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A PRELIMINARY ASSESSMENT OF TIMING AND MIGRATION OF SHOREBIRDS ALONG THE NORTHCENTRAL ALASKA PENINSULA

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ABSTRACT.—An intensive study of post-breeding and migrating shorebirds was conducted in 1976 on a major estuary of the Alaska Peninsula at Nelson Lagoon. Twenty species were recorded, eight of them breeding on the study area. Temporal patterns of relative abundance were obtained from aerial and ground censuses. Prominent events in the seasonal southward movements were (a) congregation of non- and post-breeding birds after mid-June, (b) an early migratory peak before early August dominated by Western Sandpipers, Short-billed Dowitchers, Least Sandpipers, and Whimbrels, and (c) a later, much larger peak in late Setember and early October dominated by Dunlins, Rock Sandpipers, Bar-tailed Godwits, and Long-billed Dowitchers. In the five-month period July–November, several hundred thousand shorebirds used the study area as a stopover and/or staging area. The most abundant species was the Dunlin. The area is also critical for such species as the Bar-tailed Godwit, apparently serving as a unique concentration site for this species prior to fall migration.

It is understandable that almost all Alaska shorebird investigations have concentrated on aspects of reproductive biology or other physiological processes while on the breeding grounds (for reviews, see, e.g., Holmes 1966a, 1966b, 1966c, 1971, 1972, Holmes and Pitelka, 1968, MacLean and Holmes, 1971, Norton 1972, Pitelka 1959 and Pitelka et al., 1974). Comparatively few Alaska studies have focused on post-breeding movements or staging patterns of migrant shorebirds. Indeed, over much of southwest Alaska and the Alaska Peninsula, an area with over 200 km^2 of intertidal substrates and 1800 km of coastline, there have been no studies directed specifically at migrant shorebird use of intertidal habitats. We know from cursory observations that over 30 species of shorebirds utilize these habitats during migration, often by the tens if not hundreds of thousands (Chapman 1904, Jaques 1930, Hurley 1931, 1932, Murie 1959, P. Arneson, M. Dick, D. Gibson, J. King, M. Peterson, unpublished data).

In this paper we report the results of the first quantitative assessment of the timing and migration of shorebirds along a major estuary of the north Alaska Peninsula.

STUDY AREA

The study was conducted along the northcentral Alaska Peninsula at Nelson Lagoon (56°00′N, 161°10′W) from 22 April through 1 December 1976 (Fig. 1). The north Alaska Peninsula is typified by a relatively regular coastline comprising numerous sand beaches, low terraces and alluvial fan deposits. The coastal lowland, which is dotted by numerous small lakes and drained by several river systems, extends inland between 10 and 20 km to the base of the Aleutian Range.

Nelson Lagoon is a 100 km^2 component of the larger 540 km^2 Herendeen Bay-Port Moller estuarine complex which, in itself, comprises approximately 44% of all estuarine habitat along the north Alaska Peninsula (P. Arneson, unpublished data). The Lagoon is fed by the combined discharge of the Caribou and Sapsuck rivers which originate in the Mt. Pavlof and Mt. Dana areas, respectively. The upper lagoon is a delta of several small, unstable islands grown to *Calamagrostis canadensis, Carex aquatilis* and *C. Lyngbyaei*. The adjacent uplands are grown predominantly to *Elymus arenarius mollis*, interspersed with *Honckenya peploides major* and *Lathyrus maritimus pubescens*. Several beds of *Zostera marina* occur throughout the estuary; however, none is present in Nelson Lagoon.

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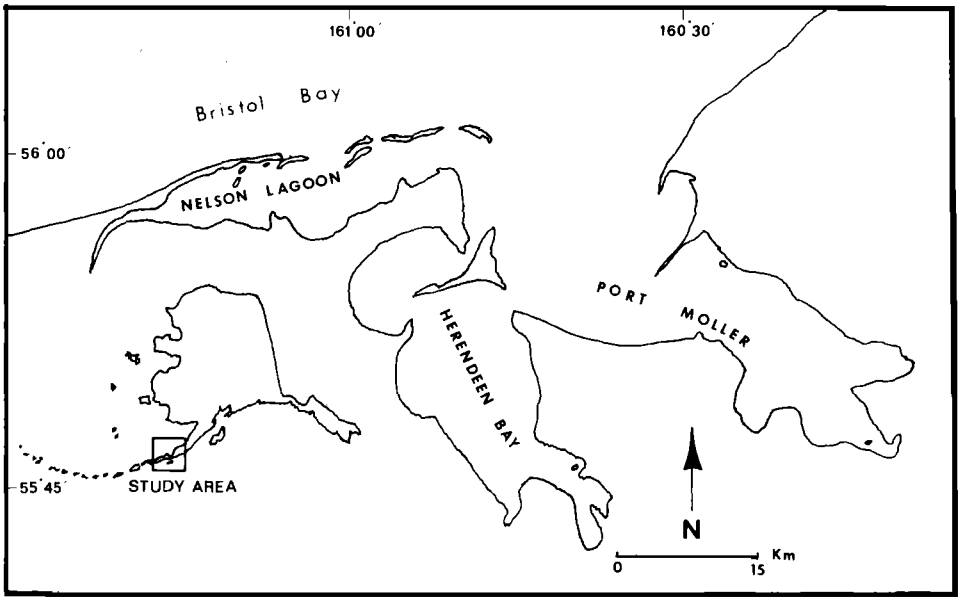

FIGURE 1. The study locale showing its position on the Alaska Peninsula.

The study was conducted over approximately 34 km² of western Nelson Lagoon (Fig. 2). Intertidal substrates within the study area were identified as: mudflats, 950 ha; mixed mud- and sandflats, 3250 ha; and rocky beaches, 300 ha. Barrier islands (150 ha) and vegetated coastal sand dunes and beaches (280 ha) were used as high tide roosts by shorebirds. Approximately 575 ha of open water remains at MLLW (mean lower-low water).

The estuarine waters of the study area are usually ice free between late April and October. The weather during the study was quite variable. May, July and September mean minimum and maximum temperatures were recorded as 2–7°, 9–13°, and 4–10°C, respectively. Prevailing winds are from the NW and SE during this period. The lagoon experiences two low and two high tides each lunar cycle and has a recorded mean diurnal tide range of 3.2 m.

METHODS

Shorebird data were derived primarily from aerial and ground censuses. Numerous incidental shorebird observations were collected during investigations of other components of the study area avifauna. An initial aerial survey of the study area was made by Gill on 23 April. A permanent field camp was established along Lagoon Point on 18 May, approximately 1 km E of the village of Nelson Lagoon. We were present on the study area between 18 May and 3 September, 13 September through 15 October and again between 17–24 November. Interim observations were provided by Mr. Peter Kust, Sr., who also acted as our pilot throughout the study.

Seven census areas were delineated within the study area and their intertidal substrates identified and mapped (Fig. 2). Census areas ranged between 56 and 950 ha.

Ground Censuses

Between 21 May and 16 September, ground shorebird surveys focused on census area II, in front of our study headquarters. Censuses were conducted approximately every four days using a 20× spotting scope. We counted all birds on the area but made no distinction among species use of substrate types. A second type of census, also conducted approximately every four days throughout this same period, was directed specifically at shorebirds and their substrate selection. Several additional ground censuses were conducted on census areas I and III–VII but were conducted too infrequently to evaluate patterns of occurrence and abundance. The chief value of these surveys was to

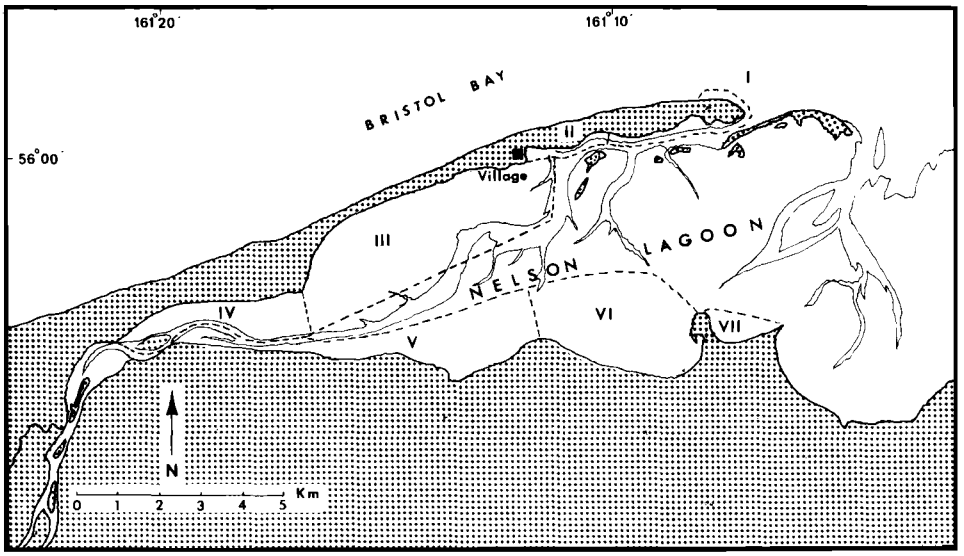

FIGURE 2. The Nelson Lagoon study area showing shorebird census areas I–VII.

provide comparative data for aerial and ground censuses over the same area during the same tidal cycle.

Aerial Censuses

Between 1 July and 15 October, weekly aerial surveys were flown over census areas I–VII. Only one census was conducted over area I during July. No censuses were flown over any of the areas between 3–13 September. From 16 October through 1 December, bi-weekly censuses were flown over all areas.

Censuses were flown in a Piper Super Cub at an elevation of between 50 and 75 m and at an airspeed of 75 knots. The pilot plus one observer conducted most censuses. Only the observer counted shorebirds but often relied on the pilot to locate concentrations of birds. Of 16 total censuses, Gill conducted 10, Jorgensen 4, while Kust flew 2 during our absence in October and November. Censuses were flown 1.5 hours before or after low, slack tide. Census duration averaged 45 minutes. Censuses started at area I and followed in sequence through area VII.

Shorebird numbers were voice recorded on magnetic tape and later transcribed to census forms. Censuses were conducted by first flying the edge of the substrate/water interface since most shorebirds were found concentrated along this area during early stages of each low tide. We then returned to survey other portions of each census areas as we saw shorebird concentrations. The airplane invariably disrupted concentrations of foraging shorebirds; however, we found most concentrations resettled within several hundred meters of their initial area. We feel duplicate counts from any one area or between areas were, therefore, at a minimum. During most of the study, shorebirds were recorded in groups of 100's except during peak migration in September and early October when we often counted shorebirds in groups of 1000's.

Shorebirds were usually identified to species except during late June through August when populations of Western Sandpipers (*Calidris mauri*), Dunlins (*C. alpina*) and Least Sandpipers (*C. minutilla*) occurred together over much of the study area. For purposes of this study these species were recorded as "small sandpipers" during censuses. Populations of each were subsequently determined from periodic comparisons of population ratios of all three species. These were derived from ground censuses conducted usually within 72 hours of an aerial census. Only ground and aerial censuses conducted over the same area or similar substrate types were used for such comparisons. We found numbers of *C. minutilla*, however, to be too small and the species' occurrence too irregular to accurately evaluate use patterns for each census area.

Numbers of Short-billed (*Limnodromus griseus*) and Long-billed Dowitchers (*L. scolopaceus*) were

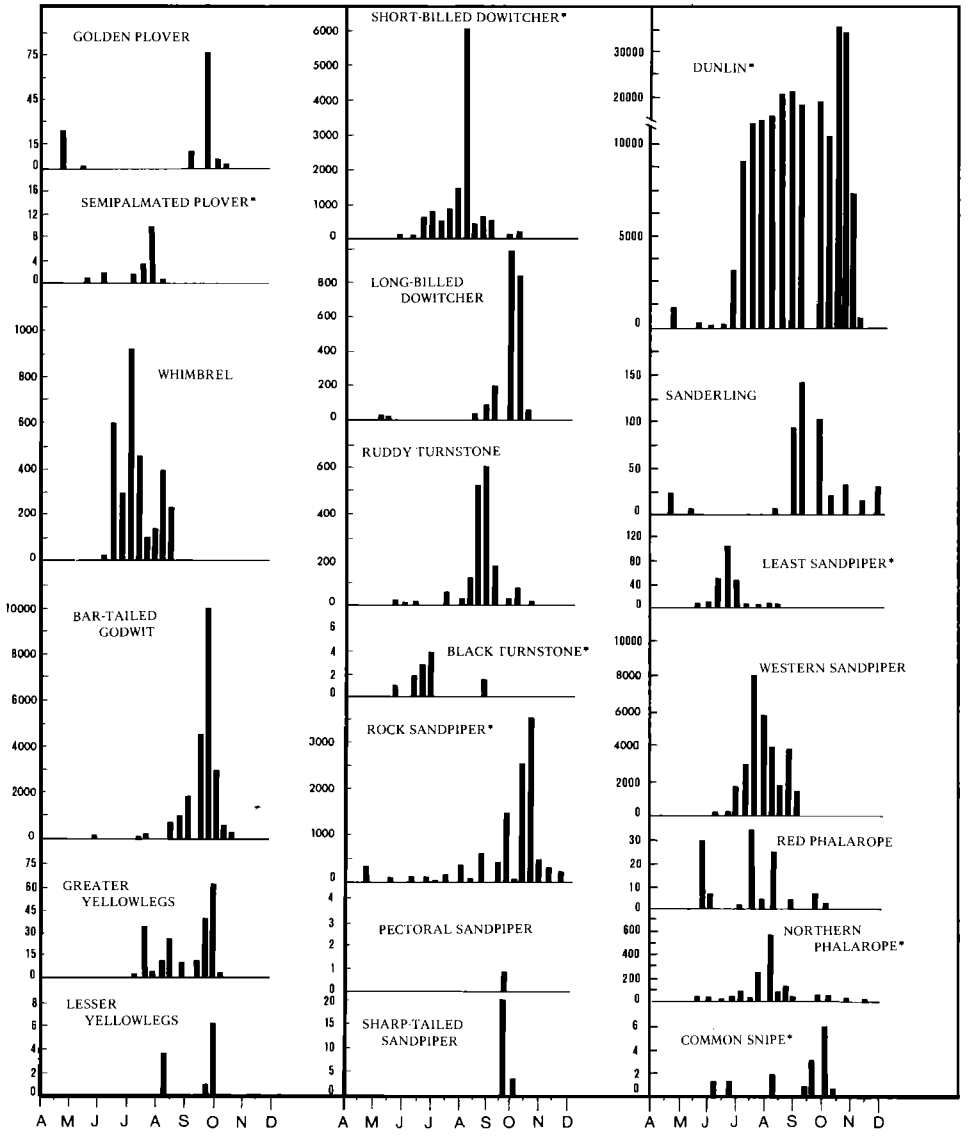

FIGURE 3. Comparative temporal abundance of 20 shorebird species at Nelson Lagoon, 22 April–1 December 1976. Species histograms incorporate aerial as well as ground census data obtained prior to migratory buildups beginning in late June. Numbers prior to 1 July do not necessarily reflect overall shorebird use of the study area but do accurately reflect timing of migratory buildups. Species noted by an asterisk nested on the study area.

similarily derived but presented less of a problem since the two species exhibited different habitat preferences and only briefly overlapped in occurrence during the study.

RESULTS

Occurrence

Twenty species of shorebirds were recorded during the study, eight of which nested locally (Fig. 3). Of the nesting species, only Northern Phalaropes (*Lobipes*

TABLE 1

AMOUNT AND COMPOSITION OF SUBSTRATE TYPES WITHIN EACH CENSUS AREA, NELSON LAGOON, ALASKA, 1 JULY–1 DECEMBER 1976

Substrate type	Census area							Total
	I	II	III	IV	V	VI	VII	
Sand dunes and beaches	40[a](100.0%)[b]							40 (1.0%)[c]
Rocky intertidal beaches	6 (35.0)	4 (24.0)	6 (35.0)				1 (6.0)	17 (0.5)
Mudflats			101 (16.0)	486 (75.0)	40 (6.0)	18 (3.0)		645 (19.0)
Mixed mud and sandflats	10 (0.5)	53 (2.0)	830 (30.5)		769 (28.0)	930 (34.0)	130 (5.0)	2722 (79.5)
Total	56 (1.5%)[d]	57 (1.5)	937 (27.0)	486 (14.0)	809 (24.0)	948 (28.0)	131 (4.0)	3424 (100.0)

[a] Amounts are in hectares.
[b] % of all such substrate within the study area.
[c] % composition of total study area.
[d] % by census area of total study area.

TABLE 2
PERCENT SHOREBIRD COMPOSITION BY SUBSTRATE TYPE FROM 16 AERIAL CENSUSES, 1 JULY–1 DECEMBER 1976, NELSON LAGOON, ALASKA

	Habitat type				
	Sand dunes and beaches	Rocky intertidal beaches	Mudflats	Mixed mud/sandflats	Open water
Species					
Northern Phalarope					100.0%
Short-billed Dowitcher			0.8%	3.0%	
Long-billed Dowitcher			2.5	1.0	
Rock Sandpiper		72.0%		<0.5	
Dunlin	84.5%		75.1	80.0	
Western Sandpiper	15.5		20.7	9.7	
Bar-tailed Godwit				4.9	
Sanderling				<0.5	
Greater Yellowlegs			1.0	<0.5	
Lesser Yellowlegs			<0.5	<0.5	
Whimbrel				<0.5	
Golden Plover				<0.5	
Ruddy Turnstone		28.0		<0.5	
Total nos. recorded	52,500	4000	10,000	260,000	130
Percent of total	16.0	1.0	3.0	80.0	0.1

lobatus), Rock Sandpipers (*C. ptilocnemis*), Least Sandpipers and Dunlin nested in significant numbers, probably fewer than several hundred pairs each.

Since we did not open a permanent field camp until 18 May, early spring occurrence data are incomplete. During the aerial survey of Nelson Lagoon and Port Moller on 22 April, much of the intertidal area was still ice fast. Nevertheless, small numbers of Golden Plovers (*Pluvialis dominica*), Sanderlings (*C. alba*), Dunlins and Rock Sandpipers were present along ice free intertidal areas. We detected small numbers of Golden Plovers, Bar-tailed Godwits (*Limosa lapponica*), Red Phalaropes (*Phalaropus fulicarius*) and Dunlins moving northeast along the Peninsula through early June. Beginning mid-June, populations of post- and non-breeding shorebirds began congregating on the study area. We found that once a migrant species settled onto the area it remained at various population levels until fall departure. Populations of Dunlins, Ruddy Turnstones (*Arenaria interpres*), Red and Northern phalaropes and Short-billed Dowitchers remained for approximately 100 days. Golden Plover, Greater Yellowlegs (*Tringa melanoleucus*), Lesser Yellowlegs (*T. flavipes*), Black Turnstone (*A. melanocephala*), and Long-billed Dowitchers were present for less than 70 days during autumn migration, while Pectoral (*C. melanotos*) and Sharp-tailed Sandpipers (*C. acuminata*) were present for less than 30 continuous days.

Most species departed by the second week of October just prior to a major storm system which passed over the southwest Peninsula. Rock Sandpipers and Sanderlings were both present on the study area on 22 November as were Red and Northern phalaropes. The former two species are considered winter residents of the Alaska Peninsula and Aleutian Islands (Gabrielson and Lincoln 1959). Neither phalarope has been reported in the Bristol Bay area after the first week of November, but we do not consider our late November sightings unusual since much of Alaska experienced an abnormally mild fall and winter during 1976–1977.

TABLE 3
TOTAL SHOREBIRDS AND THEIR DISTRIBUTION RECORDED FROM AERIAL CENSUSES, 1 JULY–1 DECEMBER 1976, NELSON LAGOON, ALASKA

	Total nos. recorded	Census area						
		I	II	III	IV	V	VI	VII
Species								
Northern Phalarope	130	77.0%						23.0%
Short-billed Dowitcher	8600	0.5	23.0%	45.0%	0.5%	2.5%	2.5%	26.0
Long-billed Dowitcher	2500		23.0	23.0	7.0	28.0	5.0	14.0
Rock Sandpiper	4000	25.0	47.0	27.0				0.5
Dunlin	260,000	20.0	10.0	54.0	1.5	5.0	7.0	2.5
Western Sandpiper	36,000	24.0	21.0	34.0	1.5	6.0	9.5	4.0
Bar-tailed Godwit	13,000			87.0		1.0	12.0	<0.5
Sanderling	400			97.0		3.0		
Greater Yellowlegs	130				32.0	48.0	20.0	
Lesser Yellowlegs	6				33.0		67.0	
Whimbrel	1000					15.0	28.0	57.0
Golden Plover	75			10.0		90.0		
Ruddy Turnstone	1000	85.0	6.0	4.0		<0.5	0.5	4.5
Total numbers	326,000	62,500[a]	38,000	169,500	4700	16,500	24,000	11,000
Percent of total		19.0	12.0	52.0	1.5	5.0	7.0	3.5

[a] Predominantly roosting birds.

HABITAT UTILIZATION

Table I breaks down the various substrate types within each area by size and composition. A mixture of fine sand and mud was the predominant intertidal substrate and it occurred over all but census area IV. This area encompassed the delta region of the Caribou and Sapsuck rivers. As such, the substrate was a mixture of fine silt and organic materials. Census area I, Lagoon Point, was comprised mostly of barrier sand dunes and sand and rock beaches. During August and early September this area was used as a high tide roost by virtually all Dunlins and Western Sandpipers within the study area. Counts of both species returning to roost at Lagoon Point on 8 and 18 August and 2 September were only 6, 4, and 12% higher, respectively, than aerial counts of all "small sandpipers" taken within 48 hours of the same dates over census areas I–VII.

We did not find shorebird selection of Lagoon substrates to vary appreciably from previously reported habitat preferences for each species (Table 2). Rock Sandpipers and Ruddy Turnstones were most frequently observed along rocky intertidal beaches while few were observed on mud/sandflats. Both Greater and Lesser yellowlegs preferred mudflats and to a lesser extent mud/sandflats. We did not, however, record either species on area III which accounts for 16% of the mudflat substrate in the study area and which lies immediately adjacent to the extensive mudflats in area IV. Three species, Dunlin, Western Sandpiper and Short-billed Dowitcher utilized portions of mud/sandflats within all census areas. Golden Plovers, Bar-tailed Godwits, Sanderlings, and Whimbrels (*Numenius phaeopus*), were only found on mixed sand/mud substrate. Whimbrels, however, were never recorded on area III, which accounts for 30% of this substrate type within the study area. Long-billed Dowitchers tended to prefer mudflats, especially along the upper reaches of the Lagoon, while Short-billed Dowitchers

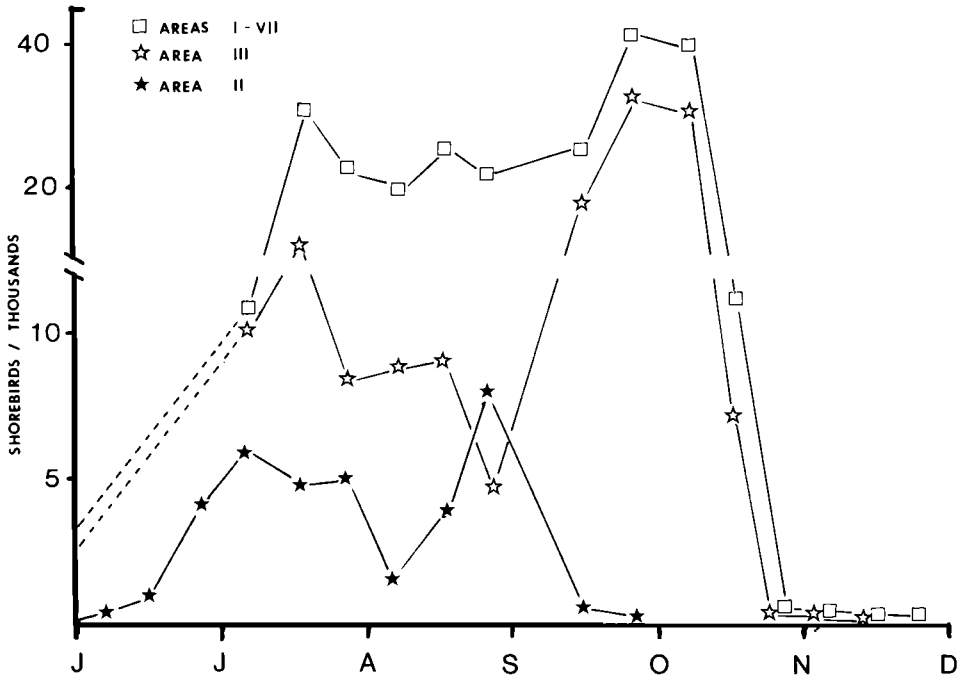

FIGURE 4. Peak periods of migration and approximate total numbers of shorebirrds on the census areas (squares), on census area III (open stars) and on census area II (closed stars). Census area II incorporates ground census data prior to 1 July.

were most frequently observed on mud/sand substrate. This difference in substrate selection between the two species has also been observed on their wintering grounds (Lenna 1969, Page 1975). Most of the shorebirds recorded on sand dunes and beaches were roosting.

Abundance

Table 3 presents percent shorebird composition in each census area as recorded during 16 aerial censuses. Total numbers reflect cumulative census results; since we did not qualify shorebird turnover, or determine ingress and egress to and from the study area, they do not represent overall numbers of shorebirds using Nelson Lagoon during autumn and fall migration. Comparative temporal abundance of all species is presented in Figure 3. These data incorporate aerial and ground census data obtained prior to migratory buildups beginning in late June. Numbers depicted prior to 1 July do not necessarily reflect overall shorebird use of the study area, but do accurately reflect timing of migratory buildup.

Overall, total numbers increased steadily between late June and early October. Two peaks of migration were recorded during this period (Fig. 4). Western Sandpipers, Short-billed Dowitchers, Least Sandpipers and Whimbrels peaked between early June and early August. Whimbrels exhibited the earliest migration but it is unknown whether these birds represented non-breeders or unusually early autumn migrants. Isleib and Kessel (1973) report small numbers of non-breeding Whimbrels as uncommon from late May through July on the Copper

River Delta (61° N). Fall migrant Whimbrels are reported to arrive on the Copper River Delta by late June and are common by mid-July (op. cit.).

A second, much larger, fall peak composed of Dunlins, Rock Sandpipers, Bar-tailed Godwits and Long-billed Dowitchers occurred between the last week of September and the first week of October. Twenty-seven percent of all shorebirds counted during the study were recorded during this period. This bimodal migratory movement was reflected on all census areas except area II, where shorebird use virtually ceased in late September just as fall numbers peaked over all other areas (Fig. 4). A possible explanation is over-exploitation of food resources, but we conducted no benthic studies to confirm this.

DISCUSSION

We found little comparative material concerning migratory chronology or abundance of fall migrant shorebirds along other coastal areas of the Alaska Peninsula. Robert Jones (pers. comm.) reports tens of thousands of Dunlins occurring each fall (1960–1973) on Izembek Lagoon, approximately 100 km W of Nelson Lagoon. More recently, Paul Arneson, Alaska Department of Fish and Game (pers. comm.), recorded 45,000 "small," 20,000 "medium" and 600 "large" shorebirds during a 13–16 October 1976 aerial survey of the north Alaska Peninsula between Ugashik and Izembek Lagoon.

Away from the Peninsula on Angyoyaravak and Hooper bays (61°N), Holmes (1971) found post-breeding Dunlins concentrating on tidal flats in late July, and by late August he reported tens of thousands along several miles of coastline. Although he made no September observations, Holmes felt, based on the timing of arrival on wintering areas, that Dunlins remained through most of the month.

At Nanvak Bay (59°N) along the northwest corner of Bristol Bay, M. Dick and M. Petersen (unpublished data) found comparatively little fall Dunlin use of mudflats in 1971 and 1973. Between July and September 1976, Petersen observed Dunlins on Nanvak Bay on only four occasions. Other species using this area, including Whimbrel, Least and Rock sandpipers, Ruddy Turnstone, and Greater Yellowlegs had similar fall occurrence patterns as those found at Nelson Lagoon (M. Dick and M. Petersen, pers. comm.).

We also found that the occurrence of these species at Nelson Lagoon coincided with fall movements of the same species through Prince William Sound and the North Gulf of Alaska (60°N) (Isleib and Kessel 1973). However, the period of peak fall migration of Western Sandpipers and Dunlins through Prince William Sound has been recorded as much as 30 days ahead of Nelson Lagoon and both species are reported to occasionally overfly the Sound in fall (S. Senner and P. Isleib, pers. comm.).

These fragmentary occurrence patterns corroborate the suggestions of Holmes (1966) and Holmes and MacLean (1971) that the fall migration from staging to wintering areas of Dunlins is direct and rapid. Furthermore, the large concentrations of Dunlins along the Alaska Peninsula, the comparatively later staging period at Nelson Lagoon and elsewhere along the Peninsula, and the lack of such reported concentrations along coastal south and southeast Alaska during this period, allow us to hypothesize that Dunlins (*C. a. pacifica,* see Holmes and MacLean 1971) staging on Nelson Lagoon embark for their winter quarters on a direct transoceanic migration of the northeast Pacific. It seems unlikely that Dun-

lins coming from northern breeding grounds on the Yukon-Kuskokwim Delta, and staging along the western Alaska Peninsula, would move northeast again to Prince William Sound before continuing south along or off the coast of British Columbia. Dunlins reported from Prince William Sound in fall are probably flying directly from the Yukon-Kuskokwim breeding grounds, while an additional segment of this population moves south across Bristol Bay to Nelson Lagoon and other estuaries along the western Peninsula. We hope to confirm this by extensive banding and color marking in 1977.

The heretofore unreported large numbers of Bar-tailed Godwits observed on Nelson Lagoon in 1976 and the absence of such concentrations from elsewhere in Alaska suggests that Nelson Lagoon is probably the major fall staging area for most of the Alaska breeding population and not Nunivak and areas farther north as Gabrielson and Lincoln (1959) suggest. Confirmation of this will require observations during subsequent seasons.

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