded the number of individuals in the pooled species group. Pooled groups of three species were allocated to single species groups only if the total number of identified individuals was greater than 100 and exceeded the number of individuals in the pooled species group.

Field observations of winter shorebird flock movements in 1989-90 (November through February) were limited to incidental observations during censuses and occasional vigils at key locations. Some observations were focused on periods of the tidal cycle when intertidal feeding areas were first exposed, or became completely covered, or before and after high tide rooting periods. During censuses, observers recorded the species, number, time, and direction of movement of all shorebirds seen leaving or entering their areas. One all-day count was coordinated with the Bodega Marine Laboratory on 7 December 1989, with observers stationed from Cypress Grove Preserve north to Sand Point (Brazil Beach), and at the Estero Americano and Bodega Harbor (John Maron, Bodega Marine Laboratory). The all-day count will serve as a model for conducting more frequent observations of flock movements in 1990-91.

RESULTS AND DISCUSSION

Shorebird Censuses

We estimated an average of 16,262 shorebirds of 22 species occurring on Tomales Bay in early winter (November-December) and 9,145 shorebirds of 20 species in late winter (January-February). These numbers are greater than reported at each of the other major coastal wetlands in Marin and Sonoma Counties and represent an estimated 29 to 38 percent of the shorebirds wintering in the region (Gary Page, Point Reyes Bird Observatory, and Peter Connors, Bodega Marine Laboratory, personal communication).

We estimated an average of 10,763 shorebirds of 21 species during the spring (April) migration (Table 1). The 1989 spring shorebird count, conducted on 21 April as part of the Point Reyes Bird Observatory's Pacific Flyway survey, estimated that Tomales Bay supports 19 percent of the shorebirds migrating along the Marin and Sonoma Coast (Page et al. 1989) — however, peak numbers of spring migrants are difficult to capture, and this estimate will likely be revised as additional censuses are conducted.

The abundances of most species were greatest at the north and south ends of the bay, with relatively low numbers of most species along the east shore (Figure 1, Table 2). A few species, such as Spotted Sandpipers, Black Turnstones, and Killdeer, that are generally associated with rocky or gravelly shorelines, were present in larger numbers along the east shore. The west shore of Tomales Bay is primarily composed of rocky cliffs or steep sandy coves, and provides little, if any, appropriate habitat for most species.

Dunlin were the most abundant shorebird species in Tomales Bay during winter, but were not observed at White Gulch or along the Inverness Shoreline (Tables 2 and 3). During Spring, no Dunlin were found at White Gulch, and relatively few along the Inverness Shoreline (Table 2 and 3). The large (71%) winter decline in Dunlin (Table 1) was associated with greater decreases (79%) in the south bay and smaller decreases (56%) in the north bay. Similar declines were observed at all other major wetland areas in coastal Marin and Sonoma Counties (Gary Page and Peter Connors, personal communication).

Tomales Bay supported more Marbled Godwits than all other major wetland areas in coastal Marin and Sonoma Counties except Bodega Harbor (Gary Page and Peter Connors, personal communication). North Tomales Bay habitats supported 93, 82, and 80 percent of the Tomales Bay population of Marbled Godwits during early winter, late winter, and spring, respectively (Table 2). The tide flats at Walker Creek Delta and in the Brazil Beach area are similar to intertidal areas in Bodega Harbor, providing the relatively sandy foraging substrates apparently preferred by Marbled Godwits. During early winter, Marbled Godwits were the most abundant species at Brazil Beach and Tom's Point -- second most abundant along the Inverness Shoreline (Table 3). In late winter, godwits were the most abundant species at Brazil Beach and the Inverness Shoreline (Table 3). In spring, Marbled Godwits were the most abundant species at Brazil Beach, Tom's Point, and the Inverness Shoreline (Table 3).

Western Sandpipers appear to have increased between early and late winter, although these results are somewhat confounded by large unallocated flocks of Least/Western Sandpipers. Counts in other areas in the region also suggested late-winter increases in the numbers of Western Sandpipers. Large increases in Western Sandpipers were observed on Tomales Bay in April (Table 1), reflecting increases observed during spring migration in San Francisco Bay (Page et al. 1989). Western Sandpipers were not detected at White Gulch or the Inverness Shoreline during winter (Tables 2 and 3).

Mean estimates for Pacific Golden-Plovers (*Pluvialis dominica fulva*) are probably low because of the difficulty in locating birds in the pasture at Lawson's Landing, and because they occasionally move between the pasture and shoreline feeding areas during census tides. However, our ability to identify and relocate individuals during their pre-alternate molt in April indicate that the observed winter decline in this group is probably accurate (Table 1). This small group of Pacific Golden-Plovers is worthy of close attention. Although currently considered a subspecies of the Lesser Golden-Plover, strong evidence exists for distinct species status (Connors 1983). Pacific Golden-Plovers breed from Western Alaska east across Siberia. Most of them winter from East Africa west to New Zealand, some migrate across water to Pacific islands, and very few winter in isolated spots in California -- such as the pasture near Brazil Beach.

Large decreases in Killdeer were observed during winter (Table 1), primarily along the east shore (Table 2). Yellowlegs occurred in greater numbers in the south bay in all three censuses (Table 2). A group of 18 or 19 Red Knots wintering at Brazil Beach on the tide flats below the dunes suffered no apparent losses.

Winter Movements of Shorebirds

Preliminary observations of winter shorebird flock movements, pooled for Least Sandpipers, Western Sandpipers, and Dunlin, are presented in Figures 2 and 3. Because the time spent collecting preliminary observations of flock movements was not equal among various observation points, the relative numbers of birds cannot be compared among locations. However, the relative numbers observed flying in different directions at each observation point provide a sense of movement patterns. Observations of movements of other species were too few for useful analysis.

During falling tides from 5.7 feet down to 2.3 feet birds tended to move southward, with some movement northward from Walker Creek Delta. Most of the southward movement observed at Walker Creek Delta during falling tides was by birds arriving at the delta to feed.

Birds generally flew northward between 1.2 and 4.5-foot rising tides. During 2.5 to 3.5-foot rising tides, large numbers of birds regularly flew southeast from Willow Point to the tide flats behind the old railroad berm at the southeast end of the bay, but departed northward up the center of the bay before the tide reached 4.5 feet. Shorebirds moving northward from Walker Creek Delta during rising tides often stopped for 10 to 60 minutes at the south shore of Tom's Point before heading northward toward Brazil Beach.

A winter high tide day-roost of up to 2000 Dunlin/Western/Least Sandpipers was observed at Cypress Point, apparently used by birds that feed on the south bay tide flats. Other major high tide roosts were observed at Walker Creek Delta, Sand Point, and Brazil Beach; smaller roosting flocks were observed 0.5 mile south of Willow Point, 0.75 mile north of Cypress Point, at White Gulch, at Chicken Ranch Beach.

The 1989-90 (preliminary) results suggest that shorebird movements may be restricted between Cypress Point and Walker Creek Delta, resulting in two relatively distinct areas of habitat use by shorebirds wintering on Tomales Bay. Future observations of winter shorebird movements will be standardized for relative effort among observation points, and for factors that might influence shorebird movements, such as tidal conditions, rainfall, wind, disturbances, and intra-seasonal effects.

Conclusions

Tomales Bay may support approximately one third of the winter shorebirds along coastal Marin and Sonoma Counties, and appears to provide habitat for more wintering shorebirds than other major wetlands in this coastal region. Preliminary observations of flock movements suggest that some small sandpipers (*Calidris* spp.) may depend primarily on either northern or southern sites in Tomales Bay during winter. Tomales Bay also supports a large proportion of spring migrants in the coastal region. The Tomales Bay Shorebird Project establishes a valuable tool for long-term monitoring of wetlands around Tomales Bay.

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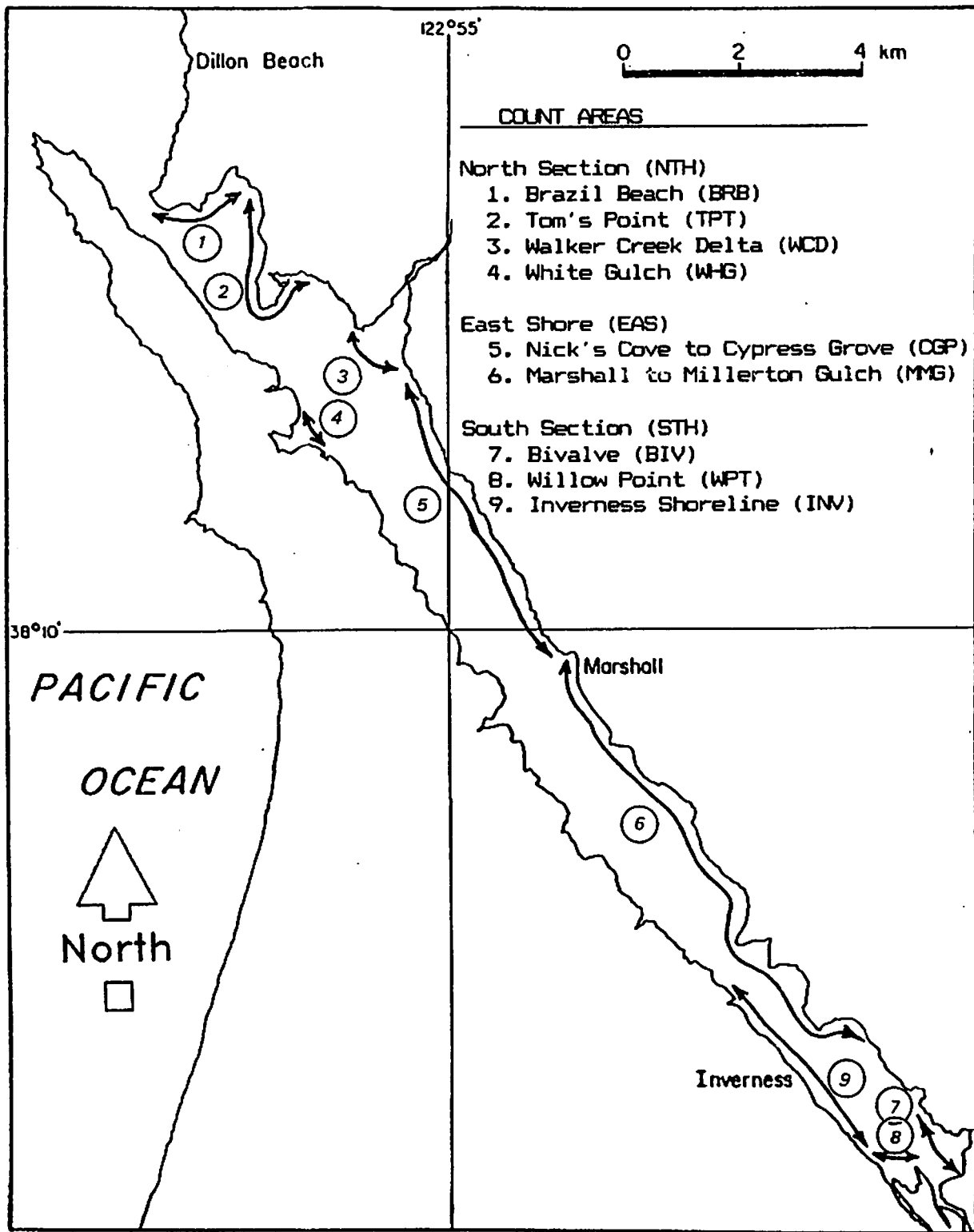


Figure 1. Count areas of the Tomales Bay Shorebird Project.

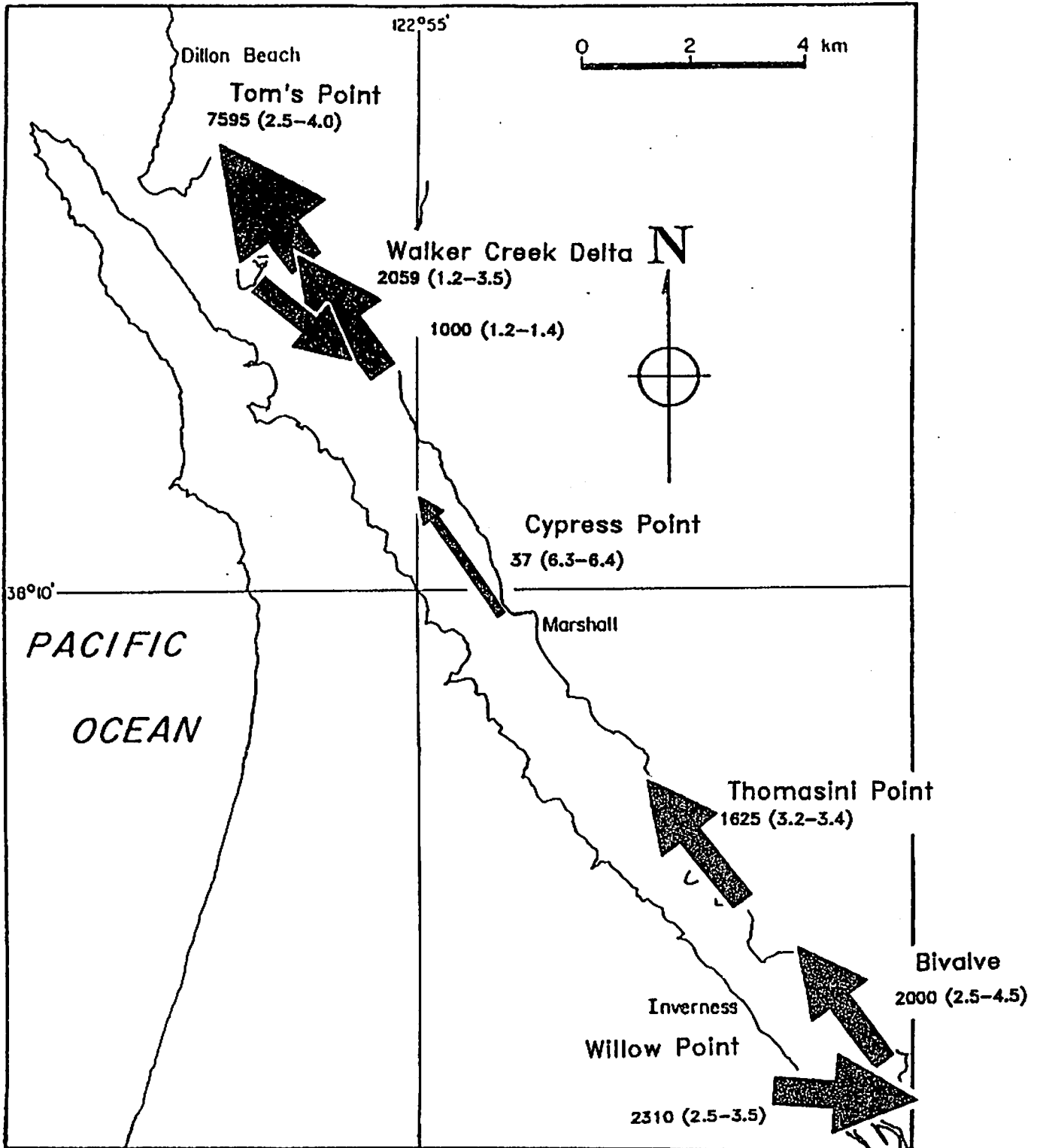


Figure 2. Winter (November-February) Diurnal movements of Dunlin, Western Sandpipers, and Least Sandpipers on Tomales Bay during rising tides. Total numbers and tide level range (feet above mean low low water at Blake's Landing in parentheses) are given for each observation site.

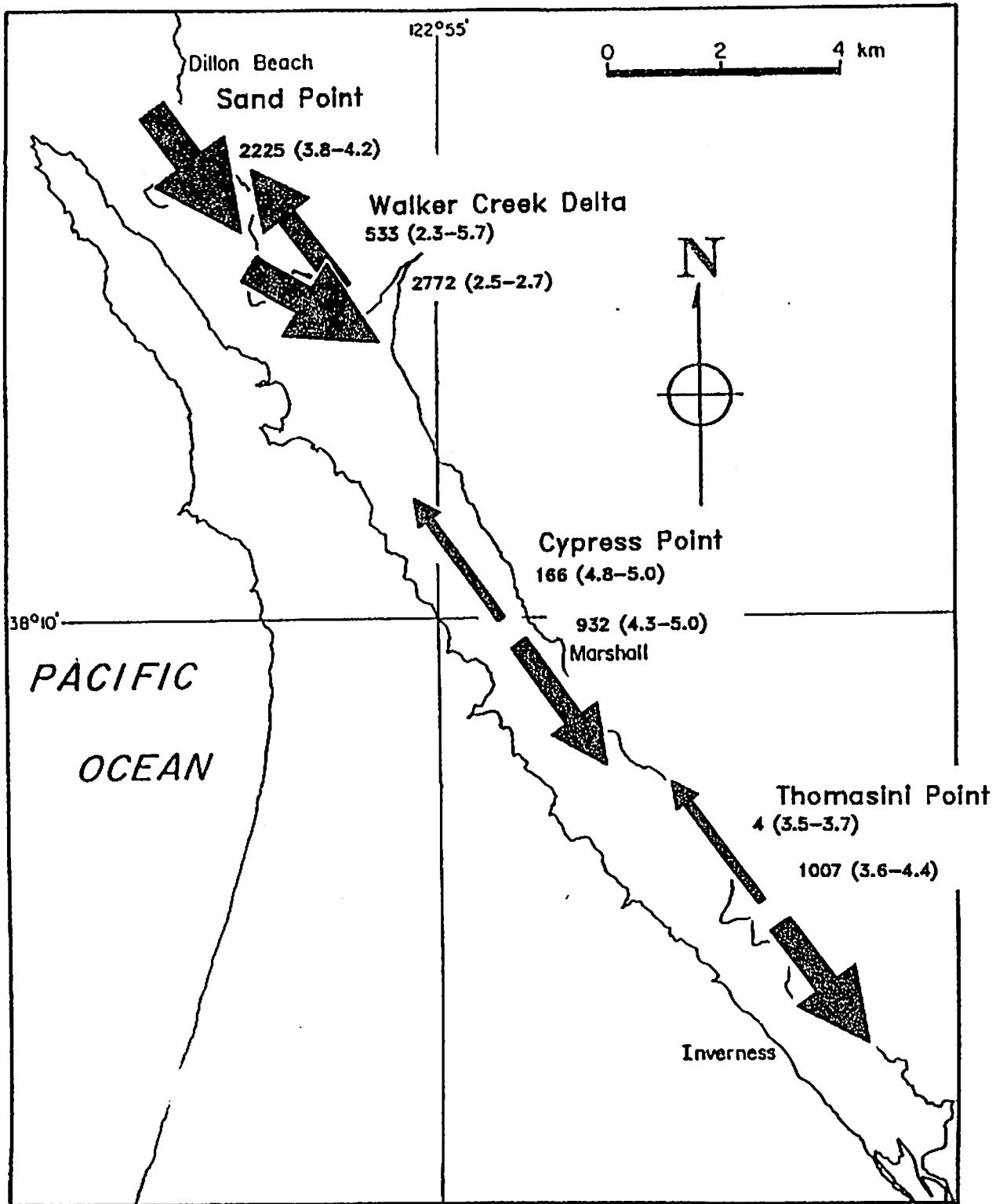


Figure 3. Winter (November-February) Diurnal movements of Dunlin, Western Sandpipers, and Least Sandpipers on Tomales Bay during falling tides. Total numbers and tide level range (feet above mean low low water at Blake's Landing in parentheses) are given for each observation site.

Table 1. Mean, minimum, and maximum adjusted total abundance of shorebirds in Tomales Bay during early winter, late winter, and spring, 1989-90.

Species	Early Winter			Late Winter			Spring		
	Mean (n=3)	Min.	Max.	Mean (n=3)	Min.	Max.	Mean (n=3)	Min.	Max.
Black-bellied Plover	210.0	154	293	157.7	84	198	91.3	67	112
Pacific Golden-Plover	7.3	5	9	4.0	0	6	2.7	0	5
Snowy Plover	2.0	0	4	0.0	0	0	0.0	0	0
Semipalmated Plover	33.7	0	68	39.3	3	89	55.0	15	77
Killdeer	74.3	36	111	14.3	6	28	7.0	4	9
Greater Yellowlegs	4.0	2	6	1.0	0	2	15.0	9	20
Lesser Yellowlegs	.3	0	1	.3	0	1	2.3	0	6
Yellowlegs species	0.0	0	0	0.0	0	0	.7	0	2
Willet	420.7	363	491	368.7	265	479	250.3	187	291
Wandering Tattler	0.0	0	0	0.0	0	0	.7	0	2
Spotted Sandpiper	2.0	2	2	2.0	0	4	2.0	0	4
Whimbrel	5.3	0	15	.7	0	2	4.0	2	7
Marbled Godwit	1102.3	860	1473	980.7	781	1186	1421.3	1085	1998
Ruddy Turnstone	17.0	3	41	17.0	12	26	17.3	9	30
Black Turnstone	17.7	1	37	98.3	67	126	143.0	127	156
Surfbird	0.0	0	0	0.0	0	0	39.0	8	96
Red Knot	10.3	0	19	12.0	0	18	7.0	0	20
Sanderling	480.0	345	602	592.7	296	841	57.3	15	117
Western Sandpiper	636.7	226	1007	2240.1	1748	3066	4652.8	2548	7162
Least Sandpiper	1486.3	1015	1763	1551.7	1165	1822	635.7	338	810
Least/Western	1319.0	0	2470	.3	0	1	9.7	0	29
Dunlin	10155.3	7479	11975	2962.0	2029	4201	3087.3	1055	4265
Least/Western/Dunlin	188.0	0	533	83.3	0	250	0.0	0	0
Short-billed Dowitcher	27.7	0	82	0.0	0	0	39.3	0	78
Long-billed Dowitcher	6.7	0	17	0.0	0	0	1.3	0	4
Dowitcher species	53.0	19	75	9.0	0	22	220.3	119	273
Common Snipe	2.3	0	4	9.7	7	12	0.0	0	0
Dowitchers	87.3	66	104	9.0	0	22	261.0	119	351
Shorebirds (total)	16262.1	13115	18191	9144.7	8076	10523	10762.5	8012	13580

Table 2. Mean (n=3) percent composition of shorebird species among 9 count areas and three sections of Tomales Bay during early winter (A), late winter (B), and spring (C) census periods. See Figure 1 for area codes. A plus symbol indicates less than one percent.

A. EARLY WINTER													
SPECIES	BRB	TPT	WCD	WHG	CGP	MMG	BIV	WPT	INV	NTH	STH	EAS	
Black-bellied Plover	37	2	17	+	3	9	5	26	0	57	31	12	
Pacific Golden-Plover	100	0	0	0	0	0	0	0	0	100	0	0	
Snowy Plover	100	0	0	0	0	0	0	0	0	100	0	0	
Semipalmated Plover	37	0	0	0	+	9	40	+	13	37	53	10	
Killdeer	14	0	3	2	37	28	11	1	4	19	16	65	
Greater Yellowlegs	0	0	0	0	0	25	0	75	0	0	75	25	
Lesser Yellowlegs	0	0	0	0	0	100	0	0	0	0	0	100	
Willet	39	9	6	1	1	17	7	16	3	56	26	19	
Spotted Sandpiper	0	0	0	17	83	0	0	0	0	17	0	83	
Whimbrel	0	50	0	6	0	0	44	0	0	56	44	0	
Marbled Godwit	38	36	18	+	+	1	+	3	2	93	6	1	
Ruddy Turnstone	18	0	25	0	4	0	53	0	0	43	53	4	
Black Turnstone	9	23	19	0	49	0	0	0	0	51	0	49	
Red Knot	100	0	0	0	0	0	0	0	0	100	0	0	
Sanderling	33	13	18	2	6	6	13	9	+	65	23	12	
Western Sandpiper	3	25	20	0	1	6	0	45	0	48	45	7	
Least Sandpiper	1	8	38	2	1	5	8	35	1	49	44	7	
Least/Western	0	0	0	0	0	13	87	0	0	0	87	13	
Dunlin	1	3	30	+	1	+	22	43	+	34	65	1	
Least/Western/Dunlin	0	95	0	0	5	0	0	0	0	95	0	5	
Dowitchers	7	0	8	5	6	+	0	73	0	20	73	6	
Common Snipe	43	0	0	0	14	0	43	0	0	43	43	14	
Shorebirds (total)	7	8	25	+	2	3	22	33	+	40	56	4	
B. LATE WINTER													
SPECIES	BRB	TPT	WCD	WHG	CGP	MMG	BIV	WPT	INV	NTH	STH	EAS	
Black-bellied Plover	26	12	13	+	7	7	23	12	0	52	35	13	
Pacific Golden-Plover	100	0	0	0	0	0	0	0	0	100	0	0	
Semipalmated Plover	0	0	0	0	3	42	17	39	0	0	56	44	
Killdeer	49	2	0	0	21	28	0	0	0	51	0	49	
Greater Yellowlegs	0	0	33	0	0	0	33	33	0	33	67	0	
Lesser Yellowlegs	0	0	0	0	0	0	100	0	0	0	100	0	
Willet	16	13	19	+	2	6	15	24	5	48	43	8	
Spotted Sandpiper	0	0	0	0	100	0	0	0	0	0	0	100	
Whimbrel	0	50	0	50	0	0	0	0	0	100	0	0	
Marbled Godwit	30	25	25	2	+	2	8	4	3	82	16	2	
Ruddy Turnstone	0	0	10	0	84	6	0	0	0	10	0	90	
Black Turnstone	+	24	1	0	57	18	0	0	0	25	0	75	
Red Knot	100	0	0	0	0	0	0	0	0	100	0	0	
Sanderling	17	21	17	5	9	3	15	13	0	60	28	12	
Western Sandpiper	+	19	19	0	0	0	58	3	0	39	61	0	
Least Sandpiper	+	7	22	14	+	4	30	21	0	44	51	5	
Least/Western	0	0	0	0	100	0	0	0	0	0	0	100	
Dunlin	3	3	41	0	3	2	24	23	0	47	47	6	
Least/Western/Dunlin	0	0	0	0	0	0	0	100	0	0	100	0	
Dowitchers	0	0	19	56	0	0	0	26	0	74	26	0	
Common Snipe	100	0	0	0	0	0	0	0	0	100	0	0	
Shorebirds (total)	7	12	27	3	3	3	30	15	+	49	46	6	

Table 2. Mean (n=3) percent composition of shorebird species among 9 count areas and three sections of Tomales Bay during early winter (A), late winter (B), and spring (C) census periods. See Figure 1 for area codes. A plus symbol indicates less than one percent. (continued)

C. SPRING SPECIES	BRB	TPT	WCD	WHG	CGP	MMG	BIV	WPT	INV	NTH	STH	EAS
Black-bellied Plover	11	14	16	0	7	11	27	14	0	41	42	18
Pacific Golden-Plover	100	0	0	0	0	0	0	0	0	100	0	0
Semipalmated Plover	6	0	61	0	2	18	12	0	0	67	12	21
Killdeer	14	14	0	0	5	43	0	5	19	29	24	48
Greater Yellowlegs	0	0	29	0	0	2	67	0	2	29	69	2
Lesser Yellowlegs	0	0	0	0	0	14	14	71	0	0	86	14
Yellowlegs species	0	0	0	0	0	100	0	0	0	0	0	100
Willet	10	10	29	+	1	2	19	14	13	50	47	3
Wandering Tattler	0	0	0	0	0	100	0	0	0	0	0	100
Spotted Sandpiper	0	0	0	0	50	0	33	0	17	0	50	50
Whimbrel	8	0	58	8	17	8	0	0	0	75	0	25
Marbled Godwit	24	11	44	2	+	1	8	6	4	80	18	2
Ruddy Turnstone	0	0	60	0	29	8	4	0	0	60	4	37
Black Turnstone	+	4	30	0	22	37	6	0	0	34	6	59
Surfbird	0	0	2	0	90	9	0	0	0	2	0	98
Red Knot	81	0	5	0	0	0	0	14	0	86	14	0
Sanderling	76	0	0	0	0	0	0	20	3	76	24	0
Western Sandpiper	3	1	30	+	0	13	34	17	+	35	51	13
Least Sandpiper	3	14	41	15	2	9	7	6	3	74	15	11
Least/Western	0	0	0	0	100	0	0	0	0	0	0	100
Dunlin	8	2	19	0	+	2	51	18	+	28	70	2
Dowitchers (total)	0	+	9	0	0	3	67	16	4	9	87	3
Shorebirds (total)	8	4	29	1	1	8	33	15	1	41	50	9

Table 3. Mean (n=3) percent composition of shorebird species within Tomales Bay (ALL), and within 9 count areas and three sections of Tomales Bay during early winter (A), late winter (B), and spring (C) census periods. See Figure 1 for area codes. A plus symbol indicates less than one percent.

A. EARLY WINTER

SPECIES	BRB	TPT	WCD	WHG	CGP	MMG	BIV	WPT	INV	NTH	STH	EAS	ALL
Black-bellied Plover	7	+	+	1	3	4	+	1	0	2	+	3	1
Pacific Golden-Plover	+	0	0	0	0	0	0	0	0	+	0	0	+
Snowy Plover	+	0	0	0	0	0	0	0	0	+	0	0	+
Semipalmated Plover	1	0	0	0	+	+	+	+	7	+	+	+	+
Killdeer	1	0	+	2	10	5	+	+	5	+	+	7	+
Greater Yellowlegs	0	0	0	0	0	+	0	+	0	0	+	+	+
Lesser Yellowlegs	0	0	0	0	0	+	0	0	0	0	0	+	+
Yellowlegs species	0	0	0	0	0	0	0	0	0	0	0	0	0
Willet	16	3	+	7	2	16	+	1	21	4	1	11	3
Spotted Sandpiper	0	0	0	+	+	0	0	0	0	+	0	+	+
Whimbrel	0	+	0	+	0	0	+	0	0	+	+	0	+
Marbled Godwit	40	32	5	15	+	3	+	+	30	16	+	2	7
Ruddy Turnstone	+	0	+	0	+	0	+	0	0	+	+	+	+
Black Turnstone	+	+	+	0	3	0	0	0	0	+	0	1	+
Red Knot	+	0	0	0	0	0	0	0	0	+	0	0	+
Sanderling	15	5	2	10	11	6	2	+	6	5	1	8	3
Western Sandpiper	2	13	3	0	3	8	0	5	0	5	3	6	4
Least Sandpiper	2	9	14	51	8	18	3	10	31	11	7	14	9
Least/Western	0	0	0	0	0	38	32	0	0	0	13	24	8
Dunlin	13	22	74	6	52	2	61	80	+	53	72	21	62
Least/Western/Dunlin	0	14	0	0	4	0	0	0	0	3	0	1	1
Dowitchers	+	0	+	7	2	+	0	1	0	+	+	+	+
Common Snipe	+	0	0	0	+	0	+	0	0	+	+	+	+

B. LATE WINTER

SPECIES	BRB	TPT	WCD	WHG	CGP	MMG	BIV	WPT	INV	NTH	STH	EAS	ALL
Black-bellied Plover	7	2	+	+	4	4	1	1	0	2	1	4	2
Pacific Golden-Plover	+	0	0	0	0	0	0	0	0	+	0	0	+
Semipalmated Plover	0	0	0	0	+	7	+	1	0	0	+	3	+
Killdeer	1	+	0	0	1	2	0	0	0	+	0	1	+
Greater Yellowlegs	0	0	+	0	0	0	+	+	0	+	+	0	+
Lesser Yellowlegs	0	0	0	0	0	0	+	0	0	0	+	0	+
Willet	9	4	3	1	3	9	2	6	37	4	4	6	4
Spotted Sandpiper	0	0	0	0	+	0	0	0	0	0	0	+	+
Whimbrel	0	+	0	+	0	0	0	0	0	+	0	0	+
Marbled Godwit	47	22	10	6	2	6	3	3	63	18	4	4	11
Ruddy Turnstone	0	0	+	0	5	+	0	0	0	+	0	3	+
Black Turnstone	+	2	+	0	21	7	0	0	0	+	0	14	1
Red Knot	2	0	0	0	0	0	0	0	0	+	0	0	+
Sanderling	16	11	4	12	20	7	3	5	0	8	4	14	6
Western Sandpiper	1	39	17	0	0	0	47	5	0	19	33	0	24
Least Sandpiper	+	10	14	79	4	29	17	23	0	15	19	16	17
Least/Western	0	0	0	0	+	0	0	0	0	0	0	+	+
Dunlin	14	9	50	0	38	29	26	48	0	32	33	33	32
Least/Western/Dunlin	0	0	0	0	0	0	0	6	0	0	2	0	+
Dowitchers	0	0	+	2	0	0	0	+	0	+	+	0	+
Common Snipe	2	0	0	0	0	0	0	0	0	+	0	0	+

Table 3. Mean (n=3) percent composition of shorebird species within Tomales Bay (ALL), and within 9 count areas and three sections of Tomales Bay during early winter (A), late winter (B), and spring (C) census periods. See Figure 1 for area codes. A plus symbol indicates less than one percent. (continued)

C. SPRING SPECIES	BRB	TPT	WCD	WHG	CGP	MMG	BIV	WPT	INV	NTH	STH	EAS	ALL
Black-bellied Plover	1	3	+	0	5	1	+	+	0	+	+	2	+
Pacific Golden-Plover	+	0	0	0	0	0	0	0	0	+	0	0	+
Semipalmated Plover	+	0	1	0	1	1	+	0	0	+	+	1	+
Killdeer	+	+	0	0	+	+	0	+	+	+	+	+	+
Greater Yellowlegs	0	0	+	0	0	+	+	0	+	+	+	+	+
Lesser Yellowlegs	0	0	0	0	0	+	+	+	0	0	+	+	+
Yellowlegs species	0	0	0	0	0	+	0	0	0	0	0	+	+
Willet	3	6	2	2	3	+	1	2	21	3	2	+	2
Wandering Tattler	0	0	0	0	0	+	0	0	0	0	0	+	+
Spotted Sandpiper	0	0	0	0	+	0	+	0	+	0	+	+	+
Whimbrel	+	0	+	+	+	+	0	0	0	+	0	+	+
Marbled Godwit	41	37	20	15	5	2	3	5	38	25	5	3	13
Ruddy Turnstone	0	0	+	0	4	+	+	0	0	+	+	+	+
Black Turnstone	+	1	1	0	26	6	+	0	0	1	+	9	1
Surfbird	0	0	+	0	29	+	0	0	0	+	0	4	+
Red Knot	+	0	+	0	0	0	0	+	0	+	+	0	+
Sanderling	5	0	0	0	0	0	0	+	1	+	+	0	+
Western Sandpiper	17	15	46	18	0	73	44	51	14	37	45	64	43
Least Sandpiper	2	22	9	65	10	7	1	2	10	10	2	7	6
Least/Western	0	0	0	0	8	0	0	0	0	0	0	1	+
Dunlin	29	14	19	0	7	6	44	35	8	19	40	6	29
Dowitchers	0	+	+	0	0	1	5	3	7	+	4	+	2

Table 4. Mean, minimum, and maximum numbers of raptors detected during the Tomales Bay shorebird census, 1989-90.

Species	Early Winter			Late Winter			Spring		
	Mean (n=3)	Min.	Max.	Mean (n=3)	Min.	Max.	Mean (n=3)	Min.	Max.
Black-shouldered Kite	.3	0	1	2.7	0	5	1.7	1	2
Northern Harrier	1.7	0	3	4.0	3	5	1.7	1	2
Red-tailed Hawk	2.7	2	3	4.7	2	9	3.0	2	4
Red-shouldered Hawk	0.0	0	0	0.0	0	0	.3	0	1
Rough-legged Hawk	0.0	0	0	0.0	0	0	0.0	0	0
Sharp-shinned Hawk	.3	0	1	.3	0	1	0.0	0	0
Cooper's Hawk	0.0	0	0	0.0	0	0	0.0	0	0
American Kestrel	.7	0	1	1.0	1	1	0.0	0	0
Merlin	0.0	0	0	.3	0	1	0.0	0	0
Peregrine Falcon	1.7	1	2	.7	0	1	.7	0	1

Table 5. Mean, minimum, and maximum number of herons and egrets detected during the Tomales Bay shorebird census, 1989-90.

Species	Early Winter			Late Winter			Spring		
	Mean (n=3)	Min.	Max.	Mean (n=3)	Min.	Max.	Mean (n=3)	Min.	Max.
Great Blue Heron	9.7	8	11	12.3	5	23	5.0	2	8
Great Egret	6.0	2	9	7.7	6	11	10.7	8	13
Snowy Egret	7.7	4	11	8.7	7	10	2.0	1	4
Black-cr. Night Heron	3.7	1	6	.3	0	1	0.0	0	0