



U.S. Department of the Interior
Bureau of Land Management

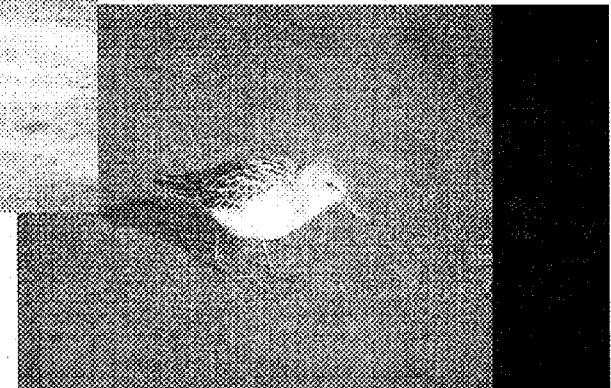
BLM-Alaska Open File Report 65
BLM/AK/ST-97/018+6700+040
March 1997



Alaska State Office
222 W. 7th Avenue, #13
Anchorage, AK 99513

Fall Migration of Shorebirds and Waterfowl at Carter Spit, Alaska

B.E. Seppi



Fall Migration of Shorebirds and Waterfowl at Carter Spit, Alaska

**A final report of the 1994 and 1995 bird migration, monitoring and inventory effort by
the Anchorage District Bureau of Land Management**

B.E. Seppi

Bureau of Land Management
Alaska State Office
Anchorage, AK 99513

Open File Report 65
March 1997

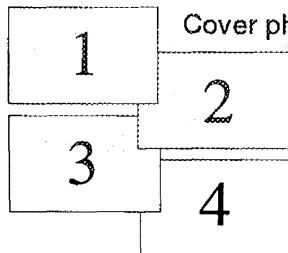
Author

B.E. Seppi is a wildlife biologist with the Anchorage District Office, Anchorage, Alaska.

Open File Reports

Open file reports identify the results of inventories or other investigations that are made available to the public outside the formal BLM-Alaska technical publication series. These reports can include preliminary or incomplete data and are not published and distributed in quantity. The reports are available at BLM offices in Alaska, the USDI Resources Library in Anchorage, various libraries of the University of Alaska, and other selected locations.

Copies are also available for inspection at the USDI Natural Resources Library in Washington, D.C. and at the BLM Service Center Library in Denver.



Cover photos by:

1. U.S. Fish & Wildlife Service
2. Bruce E. Seppi
3. Cornell Laboratory of Ornithology
4. Christopher Witt

Table of Contents

Introduction	1
Study Area	2
Methods	2
Ground Counts	2
Aerial Counts	5
Species Accounts	5
Results	6
Annotated Species Accounts	6
Waterfowl Brood Surveys	24
Discussion	25
Migrant Waterfowl	25
Migrant Shorebirds	27
Magnitude of Shorebird Migration	28
Conclusion	29
Acknowledgments	29
Literature Cited	35

Tables

Table 1. Number of broods and average brood size	24
Table 2. Species composition of adult ducks	25
Table 3. Numbers of other waterbirds	25
Table 4. Numbers and percent of species breeding and in migration in 5 habitats	26
Table 5. Total numbers of fall migrant waterfowl	27
Table 6. Total numbers of fall migrant shorebirds	28
Table 7. Estimated magnitude of shorebird migration in Carter Bay	28

Figures

Figure 1. Carter Spit study area location and names mentioned in the text	3
Figure 2. Numbers of hudsonian godwits seen in migration at Carter Spit	12
Figure 3. Number of species in each of their predominantly used habitats	25
Figure 4. Aerial and ground counts of waterfowl in coastal areas	26
Figure 5. Aerial and ground counts of shorebirds in coastal areas	27

Appendix

Appendix 1. Habitat use and seasonal occurrence of bird species at Carter Spit	31
--	----

FALL MIGRATION OF SHOREBIRDS AND WATERFOWL AT CARTER SPIT, ALASKA

Abstract

The Carter Spit area was surveyed for its importance to birds, particularly shorebirds and waterfowl, in fall migration in 1994 and 1995. I recorded 127 species of birds from 26 families during the study, including 26 waterfowl species and 31 shorebird species. Sixty eight species (54%) were confirmed breeders, 21 species (17%) were unconfirmed breeders. Overall bird use in each of the species predominantly used habitat was highest for intertidal. Inland ponds provided breeding habitat for the greatest number of species. Waterfowl brood surveys revealed a two year average production of 0.37 ducklings/km². Northern pintail, black scoter and greater scaup were the predominant brood species. The intertidal flats were used by 75% of the species in migration. Western sandpiper, *Calidris mauri* were the most abundant shorebird, northern pintail, *Anus acuta* the most numerous of waterfowl. In totaled counts, over 41,000 ducks and geese and over 80,000 shorebirds staged at Carter Spit each season. Using various known turnover rates, at least 30,000 shorebirds, mainly western sandpipers, stage on the intertidal flats of the study area. Densities of shorebirds in Carter Bay were as high as 149 shorebirds/km². Numbers of migrant birds recorded in this study suggest the area is of regional importance to migrating shorebirds and waterfowl.

INTRODUCTION

In Alaska, the eastern Bering sea region contains vast expanses of intertidal and inland vegetated intertidal areas. Many species of shorebirds depend on these littoral and supralittoral habitats for breeding and migration. Coastal areas are especially important after breeding, when populations depend on littoral habitats while undergoing molt and premigratory fat deposition (Gill and Handel 1981). The millions of birds of many species that stage and migrate in these coastal areas are vulnerable to littoral zone disturbances, particularly oil spills.

Within the eastern Bering sea region, the Yukon-Kuskokwim Delta (Y-K Delta), with littoral areas rich in benthic organisms and adjacent inland nesting areas, is used by more species, in greater numbers, and in higher densities than any other littoral area in the region (Gill and Handel 1981). An estimated 1-2 million shorebirds use the central delta for nesting and post-breeding staging, with densities in fall migration as high as 1800 shorebirds/km² (Gill and Handel 1990). The Y-K Delta supports large portions of the Pacific Rim or world populations of at least six shorebird species (Gill and Handel 1990), and includes species wintering in Asia, Australasia and Oceania, as well as the contiguous United States, Central America and South America (Gill et al. 1994).

South of the central Y-K Delta, a complex of spits and tidal mudflats exists at Carter

Spit, an area on the southern end of Kuskokwim Bay. Although the central delta and the greater Y-K Delta comprise a far greater area and support a far greater number of birds, Carter Spit is a significant migratory staging area for shorebirds and waterfowl, particularly in fall migration. The area represents the southern most extension of tidal mudflats associated with the Y-K Delta.

The area also includes a substantial number of inland tundra ponds that provide nesting and brood rearing habitat for waterfowl, and many species use the sea coast to molt, including the Stellar's Eider. This species is of particular management interest because of steady population declines over the past several decades and its subsequent listing as a category 1 candidate designation under the Endangered Species Act. The area also represents a significant post fledging staging spot for waterfowl.

Land ownership of the area is a mosaic of Federal, State of Alaska, Native Corporate and Native Allotment lands. The entire area is surrounded by the Togiak National Wildlife Refuge, and includes approximately 168 km² of BLM lands. Despite its varied land status, Carter Spit includes some of the most significant shorebird and waterfowl staging habitat within the Bureau of Land Management (BLM), Anchorage District.

The objective of this project was to inventory coastal areas during fall migration

and to evaluate the importance of coastal spits, bays and tidal mudflats to shorebirds and waterfowl. Inland areas were also inventoried for all species of birds. This information will be important to managers when making future land use decisions for the area.

STUDY AREA

The area (59° 20'N, 162° 00'W) lies 135 km south of Bethel (Figure 1). It encompassed about 400 km² and was within a line bounded by the north spit of Goodnews Bay, Jacksmith Bay, the coastal Ahklun Mountains and the Kuskokwim Bay coastline. The nearest villages are Goodnews Bay, 25 km to the southeast and Platinum, 25 km south. Carter Creek, Indian River, Cripple Creek and Jacksmith Creek flow from origins in the mountains. The deltas of these rivers form 4 coastal spits along 40 km of coastline which in combination with large expanses of tidal mudflats create exceptional habitat for migrating shorebirds and waterfowl.

The area experiences a transitional climate with a maritime influence. Fog and low cloud cover are common, often pushing inland to the mountains causing limited visibility even when areas away from the mountains farther north are clear. Storms with high winds and rain are common in summer months. Summer temperatures range from 38°F to 57°F, in winter between 7°F and 29°F with average annual precipitation of 100 cm, including 190 cm of snow (Selkregg 1976). Average break-up and freeze-up is 1 May and 19 November respectively, although ice may begin forming in October on inshore ponds (Selkregg 1976). In some seasons, pack ice extends several kilometers south of the study area (Brower et al. 1988).

The area geology is a mix of glacial moraine and drift on the coastal plain, glaciofluvial and alluvial deposits along the rivers and older deposits of interlayered alluvial and marine sediments on the coastal deltas and spits. Soils are shallow, gravelly and well drained, with a dark, acid surface layer and deep or intermittent permafrost (Selkregg 1976). Sand and coarse gravel covers the spits and coastal areas above high tide. Intertidal zones are covered in thick tidal mud and large tide differentials create vast areas of exposed mud. Tidal sloughs filled with thick tidal mud meander far inland and dominate the coastline, especially near the river deltas and within the shallow bays created by the spits.

Upland vegetation was characteristic of moist tundra inshore and wet tundra immediately along the coast. Riparian thickets of willow (*Salix spp.*) up to 4 m lined the rivers. Limited stands of balsam poplar (*Populus balsamifera*) existed on upper Jacksmith Creek. Thickets of alder (*Alnus crispa*) and willow were found in the valleys and draws on the coastal slopes of the mountains. At higher elevations, *dryas spp.* dominated heath covered windswept ridges among rocky limestone outcroppings with patches of gravel and bare soil. Spits and beaches were bare gravel or sparsely vegetated with beach pea (*Lathyrus maritimus*), beach fleabane (*Senecio pseudo-Arnica*), and lyme grass (*Elymus arenarius*) in dense meadows within the vegetated intertidal zone. In the vegetated intertidal of Carter Bay, a lush green growth of lyme grass and sedge (*Carex spp.*) covers the mud and tolerated inundation during the highest tides. Resident geese graze the sedge to create short lawns interspersed with taller lyme grass meadows. Thick belts of bluejoint grass (*Calamagrostis canadensis*) grew on disturbed ridges of the east side of Carter Bay. Plant nomenclature follows Hulten (1968).

METHODS

Although large numbers of shorebirds were encountered, only a few species congregated in tight flocks and could be easily counted. Most birds were widely distributed over intertidal zones at low tide or hidden in the coastal vegetation fringe at high tide. Because of this and the difficulties in moving around the study area due to tide fluctuations and weather, I was unable to use a single comprehensive method to estimate the total number of shorebirds and waterfowl stopping at Carter Spit each year. The methods I describe here were used to calculate estimates of the total numbers of shorebirds moving through the Carter Spit area each year using known turnover rates from the literature. Both aerial and ground counts were conducted to count shorebirds and waterfowl, but each were treated as separate estimates at a given point in time. Aerial surveys were not directly compared to ground counts because I could not complete ground counts over the entire coastline in one day due to logistic difficulties.

Ground Counts

Working from a field camp with 4 persons,

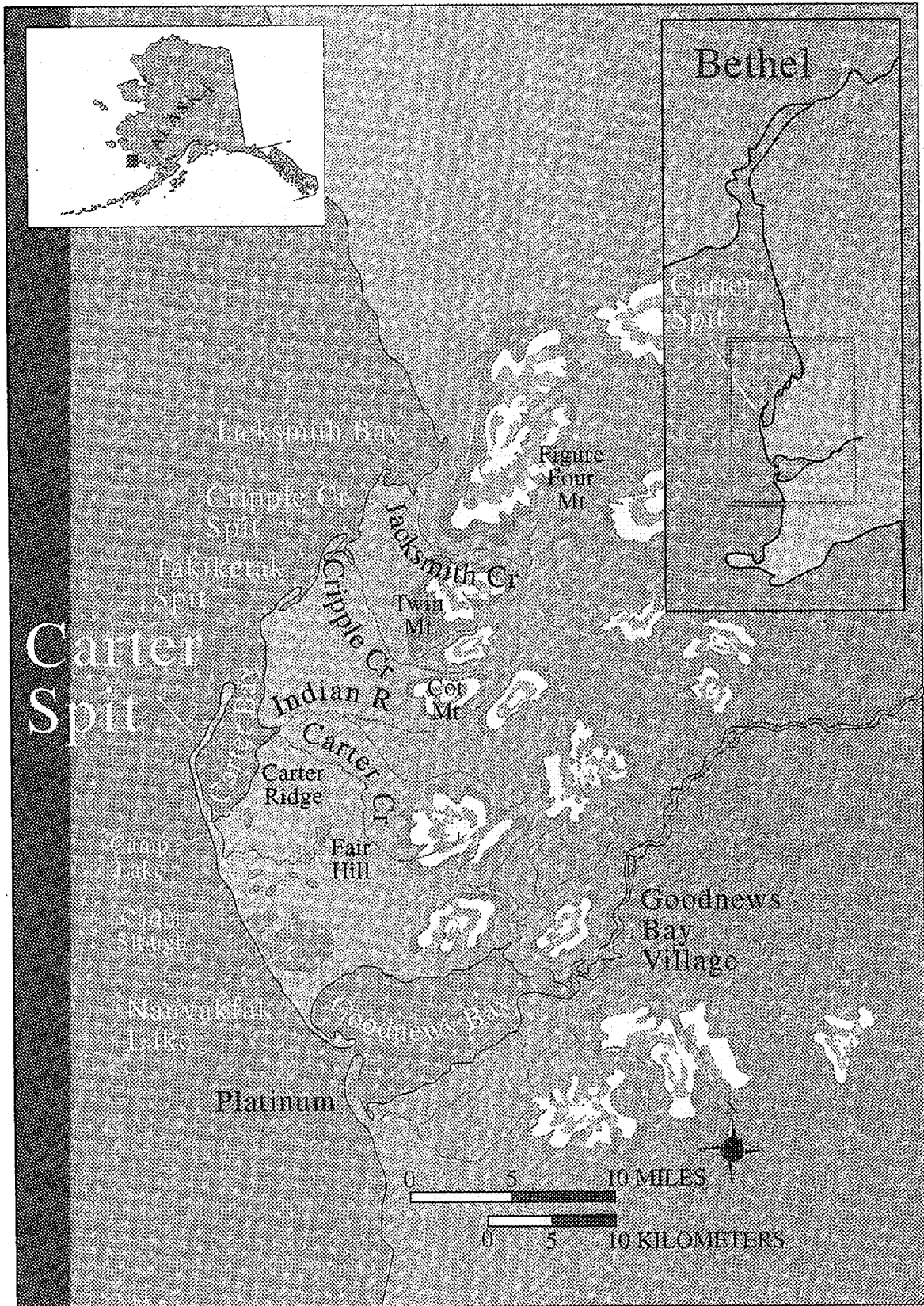


Figure 1. Carter Spit study area location and names mentioned in the text.

we were present on the study area from 2 July to 12 August in 1994 and from 11 July to 25 August in 1995. Intertidal areas included a network of tidal sloughs that prevented walking the coastline, so I used an inflatable boat and motor to access the spits and bays. Travel to the upper coastline from camp was possible by boat only at high tide using Carter Slough. In 1994, surveys involved repeated visits to observation points along Carter Spit and the coastline. Surveys were conducted in the morning, afternoon and evening depending on favorable tides and weather. Daily surveys alternated between Carter Bay, the coastline south of Carter Spit, the 3 spits north of Carter Bay, and coastal tundra. Observers walked the shoreline of spits and bays and scanned exposed mud with binoculars and spotting scopes. Location, number, age, sex, and plumage of all bird sightings were recorded when possible.

In 1995, efforts were more concentrated within Carter Bay and the Indian River Delta.

In addition to general ground counts, daily counts were done from 3 points around Carter Bay. Simultaneous counts from Carter Ridge, Indian River Delta and Carter Spit were done for 3 hours beginning at high tide. In August 1995, coastal migration counts were done from an observation point on Carter Spit, and included birds within Carter Bay, as well as birds at sea and those passing in migration. Data for migration counts were recorded 8 to 10 hours every 2 to 3 days.

We also surveyed inland areas along the Indian River by boat, using incoming tides to get up the rivers, then continuing on foot along riparian zones. Inland surveys were also done from camp by recording birds as migrant flocks passed.

Aerial Counts

A Cessna 185 floatplane was used for aerial surveys of coastal areas on 22 July and 1 August in 1994. No fixed-wing flight were done in 1995 because of low water at the Camp Lake landing site. Surveys were flown with one observer in front and 2 in back seats, recording numbers and species of birds seen on either side of the plane from 75 m altitude. Flights traveled north along the coast, staying just offshore of the eastern side of Carter Bay. Turning south at Jacksmith Bay, the return flight traveled the same path and included the shoreline of Carter Spit. Numbers of

shorebirds and waterfowl were recorded and identified to species when possible. A Bell 206B helicopter provided access to inland ponds and alpine areas on 6 and 7 August, 1994 and 24 and 25 July in 1995. Wetlands were surveyed for waterfowl broods by helicopter and included all those between the coast and the mountains from Nanvakfak Lake to Jacksmith Bay. The perimeter of ponds and groups of small wetlands within the study area were flown at 20 m altitude, with several passes on larger lakes. Species, number and age class of duck broods (Gollup and Marshall 1954) and other waterfowl and loons were recorded. Groups of 2 observers were flown to inland valleys and ridges, then walked the slopes and upper reaches of the 4 rivers and recorded numbers and species of all birds seen.

Species Accounts

The following terms are used to describe the relative abundance and seasonal occurrence of each species and are modifications from Petersen et al. (1991) and Kessel and Gibson (1978).

Relative Abundance

abundant- (A) Species occurred repeatedly in expected habitats, with available habitat heavily utilized, and/or the region regularly supported large numbers of the species.

common- (C) Species occurred in all or nearly all expected habitats, but some areas of suitable habitat were occupied sparsely or not at all and/or the region supported large numbers of the species.

fairly common- (FC) Species occurred in only some of the expected habitats, and large areas of suitable habitat were occupied sparsely or not at all and/or the region supported substantial numbers of the species.

uncommon- (U) Species occurred regularly, but uses little of the suitable habitat and/or the region supports relatively small numbers of the species. It is not observed regularly, even in expected habitats.

rare- (R) Species is within its normal range, occurred regularly but in very small numbers.

casual- (CA) Species observed beyond its normal range, but not so far that regular

observations are unlikely; usually occurred in small numbers.

accidental- (AC) Species observed so far from its normal range that observations are unlikely; usually occurred singly.

Seasonal Occurrence

resident- (r) A species known to be present in the area throughout the year.

migrant- (m) A seasonal transient between wintering and breeding grounds.

breeder- (b) A species known to breed in the area; described as possible or probable (b?) if concrete evidence is not available.

visitant- (v) A non-breeding species: may not be directly en route between breeding and winter ranges.

RESULTS

Annotated Species Accounts

We recorded sightings of 127 species of birds on the study area from 26 families in 1994 and 1995 (appendix 1). Birds were photographed when possible, none were collected. All observations were by trained and experienced observers and only birds positively identified were recorded. Taxonomic order and scientific names of birds follow American Ornithologists' Union (1983).

Gaviidae

Common Loon- *Gavia immer* U, b?

One pair of adult birds were seen on inshore ponds in 1994 during waterfowl brood surveys in August. Single birds were heard calling near camp and on Carter Bay in July and August of both years. Only 8 adult birds were recorded in the 2 year study. Common loons probably bred on inshore ponds although no chicks were seen.

Pacific Loon- *Gavia pacifica* C, b

Pacific loons were common on the study area as pairs and small groups of adult birds were seen on many inland ponds. Adult birds were commonly seen flying at the coastline and over coastal ponds, often flying to and from the ocean with food, apparently to feed young on inland ponds. Several pairs with 1 or 2 chicks were seen on coastal and inland ponds each year. Adults were seen with young in late August. Most adult birds were in breeding plumage, with the exception of one in basic plumage seen in mid July on camp lake in 1994. During waterfowl brood surveys, pacific loons were common, usually in pairs evenly distributed among small ponds. During helicopter surveys, 41 adults were counted on ponds from Carter Bay to Jacksmith Bay in 1994 and 28 in 1995.

Red-throated Loon- *Gavia stellata* C, b

Red-throated loons were common on coastal ponds and were breeding on the study area in both years. Adults were often seen flying inland from the ocean and over inland ponds. In 1995 1 adult was found attending a nest with 2 eggs on coastal ponds, and later in July and August 4 different broods (single chicks) were found on coastal ponds. Chicks were near fledging size in late August. Adults were noted in small groups on the ocean, on Carter Bay and on inland ponds during helicopter surveys.

Podicipedidae

Horned Grebe- *Podiceps auritus* U, m

Only 3 adult horned grebes were seen on the study area in 1994 and 2 in 1995. These birds were alone on coastal ponds or on Carter Bay. All birds were seen in mid July, one in basic plumage, all others in breeding plumage. There was no evidence of them breeding at Carter Spit.

Red-necked Grebe- *Podiceps grisegena* FC, b

Red-necked grebes were seen throughout the coastal areas and on coastal ponds. Five separate single chick broods were noted on coastal ponds in July of 1995. Grebes also used coastal waters and bays, and were regularly seen in pairs or alone on inland ponds during helicopter surveys.

Procellariidae

Short-tailed Shearwater- Puffinus tenuirostris R, m

Short-tailed shearwaters breed off southern Australia and spend the austral winter in the North Pacific off the coasts of south, western and northern Alaska. Shearwaters are abundant in nearby offshore water in summer (Bartonek and Gibson 1972). The only shearwaters at Carter Spit were dead, found washed up and dried out on the beach. Three adult birds were found in 1994 and 3 in 1995. All carcasses were intact and lying with drift along the high tide line, except for one with its head missing. The skull was removed and collected from one individual, and in doing so, the cause of death was apparently determined to be a small piece of red plastic lodged in its throat. Petersen et al. (1991) reports seeing these birds near Round and Hagemeister Islands near Togiak Bay, and cites similar finds of dead birds on the beaches of Crooked Island (Arneson 1977).

Phalacrocoracidae

Double-crested Cormorant- Phalacrocorax auritus U, m

Eight adult birds were seen flying in coastal areas or on Carter Bay in 1994 from ground and aerial surveys. Petersen et al. (1991) reports double-crested cormorants breeding on the south of Shiak Island and Bird Rock near Cape Newenham. No birds were found breeding at Carter Spit.

Pelagic Cormorant- Phalacrocorax pelagicus U, b

Pelagic cormorants were seen regularly flying near the coast and offshore, but never in very large numbers. Eighteen to 20 birds were recorded each year. Since cormorants require cliffs for nest building and breeding and there are no coastal cliffs on the study area, there were no breeding birds seen. Pelagic cormorants do however breed in nearby areas. A breeding colony of 350 birds was found on the coastal cliffs of Beluga Hill on the north shore of Goodnews Bay while enroute to Goodnews Village by helicopter. Cliffs with nesting colonies are also known at Cape Pierce, Shiak Island, Hagemeister Island and Walrus Island south of Cape Newenham (Petersen et al. 1991).

Gruidae

Sandhill Crane- Grus canadensis C, b

Cranes were common and seen daily either flying in pairs or small groups, walking across inland tundra or on intertidal mudflats, or could be heard in dueting calls. Four broods of 1 or 2 chicks were seen in 1994 and 1 in 1995. Birds were difficult to get close to and often flushed within a mile of our approach. Many adult birds were counted during inland helicopter surveys.

Anatidae

Tundra Swan- Cygnus columbianus C, b

Swans were seen with cygnets on the inland ponds within the coastal plain of the study area and flying along the coast. Pairs with 1 to 4 young and groups of 5 to 10 adults were common on many coastal ponds near camp and on inland ponds along the 4 creeks. In late July and August, many adult birds seemed flightless and in molt or unwilling to fly when approached. Molted swan feathers could be found on the shores of some larger ponds used by groups of apparently non breeding birds. During helicopter surveys of inland ponds, swans were found almost evenly distributed throughout the coastal plain on wetlands of more than a few acres in size and on close groups of smaller ponds.

Greater White-fronted Goose- Anser albifrons C, b

In 1994, a group of 350+ flightless adult birds and families with young formed a colony of white-fronts on a large shallow complex of wetlands south of camp. The colony spent most of July in that general area, so the largest pond was named goose lake. Groups of several hundred birds roosted in the evenings on camp lake later in the season. Flocks of 50 to 100 birds, mixed with Canada geese, could be seen on the ponds along the inland sloughs, above the high tide line in Carter Bay and on the mud flats in both years. Later in August geese were seen throughout the day moving all around Carter Bay and the coastal areas, feeding and roosting on the sedge meadows and moving short distances within the area. Flocks of 20 to 30 birds were noted flying south in high "V" formation in the third week of August, apparently in migration.

Snow Goose- Chen caerulescens CA, m

Only 1 adult snow goose was seen on July 2, 1994 on camp lake, mixed with 4 Canada geese.

Emperor Goose- Chen canagica FC, m

Only a few sightings of a single adult emperor goose were noted on camp lake and on the mud of Carter Bay in 1994, probably the same individual. In 1995, we surveyed 2 weeks later in the season, and found many more flocks of adult and juvenile birds feeding on the tidal mud and roosting on the sedge meadows adjacent to inland sloughs. We saw a total of 185 birds between 14 July and 25 August in small flocks of up to 25. Birds seemed to separate into individual family groups while near sloughs or on the mudflats. Daily counts continued to increase in August, suggesting many more birds and much larger flocks would arrive after we left the area. In late August, about 60% of the birds present were juveniles.

Canada Goose- Branta canadensis C, b

Two subspecies of Canada geese occurred in the Carter Spit area. The smaller birds, probably *B. c. minima*, and larger birds, probably *B. c. taverneri*, were seen in small groups and sometimes in mixed flocks. In both years, more birds arrived later in the season and numbers continued to increase when we pulled camp. Throughout July, 150 to 200 birds could be found in several small flocks moving from the bay to inland areas. A flock of about 100 flightless adults, mixed with greater white-fronted geese and northern pintail, were seen regularly on goose lake in 1995. The numbers of birds continued to increase in August, with as many as 800+ on Carter Bay and an additional 250 roosting on inland ponds. Many flocks of about 250 birds were seen flying during local movements from feeding to roosting areas. In late August, high flocks flying south in formation were seen throughout the day. Between 13 and 25 August, 6000 birds in flocks of about 200 overflew the area heading south. More than half of the Canada geese seen were cackler's, but counts included some mixed flocks.

Brant- Branta bernicula U, m

In August of both years, small flocks of up to 20 adult brant were on vegetated intertidal and mudflat areas with Canada geese, or flying off shore. We saw a total of 45 birds in 1994 and 140 in 1995.

Mallard- Anas platyrhynchos U, b

Relatively few mallards were seen on the area, yet one brood with 2 chicks was found on a small branch of the Indian River on 27 July, 1994. Most sightings were of 1 or 2 individuals, but as the season progressed, flocks of up to 40 birds were noticed on the mudflats of Carter Bay. Many males were in eclipse plumage. A flightless female mallard was recorded on camp lake on 21 July, 1995. Total counts of 37 mallards were noted in 1994, and 90 in 1995.

Gadwall- Anas strepera U, b?

Gadwall were seen regularly in both years, although not in great numbers. They probably breed in the area, but no broods were seen. They were usually seen in flocks of several birds on coastal sloughs and ponds, or mixed with flocks of northern pintail. About 60 birds were counted each year.

Green-winged Teal- Anas crecca C, b

Teal were common in the area. Birds raised broods on inshore and coastal ponds and large numbers of migrant birds staged on the mudflats and vegetated intertidal. Two broods were noted on the inland sloughs used to access camp, and adult birds were common throughout the coastal sloughs and ponds. Many adults on the sloughs were flightless in July, but capable of flight later in August. By mid August, migrant adults began accumulating along coastal sloughs and on the mudflats, with numbers continually rising later in August. At least 2000 birds were recorded feeding and roosting on Carter Bay at low tide from helicopter surveys on 6 August in 1994. By 17 August in 1995, 1000+ birds could be flushed from Carter Slough as we boated out into Carter Bay each day. Many hundred additional birds were seen on nearby ponds. Numbers of green-winged teal were high and increasing in August of both years.

American Wigeon- Anas americana U, b?

Wigeon were relatively uncommon at Carter Spit, but numbers of migrants greatly increased in late August in 1995. No broods or breeding birds were found, but birds may breed on inland ponds. In late August, flocks of up to 270 birds were counted on coastal ponds.

Eurasian Wigeon- Anas penelope AC, v

One male Eurasian wigeon in eclipse plumage was seen on 18 August 1995 on coastal ponds south of Carter Spit with a flock of 130 American wigeon.

Northern Pintail- Anas acuta C, b

Northern pintail were the most common species of waterfowl on the study area, breeding on inshore ponds and migrating in large numbers along the coast and staging in Carter Bay. Flocks of 50 to 100 adult birds were seen daily in July, but numbers steadily increased until many thousands were present in large flocks in Carter Bay by the second week of August. From aerial surveys on 6 August of 1994, 1500+ birds were noted of the exposed mud of Carter Bay. A mixed flock of ducks (probably green-winged teal and pintail) viewed at great distance on 22 August 1995 numbered 2750 birds. During ground counts from Carter Ridge from 15-24 August, 1995, counts ranged from 300 to 1400 birds dispersed across the mud from Carter Bay to the Indian River Delta. An additional 800 to 1000 birds were recorded at the same time on Camp Lake, Goose Lake and Tern Lake. In late July and August, 500 to 1200 molting flightless adults were regularly seen scattered throughout the inland ponds. A single flock of 900 birds, mostly flightless and molting, was recorded on 19 July near Camp Lake. Total counts of 5321 in 1994 and 16,679 in 1995 were recorded for pintails. Waterfowl brood surveys in late July (95) and early August (94) on inshore ponds revealed northern pintail broods in IIa-IIc age classes.

Northern Shoveler- Anas clypeata FC, b?

Few shovelers were seen early in July, but numbers dramatically increased in late August as migrating flocks stopped to feed on Carter Bay. The birds probably breed on inshore ponds, although no broods were seen. A flock of 620 adults was the largest seen on 22 August 1995, mixed with northern pintail and green-winged teal. Small groups of 5-10 birds were common in the shallow water and mud margins of Camp Lake in August. A total of only 96 shovelers was noted in 1994, with 3498 birds in 1995.

Canvasback- Aythya valisineria R, m

Canvasback were rare on the study area. Only 14 total birds were seen in 1995. Eight males and 1 female were recorded on inland ponds on 13 July, and 3 males and 2 females flying inland on 19 July. All birds were assumed to non-breeding individuals.

Greater Scaup- Aythya marila C, b

Greater scaup were common on the area, breeding on inland ponds and feeding in rafts in Carter Bay and offshore. Scaup were the most common diving duck brood recorded in aerial brood surveys. Flightless molting birds in rafts of about 100-350 birds mixed with eiders were seen regularly at high tide and the deeper areas of Carter Bay. Rafts of 100 flightless birds were seen on some of the larger inland ponds in late July. More than 2500 scaup were recorded in 1994 and 591 in 1995 in total counts.

Common Eider- Somateria mollissima U, m

Common eiders were seen occasionally in groups of 1-3 birds in mixed flocks of scaup and other eiders. The birds stop at Carter Spit in spring migration as aerial waterfowl surveys by USFWS recorded 376 adult birds in April 1993 and 393 in April 1994 (Larned 1995). We only noted 7 birds in 1994 and 10 in 1995. Common eiders probably prefer deeper nearshore waters and nearshore islands. The mudflats of the Carter Bay area are apparently not attractive to nesting or non-breeding birds. Common eiders are known to nest and raise broods in Nanvak and Chagvan Bays to the south (Petersen et al. 1991).

King Eider- Somateria spectabilis FC, m

King eiders were seen only along the coast. Small flocks of up to several hundred birds were noted on Carter Bay throughout the summer, with numbers increasing later in the season. Birds were mostly non-breeders, with some fledged immatures in August. Several hundred birds could be seen moving south offshore in small groups in late August. The largest group counted in Carter Bay was 520 on 19 August 1995. We recorded total counts of 864 in 1994 and 5970 in 1995. The area may be more important to the spring migration of king eiders, when very large flocks are known to migrate along the coast, on their way to more northern breeding areas. Petersen et al. (1991) reported more than 62,000 birds per hour for 2 hours passing Cape Pierce on 2 May, 1973. More recently, USFWS spring surveys in April 1993 reported 21,867 king eiders from Carter to Jacksmith Bays, of which 21,687 were seen in Carter Bay or just offshore of Carter Spit, and 10,967 recorded in 1994 (Larned 1995).

Stellar's Eider- Polysticta stelleri U, m

Stellar's eiders were uncommon and found only on the coast in mixed flocks with greater scaup. No great numbers of birds were found. Birds were usually in groups of 3-20, in rafts on Carter Bay or flying offshore. Spring aerial surveys by USFWS reported 1,510 Stellar's eiders from Carter Bay to Jacksmith Bay in April 1993 and 5,374 in April 1994 (Larned 1995). We recorded 84 birds in 1994 and 105 in 1995.

Black Scoter- Melanitta nigra C, b

Individuals and flocks of 2 to 300+ birds were counted in coastal areas, offshore and on coastal ponds mixed with king eiders and scaup. The larger flocks were commonly on the deeper parts of Carter Bay. Black scoter broods were seen in both years on inland ponds, particularly in 1995 when aerial brood surveys were done in late July. In total counts 795 were noted in 1994 and 1,626 in 1995.

White-winged Scoter- Melanitta fusca FC, m

White-winged scoter are known to breed on inshore ponds of the area and pass through in molt migrations along the coast (Petersen et al. 1991). We did not see any evidence of breeding birds. We saw small groups moving south along the coastline in July and small groups of 40-50 birds mixed with king eider on Carter Bay. The largest flock seen was 140 adults flying over Carter Bay on 12 July, 1994.

Surf Scoter- Melanitta perspicillata U, m

Surf scoter were seen in Carter Bay or offshore, in small groups of 1-5 or in flocks of up to 30 adults. Birds were often found mixed with scoters and eiders. Only 56 birds were seen in 1994 and 72 in 1995. There was no evidence of surf scoters breeding in the Carter Spit area.

Harlequin Duck- Histrionicus histrionicus R, b?

Harlequins are known to breed in the area on swift streams and molt along the coastal areas, but few birds were seen and no broods found. The birds are most common on rocky coastal areas, so the mudflats of the spits are apparently an unattractive habitat for them. Two females were seen on the upper fork of the Indian River on 27 July, 1994, so it is possible harlequins breed on this river. All other sightings were in coastal areas. Only 6 birds were seen in 1994, and 2 in 1995.

Oldsquaw- Clangula hyemalis U, m

Oldsquaw nest in the Ahklun Mountain region, but no breeding birds were found at Carter Spit. Birds seen were thought to be non-breeders in migration using inshore ponds and coastal waters. Most sightings were of small groups of 1-4 birds on inland ponds. Only 21 adults were counted in 1994 and 8 in 1995.

Bufflehead- Bucephala albeola U, m

Bufflehead are known to breed in the Ahklun Mountains region (Petersen et al., 1991), but we saw no evidence of birds breeding in the Carter Spit area. Few birds were seen, all were on Camp Lake

or nearby inland ponds, and were probably birds in migration. We saw only 13 bufflehead in 1994 and 12 in 1995.

Common Merganser- Mergus merganser R, b?

Only one female common merganser was seen at the mouth of the Indian River on 17 July 1995. It was a flightless individual in molt, and may have been raising a brood on the river, but no young were seen.

Red-breasted Merganser- Mergus serrator FC, b

Red-breasted mergansers were seen in inland areas, along the coast in Carter Bay and flying offshore. Hens with broods were found on the Indian River and on brackish coastal ponds. In total counts, 189 adult birds were seen in 1994 and 108 in 1995. Flocks of up to 50 birds of both sexes were counted inland and on coastal waters.

Charadriidae

Semipalmated Plover- Charadrius semipalmatus C, b

Semipalmated plovers were common on the beaches and along gravel spits. Adults were seen regularly in the sparse vegetation of the upper beach, often with downy young or feigning to distract our attention from their brood. Later in August, adults and fledged juveniles in flocks of up to 10 individuals were observed on the coastal flats and on mud margins of inland ponds. We recorded 90 adults in 1994 and 171 in 1995.

Black-bellied Plover- Pluvialis squatarola C, m

Black-bellied plovers were seen on the tundra individually and later in migration in large flocks of up to 320 birds flying high and fast to the south. At low tide groups of 100 to 200 birds roosted and fed on the mudflats with western sandpipers and other peeps. During migration watches from camp and from the spit, flocks of 50 to 100 black-bellied plovers passed in "V" formation at regular intervals in the morning and evening heading south, apparently in migration. Totals of 3,140 birds were counted in 1994 and 1,930 in 1995. Many flocks probably passed unnoticed.

American and Pacific Golden Plover- Pluvialis dominica & P. fulva FC, b?

Individuals, pairs and small groups of these birds were seen throughout the season, although dominica and fulva were hard to distinguish. In early August, small migrating flocks of about 25 birds flew past the area, flying high and fast to the south. Golden plovers were seen on the tundra, on inland lakes and sometimes on the edges of mudflats. No young birds were found, but they possibly breed on the tundra near the upper Indian River. Molting adults and juvenile birds of both species were recorded. The majority of the golden plover identified to species were P. fulva. Only one juvenile P. dominica was positively identified. We counted 809 total birds in 1994 and 157 in 1995.

Scolopacidae

Bar-tailed Godwit- Limosa lapponica FC, m

Bar-tailed godwit were regularly seen flying in the area, feeding on the mudflats or roosting on inland ponds. In the 1995 season, we found a roosting site of bar-tailed and hudsonian godwits at an inland pond near Camp Lake. The area was named godwit lake. Although godwits were seen in small flocks throughout the area, as many as 100+ bar-tailed godwit could be found at the roost site mixed with hudsonian godwits, particularly later in August. The largest single flock of bar-tailed was 171 birds at the roost site on 4 August, and 210 birds roosting on Camp Lake, and 40 more eating berries on the surrounding tundra on 19 August 1995. The majority of the birds observed were juveniles, especially later in the season. Total counts for bar-tailed godwits were 153 in 1994 and 1101 in 1995. Larger flocks and greater numbers of birds appeared later in the season. We probably would have recorded a far greater number of birds using the area if we had been present later in September and October. Petersen et al. (1991) reported over 2200 bar-tailed godwits in Carter and Jacksmith Bays in October 1979. Birds are apparently staging on the area before impressive trans-oceanic migrations to New Zealand and surrounding islands (Marchant et al. 1986).

Hudsonian Godwit- *Limosa haemastica* FC, m

Hudsonian godwits were seen feeding on the mud flats, flying individually or in small flocks, or at godwit lake in roosting flocks of up to 275 birds. An additional 138 birds were feeding at the same time on Camp Lake on 20 July 1995. Adults were in breeding plumage, with some adults in general body molt as well as birds with juvenile plumages. In early July, flocks were mostly adult birds, but by the first days of August, numbers of adults declined and juveniles dramatically increased. Adults apparently leave the area first, while juveniles move through later and stay later. The number of birds present of all ages seemed to peak in mid July (Figure 2), although hudsonian godwits were present on the study area for the entire time we were present. Total numbers counted were 1,204 in 1994 and 3,992 in 1995. Hudsonian godwits have been noted in the northern, western and south coastal areas of the state (Williamson and Smith 1964), and more recently in nearby Nanvak Bay (Petersen et al. 1991) and the Y-K Delta (Kessel and Gibson 1978). Our sightings may be significant, as few reports of relatively large numbers of migrating hudsonian godwits have been reported for the state, with the exception of Cook Inlet (Williamson and Smith 1964, Kessel and Gibson 1978). These sightings of relatively large flocks (275+), and the total numbers of birds suggests the Carter Spit area is an important staging site for the species (Seppi 1995). Birds are likely from western Alaska, in migration to southern South America.

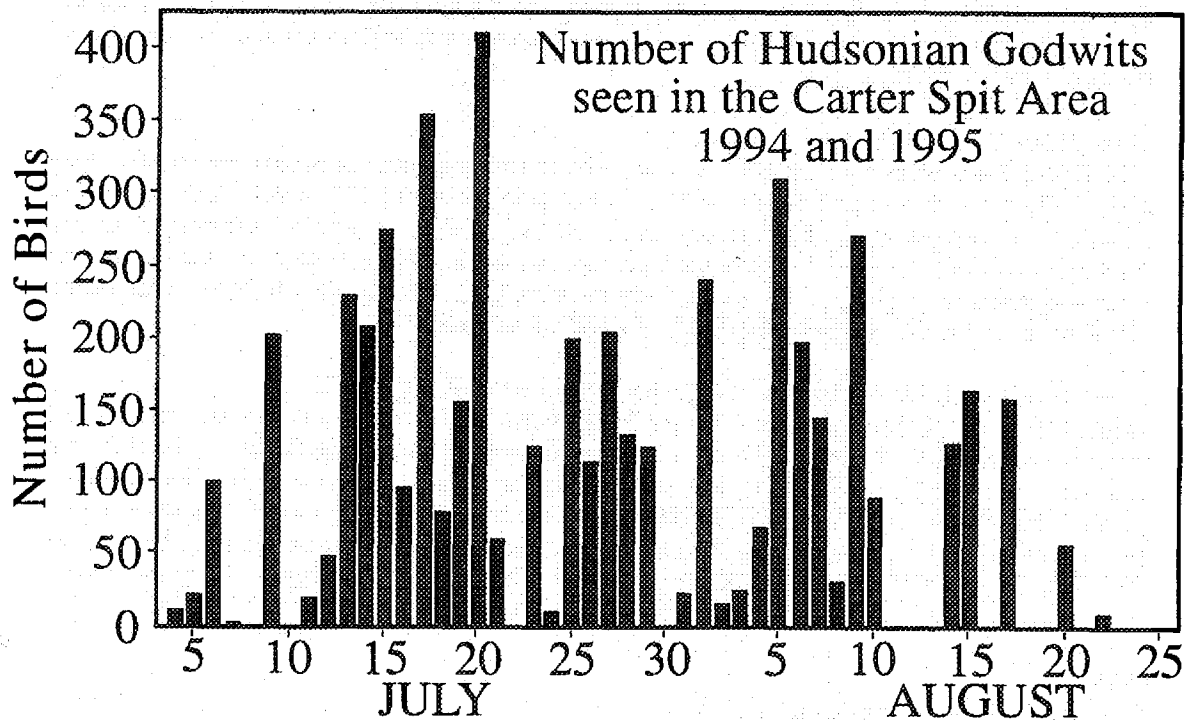


Figure 2. Numbers of hudsonian godwit seen in migration at Carter Spit in 1994 and 1995.

Bristle-thighed Curlew- *Numenius tahitiensis* U, m

Bristle-thighed Curlews were seen flying within the study area and feeding on the mudflats. Birds were most readily distinguished from whimbrel by their calls and their rusty orange upper tail coverts when visible. The birds were uncommon, only 20 total sightings recorded in 1994 and 65 in 1995.

Whimbrel- *Numenius phaeopus* FC, b?

Whimbrel were seen regularly on the mudflats and on open tundra areas, but we saw no evidence of breeding birds. Some birds with shorter bills were noted and assumed to be juveniles, but most birds recorded were adults. There was much local movement of whimbrel in small flocks. The largest

flock recorded was 140 birds, with the largest total daily count of 520. Some flocks were seen feeding on crow berries in the surrounding tundra. We recorded 535 birds in 1994 and 1,938 in 1995.

Greater Yellowlegs- Tringa melanoleuca C, m

Greater yellowlegs were regularly present, especially in August when flocks of over 100 birds, mixed with lesser yellowlegs, were noted on sloughs and ponds. Flocks continued to get larger as the season progressed, with 110 yellowlegs of both species and ages at Carter Slough on 21 August 1995. Over 150 were recorded at the same time dispersed over coastal ponds south Carter Spit. Counts included many juveniles birds and adults molting to basic plumage. Of the yellowlegs that could be identified to species, greateres were far more abundant than lesser yellowlegs (Tringa flavipes).

Lesser Yellowlegs- Tringa flavipes FC, m

As described above lesser yellowlegs were observed in flocks mixed with T. melanoleuca. Many of the birds recorded were juveniles. T. flavipes may breed in the area, but no evidence was found. Our field notes record only about 20 lesser yellowlegs each year, but numbers recorded are probably low due to the difficulty in distinguishing them from T. melanoleuca, which were more abundant.

Spotted Sandpiper- Actitis macularia U, b?

Only one adult spotted sandpiper was seen and heard calling on the upper Jacksmith River on 25 July, 1995. This species probably breeds in the area, but was not verified.

Wandering Tattler- Heteroscelus incanus U, m

During migration watches along Carter Spit, small flocks of tattlers were noted in migration along the coast. Birds were in flocks of 2-3, and constantly calling as they flew, which was used as a positive identification. Only 15 birds were recorded on 3 different days, two in late July and one in mid August 1995.

Red-necked Phalarope- Phalaropus lobatus A, b

Red-necked phalaropes were seen daily feeding on the mudflats and flying in unison with flocks of western sandpipers. They were fairly abundant in some places, including wet tundra and inland ponds. Birds were breeding on inshore ponds which became most apparent in late July when an influx of juvenile birds could be seen in flocks along the spits and mudflats. Molting flocks were common on the mud in mid July, and adults in complete basic plumage were noted by mid August. Flocks of over 400 birds used the vegetated intertidal of upper Carter Bay. We recorded total counts of 3,691 in 1994 and 1,354 in 1995.

Red Phalarope- Phalaropus fulicaria U, m

Only 15 red phalarope were recorded in 1994. Birds were in migration, usually mixed with western sandpipers. On 3 July, we saw one bird in basic plumage at Camp Lake. On 5 July, one bird in alternate plumage was feeding with western sandpipers in upper Carter Bay. On 6 July, 3 birds in breeding plumage were seen flying over Carter Spit, and on 8 July, 5 adults were seen flying south just offshore along Carter Spit.

Short-billed Dowitcher- Limnodromus griseus C, m

Short and long-billed dowitcher were found in mixed flocks and difficult to distinguish, but comparisons of both species seen together at close range and their calls, which are distinct, were used to separate the species. For those birds we were able to identify to species, about 60% were short-billed. Most birds counted were juveniles, especially later in the season, when large flocks were counted on Camp Lake and other inland ponds, on the vegetated intertidal, and some on exposed intertidal mud. The migration for both dowitcher species dramatically increased later in the season, and is reflected in the numbers of birds counted each year. In 1994, when we left the area on 12 August, only 754 total birds were tallied, but in 1995 we counted 11,705 through 24 August. Flocks of 400 to 500 birds were common on Camp Lake in 1995 in August. The largest flock counted was 800 birds. The majority of the flocks were juvenile short-billed dowitchers. Birds may have bred on inland

tundra, but was not confirmed. I believe the majority were migrants from other breeding areas to the north.

Long-billed Dowitcher- Limnodromus scolopaceus FC, m

Long-billed dowitchers were less common than short-bills, but found mainly in the same habitats of shallow water of inland ponds and wet spots in the vegetated intertidal. Most birds were juveniles. The largest flock of confirmed long-billed was 105 on Camp Lake on 10 August 1995.

Common Snipe- Gallinago gallinago C, b

Snipe could be heard winnowing near camp in both years throughout July and into August. As the presence of winnowing birds decreased by mid August, adults were seen inland, flushed as we walked through wet tundra. Snipe were noticed in wet inshore tundra giving distraction displays in August of both years, suggesting the presence of young. Total numbers of birds were hard to determine, but from field notes they were encountered on a daily basis, especially when birds were winnowing.

Ruddy Turnstone- Arenaria interpres FC, m

Ruddy turnstone were present in July and August and seen alone or in groups of 2-5. Birds used mostly gravel beaches, but were also found on inshore ponds margins and vegetated intertidal flats. Fewer than 100 birds were recorded each year.

Black Turnstone- Arenaria melanocephala FC, m

Blacks turnstone also use gravel beaches, pond margins and tidal flats in small groups. Larger flocks appeared in late July. A flock of 60, mostly juveniles and adults in winter plumage were recorded on 31 July, 1995. As many as 354 total birds were recorded in 1995. Black turnstone may have bred on coastal tundra, but birds at Carter Spit appeared to be migrants.

Rock Sandpiper- Calidris ptilocnemis FC, m

Petersen et al. (1991) reports breeding rock sandpipers at Goodnews Bay and several thousand in migration in April at Jacksmith Bay. We did not see any evidence of breeding or any large numbers of birds in the fall migration at Carter Spit, but they were regularly present with other peeps and may have nested on the wet inland tundra. We recorded 896 in 1994 and 151 in 1995, in coastal ponds and slough margins, gravel beaches and vegetated intertidal. Most adult birds were in molt to basic plumage, but the majority of flocks were juvenile birds.

Red Knot- Calidris canutus R, m

A total of only 12 red knots were sighted in 1995, in small groups of 1-3 birds in mid to late August on the exposed mudflats and pond margins. All birds seen were juveniles. The migration of red knots in fall is not large on the study area, but spring migrations of flocks of 10,000+ birds have been reported on the central Y-K Delta (Pers. Comm., Brian McCaffery, USFWS, Y-K Delta National Wildlife Refuge, Bethel).

Dunlin- Calidris alpina A, b

Dunlin were the second most common bird in the study, behind western sandpipers. They were present in large flocks on the mudflats and roosted on the spits at high tide. Large numbers of juveniles were mixed with adults and some pre-fledgling birds were seen on open tundra and inshore ponds. In August, roosting flocks of 1,350+ birds, mostly molting adults, were found on the gravel spits during high tide. Several thousand dunlin were common on the exposed mud of Carter Bay and the Indian River Delta. Numbers of birds increased later in the season, suggesting that the bulk of the migration may have occurred into September. Total counts of 7,710 in 1994 and 4,251 in 1995 were recorded. Petersen et al. (1991) reports over 8000 dunlin present at Carter Bay as late as 1 October 1979 from aerial surveys.

Sanderling- Calidris alba R, m

Sanderling are common migrants along the west coast of Alaska, but only a few birds were recorded. One adult in breeding plumage was seen on Carter Spit on 14 and 25 July 1995. Several individual juvenile birds used inland ponds in late August in 1995. A single juvenile bird on the mud margin of Camp Lake allowed close up observations in August 1995.

Semipalmated Sandpiper- Calidris pusilla U, m

Semipalmated sandpipers were seen in small numbers on inland ponds and vegetated intertidal zones. Most birds were adults, but numbers of juveniles increased later in the season. Most sightings were of flocks of 2-5 birds, with a flock of 40 on 5 and 10 July 1994. A total of 134 birds were recorded in 1994 and 20 in 1995.

Western Sandpiper- Calidris mauri A, b

Western sandpipers were by far the most abundant bird on the study area. Almost 60,000 were counted in 1994 and 53,000 in 1995. Birds were found breeding on inland tundra, and staging and migrating on nearby intertidal areas. Flocks were evenly dispersed over large expanses of exposed mud at low tide, and roosted on the spits and especially in the margin of vegetation at the high tide line. In both years, when we arrived in early July, adults outnumbered juveniles in all the counts we were able to get close enough to age birds. That quickly changed, and by mid July, it was hard to find an adult western sandpiper, all the birds were juveniles. The adults had apparently left on their southern migration, leaving juveniles to feed on the mudflats to mature and gain migration reserves. Using ground counts from 3 points around Carter Bay, numbers of peeps, mainly western sandpipers, varied between 1000 and 4000 birds at low tide. The peak ground count in 1994 was 4287 birds on 25 July. In an aerial count by float plane on 22 July, 1994, we recorded 13,423 peeps, largely western sandpipers, from Carter to Jacksmith Bay. In float plane surveys of the coast on 1 and 6 August 1994, we counted about 8,000 and 11,000 birds. Numbers of peeps in Carter Bay varied between 1,000 and 5,000 in August 1995, with a peak count of 5800 birds on 10 August, largely westerns.

Least Sandpiper- Calidris minutilla C, b

Least sandpipers were common on the vegetated intertidal and gravel beaches mixed with western sandpipers. Most of the birds sighted were juveniles, especially later in the season. Least were probably more abundant than our numbers indicate, as close observation was needed to separate them from the far more numerous western sandpipers. Many hundreds of juvenile birds could be found along Carter Spit and the gravel beaches in August. Least were also common on the margins of inshore ponds and sloughs.

Baird's Sandpiper- Calidris bairdii U, m

Only a few Baird's sandpipers were seen mixed with western sandpipers. Five adults and 1 juvenile were noted in 1994, and 2 unaged birds in 1995, all in July or early August.

Long-toed Stint- Calidris subminuta CA, v

This Asian sandpiper was only seen in 1994. Two adults in breeding plumage and possibly 2 additional adult birds were seen by Chris Witt on 6 July along Carter Spit. One pair was standing in beach debris, the 2 others on the gravel on the bay side of the spit. The positively identified pair was observed with a spotting scope for an extended period. The 2 other probable stints were noticed earlier as something different, but not identified as long-toed stints until after they were gone. It is possible the same pair was observed in both cases.

Rufous-necked Stint- Calidris ruficollis R, m

Two members of a very observant field crew were able to pick out and identify rufous-necked stints in both years. In 1994, along Carter Spit, Chris Witt alerted the crews attention to a single rufous-necked stint in breeding plumage with 10 western sandpipers on 6 July. The bird was observed for several minutes with a spotting scope. A similar bird in breeding plumage was seen later in the day with 4 western sandpipers farther down the spit. The second sighting may have been the same bird. In 1995, Louis Dombroski identified a single juvenile on Camp Lake. It was watched at close

range and with a spotting scope for more than an hour before a positive identification was made. It was first seen on 17 August and again in the same place on 18 August, probably the same individual.

Sharp-tailed Sandpiper- Calidris acuminata R, m

We recorded a total of 14 sharp-tailed sandpipers in 1995 only, from 18-23 August. The birds were using the margins of ponds or vegetated slough margins alone, or in groups of 2-5 birds. All individuals appeared to be juveniles. These sandpipers started to appear in late August and undoubtedly would have been more frequent later in the season. The late August and September migration of sharp-tailed sandpipers in western Alaska accounts for their absence from the 1994 records.

Pectoral Sandpiper- Calidris melanotos U, m

Only 12 and 61 pectoral sandpipers were noted in 1994 and 1995 totals respectively. Groups of 2-10 birds used pond or slough margins or sometimes exposed mudflats. Both juvenile and adult birds were noted.

Laridae

Pomarine Jaeger- Stercorarius pomarinus R, m

In 1994, 1 adult pomarine jaeger was seen roosting on the gravel of Carter Spit on 28 July. During migration watches in 1995 along Carter Spit, 1 adult passed offshore on 4 August, and 3 additional adults were observed roosting on Carter Bay mudflats.

Parasitic Jaeger- Stercorarius parasiticus C, b?

Parasitic jaegers worked the mudflats alone or in groups of 2 or 3, hunting shorebirds and robbing food from gulls and terns. Parasitic jaegers are known to breed in the area. Territorial pairs and young have been reported along the coast between Goodnews and Chagvan Bays by Petersen et al. (1991). We did see birds inshore, not far from the coast, but no concrete evidence of breeding. The birds dominated all others as they cruised the coastline and inshore tundra while foraging. We were often entertained by their spectacular flying ability and bold attitude. Pairs of jaegers would often fly into a group of fleeing western sandpipers, separate out one individual, then literally fly it into the ground before capturing it in their bill and making a quick meal of it. Both dark and light phase birds were seen regularly. Immature birds were noted in late August.

Long-tailed Jaeger- Stercorarius longicaudus FC, b

Long-tailed jaegers were seen regularly along the coast and are known to breed between Chagvan and Jacksmith Bays. I saw territorial pairs inshore from Cripple Creek in July 1987. Like the parasitic jaegers, long-tailed jaegers are magnificent flyers and we often watched them soaring effortlessly along the coast and inshore tundra, even during storms with very high winds. They would often fly in and approach us from a great distance, flying within feet of our heads, seemingly to check us out. Most birds were adults, but one individual was noted lacking tail streamers in company with 4 adult birds on 3 August 1995.

Bonaparte's Gull- Larus philadelphia FC, b?

Both adult and juvenile bonaparte's were seen regularly on inshore and coastal pond margins, or hawking insects over the tundra. Many hatch year birds were seen in July and August, and were probably raised on ponds in the area, but could not be confirmed. Many first winter birds were noted. Birds were in small groups or flocks of up to 15 individuals.

Mew Gull- Larus canus C, b

Mew gulls were common along the coast and found breeding on coastal ponds. Birds were common on inshore areas, with small flocks of adults at Camp Lake, as well as a breeding colony of about 70 adults and several chicks at Godwit Lake. Downy chicks were noted as early as 20 July, and flightless chicks defended by adults as late as 15 August. A hatch year bird in fresh plumage was seen at the Indian River Delta on 23 July in 1994. First winter and second winter birds were noted with flocks of adults of up to 45 birds in late August.

Herring Gull- Larus argentatus FC, m

Herring gulls were fairly common, especially at the tip of Carter Spit with glaucous gulls. Adults as well as 1st, 2nd and 3rd year birds were present, but not in large numbers. Individuals or flocks of 2-4 were common. Herring gulls did not appear to breed in the area.

Glaucous Gull- Larus hyperboreus C, b

Glaucous gulls were seen along the coast daily on the spits and shorelines and flying up and down the coast. They were probably the most common gull on the study area. As many as 575 adults and sub adults were counted in several large flocks in Carter Bay in mid July of 1994, and from aerial surveys of the coast, 865 birds were noted from Carter to Jacksmith Bays on 22 July 1994. First, 2nd and 3rd year birds were present in both years. A flock of several hundred glaucous gulls were regulars on the exposed mud of the Indian River Delta in both years. Birds were also seen off shore sitting on the water and scavenging dead sea mammals on the beaches. A flock of 20-30 adults and sub adults could always be found roosting on the very tip of Carter Spit. This gull was first found breeding on brackish coastal ponds just south of the base of Carter Spit in 1994. The colony, present again in 1995, was a very noisy, raucous group of about 200+ adults and at least 15 downy chicks on 21 July. As we approached, the entire colony would circle and call loudly, sometimes swooping at our heads if we got too close. An additional flock of 25 adults and 5+ chicks was present a few hundred yards south of the larger colony. During visits to this colony in late August several newly fledged chicks in fresh plumage were noted.

Slaty-backed Gull- Larus schistisagus CA, v

We saw slaty-backed gulls each year, usually 1 or 2 birds mixed with glaucous gulls on the tip of Carter Spit. In 1994, a single bird in 3rd summer plumage was photographed at the tip of Carter Spit. A bird in the same plumage was seen again on 30 July, probably the same bird. On 30 July and 2 August, a second bird with very worn flight feathers was recorded along the spit. In 1995, a 3rd summer bird was again noticed with the glaucous gulls on 15 July. An adult slaty-backed gull was seen roosting on the mud flats on 22 July. Later in July and August, an adult and a 3rd summer bird were seen together on 3 other occasions along the spit or roosting on the mud flats nearby.

Glaucous-winged Gull- Larus glaucenscens FC, b

We found glaucous-winged gulls nesting with glaucous gulls on brackish coastal ponds and non breeding birds roosting on the mud flats and gravel beaches. This gull was far less numerous than glaucous gulls. As many as 15 adults were noticed in the breeding colony and 1st and 2nd year birds were present.

Black-legged kittiwake- Rissa tridactyla C, m

Kittiwakes were seen regularly along the coast, often flying in large groups up and down the coastline or offshore. A breeding colony is known on the sea cliffs at Cape Pierce, about 100 kilometers to the south. During daily migration watches along Carter Spit in early August 1995, several hundred were counted moving past in 6-8 hours intervals. The majority of the birds were adults, with several hatch year birds seen throughout the season. Adults showed basic winter plumage in late July and August. Adult birds were sometimes seen bathing in the fresh water of inland ponds.

Sabine's Gull- Xema sabini FC, b

Sabine's gulls were found in coastal areas in small groups and individually, and one adult was observed with an attendant juvenile in an arctic tern colony at Godwit Lake. Juvenile birds were seen with adults in August, and a few birds with incomplete black hoods (first summer bird) were noted. Sabine's gulls roosted on the mud flats and in the pond margins, and were present throughout July and August.

Arctic Tern- Sterna paradisaea C, b

Arctic terns were seen and heard every day, constantly flying along the coast and off shore. A breeding colony was found on a shallow inland pond south of camp and named Tern Lake. Arctic terns were also found breeding at Godwit Lake. Adults were very defensive of breeding areas, and often dove

and screeched at us as we approached. Adults numbered at least 65 at Tern Lake and more than 120 at Godwit Lake. By mid July in both years, downy chicks and older, newly fledged birds were present. Many more fledged birds were apparent roosting with adults on inshore ponds later in August. Subadult birds were present in both years. Adults could be found hawking insects over the tundra in the evening. Arctic terns were also noted in an apparent "feeding frenzy" in the deepest parts of Carter Bay near the tip of the spit where water remains at the lowest tides. The birds were flying and briefly alighting on the water as though catching fish or other prey near the surface while calling loudly.

Aleutian Tern- Sterna aleutica C, b

Aleutian terns were common along the coast and nesting in a small colony on the wide grassy area near the end of Carter Spit in 1994. Birds could be seen flying back and forth from the sea to the colony carrying fish. Sand lance were found next to chicks that were being fed on the ground. At least 50 pairs nested on the spit in mid July 1994, when several chicks and nests with 2 olive brown dark mottled eggs could be found. Parasitic jaegers worked the colony and would often force adults to drop the mouthfuls of fish as they flew into the colony. A red fox was also flushed from the tall grass within the colony. Nests with young were found in the area as late as 30 July. Upon our return in 1995, the nesting colony was gone. Adult birds were present, but no nests, breeding activity or young could be found. Some Aleutian terns may have nested at Tern or Godwit Lakes, but non were recorded there. Hatch year birds were present with adults in 1995, along the coast and on inland ponds.

Alcidae

Common Murre- Uria aalge U, m

Common murre nest on the seacliffs at Cape Pierce, but they were only seen at Carter Spit through binoculars flying offshore individually or in groups of 2-40. When flying past the cliffs of Beluga Hill at Goodnews Bay by helicopter, several common murre were noted on the cliffs with pelagic cormorants and a few horned puffins. Murre were never seen at close enough range to determine if any were thick-billed murre (Uria lomvia).

Pigeon Guillemot- Cepphus columba R, m

A single pigeon guillemot was recorded in 1995, flying south over the sea on 29 July during a coastal migration watch. These birds nest in more suitable habitat on the seacliffs and offshore islands south of Carter Spit.

Parakeet Auklet- Cyclorhynchus psittacula R, m

We had only one confirmed sighting of a parakeet auklet in 1994 on 19 July when a single bird flew past over the mudflats of Carter Bay as we were hiking up the spit. We did see other "unidentified small alcids" in 1995 flying past offshore which may have been this species or a murrelet, but non were confirmed. This species is also found in the more suitable habitats of the seacliffs and offshore islands to the south of the area.

Horned Puffin- Fratercula corniculata U, m

Few horned puffins were seen. All birds recorded were flying offshore in small groups observed during migration watches, or on the cliffs at Beluga Hill as we flew past by helicopter enroute to Goodnews. A carcasses of an adult horned puffin was found dried and washed up on the beach each year. Horned puffins can be found nesting on the cliffs of Cape Pierce south of the area.

Tufted Puffin- Fratercula cirrhata U, m

One individual was seen offshore on 14 July in 1994, and two birds mixed with common murre on 8 August 1995. Tufted puffins nest in the seacliffs at Cape Pierce.

Accipitridae

Golden Eagle- Aquila chrysaetos U, r

On August 6, 1994 we used a helicopter to survey alpine areas. When landing in the elevated valley between Figure Four and Cone Mountains, an adult golden eagle was flushed from a rocky outcropping in the saddle between the peaks. The limestone spires had 3 large stick nests, two which

looked long abandoned, and a third on the highest rock face that probably had fledged young that year. Below the nest were numerous molted eagle feathers and the face of the cliff was white-washed and had orange lichen. The nest may have been used by a young adult pair that did not produce young. In 1995 I returned to the site on 24 July, but no eagles were present, and the nests looked unused.

Bald Eagle- Haliaeetus leucocephalus U, r

Bald eagles were encountered on several occasions each year, usually near the creeks or near river deltas. In 1994, we saw an adult bald eagle in July, twice near Carter Creek and once at Jacksmith Bay during aerial surveys. In 1995, an adult was again noted on Carter Creek, and in the upper reaches of the Indian River on 25 July during inland helicopter surveys. A pair of adults were also noted perched in the cottonwood trees in the very upper reaches of Cripple Creek from the helicopter. The birds were probably a breeding pair, but no evidence of nesting was seen. The eagles use of the rivers is probably due to the availability of dead salmon starting in July.

Northern Harrier- Circus cyaneus FC, b

Harriers were seen regularly hunting the coastal and inland tundra. Birds flew low over the tundra and wetland margins looking for prey. Harriers were usually seen hunting alone, but later in the season groups of up to 3 juvenile birds, probable siblings, were noticed flying together. Both brown females and grey males were seen, females being more common. Sightings of juveniles became more frequent in late July and August. Harriers most likely bred within the study area, but some may have been migrants.

Sharp-shinned Hawk- Accipiter striatus U, m

We saw only one sharp-shinned hawk on 2 August 1994, flying low along the willow and alder thickets of the Indian River.

Rough-legged Hawk- Buteo lagopus U, b?

Rough-leggeds are known to nest in the region on coastal hillside rock outcroppings, sea cliffs and inland riparian banks, cliffs or canyons (Petersen et al. 1991). We saw only one bird on 27 July 1994 during an expedition to a rocky outcropping southwest of Cot Mountain. No evidence of breeding was apparent, but the habitat is prime for nesting. Several rocky outcroppings exist on or near the study area in the coastal Ahklun Mountains where birds may produce young.

Falconidae

Merlin- Falco columbarius FC, b?

Only one female merlin was recorded in 1994 on 23 July flying along Carter Creek about 2.5 km up stream from the delta. In 1995, all merlin sightings were in late August (14-22 August), of birds hunting in coastal areas. Merlin nest in the Kilbuck Mountains (Petersen et al. 1991), and may nest in alpine areas just outside the study area where broad valleys and surrounding cliffs provide more suitable habitat. Many of the birds seen at Carter Spit were probably migrants.

Peregrine Falcon- Falco peregrinus U, r

Peregrine falcons were seen on several occasions, each year hunting along the coast, sometimes in pursuit of flocks of western sandpipers, or flying to or from the coast to inland areas. Peregrines were sighted on 4 different occasions in 1994 and twice in 1995. These falcons may breed in alpine areas on rocky spires or outcroppings, but no evidence of breeding was confirmed, aside from adults hunting shorebirds along the coast and returning inland, possible to feed young.

Gyrfalcon- Falco rusticolus U, r

In 1994, a single gyrfalcon was occasionally seen flying to or from the coast and the inland mountains possibly on foraging flights to feed young at a nest in the Ahklun Mountains. This was confirmed on 28 July on an expedition up the north fork of the Indian River to a rocky outcropping at the base of Cot Mountain. A male and female gray morph pair were found roosting on the limestone spires there. The rocks were covered with whitewash, and feathers, pellets and prey remains covered the area below. Pellets contained ptarmigan feathers and ground squirrel fur. Prey remains included

feathers of lapland longspur and tree swallow. There was no defensive behavior observed. This pair may have been failed breeders or fledged young. The outcropping is likely a nesting/roosting site. Gyrfalcons were seen on 3 other occasions in 1994, along the coast. In 1995, a light grey adult was sighted on 3 consecutive days in late July on the Indian River delta and in the upper reaches of Carter Creek near rocky outcroppings.

Phasianidae

Rock Ptarmigan- Lagopus mutus U, r

In 1994, during surveys in alpine areas near Cone, Twin and Figure Four Mountains, 5 rock ptarmigan were seen. On 6 August on the slopes of Twin Mountain, 2 were flushed from an alder thicket. One male and 1 female in breeding plumage and 2 females were spotted on elevated tundra on 7 August on an over night expedition to Figure Four Mountain. No rock ptarmigan were recorded in 1995.

Willow Ptarmigan- Lagopus lagopus C, r

Willow ptarmigan were common on inland tundra. Birds could be heard cackling in the evenings near camp in both years, and were frequently flushed while hiking overland across the tundra. Adult birds became quite accustomed to our presence at camp, and one female allowed us to approach and photograph her at very close range. Broods were also encountered; 3 in 1994 and 1 in 1995 with 6-10 chicks each, capable of bursts of flight for short distances when flushed. The entire coastal tundra from the base of the mountains to the mudflats probably supported a significant number of willow ptarmigan. On 31 July, 1995 a fully feathered juvenile bird was found dead on the mud margin of Camp Lake. It had apparently landed in the thick sticky mud, and after sinking in and becoming covered with mud, could not fly out.

Strigidae

Short-eared Owl- Asio flammeus U, b?

Short-eared owls were seen on three occasions during the study. In 1994 on 12 July at 1 A.M. hunting along Carter Ridge, and on 27 July at 12:30 A.M. hunting at Carter Slough. Another bird was noted in 1995 on 24 July, flushed from the upland tundra near Cripple Creek as I passed in the helicopter. Short-eared owls are known to breed throughout the state, and have been observed at Platinum and Chagvan Bay, particularly in high lemming years (Petersen et al. 1991). We did not see evidence of breeding during this study.

Tyrannidae

Say's Phoebe- Sayornis saya U, b?

The only phoebes seen were in 1994 during a hiking expedition up the Indian River to a rocky outcropping near Cot Mountain. Chris Witt and Scott Harris observed 1 adult bird near the rock outcropping while camping overnight on 27 July. Four other adult birds were observed in that area near a possible nest hole, but a nest site could not be confirmed.

Alder Flycatcher- Empidonax alnorum U, b?

Only one bird was seen in 1994 in an alder grove in a sheltered draw on the western mountain slopes on 16 July. While this bird may have been a migrant, alder flycatchers probably bred in riparian zones of the drainages, but could not be confirmed.

Alaudidae

Horned Lark- Eremophila alpestris FC, b

We saw horned larks in both years, but only in alpine areas. Individual birds or groups of 2-5 were noted, including several hatch year birds on sparsely vegetated gravel ridges at 500 meter elevations on 7 August 1994 and 25 July 1995. Horned larks are common throughout the state and breed on the study area.

Hirundinidae

Tree Swallow- Tachycineta bicolor U, b?

A few tree swallows were seen flying along the coast and near camp, both adults and juveniles. Birds were also noted at Goodnews Bay Village in 1995, and have been recorded nesting at Platinum and Cape Pierce (Petersen et al. 1991), but no nesting birds were noted at Carter Spit.

Bank Swallow- Riparia riparia U, m

Bank swallows were recorded in both years in small numbers. Birds were seen at Camp Lake, flying in inland areas and in groups of up to 10 birds moving along the coast. All sightings appeared to be migrants. Bank swallow may nest on river cut banks of Cripple Creek.

Cliff Swallow- Hirundo pyrrhonota FC, b

Cliff swallows used coastal areas in migration and were found breeding on the rocky faces of the outcroppings near Cot Mountain. The breeding colony consisted of at least 16 nests under ledges on the cliff and 30 adults.

Corvidae

Common Raven- Corvus corax C, r

Ravens were seen everywhere, individually or in groups of several birds. They were regularly seen scavenging along the beaches and mudflats. An old stick nest was found near Cot Mountain in 1994, but no other signs of breeding were found. They undoubtedly breed somewhere within the study area, probably in alpine areas or the river valleys.

Paridae

Black-capped Chickadee- Parus atricapillus U, b?

At least one individual was heard but not seen on 23 July 1995 near the mouth of the Indian River in the riparian willows where they probably nest.

Sittidae

Red-breasted Nuthatch- Sitta canadensis U, b?

One individual was heard calling and then seen feeding in the riparian willows of the Indian River on 20 August 1995. Nuthatches likely breed in the riparian zones of the area.

Muscicapidae

Grey-cheeked Thrush- Catharus minimus U, b

Grey-cheeked thrush were seen and heard singing in the riparian willow of the Indian River in early July. It was only recorded in 1994, but is probably a fairly common breeder in the riparian zones of the creeks on the study area.

Hermit Thrush- Catharus guttatus U, b

Hermit thrush were seen in the willows of riparian zones of Cripple Creek and Indian River. Three adults were recorded on 6 August 1994 near Figure Four Mountain. Hermit thrush probably nest in the riparian zones of the rivers, but birds would have been fledged and starting to leave the area by 6 August. No hermit thrush were noted in 1995.

American Robin- Turdus migratorius U, b

Robins were heard singing near Cot Mountain on 27 July and seen on 28 July in 1994, and at the mouth of the Indian River on 17 July 1995. Robins probably breed on the study area.

Northern Wheatear- Oenanthe oenanthe U, b

Wheatear were seen on two occasions, but only in elevated, rocky, open areas in the mountains in 1994. Two adults were seen on 6 August near a rocky outcropping in the saddle between Twin and Figure Four Mountains. One adult and 1 juvenile were noted on 7 August on the south slope of Figure Four Mountain above Jacksmith Creek. Wheatear are likely breeders in alpine areas, but non were seen in 1995.

Lanidae

Northern Shrike- Lanius excubitor U, b

Shrikes used riparian zones and river valleys. Fledglings were observed in late July of both years begging food from adult birds on the upper Indian River, and juveniles noted on the upper Jacksmith River, lower Indian River, and Carter Creek by 23 July. In 1994, adults were present by a rocky outcropping southwest of Cot Mountain on 28 July and on the south slope of Figure Four Mountain on 6 August. One unaged shrike was seen as late as 20 August at Carter Creek in 1995.

Motacillidae

American Pipit- Anthus rubescens U, b

Pipits were found breeding in alpine areas. In 1994, many adult and juvenile birds were noted near Figure Four Mountain and above Jacksmith Creek in groups of 2-14 individuals. Several pipits, including adults and juveniles were found along ridges at 500 to 600 m elevations on 25 July 1995. Four unaged birds were also noted in early August on the beach in 1995.

Yellow Wagtail- Motacilla flava C, b

In both seasons, yellow wagtails were common to abundant on inshore tundra and around the rivers. Breeding pairs were common around camp and common in the willow and alder thickets inland. In July, birds were calling throughout the day near camp. Later, in August, wagtails became more noticeable as they formed flocks of adults and juveniles, prior to leaving the area. Birds could still be seen and heard on 22 August in 1995 around Camp Lake.

Cinclidae

American Dipper- Cinclus mexicanus U, r

Only one dipper was recorded on 25 July, 1995 calling and flying up a small tributary of the Jacksmith River. Dippers are probably more common on area rivers than our field notes suggest.

Emberizidae

Orange-crowned Warbler- Vermivora celata C, b

This warbler was noted only in the riparian zones of the Indian River, Carter Creek, Cripple Creek and Jacksmith Creek. In both seasons adults and juveniles were seen and heard regularly. Birds were noted as "common" at Indian River and Carter Creek as late as 20 August.

Blackpoll Warbler- Dendroica striata U, b

One to two blackpoll warblers were heard singing along the lower Indian River on 13 and 17 July 1994. While relatively uncommon, the birds breed in the riparian zones of the rivers.

Yellow Warbler- Dendroica petechia C, b

In both seasons, yellow warblers were common in the riparian willows of the rivers where they were nesting. Males would readily come to our calls in mid July, and adults were still noted on the river in early August.

Wilson's Warbler- Wilsonia pusilla C, b

Wilson's warblers were seen in the riparian zones of the rivers where they probably bred. Males came to calls in mid July and two birds were still heard singing on August 3 at the Indian River, where adults were recorded as late as 20 August.

Northern Waterthrush- Seiurus noveboracensis C, b

Waterthrush were seen and heard singing along the rivers. At the Indian River, adults were singing and seen carrying food to fledglings in late July of both seasons, and heard singing as late as 20 August in 1995.

Savannah Sparrow- Passerculus sandwichensis A, b

Savannah sparrows were seen everywhere in all habitats except the mudflats, and were the most abundant passerine in the study. They were seen carrying food and feeding young on the open inshore

tundra, in the willow and alder thickets along the rivers, on the wide grassy areas of Carter Spit, and a few in alpine areas. Adults were commonly heard singing in early July, and feeding young throughout the month. Many more juvenile birds were noted later in July, and still abundant on 23 August 1995.

American Tree Sparrow- Spizella arborea C, b

We saw this sparrow on the tundra, in coastal areas and along riparian willow thickets. Birds were common and found singing and carrying food in alder and willows on inland hillsides and riparian zones in July. Fledged juveniles were noted in mid July and became more abundant later in the season. Tree sparrows were still common on 20 August 1995 along the Indian River.

White-crowned Sparrow- Zonotrichia leucophrys FC, b

Only one hatch year bird was observed at the Indian River on 23 July 1995. White-crowns breed in the riparian zones and are probably much more common than the single observation suggests.

Golden-crowned Sparrow- Zonotrichia atricapilla C, b

Golden-crowns were common in willow thickets and riparian zones along the rivers in both seasons. They were very common up the Indian River, singing regularly. Juveniles birds were noted in the alders on Fair Hill on 16 July, and both adults and juveniles present at the rocky outcropping near Cot Mountain on 27 July, when adults were seen carrying food. A juvenile bird was noted along Carter Spit on 14 August with savannah sparrows.

Fox Sparrow- Passerella iliaca FC, b

Fox sparrows were seen in the riparian willows of the Indian River and Cripple Creek. Adults were heard singing on 13 and 18 July in 1994, and on 23 and 25 July in 1995. A juvenile was seen on Cripple Creek on 25 July, 1995.

Lapland Longspur- Calcarius lapponicus A, b

Longspur were seen and heard everywhere on the tundra and in open grassy areas. A nest in a tussock was found near camp with 4 mottled eggs on 3 July 1994, and the eggs noted as hatched by 9 July. Hatch year birds were common by mid July in both seasons, and groups of 30-50 birds were moving around the area by late July. They were present on the beach and on the tundra, with flocks as large as 250 birds, with juveniles moving everywhere. Some adults were still singing by mid August in 1995 and some still had breeding plumage. Both juveniles and adults were still very numerous by 23 August.

Snow Bunting- Plectrophenax nivalis C, b

Snow bunting were common, but seen only in open alpine valleys and the slopes rising up from the rivers. Flocks of 2 to 45 birds were noted on the slopes of Figure Four Mountain on 6 August, and above Jacksmith Creek on 7 August 1994. Adults and juvenile birds were common at the 500 to 600 m rocky ridge tops above Cripple Creek in 1995, with more than 20 birds noted in a 1 hour and 40 minute hike along the ridge.

Red Crossbill- Loxia curvirostra R, m

A single unstreaked olive-green individual, probably an adult female, was spotted on the upper gravel beach at the base of Carter Spit on 15 August 1995 with a flock of common redpoll.

Common Redpoll- Carduelis flammea A, r

Redpoll were common on inshore tundra and abundant in the willow and alder thickets of the draws and rivers where they nested. Adult birds in breeding plumage were common in coastal areas in July, and were heard singing daily. In August, flocks of juvenile birds were common along the coast and on Carter Spit in the beach vegetation. These flocks were usually 30 to 40 individuals, but by mid August some flocks had increased to 150+ birds. Common redpoll were also abundant on the ridges of the inland mountains at the 500 to 600 m level. Birds remained abundant throughout August.

Hoary Redpoll- *Carduelis hornemanni* C, r

Hoary redpoll were found in the same places as common redpoll. Hoary's were probably more abundant than our field notes suggest as they were not readily noticed in the flocks of commons. Adults were noted on Carter Ridge and near Camp Lake in July. Although far less common than common redpoll, hoary's were seen regularly in coastal areas.

Species	Number of Broods		Brood Size	
	1994	1995	2-Year Average	Species Average*
Red-throated Loon	2	4	1.3	-
Pacific Loon	1	6	1	-
Red-necked Grebe	0	2	0.5	-
Tundra Swan	7	9	3.1	-
Red-breasted Merganser	3	3	7	7.8
Green-winged Teal	1	2	6.5	5.7
Northern Pintail	3	7	6.3	5.6
Mallard	1	0	1	6.1
Greater Scaup	3	3	4.6	6.3
Black Scoter	1	6	8.3	4.2
Unidentified Duck	1	7	6.6	

Table 1. Number of broods and average brood size of waterbirds recorded during helicopter surveys in 1994 and 1995 at Carter Spit, Alaska. * = Bellrose 1980

Waterfowl Brood Surveys

A total of 13 duck broods with 96 ducklings were observed in 1994, 28 broods with 156 ducklings in 1995 (Table 1). Dabbling broods were represented by mallard, green-winged teal and pintail, divers and sea ducks by red-breasted merganser, greater scaup and black scoter. These species were among those most abundant in duck production surveys of nearby Bristol Bay and Y-K Delta (Hodges and Conant 1990). Dabbling ducks made up 49% of duck broods seen, divers 34% and sea ducks (black scoter) 17%.

The average duck brood size for all broods ranged from 8.3 for black scoter to 1 for mallard, although only one mallard brood was recorded for the study. Most broods were of age class II. Brood size was high for some species and low for others when compared to known averages for class II broods (Bellrose 1980), however total brood numbers were low (Table 1). Total production of ducklings for the study area was 0.04/km² in 1994 and 0.08/km² in 1995. The two year production average for the area was 126±42 ducklings or 0.37/km². This value is low when compared to production estimates on the Y-K Delta in 1990 of 9.7 ducklings/km² (Hodges and Conant 1990) and 16.4 ducklings/km² in 1994 and 1995 on the Pah River Flats (Jandt and Fisk 1996). The Carter

Spit area is more coastal and less diverse, involved fewer species and contains comparatively less suitable brood rearing habitat, which may explain its lower production.

Observers recorded a total of 659 adult ducks during broods surveys in 1994 and 800 in 1995. Northern pintail and green-winged teal were the most common species recorded accounting for 65% to 75% of total adults (Table 2). Northern shoveler, mallard, gadwall and American wigeon were the other dabbling species observed. Greater scaup were the most common diver species observed accounting for up to 19% of total adults (Table 2). Black scoter and red-breasted merganser were the other diver species recorded. Other waterbird species noted were Pacific loon, red-throated loon, red-necked grebe and common loon (Table 3). A total of 260 geese were observed in 1994 and 153 in 1995. These birds were Canada geese and greater white-fronted geese and were mostly associated with a mixed breeding colony in the southern portions of the study area. Observers noted 79 adult tundra swans in 1994 and 78 in 1995. During all of the projects aerial surveys, many breeding, non-breeding groups of swans were noted. The Bristol Bay and Y-K Delta areas are known for their significance to swan production (Groves et al.

1990). Our observations suggest the coastal tundra ponds between Goodnews Bay and Jacksmith Bay provide similar swan habitat and is an important swan breeding area for its relatively small size.

DISCUSSION

Of the 127 species of birds seen on the study area, 68 (54%) are known to breed and 21 (17%) suspected of breeding but not confirmed (Appendix 1). Inland ponds provided breeding habitat for the most species (30), alpine the least (13, Table 4). Twenty one landbird species were found breeding in riparian zones and alder thickets on mountain slopes. Intertidal habitats hosted 21 species of breeding birds, mainly shorebirds, gulls and waterbirds that used the mudflats as a food source to feed young. Only 7 of the 31 shorebird species recorded were confirmed breeders, but the mudflats were probably equally important to local breeders as migrants. Coastal tundra provided breeding habitat for sandhill cranes, raptors, ptarmigan, shorebirds, jaegers, gulls and some passerines, among others (Appendix 1). Raptors and other landbirds were also noted in alpine zones.

	1994	1995
Northern Pintail	23%	74%
Green-winged Teal	42%	<1%
Greater Scaup	17%	19%
Northern Shoveler	11%	0
Gadwall	2%	<1%
Black Scoter	<1%	2%
Mallard	4%	0
Wigeon	<1%	0
Red-breasted Merganser	<1%	1%

Table 2. Species composition of adult ducks recorded during helicopter surveys in 1994 and 1995 at Carter Spit, Alaska.

There were at least 75 bird species that used the Carter Spit area for migration and staging. Many species listed as breeding also migrated from breeding areas elsewhere. Intertidal zones, both vegetated and unvegetated, were the most important habitats for staging shorebirds and waterfowl and the local movement of gulls and terns, cormorants and some seabirds. Coastal tundra was used by some migrating raptors and shorebirds, and inland ponds by migrating loons, grebes and waterfowl. The largest number and most

sudden influx of migrants was seen on intertidal zones.

	1994	1995
Pacific Loon	53	29
Red-throated Loon	46	44
Red-necked Grebe	15	6
Common Loon	3	0

Table 3. Numbers of other waterbirds recorded in 1994 and 1995 during helicopter surveys at Carter Spit, Alaska

Overall bird use in each of the species predominantly used habitats was highest for intertidal zones with 55 species, about 43% of total species recorded in the area (Figure 3). Twenty six species (20%) used inland ponds, with the remaining use distributed among coastal tundra, riparian and alpine habitats respectively. The intertidal flats were used by 75% of the species in migration at Carter Spit (Table 4), suggesting the importance of intertidal zones to migrating birds relative to other habitats.

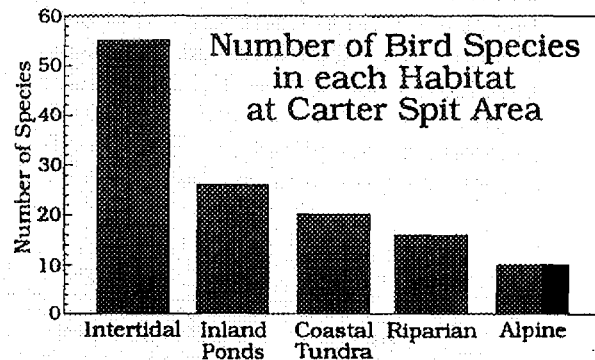


Figure 3. Number of species in each of their predominantly used habitats.

Migrant Waterfowl

The mudflats of Carter Bay and the other spits were a significant fall staging site for waterfowl, beginning in early August. Most observations were of large mixed flocks of northern pintail, green-winged teal and northern shoveler. Petersen et al. (1991) reports similar migrations in August and September at nearby Goodnews Bay and Chagvan and Nanvak Bay, 75 km south.

In July 1994, about 1,000 ducks used Carter Bay, usually in flocks of a few hundred birds each. The peak ground count in 1994 was 1,751 birds on 4 August (Figure 4). By 6

	Intertidal	Inland Ponds	Coastal Tundra	Riparian	Alpine	Total ¹
# of Species Breeding ²	21(20%)	30(28%)	20(19%)	23(21%)	13(12%)	107
# of Species in Migration	56(75%)	16(21%)	3(4%)	0	0	75
Total # Species	77	46	23	23	13	

¹= Some species included in more than one habitat ²= Includes unconfirmed breeders

Table 4. Numbers and percent of species seen breeding and in migration in 5 habitats at Carter Spit, Alaska in 1994 and 1995.

August, 5,700 ducks were recorded in coastal bays during aerial surveys. High winds and rain precluded further aerial counts in 1994, but large flocks of ducks and geese continued to move into Carter Bay until we left on 12 August. Much of the waterfowl migration was missed in 1994 as many species numbers peak in September and October in western Alaska (Petersen et al. 1991). Our estimates should therefore be regarded as minimums. A similar trend in waterfowl migration numbers occurred in 1995. Aerial counts on 24 and 25 July showed about 1,000 birds (24th-140 at high tide, 25th-1,062 at low tide) in Carter Bay. The peak ground count was 4,200 birds on 22 August (Figure 4), mostly northern pintail and Canada geese, probably cacklers and taverners. Unfortunately, no aerial counts were done in August 1995 because limited landing sights

became too shallow to land a floatplane. Surveys in both years did show a significant increase in waterfowl numbers in August (Figure 4).

In total counts that included 26 species of waterfowl, over 17,000 ducks and geese were recorded in 1994 and over 40,000 in 1995 (Table 5). The increase in 1995 resulted from later survey dates closer to migration peaks. Northern pintail were the most abundant migrant duck with over 16,000 birds recorded in total counts (Table 5), most in August in flocks of several thousand in Carter Bay. Green-winged teal and northern shovelers also staged in large numbers on intertidal areas. About 6,000 king eiders were recorded in 1995, most passing during migration watches from Carter Spit. Black scoter and greater scaup were the most common migrant sea ducks.

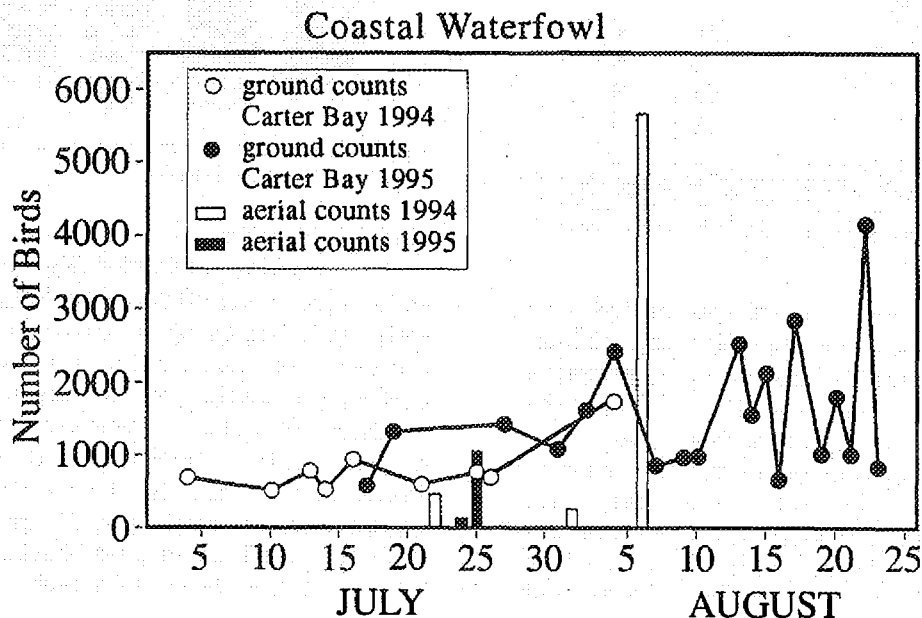


Figure 4. Aerial and ground counts of waterfowl in coastal areas of Carter Spit in 1994 and 1995.

Coastal Shorebirds

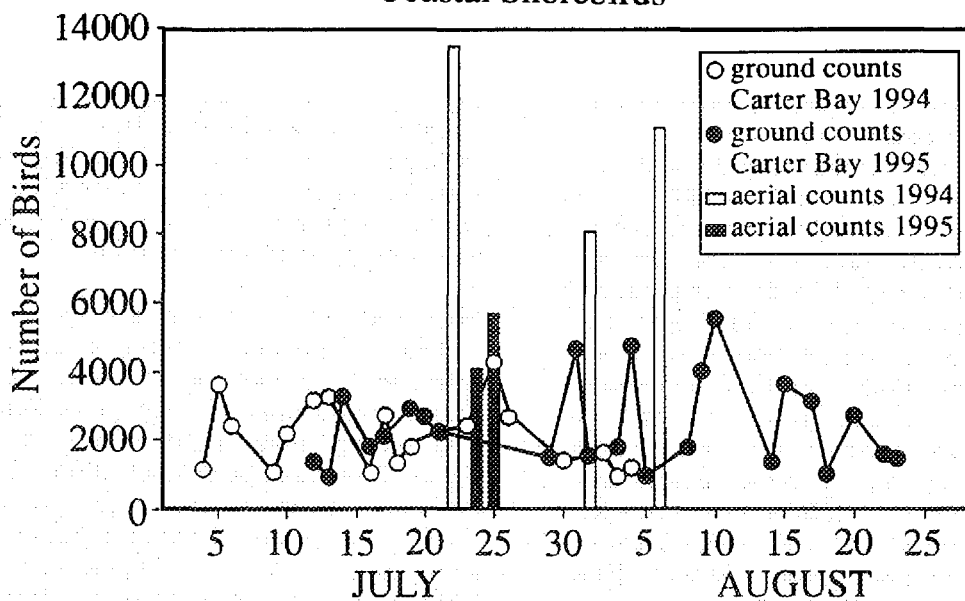


Figure 5. Aerial and ground counts of shorebirds in coastal areas of Carter Spit in 1994 and 1995.

Species	Total Numbers Counted		Average
	1994	1995	
Northern Pintail	5,321	16,679	11,000
Canada Goose	1,631	6,594	4,113
King Eider	864	5,970	3,417
Green-winged Teal	2,638	2,664	2,651
Greater WF Goose	2,652	1,316	1,984
Northern Shoveler	96	3,498	1,797
Greater Scaup	2,573	591	1,582
Black Scoter	795	1,629	1,211
American Wigeon	217	714	466
White-winged Scoter	330	98	214
Red-breasted Merganser	189	108	149
Tundra Swan	129	164	147
Emperor Goose	5	203	104
Brant	45	154	100
Stellar's Eider	84	105	95
Surf Scoter	56	72	64
Mallard	35	90	63
Gadwall	44	57	51
Oldsquaw	21	8	14
Bufflehead	13	12	13
Common Eider	7	10	9
Canvasback	0	18	9
Harlequin Duck	6	2	4
Common Merganser	0	1	1
Snow Goose	1	0	1
Eurasian Wigeon	0	1	1
Total	17,752	40,758	

Table 5. Total numbers of fall migrant waterfowl in 1994 and 1995 at Carter Spit, Alaska.

Migrant Shorebirds

Shorebird counts in 1994 in Carter Bay varied from 1,000 to 4,000 birds, made up mostly of western sandpipers. The peak ground count in 1994 was 4,287 birds on 25

July (Figure 5). I recorded 13,423 "peeps" from Carter Bay to Jacksmith Bay in a fixed wing aerial survey on 22 July, a figure that is about 3 times the number of birds from ground counts in Carter Bay. Intertidal zones in Carter Bay encompass about 1/3 of the total for the study area coastline, so ground and aerial surveys suggest that shorebirds were evenly distributed on exposed intertidal mud. Foraging sandpipers did not form tight flocks, but were widely dispersed. At high tide, birds did not roost in large numbers, but sat in the fringe of vegetation at the tide line making ground counts useless. Roosting birds were most apparent during helicopter surveys at high tide. Flying along the fringe of vegetation at the high tide line, birds flushed and were relatively easy to count. Shorebirds quickly moved onto the mud as the water receded, therefore fixed wing surveys were done on out going tides. In aerial counts on 1 and 6 August, we counted about 8,000 and 11,000 peeps respectively (Figure 5).

About 5,000 and 6,000 birds were recorded in the only two aerial counts of the coastline in 1995 from a helicopter (Figure 5). Ground counts in 1995 varied between 1,000 and 5,000 in August. The peak ground count was 5,800 birds in 1995 (Figure 5).

We recorded 31 species of shorebirds, with totaled daily counts for all species of 80,000 each year (Table 6). Western sandpipers were the most abundant shorebird with total counts

over 50,000 each year. Over 11,000 dowitchers were recorded in 1995, in small flocks in vegetated intertidal or on inland ponds. Sixty percent of those that could be identified to species were short-billed dowitchers.

We regularly saw hudsonian godwits and found a roosting flock of 200 to 300 on an inland pond that remained for several weeks. Hudsonian Godwits breed on the Seward Peninsula (Marchant et al. 1986), and probably pass through Carter Spit in fall migration. They winter in southern South America (Marchant et al. 1986) but their migration route is not known. The species is known on the tide flats of the northern Y-K Delta in mid July in flocks of 200 or more (Jones and Kirchoff 1977) and in Cook Inlet in August with a maximum count of 106 birds along 5 km of mudflats (Kessel and Gibson 1978). The hudsonian godwits at Carter Spit represent a previously unknown point for the presence of

Species	Total Numbers Counted		
	1994	1995	Average
Western Sandpiper	59,960	52,998	56,479
Short-billed Dowitcher (60%) ¹			
Long-billed Dowitcher (40%)	754	11,705	6,230
Dunlin	7,710	4,251	5,981
Hudsonian Godwit	1,204	3,992	2,598
Black-bellied Plover	3,140	1,930	2,535
Red-necked Phalarope	3,691	1,354	2,523
Whimbrel	535	1,948	1,242
Bar-tailed godwit	153	1,101	627
Rock sandpiper	896	141	519
Least sandpiper	613	401	507
Greater Yellowlegs	47	929	488
Am./Pac. Golden Plover	809	157	483
Black Turnstone	89	354	222
Semipalmated Plover	90	171	131
Semipalmated Sandpiper	134	20	77
Ruddy Turnstone	96	53	75
Bristle-thighed Curlew	20	65	43
Pectoral Sandpiper	12	61	37
Common Snipe	20	36	28
Lesser Yellowlegs	13	20	17
Wandering Tattler	0	15	8
Red Knot	0	12	6
Red Phalarope	10	0	5
Sharp-tailed sandpiper	0	10	5
Sanderling	1	6	4
Baird's Sandpiper	6	2	4
Spotted Sandpiper	5	1	3
Rufous-necked Stint	1	2	2
Long-toed Stint	2	0	1
Total	80,011	81,735	

¹=Sixty percent of dowitchers identified were short-billed, 40% long-billed.

Table 6. Total numbers of fall migrant shorebirds in 1994 and 1995 at Carter Spit, Alaska.

the species in fall migration and is therefore significant. From daily counts with both years data combined, figure 2 is a depiction of hudsonian godwit migration at Carter Spit. Numbers peaked in late July then declined through August. Some birds, mostly juveniles, were still present in late August with flocks of bar-tailed godwits. A single flock of 400 birds was present on 20 July in 1995.

Magnitude of Shorebird Migration

From counts of shorebirds on Carter Bay, I estimated the number of birds staging on coastal areas from 15 July to 15 September. The average daily ground count of birds in Carter Bay was about 2,500 birds. I did not determine turnover rates for shorebirds at Carter Spit, but Butler et al. (1987) estimated adult western sandpipers stayed on the Frazer River Delta for 1 to 3 days. Fifteen day turnover rates were reported in fall for semipalmated sandpipers in the Bay of Fundy by Hicklin (1987). Juvenile western sandpipers and adult and juvenile dunlin are the major shorebird migrants at Carter Spit in July and August, and from my observations during this study it is probable that juvenile birds stay longer than adults to mature and gain migration reserves. Using 8 hypothetical turnover rates, table 7 gives estimates for the number of birds using Carter Bay and the entire study area coastline from 15 July to 15 September. Using an average daily count of 2,500 birds in Carter Bay and multiplying by 3 for all spits and bays, table 7 suggests the potential bird use for the various turnover rates over 63 days. If the length of stay is 2 days, over 230,000 shorebirds, mostly western sandpipers, move through the area in that time frame. If birds stay for 15 days, about 31,000 use intertidal habitats. These estimates do not

Length of Stay (Days)	Number of Shorebirds	
	Carter Bay	All Spits and Bays
2	78,750	236,250
3	52,500	157,500
4	39,375	111,125
5	31,500	94,500
6	26,000	78,750
7	22,500	67,500
10	15,750	47,250
15	10,500	31,500

Table 7. Estimated magnitude of shorebird migration in Carter Bay and all coastal areas from 15 July to 15 September using hypothetical turnover rates.

include adult sandpipers that migrate south by 15 July or other shorebird species that stage on inland areas, and therefore should be considered conservative.

If migration estimates are correct, at least 30,000 shorebirds stage on intertidal habitats of the study area each fall. The Carter Spit area lies just south of the greater Central Y-K Delta where peak densities of 1200 shorebirds/km² have been recorded in early September (Gill and Handel 1990). Many shorebirds from the Central Delta may stop at the Carter Bay area in fall migration. Within the 39 km² survey area of Carter Bay, densities peaked at 149 shorebirds/km² on 10 August 1995 and averaged 64 shorebirds/km² in July and August. In 1994, 110 birds/km² were recorded in late July. Higher densities are likely in September as birds leave the Central Delta in southern migration.

CONCLUSIONS

The numbers of migrant birds recorded in this study suggest the areas intertidal and coastal habitats are of regional importance to migrating shorebirds and waterfowl. Many species are later migrants and have later migration peaks which increases the areas significance. Coastal wetlands and riparian habitats host breeding waterfowl and landbirds. In addition, the areas rivers support salmon runs which provide a food source for the regions brown bears, further increasing its wildlife value.

Carter Spit has been recognized as an Important Bird Area by the American Bird Conservancy. Such recognition is key to ensuring the area remains ecologically healthy and available to migrating birds and other wildlife.

ACKNOWLEDGMENTS

I thank Chris Witt, Rick Knight, Scott Harris, Jeff Mason and Louie Dombroski for their exceptional birding skills and help with collection of the data. Mike Hinkes, Togiak National Wildlife Refuge, Dillingham, Alaska, provided use of refuge communications and daily contacts with refuge staff. Logistic and field support was provided in part by the Yukon Delta National Wildlife Refuge, Bethel, Alaska. I especially thank John Morgart for use of refuge facilities and vehicles, Brian McCaffery for help with aerial surveys and George Walters for his flying skills and use of refuge

aircraft during camp logistics and reconnaissance of the area. Yukon Aviation and Trans Alaska Helicopters provided additional aerial survey and resupply support. Bill Larned, Kenai National Wildlife Refuge, Soldotna, Alaska provided spring eider survey data for the Carter Spit area. Tom Pogson, Alaska Bird Observatory, Fairbanks, Alaska provided a member of the field crew each season through a cooperative agreement with Anchorage District Office BLM.

Faint, illegible text in the upper left quadrant of the page.

Faint, illegible text in the upper right quadrant of the page.

Faint, illegible text in the middle right section of the page.

Faint, illegible text in the lower right section of the page.



Appendix 1. Habitat use and seasonal occurrence of bird species seen at Carter Spit, Alaska in 1994 and 1995.

Species	Habitat				
	Intertidal	Inland Ponds	Coastal Tundra	Riparian	Alpine
Gaviidae					
Common Loon		b?			
Pacific Loon	m	b			
Red-throated Loon	m	b			
Podicipedidae					
Red-necked Grebe		b			
Horned Grebe	m	m			
Procellariidae					
Short-tailed Shearwater	m				
Phalacrocoracidae					
Double-crested Cormorant	m				
Pelagic Cormorant	m				
Gruidae					
Sandhill Crane		b	b		
Anatidae					
Tundra Swan		b			
G. White-fronted Goose	m	b			
Snow Goose	m				
Emperor Goose	m				
Canada Goose	m	b			
Brant	m				
Mallard	m	b			
Gadwall	m	b?			
Green-winged Teal	m	b			
American Wigeon	m	b?			
Eurasian Wigeon		v			
Northern Pintail	m	b			
Northern Shoveler	m	b?			
Canvasback		m			
Greater Scaup	m	b			
Common Eider	m				
King Eider	m				
Stellar's Eider	m				
Black Scoter	m	b			
White-winged Scoter	m				
Surf Scoter	m				
Harlequin Duck	m				
Oldsquaw	m	b?			
Bufflehead	m	m			
Common Merganser		m			
Red-breasted Merganser	m		b		
Charadriidae					
Semipalmated Plover	b				
Black-bellied Plover	m		b		
American Golden Plover		m	b?		
Pacific Golden Plover		m	b?		
Scolopacidae					
Bar-tailed Godwit	m	m			
Hudsonian Godwit	m	m			
Bristle-thighed Curlew	m	m			
Whimbrel	m	b?			
Greater Yellowlegs	m				
Lesser Yellowlegs	m				
Spotted Sandpiper			b?		

Appendix 1. Habitat use and seasonal occurrence of bird species seen at Carter Spit, Alaska in 1994 and 1995 (continued).

Species	Intertidal	Inland Ponds	Habitat		
			Coastal Tundra	Riparian	Alpine
Scolopacidae					
Wandering Tattler	m				
Red-necked Phalarope	m	b			
Red Phalarope	m				
Dunlin	m	b			
Short-billed Dowitcher	m	m			
Long-billed Dowitcher	m	m			
Common Snipe			b		
Red Knot	m				
Ruddy Turnstone	m	m			
Black Turnstone	m	m			
Rock Sandpiper	m				
Sanderling	m	m			
Semipalmated Sandpiper	m				
Western Sandpiper	m	b			
Least Sandpiper	m	b			
Baird's Sandpiper		m			
Long-toed Stint	v				
Rufous-necked Stint	v				
Sharp-tailed Sandpiper		m			
Pectoral Sandpiper	m				
Laridae					
Pomarine Yeager	m				
Parasitic Yeager	b?		b?		
Long-tailed Yeager	b?		b?		
Bonaparte's Gull	m	b?			
Mew Gull	m	b			
Herring Gull	m				
Glaucous Gull	m	b			
Slaty-backed Gull	v				
Glaucous-winged Gull	m	b			
Black-legged Kittiwake	m				
Sabine's Gull	m	b			
Arctic Tern	b	b			
Aleutian Tern	b	b			
Alcidae					
Common Murre	m				
Pigeon Guillemot	m				
Parkeet Auklet	m				
Horned Puffin	m				
Tufted Puffin	m				
Accipitridae					
Golden Eagle					r
Bald Eagle			r		
Northern Harrier			b		
Sharp-shinned Hawk			m		
Rough-legged Hawk					b?
Falconidae					
Merlin					b?
Peregrine Falcon					r
Gyrfalcon					r
Phasianidae					
Rock Ptarmigan					r
Willow Ptarmigan			r		

Appendix 1. Habitat use and seasonal occurrence of bird species seen at Carter Spit, Alaska in 1994 and 1995 (continued).

Species	<u>Habitat</u>				
	Intertidal	Inland Ponds	Coastal Tundra	Riparian	Alpine
Strigidae					
Short-eared Owl	m		b		
Tyrannidae					
Say's Phoebe					b?
Alder Flycatcher					
Alaudidae					
Horned Lark					b?
Hirundinidae					
Tree Swallow	m		m	b?	
Bank Swallow	m		m		
Cliff Swallow					b
Corvidae					
Common Raven	r		r		r
Paridae					
Black-capped Chickadee				b?	
Sittidae					
Red-breasted Nuthatch				b?	
Muscicapidae					
Grey-cheeked Thrush				b	
Hermit Thrush				b	
American Robin				b	b?
Northern Wheatear					b
Laniidae					
Northern Shrike				b	
Motacillidae					
American Pipit			b		b
Yellow Wagtail			b		
Cinclidae					
American Dipper				b	
Emberizidae					
Orange-crowned Warbler				b	
Black-poll Warbler				b	
Yellow Warbler				b	
Wilson's Warbler				b	
Northern Waterthrush				b	
Savannah Sparrow			b	b	
American Tree Sparrow				b	
White-crowned Sparrow				b	
Golden-crowned Sparrow				b	
Fox Sparrow			b	b	
Lapland Longspur			b		
Snow Bunting					b
Fringillidae					
Red Crossbill	m				
Common Redpoll	m		b	b	
Hoary Redpoll	m		b	b	

r=resident m=migrant b=breeder b?=probable breeder, not confirmed v=visitant

THE UNIVERSITY OF CHICAGO

PHYSICS DEPARTMENT

PHYSICS 311

LECTURE 1

MECHANICS

1.1 Kinematics

1.2 Dynamics

1.3 Energy

1.4 Momentum

1.5 Angular Momentum

1.6 Oscillations

1.7 Waves

1.8 Relativity

1.9 Quantum Mechanics

1.10 Statistical Mechanics

1.11 Thermodynamics

1.12 Electromagnetism

1.13 Optics

1.14 Modern Physics

1.15 Miscellaneous

1.16 Problems

1.17 Experiments

1.18 References

1.19 Appendix

1.20 Index

1.21 Glossary

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100

LITERATURE CITED

- American Ornithologist's Union. 1983. Check-list of North American birds. 6th ed., American Ornithologist's Union, Washington D. C. 877pp.
- Arneson, P. D. 1977. Identification, documentation and delineation of coastal migratory bird habitat in Alaska. Pages 83-99 In: Environmental assessments of the Alaskan Continental Shelf, quarterly reports of principal investigators, Vol. X. (National Oceanographic and Atmospheric Administration, Environ. Res. Lab., Boulder, Colo.).
- Bartonek, J. C. and D. D. Gibson. 1972. Summer distribution of pelagic birds in Bristol Bay, Alaska. *Condor* 74:416-422.
- Brower, W. A., Jr., R. G. Baldwin, C. N. Williams, Jr., J. L. Wise, and D. L. Leslie. 1988. Climatic atlas of the outer continental shelf waters and coastal regions of Alaska. Vol. 2. Bering Sea. Arctic Environmental Information and Data Center, University of Alaska, Anchorage.
- Butler, W. R., G. W. Kaiser, and G. E. J. Smith. 1987. Migration chronology, length of stay, sex ratio, and weight of western sandpipers (*Calidris mauri*) on the south coast of British Columbia. *J. Field Ornithol.* 58:103-111.
- Gill, R. E. Jr., and C. M. Handel. 1981. Shorebirds of the Eastern Bering Sea. Pages 719-738 In: D. W. Hood and J. A. Calder eds., Eastern Bering Sea Shelf: Oceanographic Resources. Office of Marine Pollution Assessment, Rockville Maryland.
- Gill, R. E. Jr., and C. M. Handel. 1990. The importance of subarctic intertidal habitats to shorebirds: a study of the central Yukon-Kuskokwim Delta, Alaska. *Condor* 92:709-725.
- Gill, R. E., R. W. Butler, P. S. Tomkovich, T. Mundkur and C. M. Handel. 1994. Conservation of North Pacific Shorebirds. Pages 63-78 In: *Trans. 59th No. Am. Wildl. & Nat. Resour. Conf.*
- Gollup, J. B. and W. H. Marshall. 1954. A guide for aging duck broods in the field. Mississippi Flyway Council Technical Section Report. Minneapolis, Minn. 14pp.
- Groves, D. J., B. Conant and J. I. Hodges. 1990. A summary of Alaska tundra swan surveys- 1990. Unpubl. Rep., Migratory Bird Manage., U. S. Fish and Wildl. Serv., Juneau.
- Hicklin, P. W. 1987. The migration of shorebirds in the Bay of Fundy. *Wilson Bull.* 99:540-570.
- Hodges, J. I. and B. Conant. 1990. Alaska duck production surveys, 1990. Unpub. Rep., U. S. Fish and Wildl. Serv., Migratory Bird Manage., Juneau, AK. 26pp.
- Hulten, E. 1968. Flora of Alaska and neighboring territories. Stanford University Press, CA. 1088pp.
- Jones, R. Jr., and M. D. Kirchoff. 1977. Draft: coastal habitat for migratory birds in western Alaska. U. S. Fish and Wildlife Service, Anchorage, AK.
- Kessel, B. and D. D. Gibson. 1978. Status and distribution of Alaska birds. *Studies in Avian Biology* No. 1, Cooper Ornithological Society. 100pp.
- Larned, W. 1995. Stellar's eider survey-unpublished data from 1993 and 1994 surveys. U. S. Fish and Wildlife Service, Migratory Bird Management, Soldotna, Alaska.
- Marchant, J., T. Prater and P. Hayman. 1986. Shorebirds- and identification guide. Houghton Mifflin Co., New York. 412pp.
- Petersen, M. R., D. N. Weir and M. H. Dick. 1991. Birds of the Kilbuck and Ahklun Mountain region, Alaska. U. S. Dept. Int., Fish Wildl. Serv., No. Am. Fauna No. 76.

Selkregg, L. L. 1976. Alaska regional profiles. Office of the Governor, Alaska Joint Federal-State Land Use Planning Commission for Alaska. Vol. III. University of Alaska, Arctic Environmental Information and Data Center, Anchorage. 313 pp.

Seppi, B. E. 1995. Hudsonian godwit migration at Carter Spit, Alaska. *Western Birds* 26:167.

Williamson, F. S. L. and M. A. Smith. 1964. The distribution and breeding status of the hudsonian godwit in Alaska. *Condor* 66:41-50.