ARCTIC SLOPE AND TRANS-ALASKA PIPELINE TASK FORCE REPORT: THE BIRD RESOURCES OF ALASKA'S ARCTIC SLOPE AND PETROLEUM DEVELOPMENT

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This report was written in order to better understand the possible effects of petroleum exploration, development, and related activities upon the bird resources of Alaska's Arctic Slope (-North Slope). Information on birds from this region is summarized and discussed; the possible impact of petroleum development upon birds is discussed; and recommendations are made to the Bureau in order that it can better meet its legislative obligation to protect migratory birds.

DESCRIPTION OF THE ARCTIC SLOPE

Alaska's Arctic Slope is approximately 82,000 square miles in size. It lies north of the divide in the Brooks Range that separates the Arctic Ocean and Bering Sea drainages. The foothills and mountains of the Brooks Range are regarded as extensions of the Rocky Mountain System, and the coastal plain is the extension of the Interior Plains. Geologists have divided the Arctic Slope into the Arctic Coastal Plain, Arctic Foothills, and Arctic Mountains Physiographic Provinces (Fig. 1). These three divisions are also suitable for distinguishing between major plant and animal communities and are used in this report.

The Arctic Coastal Plain (Wahrhaftig 1965:18, 20) is a smooth plain rising imperceptibly from the Arctic Ocean to a maximum altitude of 600 feet. The shore is generally only 1 to 10 feet above the ocean. Locally pingos produce an undulating skyline. The coastal plain is poorly drained and consequently marshy. Rivers west of the Colville River meander in valleys incised 50 to 300 feet; those to the east cross the plain in braided channels and are building deltas. Most of the plain is covered by elongated thaw lakes oriented to prevailing summer winds (N 15° W); these range from a few feet to 9 miles long, are 2 to 20 feet deep, and are oval or rectangular in shape (Figs. 2 & 3). The lakes expand about a meter a year in places; then become drained through surface or sub-surface drainage. Many generations of drained lake basins may be seen. The entire land area is underlain by permafrost at least 1,000 feet thick with an active layer from 1/4 to 4 feet. A network of ice-wedge polygons covers the coastal plain.

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The Arctic Mountains (Wahrhaftig 1965:21-22) north of the divide are rugged glaciated east-trending ridges that rise generally to 7,000 to 8,000 feet. The mountains have cliff-and-bench characteristics of glacially eroded bedrock. Abrupt mountain fronts face the foothills and lowlands on the north (Fig. 7). The major rivers flowing north in flat-floored glaciated valleys are from 1/2 to 2 miles wide (Fig. 8). Large rock-basin lakes are at the mouths of several glaciated valleys, but the Brooks Range has fewer of these lakes than other glaciated areas. There are a few cirque and valley glaciers in the Brooks Range.

AVAILABLE INFORMATION ON THE BIRDS OF THE ARCTIC SLOPE

Ornithological Investigations

Alfred M. Bailey (1948) and Ira N. Gabrielson and Frederick C. Lincoln (1959), in addition to their own findings on the Arctic Slope, summarized the observations of E. W. Nelson (1883) from Bering Strait to Point Barrow, John Murdock (1885), the McIlhenny Expedition (Stone 1900), and Louis B. Bishop (1944) in the Point Barrow area, Rudolph Martin Anderson (1913, 1915) along the Arctic Coast and at Collinson Point, and Winthrop S. Brooks (1915) and Joseph S. Dixon (1943) near Humphrey Point. Additional early but brief accounts of birds and other wildlife on the Arctic Slope are given by Vilhjalmur Stefansson (1913) for the Arctic coast, Ernest de K. Leffingwell (1919) who conducted a geological reconnaissance in the Camden Bay region, and Philip S. Smith and J. B. Mertie, Jr. (1930) who conducted a geological reconnaissance west of the Colville River. Other early accounts of Arctic Slope birds are cited by Gabrielson and Lincoln (1959) and Bailey (1948) that are not specifically identified in this report.

More recent ornithological investigations have been conducted at Anaktuvuk Pass (Irving 1960), Ahlasuruk River (Irving and Paneak 1954), and the Kaolak River (Maher 1959). Brina Kessel and Tom J. Cade (1958) incorporated the observations of several observers into their detailed investigation of birds from the Colville River and delta. Supplemental observations of birds on the Arctic Slope are presented by James W. Bee (1958) for several areas, George C. West and Clayton M. White (1966) for Umiat, and

The Arctic Foothills (Wahrhaftig 1965:20) consist of rolling plateaus and low linear mountains rising in altitude from 600 to 3500 feet. Most streams crossing the foothills have swift, braided courses across broad gravel flats that are locally covered in the winter with sheets of aufeis that freezes to the stream bed; the filling of the channel cause the streams to flood their gravel flats. Beaded drainages are common (Figs. 4 & 5). A few lakes are present in the river valleys and on some divides (Fig. 4 & 6). The upper valleys of major rivers from the Brooks Range contain many morainal lakes (Fig. 7). Permafrost is continuous. Ice wedges, stone stripes, polygonal ground, and other features of a frost climate are common.

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Neil T. Argy et al (1966) for the Arctic National Wildlife Range.

Several species specific studies of birds have been conducted in and near Barrow and along the Colville River but are not cited in this report.

Ornithological information for areas immediately adjacent to the Arctic Slope, in addition to that summarized by Bailey (1948) and Gabrielson and Lincoln (1959), is available for the Old Crow Flats and Kobuk River areas (Irving 1960), the Cape Thompson area (Williamson et al 1966, Swartz 1966), the upper Sheenjek River (Kessel and Schaller, 1960), and the Baird and Schwatka Mountains (Dean 1964).

Waterfowl Surveys, Observations, and Investigations

Robert H. Smith and Robert P. Allen (1948) conducted the Bureau's first waterfowl inventory survey in the Far North between June 4 and August 4, 1948. In addition to those areas surveyed in northern Alberta, Mackenzie District, and Yukon Territories, they flew 1/4-mile transects over 40.2 square miles of "Upland tundra" lying "south and east of Point Barrow" in Alaska. Waterfowl densities on the Alaska transects averaged 3.9 ducks and 3 white-fronted geese per square mile. Species comprising the duck count were: oldsquaw, 53%; king eider, 27%; pintail, 17%; scoters, 2%; and scaup, 1%. Smith and Allen noted that the climate north of the Brooks Range was generally colder than that in similar habitat in the Mackenzie Delta area and believed that the resulting late break-up is responsible for relatively fewer waterfowl being found on the Alaska coast than in the adjacent Mackenzie Delta area.

Donald R. Griffin (1948) reported that in June when only the large rivers were open, great concentrations of ducks, geese, and shorebirds were seen at such places as the mouths of the Colville, Kuparuk, and Sagavanirktok rivers. He estimated at least 20 pairs of swans in the Colville delta area. Most of these swans seemed to be without nests. He observed either one flock or two flocks of about 100 snow geese that were flying west along the coast between the Kuparuk River and Barter Island in mid-June.

Urban C. Nelson and Raymond Woolford (Nelson 1949), from June 23 to 26, 1949, flew transects, expanded from the lw48 survey, that lay generally between Umiat, the Colville delta, and Teshekpuk Lake. The average density of waterfowl over the s85 square miles covered by the survey was 2.5 birds per square mile. Species composition was: swan, 2%; geese (white-fronted, black brant, lesser Canada), 5%; "game" ducks (pintail, 30%; mallard; scaup), 40%; and "non-game" ducks (oldsquaw, 45%, eiders), 53%.

Urban C. Nelson, David Walsh, and Thomas Spining (Nelson 1949) conducted waterfowl nesting studies and banding on the Col-

ville River and delta from June 26 to August 3, 1949. Their observations from the ground indicated a density of about 3 to 4 birds along and up to 10 miles from the river. Nelson found Canada geese along the foothill portion of the Colville River and all but one pair of white-fronted geese on the delta. Black brant were observed on the delta during aerial surveys with Woolford, but none were seen afterwards. Oldsquaws, pintails and greater scaup were the most abundant ducks in this area; however, no evidence was found of pintails breeding. A few common eider were seen. Pairs and single red-breasted mergansers were seen almost daily along the river. He presents a list of birds observed during the summer. Predation on waterfowl young by either jaegers or gulls did not appear to be significant on the delta. Nelson (1953) described the cliff-nesting behavior of the Canada geese from the Colville River.

Raymond Woolford and Ira N. Gabrielson (Nelson 1950) between June 21 and 22, 1950, flew transects over essentially the same area as in 1949 and covered 315 square miles. The waterfowl density averaged 2.6 birds per square mile; and the population consisted of geese (lesser Canada, white-fronted), 15%; game ducks (pintail, scaup, mallard), 45%; eider and scoters, 40%. Nesting white-fronted geese were observed on the Colville Delta. No swans were mentioned in this report although 17 were included in the counts of the 1949 survey of 285 square miles. Gabrielson published (Gabrielson and Lincoln 1959) his bird observations from this trip.

Raymond Woolford, Neil W. Hosley, and John L. Buckley (Nelson 1951) on June 24, 1951, flew transects that covered 260 square miles. Waterfowl densities averaged 0.5 geese and 2.5 ducks per square mile. Twenty-two swans were observed but apparently not included in the waterfowl density calculations as was the case in 1949. The "usual" concentration of geese on the Colville River Delta was not observed. Annual breeding waterfowl inventories were thereafter discontinued on the North Slope because of the low densities of "game" ducks encountered since 1948.

Daniel Q. Thompson and Richard A. Person (1963) reported on the eider migration and shooting by Eskimos at Point Barrow during the summer of 1953. They estimated that 1,000,000 adult eiders passed the point by September 1 to some yet unknown molting area. The adult sex ratio shifted from predominately males in early-August to predominately females by mid-August. Most (99.9%) of the 45,616 waterfowl observed were king and Pacific eiders. The remaining scattered migrants included 80 oldsquaws, 47 black brants, 46 pintails, 21 Steller's eiders, 16 unidentified ducks, 4 thick-billed murres, and 2 Arctic loons. It is unusual that spectacled eiders were not reported and that the numbers of other waterfowl and loons were so low. During a 4-hour stay at the eider pass on July 22, 1969, I counted 87 Steller's eiders and saw hundreds of oldsquaw and many loons, including an Arctic loon killed by Eskimos.

Henry A. Hansen and James G. King (Hansen 1957) flew 64 16-mile segments from July 7 to 10, 1957. Transects were located regularly on each degree of longitude from 148° to 160°W., from "the coast inland to the edge of the waterfowl habitat" (this habitat apparently included only the coastal plain). Of the 216 s square miles covered (slightly less than 1% of the Coastal Plain), the density of ducks averaged only 3.1 birds per square mile. Species composition for Hansen's Strata I, which was comprised of over 95% ducks from the Arctic Slope, was: oldsquaw, 68%; scaup, 8%; pintail, 5%; scoter, 5%; eider, 2% and goldeneye, mallard, green-winged teal, and bufflehead, each less than 1%. The less than 5% ducks from the Susitna-Kenai area probably accounted for all of the goldeneyes and bufflehead and most of the mallards in data for Strata I. About 10,000 black brant and 1,300 snow geese--most of which were nonbreeding birds--were "discovered" near Cape Halkett. Four Canada geese, 82 white-fronted geese, and 17 swans were also counted.

M. T. Myres (1958) working out of Point Barrow reported in detail on the eider migration, spring mortality from starvation, molt and fall migration, and utilization by Eskimos.

Peter E. K. Shepherd (1961) for the Alaska Department of Fish and Game made a reconnaissance of the black brant populations from Cape Lisburne to the Colville River Delta during late June and early July of 1960. The only significant brant breeding populations were found between Point Barrow and the Colville River Delta. Nearly 400 brant were located along shoreline habitat and up to 10 miles inland. A few scattered groups of brant were found as far as 25 miles inland. Shepherd found 44 active nests on the Colville River Delta and reported an additional 30 nests from Pitt Point.

Neil T. Argy, Averill S. Thayer, Ben H. Crabb, David R. Klein, and Vernon Harmes (Argy et al 1965) conducted a patrol and reconnaissance of the Arctic National Wildlife Range between June 9 and 25, 1965. They reported seeing pintails at Peters Lake and oldsquaws, common and white-winged scoters, eiders, and bufflehead at the mouths of the Jago and Sadlerochit rivers. If they were correct in identification, their observations of bufflehead and common scoters constituted the first and second records, respectively, of these species on the Arctic Slope. They did not mention the uniqueness of these sightings. Approximately 400 to 450 black brant were observed between the mouths of the Hulahula River and Demarcation Bay. Swan were seen at several locations along the coast. A list of birds observed on this trip was included in their report.

James G. King and Terry Brady (King [1967]) conducted an aerial survey of geese and swan on the Arctic Slope from July 28 to August 2, 1966. Flight paths were along the entire coast from

Barter Island to Point Lay and inland up to 60 miles. Flight courses were selected to pass over the river deltas, principal lakes, and the more productive and promising areas. They observed 159 swans, and King estimated that the swan population on the Arctic slope was not over 800 birds. The North Slope population of Canada geese was estimated at 15,000 birds, most of which were nonbreeding birds north of Teshekpuk Lake and believed to have been produced elsewhere. Nearly 90% of the brant observed were nonbreeders and found "exclusively" on the thaw lakes north of the Teshekpuk Lake near Cape Halkett. King estimated the Arctic Slope black brant population to number 30,000 adults and sub-adults and 5,000 young. Small flocks of adult brant with young were encountered from Peard Bay to Barter Island, primarily on the river deltas and in areas of larger lakes up to 20 miles inland. King saw 6,700 whitefronts and estimated that the regional population was more than 50,000 birds. Nineteen broods and 343 molting, nonbreeding snow geese were seen east of Barrow; and there are probably less than 1,000 snow geese on the Arctic Slope. King believes that despite many similarities between the habitats on the Arctic Slope and the Yukon--Kuskokwim Delta that the colder climate is responsible for there being fewer brant, geese, and swan in the north.

James W. Brooks and Averill S. Thayer (pers. comm.) observed an estimated 400 molting black brant at Camden Bay on the Arctic coast during July 1968.

Averill S. Thayer, David R. Klein, James W. Brooks, James Coutts and I participated in varying degrees and durations during the summer of 1969 in reconnaissances of the Arctic Slope for the purpose of appraising the potential impact of petroleum development upon the wildlife resources. On the basis of my limited observations during 1969 near Sagwon, Kavik, and "Nora Federal #1" test well, waterfowl use and possibly production in the foothill region of the Arctic Slope appears to be significant. I saw pintails, widgeons, green-winged teal, greater scaup, oldsquaws, white-winged and surf scoters, and red-breasted mergansers using beaded and braided streams and pothole and thaw lakes and ponds in this region (Figs. 4, 5 & 6). Apparently the Bureau's earlier waterfowl surveys traversed only the coastal plain (Fig. 2), but did not include the foothills. While at Pt. Storkersen, Pt. Barrow, Pt. Thompson, and Nignanak River Delta, all on the Arctic coast, I saw pintails, widgeons, greater scaup, scoters, oldsquaws, king eiders, Steller's eiders, spectacled eiders, white-fronted geese, black brant, and whistling swans. Thaw lakes which were partially drained and contained a good stand on emergent vegetation appeared to be more heavily used by waterfowl than either undrained or completely drained thaw lakes (Fig. 3). The previous aerial inventories which did not have ground studies for comparison and adjustment of data were probably underestimating pintails, greenwinged teal, widgeon, scoters and eiders, and proportionately

overestimating oldsquaws and greater scaup. Mallards are probably less important throughout the North Slope than indicated by the Bureau surveys of 1949 and 1950.

Averill S. Thayer, James Coutts and I flew along portions of the Arctic coast between the Sagavanirktok River Delta and Demarcation Bay between July 31 and August 3, 1969. I counted approximately 20,000 molting oldsquaw and estimated that there were at least 40,000 in this section of coastal water. Most oldsquaw were flightless and in compact flocks situated close to the gravel spits and barrier beaches (Fig. 9). Pack ice was against the seaward side of the graveled barrier beaches and islands. Female oldsquaws with young were not seen in these same areas. Other waterfowl counted included: 44 female eiders, mostly with young; 13 whistling swan, 25 pintails, and 20 black brant with young. Red-throated and Arctic loons, parasitic and pomarine jaegers, glaucous gulls, and Arctic owls were common along the entire coast. Yellow-billed loons and Arctic terns were less commonly seen.

David L. Spencer (pers. comm.), on August 30, 1969, saw an estimated 5,000 to 6,000 snow geese on the tundra adjacent to the Jago River and from 10 to 15 miles in from the coast. Spencer believed that there may have been more birds in the area but that time did not permit a more thorough search. Averill S. Thayer (pers. comm.) saw about 10 flocks of snow geese totalling possibly 8,000 birds between the Okpilak and Jago rivers and within 8 miles from the coast on September 2 and 3, 1969. DEW-line personnel and pilots told Thayer that snow geese were scattered along the coast as far west as Oliktok Point. Thomas W. Barry (pers. comm.) said that the Banks Island population of snow geese concentrate during September on the foothills between Shingle Point, Yukon Territories, and Demarcation Point, Alaska, to feed on berries. These geese sighted in Alaska were probably birds from Banks Island, although some may have come from the smaller colonies in the Mackenzie and Perry river deltas.

Donald E. McKnight made a reconnaissance of the waterfowl and habitat in the vicinity of the Colville River Delta, Teshekpuk Lake, and Cape Halkett during July 1969. As of this date his findings are not known to us, but they will undoubtedly be available in the immediate future.

Bryan Sage supervised Trans Alaska Pipeline System's (TAPS) ecological surveys along portions of their proposed pipeline route between Prudhoe Bay and Valdez during the summer of 1969. Emphasis was on the Arctic portion of the route. Information on birds was collected by Sage, but it is not yet available. Sage offered the preliminary conclusion in a statement read by a TAP's official at the U. S. Department of the Interior's pipeline hearing in Fairbanks, that waterfowl will not be disturbed by the line nor will forest bird communities.

Angus Gavin, Atlantic-Richfield Company's ecologist for their North Slope operations, has spent much of the 1969 summer making observations on wildlife, including waterfowl. Gavin (pers. comm.) reported seeing flocks of black brant between and on the Sagavanirktok and Colville river deltas. Approximately 500 brant were seen on the Kuparuk River Delta. Brant were in both molting flocks and flocks with young. He saw many broods of white-fronted geese on the Ugnuravik River. A more detailed report will probably be made available to Bureau personnel by Gavin.

BIRDS OF ALASKA'S ARCTIC SLOPE

One hundred and seventy-one species of birds have been reported north of the divide of the Brooks Range, Alaska. These birds are listed in Table 1 by their occurrence in each of three physiographic provinces (Arctic Mountains, Arctic Foothills, and Arctic Coastal Plain) and on the extreme western Arctic coast from Cape Lisburne to Point Barrow. Although the extreme western Arctic coast traverses both the Arctic Coastal Plain and Arctic Foothills (Fig. 1), the birds observed there were listed separately from the provinces because of the greater frequency of stragglers along the open-water of this coast than that found inland and because the many years of ornithological investigations conducted from Cape Lisburne to Point Barrow have permitted more opportunities for recording unusual birds.

Birds Other than Waterfowl

Red-throated and Arctic loons are among the most numerous and conspicuous birds on the Arctic Slope. Of the two species, red-throated loons seem to be the most numerous; and although they both nest in the same areas, red-throated loons tend to nest nearer the coast than do the Arctic loons. Yellow-billed loons are occasionally seen, and common loons are rarely reported.

The rough-legged hawk is the most common raptor of the Arctic Slope. They and the less numerous peregrine falcons, gyrfalcons, and golden eagles are widely scattered along the escarpments and river bluffs of the foothills; and they are occasionally seen in the coastal plain and mountains.

Both rock and willow ptarmigans are found on the Arctic Slope. Although their ranges overlap considerably, willow ptarmigans tend to use coastal plains and foothills and rock ptarmigans tend to use foothills and mountains.

Sandhill cranes have been reported migrating across the mountains and foothills. Anderson (1913:471) believed that sandhill cranes nested on the coastal plain; however, there is no record of them breeding on the Arctic Slope.

Golden and black-bellied plovers, semipalmated, Baird's, and pectoral sandpipers, long-billed dowitchers, and red and northern phalaropes are among the most abundant Charadriiformes and birds of all the species found on the Arctic Slope.

Glaucous gulls, Sabine gulls, Arctic terns, parasitic, Pomarine, and long-tailed jaegers are commonly found along the coast and, for some species, inland through the foothills. Mew gulls are occasionally found in the foothills. Black-legged kittiwakes nest along the sea-cliffs near Cape Lisburne.

Common and thick-billed murres, horned and tufted puffins, and other sea-birds breed along the sea-cliffs near Cape Lisburne but diminish in numbers further north to Cape Beaufort where the sea-cliffs end. None of the Alcids are found along Alaska's Arctic coast east of Point Barrow.

Snowy owls and short-eared owls are found mainly on the coastal plains and particularly in areas having large lemming populations.

Lapland longspurs, Savannah sparrows, redpolls, tree sparrows, white-crowned sparrows, and snow buntings are among the most commonly encountered passerines of the Arctic Slope.

Waterfowl

The extensive mid-summer surveys by Hansen (1957) and King ([1967]) provide the best available estimates on populations of "breeding" waterfowl in the 23,000 square mile Arctic Coastal Plain (Table 2). Estimates of waterfowl in the less productive Arctic Foothills and Arctic Mountains is not available except for Canada geese which nest principally along rivers in the foothills and their population was estimated for the entire Arctic Slope. The population estimates in Table 2 are not adjusted to compensate for differential visibility of each species and, therefore, should be regarded as conservative and crude estimates. American widgeon and red-breasted mergansers were apparently missed during these surveys; and they and probably pintails, green-winged teal and eiders were both proportionately and numerically underestimated.

All surveys indicate low densities of "breeding" waterfowl on the Arctic Slope. Hansen's (1957) extensive survey indicated an average density of 3.1 ducks per square mile, and this was not greatly different from the low of 2.5 (Nelson 1949, 1951) and the high of 3.9 (Smith and Allen 1948) ducks per square mile reported in less extensive surveys.

Local densities, of course, are expected to depart from average densities. At Point Storkerson on 25 June 1969, I counted 46 waterfowl on approximately 1 square mile of habitat that included both tidal sloughs and fresh-water thaw lakes. The water-

fowl included 26 pintails, 7 king eiders, 4 oldsquaws, 1 widgeon, and 2, each, black brants, greater scaup, Steller's and spectacled eiders. Three red-throated loons, one Arctic loon, and many birds of other species were also in this area.

Whistling swans are widely reported but not numerous on Alaska's Arctic Slope. During the summer they are found scattered throughout the coastal plain but are found primarily on river deltas, near the coast, and in coastal lagoons. The Colville River delta and the Teshekpuk Lake area probably contain well over half of the Arctic Slope's swans. Early and recent reports of swans without broods suggest that either most of the Arctic Slope swans are nonbreeding or nesting is very unsuccessful, or both. Swan densities that I observed during 1968 in the area of the Mackenzie delta from Shingle Point to Baillie Island were much higher than those observed during 1969 in any portion of Alaska's Arctic Coast including the Colville delta. Swan surveys cannot be conducted as easily on the Arctic Slope as they are now done on the Yukon--Kuskokwim delta; the many bleached-white paper bags, cardboard boxes, and "Blazo" box-lids that have been strewn across the tundra during the years of petroleum exploration and the often numerous snowy owls can, at a distance, be mistaken for swans.

Canada geese are also widely reported but not particularly abundant on the Arctic Slope. King ([1967]):4 reported seeing molters along the coast from Smith Bay to the Canning River, but principally north of Teshekpuk Lake; he did not see a single brood. Bailey (1948:151-155) reports Canada geese breeding inland from Flaxman Island (along the Canning River?) to the Chipp and Meade Rivers near Barrow. Anderson (1913:468) reports them nesting along the coast from the Colville River east to Coronation Gulf. The greatest breeding concentration of Canada geese appears to be from 200 to 300 pairs reported by Nelson (1949:15-16) and Kessel and Cade (1958:3) that nest along the bluffs of the Colville River between the Kuna River and Ocean Point. Maher (1959) did not find either Canada or white-fronted geese in his study area on the upper Kaolak River, which is in the western foothills; and Angus Gavin (pers. comm.) reported seeing only one brood on the Kuparuk River during his reconnaissance of the Prudhoe Bay area during 1969. I did not see any Canada geese along the coast between the Sagavanirktok River Delta and Demarcation Bay between 31 July and 3 August 1969. Until surveys can be conducted along other major rivers I believe that it is unwise to assume that numbers of Canada geese are proportionately as numerous on the other major rivers of the Arctic Slope as on the Colville River, when in reality the bulk of breeding Canada geese may be restricted to the Colville River and possibly the Chipp and Meade River area. King's ([1967]:4) 15,000-bird extrapolation from Kessel and Cade's (1958:31) estimate for the Colville River may be excessive. The systematics of the Arctic Slope Canada geese is moot but has been discussed by Kessel and Cade (1958:31-33),

Gabrielsen and Lincoln (1959:117-120), Irving (1960:34-35), and Campbell (1967). Nelson (1953) described the cliff-nesting behavior of the geese along the Colville River.

Black brant are common along Alaska's entire Arctic coast. They breed both on the deltas of the largest rivers and near freshwater thaw lakes that are upwards of 20 miles from saltwater. Anderson (1913:469) reported brant to nest commonly on tundra in northern Alaska. Leffingwell (1919:64) considered brant to be numerous enough to constitute an important part of his food supply while living at Flaxman Island, and he said the best place to get black brant and white-fronted geese is between Smith and Harrison Bay, i.e. the area north of Teshekpuk Lake. Peter Sovalik (pers. comm.) who lived on the delta of the Sagavanirktok River from 1913 to 1934 said that the area north of Teshekpuk Lake is a traditional hunting ground for molting brant and "emperor geese" (white-fronted geese). Hansen (1957:6) reported 10,000 black brant in this same area. King ([1967]:4) estimated 25,000 molting, nonproductive black brant exclusively in this traditional molting area; elsewhere, all flocks of brant were with young. Nonproductive, molting flocks of brant have been reported elsewhere along the coast by other observers. Angus Gavin (pers. comm.) reported seeing several large flocks, up to 500 birds, of brant between the deltas of the Kuparuk River and Colville River during 1969; some flocks were without young. James W. Brooks and Averill S. Thayer (pers. comm.) reported a nonproductive flock of 400 brant at Camden Bay. King ([1967]:4-6) lucidly discussed the perplexing age structure of the Arctic Slope brant population. He points out that production (an estimated 5,000 young per 30,000 adult and sub-adults) is not sufficient to maintain the population and speculates that that brant produced along the west coast of Alaska or in Canada (or in Siberia) may congregate in the Cape Halkett area. Black brant migrate during the spring both along the coast (Bailey 1948:156-157) and through the mountain passes of the Brooks Range (Cade 1955, Irving 1960:35). Bailey (1944:157) says the fall migration starts in the Wainwright area by mid-August and concentrations occur during the first week of September in areas where "seaweed" is thrown upon the beaches by the wind. He reported "thousands" of brant near Cape Icy between September 6 and 10.

White-fronted geese are the most abundant of the geese on the Arctic Slope. King ([1967]:6) estimated their population at 50,000 birds, and Smith and Allen (1948:10) counted an average of 3 white-fronted geese per square mile along nearly 160 miles of aerial transects "south and east of Point Barrow". The area north of Teshekpuk Lake, between Smith and Harrison Bays, is also an important white-fronted goose nesting and molting area (Leffingwell 1919:64, Bailey 1944:161, Peter Sovalik pers. comm.). Angus Gavin (pers. comm.) reported seeing many white-fronted broods from the Kuparuk River to Oliktok and inland. Indirect band recoveries

in northern Alaska from birds banded at Kindersley, Saskatchewan, suggest that Arctic Slope whitefronts migrate to the west Texas coast (Miller et al 1968:105). Mertie and Smith (1930:92) and Peter Sovalik (pers. comm.) refer to "emperor geese" in the Colville River area but do not refer to white-fronted geese which I believe was the species they were discussing.

Snow geese are few in numbers on Alaska's Arctic Slope and a few of this small number breeds in scattered locations along the coast. Close to 1,000 snow geese (Hansen 1957:6, King [1967]: 6) molt in what appears to be a traditional molting area near Cape Halkett (Anderson 1913:467, Peter Sovalik pers. comm.). Except for an apparent snow goose colony near Point Barrow that has since been extripated (Bailey et al 1933:20) no nesting colony is found in Alaska. The few records of snow geese with young suggest that local production alone cannot account for the numbers of molting birds. Because of the small number of molting birds and the reported westward movements in early summer, most of the snow geese in Alaska are probably associated with the relatively small colonies on the Mackenzie River delta, or possibly those from the Perry River. The larger numbers of snow geese seen during the fall of 1969 feeding on the tundra of the western portion of the coastal plain were probably from Banks Island. Although some geese migrate south through the Brooks Range (Irving 1960:36), most probably go east along the coast and then follow the Mackenzie River drainage south. Because snow geese are not reported at Point Barrow during fall as during spring, I believe the Alaska snow geese from Cape Halkett eastward do not mix with Wrangell Island birds while in Alaska. Alaska's first blue goose will undoubtedly be observed on the Arctic Slope before being observed in southern and western Alaska. A broken or yet unestablished breeding tradition, coupled with a cold climate and probably severe avian predation, may be determining factors as to why Alaska does not have a snow goose colony.

Mallards are not abundant on the Arctic Slope, and there is only one questionable report of them breeding there (Nelson 1949: 16, Gabrielson and Lincoln 1959:144). Mallards are most frequently reported in the Colville River drainage and delta, although they have been reported elsewhere on the Slope.

Pintails are by far the most abundant summering species of dabbling duck on the Arctic Slope and, taking exception to Hansen's data (Table 2), probably second in numbers to only oldsquaws. Pintails are widely distributed in the coastal plain and foothills, but particularly near the coast where flocks of nonproductive adults concentrate for molt. Pintails do breed on the Arctic Slope, yet during the summer of 1969 I saw no broods and had the impression that most pintails were nonproductive. Nelson (1949:16) regarded pintails as the most abundant "game" duck but found no evidence of them breeding.

Green-winged teal are found along the many braided and incised streams and ponds in the mountains and foothills and, probably less frequently, on the coastal plain. Although teal are not abundant they were probably more numerous than the 150 indicated by aerial surveys (Table 2).

American widgeon are sparsely scattered throughout the North Slope and breeding there. They are possibly as numerous as green-winged teal.

Shovelers are seen occasionally on the Arctic Slope but probably number fewer than a 100 birds.

Greater scaup are found on lakes and even leaded streams throughout the Arctic Slope (Fig. 4, 5 & 6); and, taking exception to data in Table 2, they are probably the third most abundant species of ducks there. A few molting flocks were seen in coastal lagoons during August of 1969.

Lesser scaup seem to be restricted to the mountain passes and are not numerous there (Irving 1960:40-41). Because of the proximity of Old Crow Flats and the Mackenzie River delta which do have some lesser scaup, I would expect to find a few molting lesser scaup in the coastal lagoons near the U.S.--Canadian border.

Oldsquaws are by far the most abundant ducks breeding and summering throughout the Arctic Slope. An estimated 40,000 molting oldsquaws sought shelter from wind and sea-ice behind the barrier spits, reefs, and islands between just Demarcation Bay and the Sagavanirktok River (Fig. 9). Molting oldsquaws along the remainder of the protected coastline further west could conceivably increase the total to 100,000 birds. Only one female oldsquaw with a brood was seen during this survey, and she was not in a lagoon with the molting birds but, rather, up a river. Nelson (1949:17) reported oldsquaws to be the most common nesting duck in the Colville area. He saw no molting birds, and said that oldsquaws were easily flushed, except for females with young which would stay with broods even on the smallest ponds. Brooks (1915) believes that many of the oldsquaws molting in Alaska waters come from the Canadian Arctic. These limited observations of just molting birds suggest that a summering population of 150,000 oldsquaws might be a closer estimate than that of 53,350 birds from Table 2.

Harlequin ducks are nowhere common in the Arctic Slope but they are occasionally seen along the swift streams of the mountains and foothills.

Steller's eiders commonly nest along the Arctic coast. Although they may be the least abundant of the four species found there, the Arctic Slope population probably exceeds the 1,700-bird estimate for all species as is listed in Table 2. Steller's eiders also migrate along the coast to and from Canada.

Common eiders are apparently the Arctic Slope's most abundant summer-resident eider ducks. Leffingwell (1919:65) claimed that they would build nests only on the islands which fringe the coast and that nearly every island had a few nests; certain islands would have hundreds of nests (all common eiders?). Several hundred thousand common eiders also migrate along the Alaska coast to and from the Canadian Arctic.

King eiders breed along the entire coast and are possibly as numerous as common eiders. Leffingwell (1919:65) said that a few nests of king eiders and oldsquaws could be found by chance almost anywhere. Anderson (1913:465) said that they breed both in colonies on sandspits and islands and widely dispersed near freshwater ponds near the coast. Several hundred thousand king eiders migrate along Alaska's coast to and from the Canadian Arctic.

Spectacled eiders are reported by most observers to be fairly common nesters; but they are mainly found along the coast from the Colville River delta to Cape Halkett and to Cape Simpson. Spectacled eiders also migrate along the coast to and from Canada.

White-winged scoters are not common anywhere on the Arctic Slope even though they have been reported being in many places.

Surf scoters are the most numerous of the scoters. It breeds along the coast and has been reported summering throughout the Slope.

Red-breasted mergansers are common throughout the Arctic Slope and nest in the mountains, foothills, and possibly the coastal plain. Nelson (1949:17) saw pairs and singles almost everyday while he was on the Colville River.

American brants, emperor geese, Baikal teal, redheads, common goldeneyes, buffleheads, and common scoters are rarely encountered on the Arctic Slope. It is unusual that redheads which are seldom found in interior Alaska (Kessel and Springer 1966:186) were observed at Umiat (Baldwin [1953]:25, West and White 1966:302) rather than canvasbacks which breed in the Mackenzie delta, Old Crow Flats, and Yukon Flats, and have been observed in the Kotzebue Sound area.

Although there are many reports of waterfowl as summer-residents on the Arctic Slope there are inordinately fewer reports of them breeding. The literature and my impressions from this summer, suggest that Arctic Slope populations of several waterfowl species (swan, black brant, snow geese, pintails, oldsquaws, and probably others) are comprised of a large proportion of nonproductive birds. Except for possibly swans because of their longer life-span, local populations would disappear or require pioneering to be maintained if the productivity were as low as it appears. More than likely, however, many of the non-productive birds are coming as molters or displaced birds from elsewhere and are superimposed upon local

populations. The value of the Arctic Slope to waterfowl must not be related in terms of just "breeding" birds and young, but it should include its value to the unsuccessful breeding adults, non-breeding adults and sub-adults, and migrants.

Avian and mammalian predation of waterfowl nests is undoubtedly important in some years and may be particularly important in the case of colonial nesting species. During the summer of 1969 I saw many glaucous gulls, parasitic, pomarine, and long-tailed jaegers, and snowy owls along the coast and some inland in the foothills, all of which could prey upon eggs, and young, and occasionally adult-birds. Arctic and red foxes are found on much of the Arctic Slope. James W. Brooks (pers. comm.) saw several weasels near Pt. Storkersen in August 1969. Peregrines and gyrfalcons may locally affect waterfowl; but because their numbers are so few and in such peril and because ptarmigan are more often their prey, their impact is inconsequential. Anderson (1913:461) notes that eiders suffer predation when nesting alone, but when they and Arctic terns occupy the same "rookery" the ducks usually hatch unless disturbed by man. He (p. 458) also reports that large quantities of eggs of gulls and eiders are destroyed by jaegers. Reindeer and their herdsmen are believed to have eliminated snow geese from near Point Barrow which were reported to have been common (Dailey et al 1933:20).

The cold climate of Alaska's Arctic Slope is an important factor determining bird distribution and densities and affecting their survival and production. The relatively low densities of waterfowl along Alaska's Arctic Coastal Plain, when compared with the higher densities found in nearby and somewhat similar habitats, are attributed to its cold climate (Smith and Allen 1948:3, King [1967]:3). Prolonged low temperatures and sudden cold snaps during nesting season seriously affect waterfowl production throughout a species's range and particularly at the northern periphery of its range. Unusually low temperatures in the spring frequently cause the deaths by starvation of eiders in the Arctic (Myres 1958) and caused the loss of an estimated 100,000 eiders, mostly males, in the Alaska and Canadian Arctic during spring of 1964 (Barry 1968). Snow and near freezing temperatures prevailed during much of August 1969 on the Arctic Slope and may have caused mortality to some ducklings. Adult and young birds alike may perish during the fall freeze which may come early some years. Stefansson (1913:55) reported his boat being frozen in for the winter on 7 September 1908 at Smith Bay on the Arctic Coast.

The isotherms for the mean daily maximum temperatures in July show that during the summer the Arctic Coastal Plain is colder than either the foothills or mountains and colder than nearby waterfowl production areas (Fig. 10). These differences in temperatures results in ponds and lakes of comparable morphometry and head buggets becoming ice-free at earlier dates in the foothills and mountains than those in the coastal plain. As of 25 June 1969, most

of the largest lakes in the vicinity of and including Teshekpuk Lake on the coastal plain were ice-bound; but, as in Fig. 3, the small lakes and marshes in this same area were free from ice and being used by many waterfowl and loons. During this same period large lakes near Sagwon in the foothills were free from ice and used by waterfowl (Fig. 6). Griffin (1948:2) reported that almost all of the birds he saw on flights between Teshekpuk Lake and Oliktok Point from June 4 to 21, 1969, were concentrated into the river valleys and, especially, the mouths of rivers. Such concentrations are usually observed in these areas of earliest breakup.

Eskimos have traditionally hunted eiders and other ducks at Point Barrow (Leffingwell 1919:64, Myres 1958, Thompson and Person 1963). Most hunting occurs in July and August when the estimated 1,000,000 adult eiders stream along the coast from the Alaska and Canadian Arctic breeding grounds to yet unknown molting areas somewhere in the Bering Sea. King and common eiders are the most abundant species and are preferred by these Eskimos. Three teenage boys that I observed hunting at the "eider pass" would not waste their expensive shells on the small, fast-flying oldsquaws; but they would shoot unhesitatingly, and quite inaccurately, at eiders (Fig. 11). During their shoot they bagged an Arctic loon (Fig. 12) which was probably identified only after retrieval because they subsequently passed up several good shots at other loons. Eskimos at Kaktovik on Barter Island were hunting oldsquaws during August 1969. Black brant are apparently hunted both spring and fall along the western coast near Icy Cape, Wainwright and in Peard Bay. Eskimos once hunted white-fronted geese, snow geese, and black brant in traditional molting lakes north of Teshekpuk Lake (Leffingwell 1919:64, Anderson 1913:467, Peter Sovalik pers. comm.). And egging was commonly practiced on islands in the Sagavanirktok River (Peter Sovalik pers. comm., Leffingwell 1919: 65). Local hunting pressures, at the present, are neither excessive nor limiting waterfowl populations in this region.

IMPACT OF PETROLEUM DEVELOPMENT UPON BIRDS

Oil pollution is the greatest threat to the bird resource of the entire Arctic region. Crude oil and petroleum products are damaging to both birds and their habitat regardless of whether they come from leaking pipelines, leaking steel barrels, leaking well-heads, leaking off-shore platforms, leaking storage tanks, leaking sump pits, leaking tankers, or as bilge pumped from tankers. "Leak" is the key word in describing the impact of oil development on birds of Alaska's Arctic Slope. Without leaks the impact can be tolerable; with leaks the impact could be disastrouc. Oil films were seen on thaw lakes next to Sinclair--British Petroleum's Ugnu-1 (Fig. 13) and Atlantic-Richfield's "7-10-14" test wells during the summer 1969. "Empty" barrels dumped on the ice after winter operations pollute waterfowl habitat (Fig. 14)

Pollution, whether it be through negligence, by accident, or deliberate, will increase with the expanded development and exploration. Birds using the coastal waters and the narrow fringe of tidal habitat are most threatened by uncontained spills. The vast numbers of eiders (more than 1,000,000) and oldsquaws (probably more than 300,000) migrating past and summering on Alaska's northern coast are particularly threatened by a fate similar to that reported by Uspenskii (1964:175) where more than 30,000 oldsquaws perished in an oil slick near Gotland Island in the Baltic Sea.

Although esthetically unpleasant and potentially hazardous to man's health, a "little bit" of either raw or treated domestic sewage may enhance a lake's use by waterfowl and shorebirds in some southern areas; however, on the Arctic Slope it may prove detrimental. "Large amounts" of sewage could preclude waterfowl use in some lakes. To my knowledge, plankton and benthos have not been studied in fertilized Arctic waters where the ice-free period is much shorter, the mean temperatures are colder but the day-length is longer than in southern areas. Fertilized lakes to the south, such as sewage lagoons and sewage-fed marshes, develop a plankton bloom after break-up; the plankton, as such, is eaten by some birds or it provides food for organisms higher in the food chain which is then used by birds. Use of fertilized lakes may be nil for several weeks following breakup, but they should receive proportionately greater use than adjacent lakes from late July until freeze-up in early September.

Solid wastes, although esthetically undesirable, probably will not be detrimental to birds. Garbage dumps will attract glaucous gulls, mew gulls, and ravens; and consideration should be given as to their location in relation to airstrips so as to avoid bird-aircraft collisions. Some forms of solid wastes such as piles of oil drums, abandoned buildings, and discarded construction material will probably create new nesting habitat for some species while at the same time destroy habitat for others. Discarded oil drums that still contain some of their original contents pose a pollution hazard (Fig. 14).

Gravel has become a valuable resource on the Arctic Slope because it is required in tremendous quantities for almost all types of construction. Gravel is now obtained from streams and rivers (Fig. 15), but its removal may be of greater detriment to fish than birds. Gravel may soon be taken from the beaches, spits, reefs, and offshore islands along the coast, which now afford thousands of molting oldsquaws, greater scaup, eider ducks, and black brants with protection from the winds and sea-ice (Fig. 9) and which are nesting sites for glaucous gulls, Sabine's gulls, eiders, and Arctic tern. Permits should be required, and their issuance dependent upon wildlife values, for each gravel site.

Large and conspicuous birds, such as swans, peregrine falcons, gyrfalcons, and rough-legged hawks and colonial-nesting birds will probably suffer most through disturbance from man's intrusions into their breeding grounds. Man's activity, whether it be travel, construction or residence, may not be tolerated by some species, such as possibly the whistling swan; but on the other hand, it may attract other birds of species that are cosmopolitan in behavior. Birds nesting along the narrow fringe of coast (Fig. 16) are particularly vulnerable because their ecological requirements are demanding and their habitat is limited. Transportation routes, roads or pipelines, should not closely parallel the coast. Considerations in planning and development should be given first to those species requiring wilderness or to those whose ecological requirements are inflexible because they will be the most affected by the impending change.

Because of the trenching effect of bulldozed seismic trails and poorly constructed haul-roads, accelerated erosion and gullying may occur on steeper slopes and silting may occur in the lakes in which the run-off empties (Fig. 16, 17 & 18). Drainage of some thaw lakes will be hastened when the dynamically growing lakes and trenches join together permitting drainage along the trench either into or out of the lake.

All construction must be planned so as to minimize its effect upon any water system.

RECOMMENDATIONS

Although the Arctic National Wildlife Range receives considerable use along the coast from many molting ducks and migrant eiders and geese, it contains little of the important coastal plain that is so important to waterfowl production. In order to protect valuable waterfowl breeding and molting areas and to preserve some of this Arctic Coastal Plain in near pristine condition, I recommend that the Bureau and the Alaska Department of Fish and Game give early consideration to establishing a wildlife range of special waterfowl management area from Teshekpuk Lake north to the coast and between Smith and Harrison Bays and south along the coast from Cape Halkett down to and including the Colville River delta (Fig. 1). Exact boundaries should be drawn after consulting with all interested and informed parties.

On the Arctic coast where lunar and solar tides are less than a foot and wind tides a bit higher, the tidal land is extremely narrow and small in comparison to that of the Yukon-Kuskokwim delta. This habitat must be recognized by the State as a special management unit or by the Federal Government as a National Estuary because it is extremely important to those animals using or restricted to this ecological niche.

In order to protect and manage the birds of the Arctic Slope, additional information is required on their numbers, breeding status, productivity, spatial and seasonal distribution, and habitat requirements. Existing information is fragmentary and perhaps inaccurate or misleading. The waterfowl habitat that could be most seriously affected by the oil development is the limited narrow fringe of coastal habitat; its full importance should be ascertained by extensive spring-through-fall studies. The origin of the molting snow geese, black brant, and other geese, north of Teshekpuk Lake warrant banding efforts by the Division of Management and Enforcement. Intensive studies of waterfowl species at the northern periphery of their range, although unquestionably more difficult than in the center of their range, could possibly demonstrate more readily those environmental factors regulating production and survival.

Personnel from the Division of Management and Enforcement should make regular inspection or surveillance flights over the area of oil development and exploration and along the coast to determine if migratory birds are being safeguarded, to determine if deficiencies exist in regulations, to advise the Bureau, State and industry of potential hazards to wildlife, and to enforce federal regulations.

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Table 1. A checklist of birds observed in the Arctic Mountains (north of the divide), Arctic Foothills, and Arctic Coastal Plain Physiographic Provinces, and along the extreme western Arctic Coast from Cape Lisburne to Point Barrow, all in Alaska.

Mountains	Foothills	Cstl. Plain	N. Coast	Species
X		X		Common Loon
X	X	X	X	Yellow-billed Loon
X	X	X	X	Arctic Loon
X	X	X	X	Red-throated Loon
		X		Red-necked Grebe
X		X	X	Horned Grebe
		X		Black-footed Albatross
		X		Pacific Fulmar
		X	X	Slender-billed Shearwater
		X		Pelagic Cormorant
X	X	X	X	Whistling Swan
X	X	X	X	Canada Goose
X	X	X	X	Black Brant
		X		American Brant
		X		Emperor Goose
X	X	X	X	White-fronted Goose
X		X	X	Snow Goose
X	X	X	X	Mallard
X	X	X	X	Pintail
X	X	X	X	Green-winged Teal
		X		Baikal Teal
X	X	X		American Widgeon
X	X	X	X	Shoveler
	X			Redhead
X	X	X	X	Greater Scaup
X				Lesser Scaup
X				Common Goldeneye
		X		Bufflehead
X	X	X	X	Oldsquaw
X	X	X		Harlequin Duck
		X	X	Steller's Eider
		X	X	Common Eider
		X	X	King Eider
		X	X	Spectacled Eider
X	X	X	X	White-winged Scoter
X	X	X	X	Surf Scoter
			X	Common Scoter
X	X	X	X	Red-breasted Merganser
			X	Goshawk
X	X	X	X	Rough-legged Hawk
X	X	X	X	Golden Eagle
			X	Bald Eagle
		X	X	Marsh Hawk
			X	Osprey
X	X	X	X	Gyrfalcon
X	X	X	X	Peregrine Falcon
X	X	X		Pigeon Hawk
X		X	X	Sparrow Hawk
X	X	X	X	Willow Ptarmigan
X	X	X	X	Rock Ptarmigan
X	X	X	X	Sandhill Crane
X	X	X	X	Semipalmated Plover
	X		X	Killdeer
			X	Dotterel
X	X	X	X	American Golden Plover
X	X	X	X	Black-bellied Plover
X	X	X	X	Ruddy Turnstone
X	X	X		Common Snipe
X	X	X	X	Hudsonian Whimbrel
			X	Siberian Whimbrel
		X		Bristle-thighed Curlew
			X	Eskimo Curlew
X				Upland Plover
	X	X		Spotted Sandpiper
X		X		Solitary Sandpiper
X				Wandering Tattler
X	X			Lesser Yellowlegs
		X	X	Knot
X	X	X	X	Pectoral Sandpiper
X		X	X	White-rumped Sandpiper
X	X	X	X	Baird's Sandpiper
X	X			Least Sandpiper

Mountains	Foothills	Cstl. Plain	N. Coast	Species
			X	Rufous-necked Sandpiper
			X	Curlew Sandpiper
X	X	X	X	Dunlin
X	X	X	X	Long-billed Dowitcher
X	X	X		Stilt Sandpiper
X	X	X	X	Semipalmated Sandpiper
			X	Western Sandpiper
X	X	X	X	Buff-breasted Sandpiper
X	X	X	X	Bar-tailed Godwit
			X	Hudsonian Godwit
X		X	X	Sanderling
			X	Spoon-bill Sandpiper
X	X	X	X	Red Phalarope
X	X	X	X	Northern Phalarope
X	X	X	X	Pomarine Jaeger
X	X	X	X	Parasitic Jaeger
X	X	X	X	Long-tailed Jaeger
X	X	X	X	Glaucous Gull
			X	Iceland Gull
			X	Slaty-backed Gull
X	X	X	X	Herring Gull
X	X	X	X	Mew Gull
		X	X	Ivory Gull
		X	X	Black-legged Kittiwake
			X	Ross' Gull
	X	X	X	Sabine's Gull
X	X	X	X	Arctic Tern
			X	Common Murre
			X	Thick-billed Murre
			X	Dovekie
			X	Black Guillemot
			X	Kittlitz's Murrelet
			X	Parakeet Auklet
			X	Crested Auklet
			X	Least Auklet
			X	Horned Puffin
			X	Tufted Puffin
			X	Great Horned Owl
X	X	X	X	Snowy Owl
X	X	X	X	Short-eared Owl
X				Boreal Owl
			X	Common Nighthawk
		X	X	Yellow-shafted Flicker

Mountains	Foothills	Cstl. Plain	N. Coast	Species
		X	X	Eastern Kingbird
X	X		X	Say's Phoebe
		X		Hammond's Flycatcher
			X	Western Wood Pewee
X	X	X	X	Horned Lark
			X	Violet-Green Swallow
X		X	X	Tree Swallow
X	X		X	Bank Swallow
X			X	Barn Swallow
	X		X	Cliff Swallow
X	X	X		Gray Jay
X	X	X		Common Raven
X			X	Black-capped Chickadee
		X		Gray-headed Chickadee
X				Dipper
			X	Alaska Winter Wren
X	X	X	X	Robin
			X	Varied Thrush
			X	Hermit Thrush
X	X	X	X	Gray-cheeked Thrush
			X	Mountain Bluebird
X	X		X	Wheatear
X	X	X	X	Bluethroat
X	X		X	Arctic Warbler
X		X		Ruby-crowned Kinglet
X	X	X	X	Yellow Wagtail
X	X	X	X	Water Pipit
X	X	X		Northern Shrike
			X	Orange-crowned Warbler
X	X		X	Yellow Warbler
		X		Magnolia Warbler
X		X	X	Myrtle Warbler
		X		Northern Waterthrush
		X		MacGillivray's Warbler
X	X	X	X	Wilson's Warbler
			X	Red-winged Blackbird
X	X	X	X	Rusty Blackbird
			X	Brewer's Blackbird
			X	Common Grackle
			X	Western Tanager
			X	Scarlet Tanager
X				Gray-crowned Rosy Finch
X	X	X	X	Hoary Redpoll

Mountains	Foothills	Cstl. Plain	W. Coast	Species
X	X	X	X	Common Redpoll
X				Pine Siskin
		X		White-winged Crossbill
X	X	X	X	Savannah Sparrow
X	X	X	X	Slate-colored Junco
X	X	X	X	Tree Sparrow
			X	Chipping Sparrow
X	X	X	X	White-crowned Sparrow
X			X	Golden-crowned Sparrow
X	X		X	Fox Sparrow
X	X	X	X	Lapland Longspur
X	X		X	Smith's Longspur
X	X	X	X	Snow Bunting

Table 2. Estimates of "breeding ducks" (Hansen 1957) and "breeding, nonproductive, and young swans, geese, and brant" (King 1967) are for the Arctic Coastal Plain but do not include either the Arctic Mountains or Foothills. These data do not include certain duck species found on the Arctic Slope and probably underestimate others. In addition to the numbers estimated, vast numbers of ducks, particularly eiders and oldsquaw, migrate across the Arctic Slope into Canada or molt on the Arctic Slope.

	Waterfowl populations	
Species	"Breeding"	"Breeding, nonproductive and young"
Whistling Swan		800
Canada Goose		15,000
Black Brant		35,000
White-fronted Goose		50,000
Snow Goose		1,000
Mallard	150*	
Pintail	4,250*	
Green-winged teal	150*	
Scaup	14,250*	
Oldsquaw	53,350*	
Eiders	1,700*	
Scoters	3,850*	

*Hansen's (1957:3) data are based upon 95% waterfowl observed on the Arctic Slope and 5% observed on the Kenai-Susitna area, which could not be segregated for this presentation; 350 goldeneyes and 150 buffleheads that were included in his data are not presented in this table because of the improbability of them being found on the Arctic Coastal Plain.

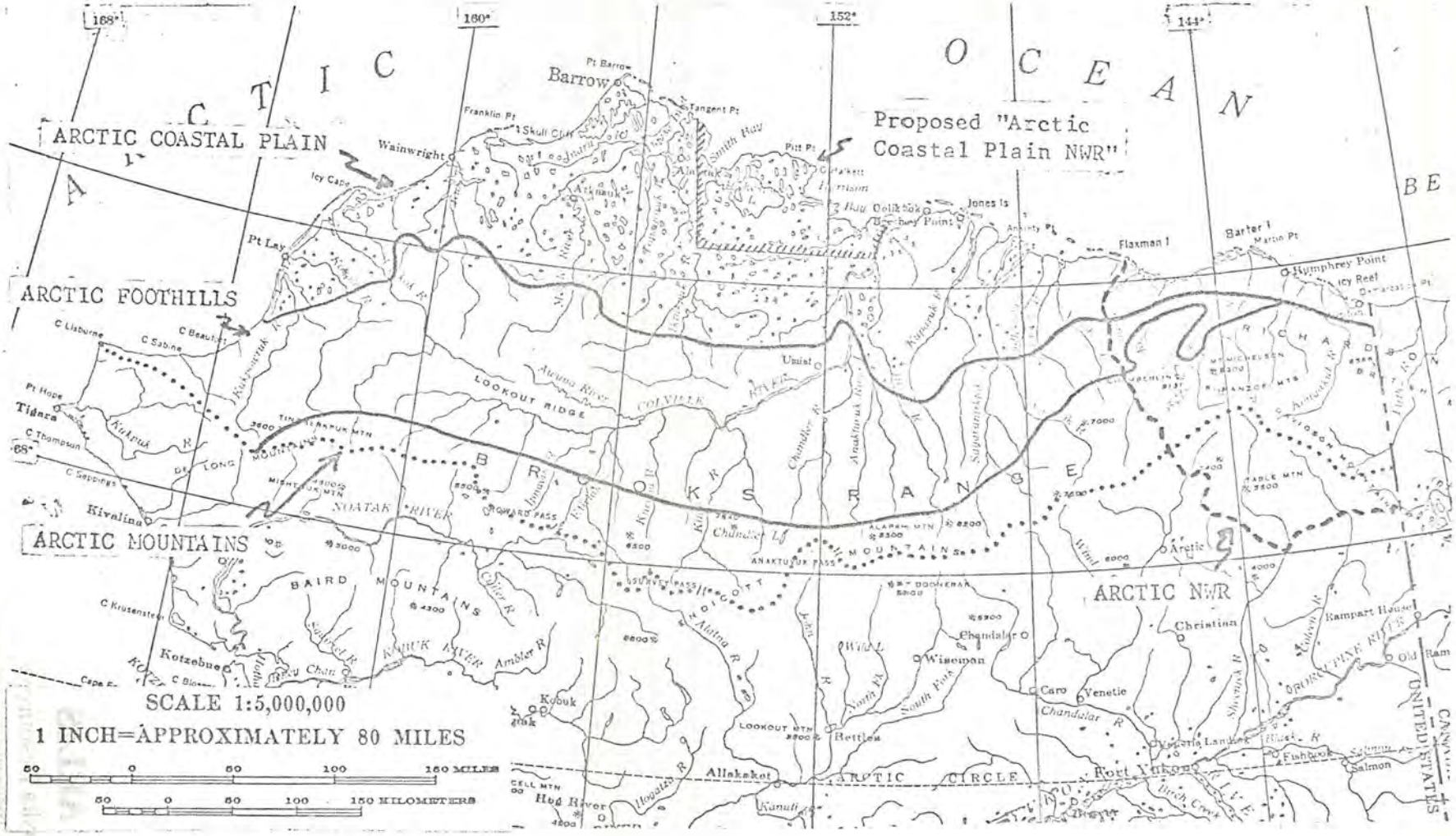

Fig. 1. The Arctic Slope includes the Arctic Mountains north of the divide (dotted line), Arctic Foothills, and Arctic Coastal Plain pysiographic regions (modified from Wahrhaftig 1965). The Arctic National Wildlife Range and a proposed "Arctic Coastal Plain National Wildlife Range" are deliniated.