

ABUNDANCE OF SHOREBIRDS AT WILLAPA BAY, WASHINGTON

JOSEPH B. BUCHANAN and JOSEPH R. EVENSON, Cascadia Research Collective, 218½ W. Fourth Avenue, Olympia, Washington 98501

There is a growing body of literature documenting large concentrations of shorebirds at wintering sites or migratory staging areas along the Pacific coast of North America. In the Pacific Northwest, such areas include the Fraser River delta (Butler 1994, Vermeer et al. 1994), Puget Sound (Buchanan 1988a, Evenson and Buchanan 1995), Grays Harbor (Herman and Bulger 1981), Willapa Bay (Widrig 1979), and beaches of the outer coast (Buchanan 1992). Some of these sites support numbers of shorebirds that qualify them as regionally or internationally important sites in the Western Hemisphere Shorebird Reserve Network (I. Davidson pers. comm.). Others comprise clusters of smaller sites that together support substantial numbers of birds (Evenson and Buchanan 1995). Identifying the role these sites play in supporting wintering and migrant shorebirds is an important step in developing conservation strategies to protect shorebirds and their habitats.

Prior research on shorebird use of Willapa Bay has been limited. At Leadbetter Point, Widrig (1979) conducted multiple shorebird surveys but only over a single year. Because shorebird abundance can vary both from year to year (Buchanan 1988a) and within a year (Evenson and Buchanan 1995), both intensive and long-term studies are essential for assessing population trends. The objective of this study was to estimate the abundance of shorebirds at Willapa Bay, Washington, to identify important candidate sites within Willapa Bay for future monitoring efforts. Here we present results of ground- and aerial-based counts of shorebirds during winter, spring, and autumn from 1991 to 1995 that document this site as among the most important to shorebirds on the west coast of North America.

STUDY AREA

Willapa Bay is on the outer coast of Washington state between Grays Harbor and the Columbia River mouth. It covers about 420 km² and is fed by the Cedar, North, Willapa, and Palix rivers in the north and the Nemah, Naselle, and Bear rivers in the south (Figure 1). A long, narrow peninsula (North Beach Peninsula) dominated by low dunes, pastures, and woodlands separates the main body of the bay from the Pacific Ocean. Of the several salt marshes around the bay, the largest are at the mouths of the Willapa River to the north and the Bear River to the south. Low tide (0.0 m) exposes about 200 km² of mud flats. Numerous sand shoals are exposed during all but the highest tides; there are no dredge-spoil islands in the bay. Two areas, Leadbetter Point and the Bear River/Lewis Unit flat, are within Willapa National Wildlife Refuge.

METHODS

Our counts involved a combination of aerial and ground-based efforts. Because Willapa Bay is large and access to many areas is limited, surveying

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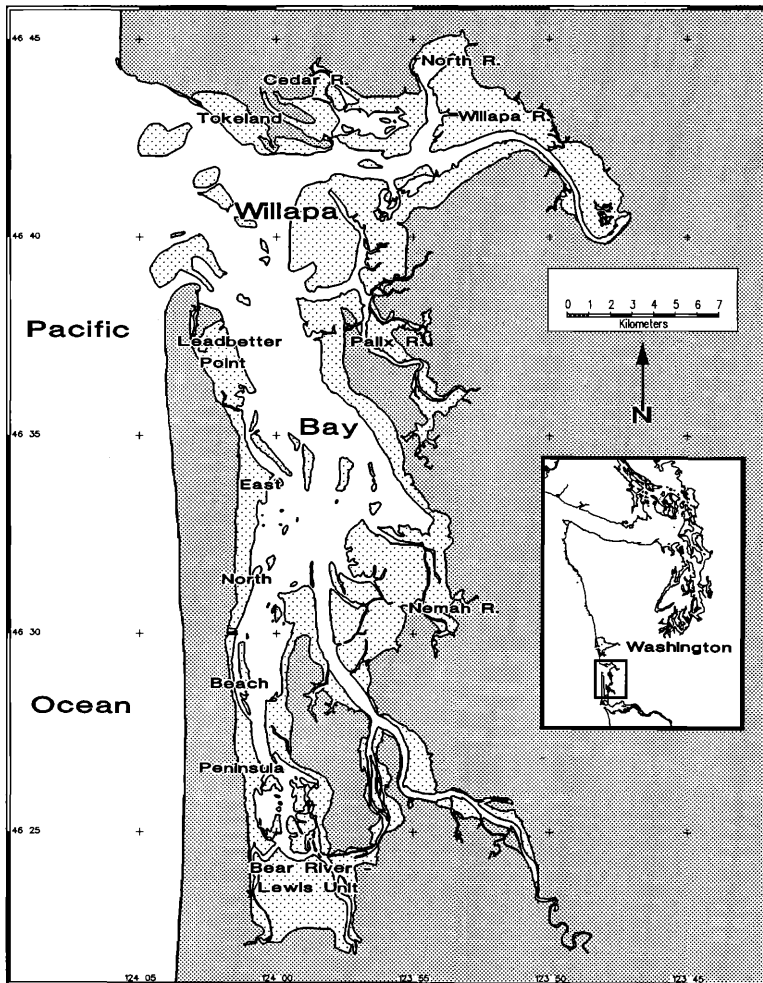


Figure 1 Willapa Bay, showing the location of sites covered by ground and aerial surveys for shorebirds between 1991 and 1995. Light stippling, intertidal foraging and roosting habitats.

shorebirds adequately from the ground is difficult. For this reason, on each survey we made counts from a small airplane flying at a height of about 60 to 70 m. These aerial counts were the basis of our primary estimates of shorebird abundance in the estuary. We also made aerial counts of birds (primarily Sanderlings) on outer North Beach on five occasions; the beach covered by the counts was 37 km long.

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Ground counts were made by a total of 18 observers (median 5 per seasonal count) who counted shorebirds at eight primary sites: Tokeland, Cedar River, North River, Willapa River, Palix River, Bear River/ Lewis Unit, East North Beach Peninsula, and Leadbetter Point. Ground counts were used to estimate the proportions of species not identified from the air. Thus, depending on the season, ground observers determined the species composition of groups of look-alike species, including the Greater and Lesser yellowlegs; Whimbrel, Marbled Godwit, and Long-billed Curlew; Western Sandpiper, Least Sandpiper, and Dunlin; and Red Knot and dowitchers. Proportions derived from ground counts of particular sites or regions of the bay were applied to the corresponding unidentified species groups from aerial counts of these regions, then regional totals were summed to provide baywide estimates. Aerial counts alone were used to estimate populations of the Black-bellied Plover. Ground counts alone were used for all other species, which consequently were underestimated because of partial coverage of the bay by this method.

Because the main objective of these counts was to identify important sites for future monitoring efforts, they were usually made only once each season (Table 1). Counts were made during rising or falling tides generally within four hours of high tide. The logistical constraints noted above necessitated conducting the ground counts at sites where shorebirds aggregated immediately prior to and/or after high tide. Consequently, aerial counts covered the entire shoreline whereas ground counts covered only the areas of major concentrations of birds. Our scheduled flights were occasionally postponed

Table 1 Dates of Shorebird Counts at Willapa Bay, Washington, 1991–1995

Aerial	Ground
Winter ^a	
28 Nov 1992	21–22 Nov 1992
4 Dec 1993	22 Nov–4 Dec 1993
31 Dec 1993	28–29 Dec 1993
21 Dec 1994	21–30 Dec 1994
9 Feb 1995	28 Jan–9 Feb 1995
Spring ^b	
27 Apr 1991	27 Apr 1991
27, 30 Apr 1993	25 Apr–1 May 1993
26 Apr, 1 May 1994	28, 30 May 1994
Autumn	
30 Aug 1993	15–20 Aug 1993

^aTwo complete (aerial and ground) counts were conducted in the winters of 1993-94 and 1994-95.

^bTwo flights were made in the springs of 1993 and 1994; each pair of flights coincided with a single ground count.

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because of adverse weather conditions, and therefore some ground counts during winter and spring were not made on the same day as the aerial counts. Nonetheless, we believe that the estimates of the proportions of species derived from these counts are reliable because the number of species during winter was low and did not vary appreciably within the bay, and most ground counts in spring were made on or within two days of the aerial counts.

RESULTS AND DISCUSSION

Species Accounts

Black-bellied Plover (*Pluvialis squatarola*). This was the second most numerous species in winter in all three years and generally the fourth most numerous species during migration (Tables 2 and 3). The total of 4049 counted on 21 December 1994 included 3848 roosting on outer North Beach at high tide, the highest known winter count at a single site in Washington state (Paulson 1993).

Semipalmated Plover (*Charadrius semipalmatus*). The irregularity of this species in Washington in winter (Buchanan 1992) is reflected in our results (Table 3). The Semipalmated Plover is locally distributed in all seasons.

Killdeer (*Charadrius vociferus*). The Killdeer was observed in low numbers in all seasons (Table 3). Widrig (1979) saw very few Killdeers at Leadbetter Point during any season.

Greater Yellowlegs (*Tringa melanoleuca*). The Greater Yellowlegs is a regularly occurring winter resident in estuarine habitats in the Pacific Northwest (Buchanan

Table 2 Seasonal High Counts of Black-bellied Plovers, Dunlins, Western Sandpipers, and Short-billed Dowitchers at Primary Census Sites in Willapa Bay, 1991-1995

Site	Winter		Spring			
	Black-bellied Plover	Dunlin	Black-bellied Plover	Dunlin	Western Sandpiper	Short-billed Dowitcher
Tokeland	415	2,320	35	832	3,603	300
Cedar River	67	450	8	756	4,844	1,780
North River	240	3,915	100	1,890	12,110	5,190
Willapa River	5	13,510	100	2,970	16,830	12,460
Between Willapa R. and Palix R.	6	3,120	180	2,481	14,059	2,345
Palix River	35	8,800	84	1,191	6,749	4,380
Between Palix R. and Nemah R.	15	2,160	85	2,586	10,344	1,465
Nemah River	205	8,150	300	2,400	9,600	4,000
Bear River	210	27,260	300	12,300	36,900	5,000
E. North Beach peninsula	50	5,115	65	2,554	3,831	680
Leadbetter Point	54	3,935	125	7,930	5,070	4,425

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Table 3 Numbers of Shorebirds Counted or Estimated at Willapa Bay, Washington, 1991–1995

Species	Winter			Spring			Autumn
	1992–93	1993–94	1994–95	1991	1993	1994	1993
Black-bellied Plover ^a	415	881	4,049	918	653	245	205
Semipalmated Plover ^b	12	0	0	27	122	264	98
Killdeer ^b	0	6	1	0	0	2	4
Greater Yellowlegs ^c	84	42	97	40	160	275	65
Lesser Yellowlegs ^d	0	0	0	0	1	0	2
Willet ^b	0	0	0	0	0	0	5
Spotted Sandpiper ^b	0	0	3	0	0	1	1
Whimbrel ^d	4	9	3	0	82	27	229
Long-billed Curlew ^d	0	67	70	0	8	1	0
Marbled Godwit ^d	0	303	462	0	115	51	70
Large sandpiper spp.	0	0	0	150	0	0	0
Ruddy Turnstone ^b	0	2	0	0	2	2	0
Black Turnstone ^b	28	26	29	1	0	7	1
Red Knot ^b	0	0	0	0	177	1	0
Sanderling ^d	372	135	16	0	0	6	2
Western Sandpiper ^d	80	^e	258	82,575	55,195	49,615	8,976
Least Sandpiper ^d	0	22	235	1	^e	150	374
Dunlin ^d	47,017	69,850	27,120	7,525	29,720	41,640	0
Long-billed Dowitcher ^b	50	94	61	0	0	0	0
Short-billed Dowitcher ^d	0	0	0	23,865	8,900	16,595	153
Dowitcher spp. ^b	0	0	0	0	0	0	31
Common Snipe ^b	10	2	0	0	1	1	0

^aDirect aerial count of the entire bay.

^bNumber counted from the ground only; total for some species may under-represent actual number of birds present.

^cDirect aerial count of the entire bay unless ground count revealed Lesser Yellowlegs, in which case proportional counts were used.

^dNumber projected from proportions of similar species counted during surveys on the ground (see Methods).

^ePresent but not counted.

1988b). The count from winter 1994–95 appears to be the highest winter count yet made in the region (Table 3; Paulson 1993, Buchanan unpubl. data).

Lesser Yellowlegs (*Tringa flavipes*). The only survey observations were of one bird in spring 1993 and two in autumn 1993 (Table 3). Widrig (1979) noted this species at Leadbetter Point only during autumn migration, whereas (Herman and Bulger 1981) found small numbers at Grays Harbor during spring.

Willet (*Catoptrophorus semipalmatus*). The five Willets at Cedar River in autumn 1993 were the only ones recorded on our surveys (Table 3). By contrast, Willets were observed fairly regularly at Willapa Bay during winter in years prior to our counts (Paulson 1993), though Widrig (1979) noted this species at Leadbetter Point only during autumn migration.

Spotted Sandpiper (*Actitis macularia*). Spotted Sandpipers were observed on single winter, spring, and autumn counts (Table 3), a pattern similar to that noted by

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Table 4 Seasonal High Counts of all Shorebird Species at Primary Census Sites in Willapa Bay, 1991–1995

Site	Winter	Spring	Autumn
Tokeland	2,447	4,530	494
Cedar River	450	6,360	150
North River	4,099	19,200	2
Willapa River	13,510	22,665	60
between Willapa R. and Palix R.	3,122	16,540	0
Palix River	8,800	9,000	2,099
between Palix R. and Nemah R.	2,307	14,495	1,690
Nemah River	8,358	16,000	—
Bear River/Lewis Unit	27,470	54,450	2,403
East North Beach Peninsula	5,119	6,465	57
Leadbetter Point	3,971	13,000	6,270

Widrig (1979) at Leadbetter Point and by Herman and Bulger (1981) at Grays Harbor during spring migration.

Whimbrel (*Numenius phaeopus*). The Whimbrel occurred primarily as a spring and autumn migrant with smaller numbers overwintering (Table 3). Widrig (1979) likewise reported it as a migrant at Leadbetter Point but did not record the species during winter. We observed Whimbrels only in the northern part of Willapa Bay (including Leadbetter Point), mostly at sites on the western shore. Herman and Bulger (1981) found Whimbrels most numerous in Grays Harbor in mid-May.

Long-billed Curlew (*Numenius americanus*). The Long-billed Curlew was observed during two winter and two spring counts (Table 3). In all seasons, it was generally found only in the northernmost part of Willapa Bay. At Leadbetter Point, Widrig (1979) recorded only a few Long-billed Curlews in spring.

Marbled Godwit (*Limosa fedoa*). We observed larger flocks of Marbled Godwits in the winters of 1993–94 and 1994–95 than during migration periods (Table 3). In all seasons, nearly all godwits were seen at Cedar River, North River, Tokeland, and Willapa River. We have no information to explain this localized distribution. At Leadbetter Point, Widrig (1979) observed no Marbled Godwits in winter and very low numbers in other seasons. Wintering numbers of Marbled Godwits in northern Willapa Bay may have increased between the early 1980s and the 1990s; counts of >100 were unusual during the earlier period (C. Chappell pers. comm.).

Ruddy Turnstone (*Arenaria interpres*). Two Ruddy Turnstones were found on a single winter and on two spring surveys (Table 3). Spring numbers may have been low because our surveys were conducted prior to the early May peak of movement of Ruddy Turnstones in this region (Paulson 1993).

Black Turnstone (*Arenaria melanocephala*). We noted very similar numbers of Black Turnstones during each of the three winters, lower counts during migration (Table 3). Black Turnstones were observed at the town of Nahcotta on the East North Beach Peninsula. Herman and Bulger (1981) recored very few Black Turnstones at Grays Harbor during spring migration.

Red Knot (*Calidris canutus*). The Red Knot occurred only in spring migration and the number of birds counted annually was quite variable (Table 3). The counts at Willapa Bay were much lower than those from Grays Harbor, where several thousand

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birds were noted by Herman and Bulger (1981). However, our spring counts there were conducted prior to the primary passage of Red Knots in this region (Paulson 1993).

Sanderling (*Calidris alba*). We regularly recorded Sanderlings each winter within the bay, but few during migration (Table 3). On outer North Beach we made three aerial counts in winter [mean 50.1 birds/km, standard deviation (SD) 6.5] and single counts during spring (78.6/km) and autumn (213.5/km). Our counts there were comparable to those made on the same beach in the winters of 1982 to 1990 (mean 46.6, SD = 14.5; Buchanan 1992) and in spring 1983 (94 birds/km.; Myers et al. 1984).

Western Sandpiper (*Calidris mauri*). Western Sandpipers were recorded each winter, although they were far more abundant during migration (Table 3). There was considerable variation among spring counts, possibly related to the timing of our counts relative to the actual peak passage.

Least Sandpiper (*Calidris minutilla*). We recorded small numbers of this species on nearly all counts (Table 3). The Least Sandpiper has a local distribution in Washington during winter.

Dunlin (*Calidris alpina*). The Dunlin was by far the most numerous species during winter (Table 3), when it constituted 85.6% to 97.9% of all shorebirds and 98.7% to 99.8% of all *Calidris* sandpipers. This is within the range of dominance noted in the greater Puget Sound region (Evenson and Buchanan 1995, Buchanan 1988a) and in an earlier study on North Beach (adjacent to Willapa Bay; Buchanan 1992). The Dunlin was the second most abundant species during spring migration (Table 3), a pattern observed at Leadbetter Point (Widrig 1979) and at Grays Harbor (Herman and Bulger 1981).

Short-billed Dowitcher (*Limnodromus griseus*). The Short-billed Dowitcher occurred primarily in spring, when it was the third most numerous species (Table 3). It was also observed during autumn but not in winter.

Long-billed Dowitcher (*Limnodromus scolopaceus*). We recorded the Long-billed Dowitcher by vocalizations in all three winters (Table 3), when it is generally the only species of dowitcher found in Washington (Buchanan 1992, Paulson 1993). We did not record this species in spring, although it is likely that it was present then each year. Similarly, Widrig (1979) found that *L. scolopaceus* constituted only about 1% of all dowitchers at Leadbetter Point in May.

Common Snipe (*Gallinago gallinago*). Recorded on only two winter and two spring counts (Table 3).

Seasonal Abundance of Shorebirds

The total abundance of shorebirds varied considerably from winter to winter. The variation in counts largely reflected variation in the abundance of the Dunlin (mean 47,996, SD = 21,382; Table 3). This approximate range of annual variation in abundance has been documented in other studies in coastal Washington (Buchanan 1992) and Puget Sound (Buchanan 1988a, Evenson and Buchanan 1995). It is currently unclear whether the variation in winter counts was related to factors in breeding areas, nonbreeding areas, or both.

Among the spring counts, we noted similar variation that was primarily related to the abundance of Western Sandpipers (Table 3). We believe it is likely that differences among spring counts may have been due to the timing of surveys relative to the peak passage of spring migrants.

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We observed within-season variation in total shorebird numbers in one of the two years in which we conducted multiple counts; our aerial count of 49,400 on 4 December 1993 was much lower than the estimate of 70,650 on 31 December 1993. Substantial changes in the within-season abundance of shorebirds also have been noted at several major sites in Puget Sound (Evenson and Buchanan 1995) but not at two smaller sites there (Buchanan 1988a). At Puget Sound sites the changes in abundance were thought to be primarily related to both regular movement among a network of sites and larger-scale movements in response to adverse weather (Evenson and Buchanan 1995). It is possible that shorebirds regularly move between Willapa Bay and Grays Harbor (16 km to the north) or the Columbia River estuary (6.5 km to the south). Although we were unable to document such movements, shorebirds are known to travel these distances in western Washington (Evenson and Buchanan 1995) and elsewhere (Warnock et al. 1995).

Adverse weather conditions are known to influence the seasonal distribution and abundance of shorebirds (Warnock et al. 1995). It is possible that the relatively low counts in winter 1994–95 were a response to mid-winter flooding at Willapa Bay. Both counts that year were made during a period of severe storms. We noticed that certain channels and flats in the bay were visibly altered between counts by scouring. In addition, flood tides inundated many foraging and roosting areas for longer than usual.

Important Areas

The importance to shorebirds of various sites in an area can be measured by the ability of sites to meet the energetic demands of overwintering or migrant birds (Goss-Custard 1984) or to support large numbers of individuals. This study was not designed to determine the energetics of shorebirds, but did provide preliminary data on the seasonal abundance of shorebirds at various sites within Willapa Bay.

Our results indicate greater total abundance of shorebirds at the Bear River/Lewis Unit and Willapa River in the winter and spring (Tables 2, 4). From the air, however, we noted that shorebirds used much of the intertidal area of the bay before congregating at the major sites when less than about 5% of the mud flats in the bay were still exposed. Emphasizing concentrations of birds at specific sites is appropriate but it is crucial to recognize the importance of the other areas used by shorebirds at other stages of the tidal cycle.

Our census efforts indicated that in all seasons some shorebird species were concentrated at specific sites or within certain regions of the bay. For example, in all seasons the Willet, Long-billed Curlew, and Marbled Godwit were observed only at sites in the northern part of the bay, primarily Tokeland, Cedar River, and North River. Other species with very local distributions included the Whimbrel (in all seasons mostly at Tokeland, North Cove, Leadbetter Point), Black Turnstone (in all seasons at Nahcotta on East North Beach Peninsula), Red Knot (in spring in the northern portion of the bay), Least Sandpiper (in winter primarily at East North Beach Peninsula, Leadbetter Point, Tokeland), Long-billed Dowitcher (in winter primarily at Bear River/Lewis Unit), and Common Snipe (in winter at Bear River/Lewis Unit, Willapa River).

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Among the sites important to shorebirds are those used for roosting, where they preen and rest during high tides. At Willapa Bay shorebirds roosted primarily in salt marsh, pastures, on islands, and on the outer beach. Our highest count of roosting birds was from the outer North Beach in spring (about 28,500 shorebirds, including several thousand Sanderlings, on 30 April 1993). Large numbers of shorebirds roost there in winter as well (about 34,600, not including Sanderlings; Buchanan 1992). We also observed several thousand spring migrant shorebirds roosting in pastures and agree with Colwell and Dodd (1995) that pastures may be important habitats for roosting shorebirds.

Willapa Bay and the Pacific Flyway

The Western Hemisphere Shorebird Reserve Network has proposed standards for ranking the importance of sites to shorebirds. Sites that support >20,000 shorebirds or 5% of a flyway population are considered regionally important, whereas sites that support >100,000 shorebirds or 15% of a flyway population are considered internationally important (I. Davidson pers. comm.). Willapa Bay meets the criteria of an internationally important site because it supports up to 15.5% of the Pacific flyway population of wintering Dunlins (derived from Page and Gill 1994) and an average of over 100,000 total shorebirds in spring. Willapa Bay's importance indicates it is a prime site for future shorebird monitoring and conservation efforts in the Pacific Northwest.

Conservation Issues

A current issue of conservation significance at Willapa Bay is the occurrence of the exotic and invasive cordgrass *Spartina alterniflora*. This salt-marsh plant appears to have spread rapidly in recent years, and in 1992 covered about 809 ha of the intertidal area of the bay (Washington Department of Agriculture et al. 1993). This species colonizes bare tideflats, traps sediments, and displaces low intertidal salt-marsh plants. Consequently, the invasion of *Spartina* will likely have a negative effect on shorebird populations by reducing foraging habitat (Goss-Custard and Moser 1988). Efforts are currently underway to control the spread of, and eventually eliminate, this exotic species.

SUMMARY

We conducted seasonal censuses of shorebirds at Willapa Bay, Washington, between 1991 and 1995. The census was designed to identify the location of potentially important sites for future monitoring efforts. The Dunlin was the most abundant species in winter, with annual total counts ranging between 27,120 and 69,850 birds. The Western Sandpiper was the most abundant species during spring; our annual counts ranged between 49,615 and 82,575. Dunlins and Short-billed Dowitchers were also abundant during spring and contributed to annual spring counts that exceeded 100,000 total shorebirds. Two estuarine areas within the bay, Willapa River and Bear River-Lewis Unit, typically supported the highest seasonal counts at higher tides, but shorebirds were well distributed along much of the

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shoreline of the bay on rising and falling tides. Willapa Bay is an internationally important site for overwintering and migrating shorebirds.

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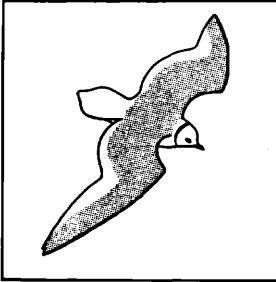
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