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SPRING MIGRATION OF SHOREBIRDS ON THE YAKUTAT FORELANDS, ALASKA

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ABSTRACT.—During spring 1996 and 1997, we conducted ground surveys at high tide to determine species composition, numbers, and timing of spring shorebird migration on the Yakutat Forelands, Alaska. Western Sandpipers (*Calidris mauri*) and Dunlins (*C. alpina*) were the most abundant shorebirds we observed in the Seal Creek-Ahrnklin River estuary; we also observed large aggregations of Marbled Godwits (*Limosa fedoa beringiae*). Using information on turnover rates of radio-tagged Western Sandpipers, we estimated that about 101,000 small calidridine sandpipers used the Seal Creek-Ahrnklin River estuary as a spring migration stopover annually in 1996 and 1997. From previous aerial survey data on shorebird distribution, we estimated that the entire Yakutat Forelands supports a spring population of more than 350,000 migrant shorebirds. Therefore, the forelands is an important stopover site to migratory shorebirds and should be included in the network of international stopover sites needed to conserve shorebirds migrating along the Pacific coast. *Received 22 Oct. 1997, accepted 30 Mar. 1998.*

Each spring, millions of shorebirds migrate north along the Pacific coast of North America to Arctic and sub-Arctic breeding grounds from temperate or tropical wintering grounds. To replenish depleted fat reserves during migration shorebirds congregate on coastal tidal flats that are often geographically restricted (Myers et al. 1987). Concentrations of shorebirds on large tidal flats can reach impressive numbers (Myers 1983). For example, most (>60%) of the world's Western Sandpipers (*Calidris mauri*), the most abundant shorebird migrant along the Pacific coast (Butler et al. 1996), stop at the Copper-Bering River Delta, Alaska, during spring migration; single-day counts in early May can exceed one million individuals (Isleib 1979, Iverson et al. 1996). Several other concentration areas along the Pacific coast annually support more than one million migratory shorebirds (e.g., Gray's Harbor, Washington; San Francisco Bay, California; Fraser River Delta, British Columbia; Page and Gill 1994, Gill et al. 1995). Protection of these primary concentration sites is critical to the conservation of migratory shorebirds and is central to the mission of the Western Hemisphere Shorebird Reserve Network (WHSRN) program (Finney 1995).

Recent evidence from the Pacific Coast (Iverson et al. 1996) and Great Plains (Skagen and Knopf 1994) suggests that small, secondary wetlands also provide important shorebird stopover habitats. Radio-tagged Western Sandpipers used short flights (generally <1000 km) to migrate between a series of coastal wetlands along the Pacific Coast, and Great Plains migrants used alternative wetlands when environmental perturbations altered the quality and availability of traditionally-used wetlands. Although most primary stopover areas have been identified, information on the importance of secondary wetlands is still needed. Evidence from aerial surveys for radio-tagged Western Sandpipers (Bishop, unpubl. data) indicated that small estuaries on the Yakutat Forelands, heretofore thought to be of minor importance to migratory shorebirds, might provide stopover habitat for shorebirds that migrate along the Pacific coast of Alaska. In fact, when Senner and coworkers (1981) assessed patterns of spring migration of Western Sandpipers in southern Alaska, little information was available about their migration between the Fraser River Delta and the Copper-Bering River Delta, Alaska. Senner (1979) earlier suggested that Western Sandpipers might use a series of stopover sites but had no quantitative information from any site in southeastern Alaska to evaluate his hypothesis. Because no intensive study of estuaries on the forelands has been conducted, we initiated a project to determine species composition, numbers, and timing of spring shorebird migration on the Yakutat Forelands and to assess its importance as a stopover habitat.

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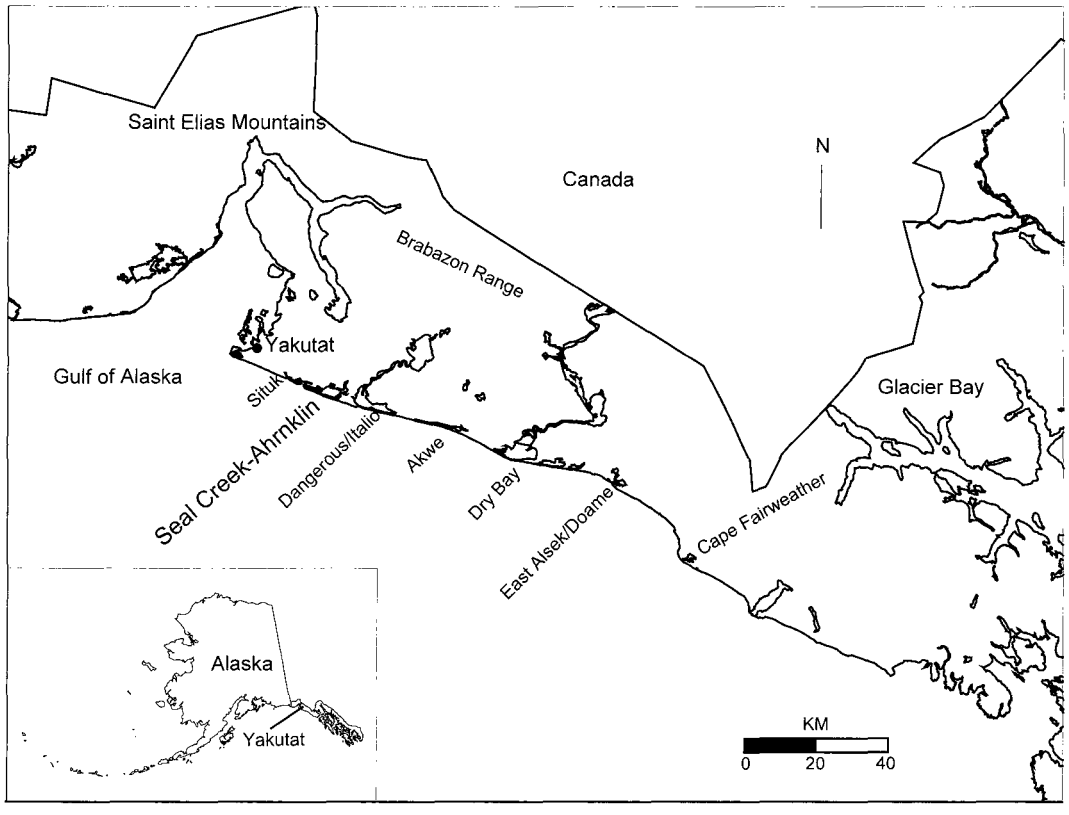

FIG. 1. Location of spring (1996, 1997) shorebird study area (Seal Creek-Ahrnklin River), other estuaries, and the village of Yakutat on the Yakutat Forelands, Alaska.

STUDY AREA AND METHODS

The Yakutat Forelands is located along the Pacific Coast of Alaska and extends 140 km from the village of Yakutat (59° 30′ N, 139° 50′ W) in the northwest to Cape Fairweather (58° 48′ N, 138° 00′ W) in the southeast (Fig. 1). This glacial plain varies in width from 30 to 70 km and is bounded on the east by the Saint Elias Mountains and Brabazon Range and on the west by the Gulf of Alaska. The forelands is characterized by sandy beaches, extensive sand dunes, tidal mudflats, deciduous shrublands, spruce forests, and muskegs, and is transected by a series of relatively short, mostly clear-running rivers (Patten 1982). Because of barrier sand-dune islands, considerable tidal flats are associated with almost all rivers that flow into the Gulf of Alaska. Aside from the Copper-Bering River Delta, the forelands provides the most extensive estuary and wetland habitat along the eastern Gulf of Alaska coast. Most of the forelands is managed by the U.S. Forest Service as part of the Tongass National Forest.

Because of numerous detections of radio-tagged Western Sandpipers made in 1995 (D. Walter, pers. comm.), we concentrated our survey effort in the Seal Creek-Ahrnklin River estuary (Fig. 1). Water depth limited our access and we had to restrict our ground surveys to about 20.5 km^2 (42%) of the estuary. In this area, we established a series of 13 points that we surveyed between two hours before and two hours after high tide; we used a motorized skiff to travel between points. Points were systematically located to cover all of the intertidal area and to minimize double-counting. At each point, two observers scanned different areas of barren or sparsely-vegetated tidal flats and identified and counted each shorebird species detected; large flocks were counted by tens. Counting areas at each point were divided between observers, and natural or flagged landmarks were used to eliminate double-counting. Because some points included wetlands dominated by sedges (*Carex* spp.), we walked prescribed routes to flush and count individuals hidden by vegetation. Except for 11, 14 May 1996 and 9 May 1997 (because of bad weather and mechanical problems), we obtained a complete, daily count of all shorebirds from 26 April to 22 May 1996 and 25 April to 23 May 1997. Except for changes in observers, survey procedures were identical between years. For the three missing survey days, we used the mean of the two counts bracketing the missing day to estimate a number for each species on those days. We averaged

TABLE 1. Annual number of individuals and percentage of total for each shorebird species observed in the Seal Creek–Ahrnklin River estuary, Yakutst, Alaska, during spring 1996 and 1997.

English name	Scientific name	Annual number observed		% obs. 1996–1997
		1996	1997	
Western Sandpiper	*Calidris mauri*	52,434	42,686	39.1
Dunlin	*C. alpina*	48,794	45,574	38.8
Long-billed and Short-billed dowitchers	*Limnodromus scolopaceus* and *L. griseus*	6159	15,179	8.8
Least Sandpiper	*Caldris minutilla*	5305	14,741	8.2
Red Knot	*C. canutus*	2406	1576	1.6
Pectoral Sandpiper	*C. melanotos*	932	103	0.8
Semipalmated Sandpiper	*C. pusilla*	1316	502	0.7
Marbled Godwit	*Limosa fedoa*	882	818	0.7
Black-bellied Plover	*Pluvialis squatarola*	373	1217	0.7
Whimbrel	*Numenius phaeopus*	119	441	0.2
Semipalmated Plover	*Charadrius semiplamatus*	222	105	0.1
Black Turnstone	*Arenaria melanocephala*	118	152	0.1
Hudsonian Godwit	*Limosa haemastica*	27	41	<0.1
Red-necked Phalarope	*Phalaropus lobatus*	22	31	<0.1
Spotted Sandpiper	*Actitis macularia*	12	33	<0.1
Greater Yellowlegs	*Tringa melanoleuca*	19	19	<0.1
Pacific Golden-Plover	*Pluvialis fulva*	15	21	<0.1
Common Snipe	*Gallinago gallinago*	7	22	<0.1
Lesser Yellowlegs	*Tringa flavipes*	4	20	<0.1
Ruddy Turnstone	*Arenaria interpres*	1	15	<0.1
American Golden-Plover	*Pluvialis dominica*	10	5	<0.1
Killdeer	*Charadrius vociferans*	—	1	<0.1

daily counts across years to determine species composition and to illustrate timing of spring shorebird migration.

We used information on the daily turnover rate of radio-tagged Western Sandpipers (Bishop, unpubl. data) to transform our daily counts into estimates of seasonal population size. From her data, 93.3% (14 of 15) of the radio-tagged Western Sandpipers located on the forelands remained there for only 1 day and 6.7% (1 of 15) remained there for 2 days. Because no explicit information exists on the turnover rates of any species other than Western Sandpipers, we assumed that the turnover rate of Least Sandpipers (*Calidris minutilla*), Semipalmated Sandpipers (*C. pusilla*), and Dunlins (*C. alpina*) would be similar to that of Western Sandpipers, therefore we combined counts of these species to yield a daily count of small calidridine sandpipers. None of these sandpipers breed in significant numbers in the estuary and our impression in the field was that their migration behaviors in the estuary were similar. Following the probabilistic approach of Butler and coworkers (1987), we used the turnover proportions to divide the daily count into the number of individuals that would stay 1 day and the number of individuals that would stay 2 days. We then calculated the number of new birds (n) on a day (t) as the daily count $- [n_{(t-1)} \times (1/15)]$ and summed the number of new birds across all days to get an annual estimate of population size; we estimated population sizes separately for 1996 and 1997.

To estimate the total number of shorebirds that used the forelands as a migration stopover, we examined aerial survey data collected on the distribution of migrant shorebirds among foreland estuaries. During spring 1980, Petersen and coworkers (unpubl. data) flew fixed-wing aircraft surveys of the forelands' estuaries every five days between 3 April and 10 May. Surveys were flown 30 m above the ground, at 130 km/hr, and shorebirds were identified and counted. We combined their counts for small calidridine sandpipers (14,092 individuals) and determined that 28.6% of the detections were made in the Seal Creek-Ahrnklin River estuary. We divided our population estimate for the Seal Creek-Ahrnklin River estuary by 28.6% to obtain an estimate of the entire spring shorebird population on the forelands. Because we surveyed only 42% of the Seal Creek-Ahrnklin River estuary, this procedure gave a conservative estimate of spring shorebird use of estuaries on the Yakutat Forelands.

RESULTS

Twenty-three species of migrant shorebirds were observed in the Seal Creek-Ahrnklin River estuary in spring 1996 and 1997 (Table 1). We recorded an additional six species on opportunistic surveys of ocean beaches adjacent to the Seal Creek-Ahrnklin River: Black Oystercatcher (*Haematopus bachmani*), Wan-

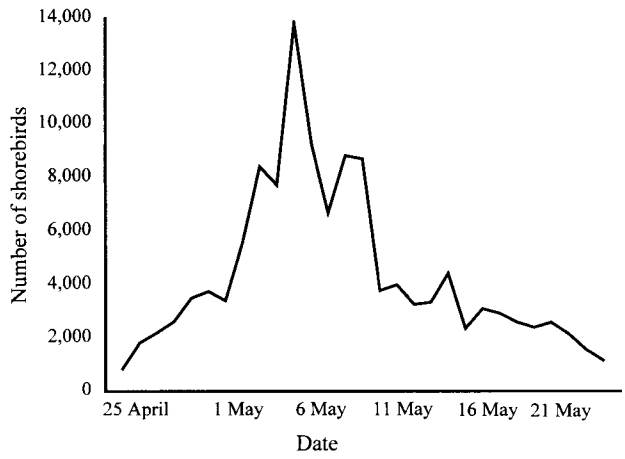

FIG. 2. Daily number of shorebirds present in the Seal Creek-Ahrnklin River estuary (averaged for 1996 and 1997) during spring migration on the Yakutat Forelands, Alaska.

dering Tattler (*Heteroscelus incanus*), Surfbird (*Aphriza virgata*), Sanderling (*Calidris alba*), Baird's Sandpiper (*C. bairdii*), and Rock Sandpiper (*C. ptilocnemis*). Small calidridine sandpipers dominated the migratory shorebird assemblage (six of the eight most abundant species), and two species, the Western Sandpiper and Dunlin, constituted 78% of all shorebird observations. Least Sandpipers, dowitchers (*Limnodromus* spp.), and Red Knots (*Calidris canutus*) also were common migrants (19% of the observations). The remaining 16 species constituted less than 4% of the shorebird observations. Marbled Godwits (*Limosa fedoa beringiae*) are rare spring migrants along the Pacific coast north of British Columbia (Kessel and Gibson 1978) and our single-day count of 358 birds on 3 May 1996 was exceptional.

Applying turnover rates to daily counts, we estimated that the small calidridine sandpiper population using the survey area in the Seal Creek-Ahrnklin River estuary was 101,300 individuals in 1996 and 100,700 individuals in 1997. Based on distribution information from the prior aerial surveys, we estimated that all estuaries on the forelands supported 354,000 (1996) and 352,000 (1997) small calidridine sandpipers during spring migration.

Shorebird numbers were highest during the first week of May (Fig. 2); daily counts exceeded 5000 individuals between 30 April and 10 May. Single-day counts exceeded 10,000 individuals on one day in 1996 (10,800 individuals on 8 May) and on two days in 1997 (19,000 individuals on 5 May and 11,400 individuals on 6 May). Numbers declined rapidly after 10 May. On the first and last surveys, 1000–2000 shorebirds were present in the study area.

DISCUSSION

Clearly, the Yakutat Forelands provides important stopover habitat for migratory shorebirds; estimates of hundreds of thousands of shorebirds were previously unreported. According to Western Hemisphere Shorebird Reserve Network abundance criteria (Harrington and Perry 1995), our estimate of a spring population of 350,000 individuals qualifies the forelands as a site of international importance (annually supports >100,000 shorebirds) to migratory shorebirds. Our estimate is most likely conservative because: (1) shorebirds were present in the estuary before and after the survey period, (2) only 42% of the Seal Creek-Ahrnklin estuary was surveyed, (3) individuals that remained on the forelands for less than one day were not considered in estimated totals, (4) shorebird use of the Ankau saltchucks was not considered (located south of the village of Yakutat; some radio-tagged birds were detected there), and (5) species other than small calidridine sandpipers were not considered in population estimates for the forelands. Accounting for any of these factors would increase our estimate of the total spring shorebird population on the forelands and

would offset any overestimate caused by assuming that migration behavior of Dunlins was similar to that of Western Sandpipers.

Counts from staging areas on the Alaska Peninsula indicate that the Pacific flyway population of Marbled Godwits is 1000–2000 individuals (Gibson and Kessel 1989). Other than the Alaska Peninsula staging areas, large aggregations of Marbled Godwits previously were unrecorded in Alaska; spring migration records from southcentral Alaska range from 1–20 individuals (Kessel and Gibson 1978). Thus, our annual estimate of about 400 individuals for the Seal Creek-Ahrnklin estuary could represent as much as 20–40% of the flyway population. Further information on the distribution of godwits among estuaries of the forelands and on the length of time they spend in the estuaries is needed to accurately assess the importance of the forelands as a migratory stopover site for this endemic Alaskan subspecies.

Composition of the shorebird assemblage on the Seal Creek-Ahrnklin River estuary was similar to the Copper-Bering River Delta; Western Sandpipers, Dunlins, Least Sandpipers and dowitchers were the most abundant species in both areas (Isleib 1979, Murphy 1981). However, Western Sandpipers and Dunlins constituted a greater proportion of all shorebird migrants on the Copper-Bering River Delta (95%) and in Kachemak Bay, Alaska (Senner et al. 1981), than at Yakutat. A greater proportion of Dunlins was observed at Yakutat than at these other southcentral Alaska sites. Although Western Sandpipers and Dunlins were also prevalent on the Fraser Delta, British Columbia, Black-bellied Plovers *(Pluvialis squatarola)* were more abundant there than at Yakutat (Butler 1994). Timing of spring migration on the forelands also was similar to the Copper-Bering River Delta and Kachemak Bay with the greatest number of shorebirds using estuaries during the first ten days of May (Isleib 1979, Murphy 1981, Senner et al. 1981). On average, individual Western Sandpipers spent much less time at stopovers on the forelands than at any other site along the Pacific Coast (Bishop, unpubl. data). This suggests that shorebirds lacking energy to reach the Copper-Bering River Delta (350 km to the northwest) use the forelands to partially replenish exhausted reserves. That many individual shorebirds were observed foraging during low tides indicated shorebirds used the estuary for more than just a rest stop. Whatever the stimuli for shorebirds to stop on the Yakutat Forelands, the magnitude of the spring shorebird migration supports Iverson's and coworkers' (1996) assertion that the conservation of Pacific Flyway populations of shorebirds depends upon a network of stopover sites. The importance of the Pacific Coast migration route to Western Sandpipers is well established (Butler et al. 1996). In the event of a major perturbation to other estuaries along the flyway, the forelands may provide critical stopover habitat to migratory shorebirds displaced from other sites. Although every site within the network may not be equally crucial to the maintenance of shorebird populations, conservation of coastal stopover sites should certainly focus on a series of well-dispersed sites that each support more than 100,000 individuals annually. Besides numerical importance, critical sites might also be defined by their functional significance to migrating shorebirds or by the effects that loss or degradation of the site would have on migratory shorebird populations (see Senner and Howe 1984).

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