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AN IMPORTANT EARLY-AUTUMN STAGING AREA FOR PACIFIC FLYWAY BRANT: KASEGALUK LAGOON, CHUKCHI SEA, ALASKA

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Abstract.—During summer-autumn 1989–1991, systematic aerial surveys of Kasegaluk Lagoon were conducted. This is a little-known region of the Chukchi Sea coast of Alaska where existing oil and gas leases are expected to be developed in the future. The results of these surveys are important because they document exceptionally large concentrations of Brant (*Branta bernicla*) using the lagoon as an autumn staging area. About 40% (58,196 of 146,012), 15% (19,406 of 127,378) and 49% (54,626 of 110,511) of the estimated total Pacific Flyway populations of Brant were present in the lagoon during peak periods (late August or early September) in autumn 1989, 1990 and 1991, respectively. Large quantities of green algae (probably *Ulva fenestrata*) probably attracted Brant to feed in this area.

LA LAGUNA DE KASEGALUK, MAR DE CHUKCHI, ALASKA, LUGAR IMPORTANTE DURANTE LA MIGRACIÓN OTOÑAL PARA LA POBLACIÓN DE LA RUTA MIGRATORIA DEL PACÍFICO DE INDIVIDUOS DE *BRANTA BERNICLA*

Sinopsis.—Durante el verano y el otoño de 1989–1991, se llevó a cabo una encuesta aérea sistemática de la laguna Kasegaluk. Esta es una región poco conocida de la costa del Mar de Chukchi en Alaska, en donde se espera que se desarrolle, en un futuro cercano, la explotación de depósitos de gas y petróleo. Los resultados de los censos aéreos son de gran importancia porque documentan la presencia (en grandes números) el ganso de Brant (*Branta bernicla*) en la laguna Kasegaluk durante el otoño. Cerca del 40% (58,196 de 146,012), 15% (19,406 de 127,378) y el 49% (54,626 de 110,511) de la población total estimada de la Ruta Migratoria del Pacífico, se encontraron presentes en la laguna, durante los períodos de mayor incidencia (finales de agosto o principios de septiembre) en el otoño de 1989, 1990 y 1991, respectivamente. Probablemente grandes cantidades de algas verdes (aparentemente *Ulva fenestrata*) atrajeron a las aves a dicha localidad.

Arctic migrant geese depend on highly productive staging areas as refueling stops during spring and autumn migration (Gill et al. in press, Johnson and Herter 1990, Owen and Gullestad 1984, Patterson 1974, Sedinger and Bollinger 1987, Wypkema and Ankney 1979). Izembek Lagoon (55°30′N, 163°W), on the Alaska Peninsula of North America, is known to support virtually the entire population of Pacific Flyway Brant (*Branta bernicla*) for 7–9 wk during autumn migration (Dau 1992, Einarson 1965), but little is known of other autumn staging locations for Brant in Alaska. This study reports on the use of Kasegaluk Lagoon, Chukchi Sea, Alaska, as an important autumn staging area by large numbers of Pacific Coast Brant.

STUDY AREA

Kasegaluk Lagoon is situated along the northeast coast of the Chukchi Sea in Alaska (Fig. 1). The Inupiaq community of Point Lay is located

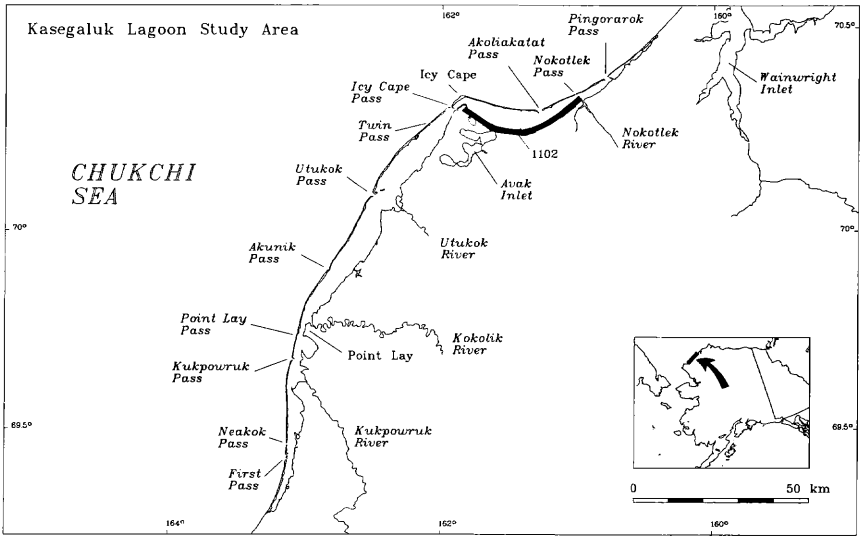

FIGURE 1. Kasegaluk Lagoon study area, Chukchi Sea, Alaska.

on the mainland shore of the lagoon, and Icy Cape is a prominent coastal feature along the outer coast of the lagoon. In total, the lagoon is about 200 km long, 135 km from the extreme southwest end to Icy Cape, and 65 km from Icy Cape to the extreme northeast end. North of Icy Cape the general orientation of the coastline changes from north-south to east-west and the lagoon is deeper and clearer, and appears to be more closely tied to the marine system than to the region south of Icy Cape (Fig. 1).

Five major rivers or inlets drain into Kasegaluk Lagoon: the Nokotlek River and Avak Inlet flow into the northern part, and the Utukok, Kokolik, and Kukpowruk rivers drain into the southern part. Barrier islands of silt, sand and gravel shelter the entire length of Kasegaluk Lagoon except where passes allow an exchange of water between the lagoon system and the Chukchi Sea. In total, 11 passes breach the barrier islands: eight southwest of Icy Cape and three northeast of Icy Cape (Fig. 1). Other details about the oceanography, hydrology and physiography of the lagoon are given in Johnson et al. (in press).

Habitats in the study area are of four general types. *Mainland shoreline* consists of coastal tundra interspersed with ponds, lakes, streams, salt and freshwater marshes, rivers, and river deltas. Salt marsh habitats were more extensive east of Icy Cape, compared to areas south of there. The lagoon margins of this habitat are primarily sand or mud beaches. During low-water this habitat is continuous with adjacent mud and sand flats. No eelgrass (*Zostera marina*) was seen from the aircraft and none was found on the beach during the one brief stop in 1990. *Mid-lagoon* habitats are relatively uniform throughout the study area. Except for the shallow salt marsh and mudflat areas east of Icy Cape, and the area at the extreme

southern end of the study area, both of which are exposed during low-water, this habitat consists exclusively of lagoon waters. *Barrier island* habitats consist mainly of sand and gravel beaches and beach ridges. *Nearshore marine* habitats consist of shallow Chukchi Sea waters and ocean beaches seaward of the lagoon. This habitat is relatively uniform along the entire length of the study area except adjacent to the passes and near the shoals extending seaward from Icy Cape.

METHODS

Strip surveys were conducted from an aircraft in each of the four habitat types in the Kasegaluk Lagoon study area. Each of these survey strips was approximately 200 km in length, and was subdivided into six shorter transects of approximately equal length. Each transect was further subdivided into 1-min time intervals that corresponded to about 3 km at a survey speed of approximately 175 km/h. Each complete survey of the study area lasted approximately 4–5 h. Replicate surveys were conducted on most occasions (see dates in Table 1); if weather permitted we conducted the surveys on consecutive days. Aside from a brief stop near Nokotlek Point on 22 Aug. 1990, no ground-based investigations were conducted.

Surveys were conducted from a float-equipped Cessna 206 with an ARNAV-50 long-range navigation (LORAN) system. One observer was seated in the front right and one was seated in the rear left of the aircraft. All surveys were conducted at an altitude of approximately 45 m ASL and at a ground speed of approximately 175 km/h, which is a standard procedure for accurately surveying marine birds from the air (Bradstreet 1979, McLaren 1982). Observers dictated into portable tape recorders all sightings made on-transect (within a 200 m strip on each side of the aircraft) and off-transect (beyond the transect strip). Information recorded included systematic details about the transect and about each sighting. More details about the survey methods are given in Johnson et al. (in press).

Brant often flushed well ahead of the survey aircraft and it was sometimes difficult to determine whether they were actually on- or off-transect when first sighted. For this reason, results are presented as geese/km, rather than geese/km^2.

RESULTS

The timing of Brant abundance in the study area was different during the 3 yr of surveys. In 1989 the peak of Brant abundance was on 24 and 26 August, and most birds had migrated out of the study area by 11 September (Table 1). In 1990 no surveys were conducted in late August and the peak numbers of Brant were recorded on 8 and 10 September. The peak of Brant abundance in 1991, as in 1989, was during the last week of August. Average peak counts for the entire study area in 1989, 1990 and 1991 were 58,196, 19,406 and 54,626, respectively (Table 2).

The distribution of Brant was similar during all 3 yr of surveys. Most

TABLE 1. Numbers of Pacific Flyway Brant recorded at Kasegaluk Lagoon, Chukchi Sea, Alaska, 1989–1991.

Survey dates	Total number on + off transect	Transect 1102	
		Number	% of total
24 Aug. 1989	63,256	41,680	65.9
26	53,135	36,667	69.0
3 Sep.	15,854	7005	44.2
4	8998	1829	20.3
11	2675	696	26.0
27 Jul. 1990	1238	40	3.2
28	1361	300	22.0
11 Aug.	10,834	8918	82.3
12	13,535	8957	66.2
22	6596	1368	20.7
23	10,530	6590	62.6
8 Sep.	25,683	7484	29.1
10	13,129	5474	41.7
30 Jul. 1991	851	0	0.0
1 Aug.	995	0	0.0
26	54,626	48,578	88.9

sightings were in the northeastern section of Kasegaluk Lagoon, east and northeast of Icy Cape. In 1989 most sightings were on or adjacent to one mainland shoreline transect (Transect 1102) between the Nokotlek River and Icy Cape (Fig. 2). In 1990 Brant were distributed more widely in barrier island and mainland shoreline habitats, i.e., southwest as well as east and northeast of Icy Cape (Fig. 2). In 1991, as in 1989, the great majority of Brant sightings were along the mainland shoreline between the Nokotlek River and Icy Cape (Fig. 2). Peak densities of 3360–4643

TABLE 2. Counts of Pacific Flyway Brant at various locations in relation to peak counts at Kasegaluk Lagoon, Chukchi Sea, Alaska, 1989–1991.

Year	Counts of Pacific Black Brant					
	Mid-winter (WA State to W. Mexico)	Izembek NWR, Alaska (Oct.–Dec.)	Teshekpuk Lake, Alaska[a] (Mid-Jul.)	Kasegaluk Lagoon, Alaska		
				Average peak #	% of mid-winter[b]	% of Izembek[c]
1989	146,012	142,037	13,701	58,196	39.9	41.0
1990	127,378	123,182	23,395	19,406	15.2	15.8
1991	110,511	125,831	12,574	54,626	49.4	43.4
1989–1991 average	127,967	130,350	16,557	44,076	34.4	33.8

[a] Teshekpuk Lake counts are from King and Butler (1990) and King and Bollinger (1992).
[b] Mid-winter counts for 1989–1991 were conducted in Jan.–Feb. of 1990–1992 (Bartonek 1992).
[c] Izembek NWR counts are from Dau (1989, 1990, 1991).

Brant/linear km were recorded during 1-min transect segments on 24 Aug. 1989 and 26 Aug. 1991 on Transect 1102. Over 40,000 Brant were recorded on Transect 1102 during peak counts in both 1989 and 1991 (Table 1), and a few flocks exceeded 9000 birds. Peak counts and flock sizes were much smaller in 1990.

About 70% of Brant sightings in 1989 were in lagoon habitats, mainly along the mainland-lagoon margin and the barrier island-lagoon margin. A relatively large proportion (11.8%) of sightings in 1989 was also recorded seaward of the barrier islands, in nearshore marine (ocean) habitats. In 1990 a markedly smaller proportion of Brant sightings was recorded in lagoon habitats vs. beaches on the seaward sides of the barrier islands (4.2% vs. 42.8%). In 1991, as in 1989, the largest proportion of Brant sightings (85.4%) was in lagoon habitats, mainly along the mainland shoreline.

DISCUSSION

About 40%, 15% and 49% of the estimated total Pacific Flyway populations of Brant (based on mid-winter counts) were present in the Kasegaluk Lagoon study area during peak periods in 1989, 1990 and 1991, respectively (Table 2). Daily turnover rates of birds were not measured, so an even greater proportion may have used the area. The estimates of numbers of Brant in Kasegaluk Lagoon far exceed the numbers estimated at the Teshekpuk Lake molting area in 1989 and 1991 (Table 2). This suggests that in some years a large proportion of the Brant staging in Kasegaluk Lagoon may be from Arctic Alaska, Canada and/or Russia.

The Pacific Flyway population of Brant currently consists of about 116,000–121,000 birds (Bartonek 1992, Dau 1991) from large nesting colonies in subarctic Western Alaska, and smaller colonies in Arctic East Siberia, Arctic Alaska and Western Arctic Canada (Bellrose 1980). Many non-breeding and failed-breeding birds from western Alaska and colonies farther north undertake a mid-summer molt-migration to the Beaufort Sea coast of Alaska (Derksen et al. 1979, King 1970). Thus, many Pacific Flyway Brant may begin their autumn migration well north of some of the largest nesting colonies in Western Alaska, and the migration may involve several forms (Boyd et al. 1988, Reed et al. 1989a,b).

The autumn migration of Pacific Coast Brant may be broken down into two major legs. The first leg is from northern nesting or molting areas to the tip of the Alaska Peninsula, where virtually the entire population feeds for 7–9 wk (Reed et al. 1989b) in the rich eelgrass beds at Izembek and Moffett lagoons. The second leg is to wintering areas mainly along the west coast of Mexico (Bellrose 1980, Dau 1992, Einarson 1965, Ward et al. 1992).

Previous to this study, Kasegaluk Lagoon was not known to be a major fall staging area for migrant Brant. It was known, however, that thousands of Brant migrated northward through the Kasegaluk Lagoon system during July (Lehnhausen and Quinlan 1982), apparently *en route* from subarctic nesting colonies in western Alaska to molting areas on the

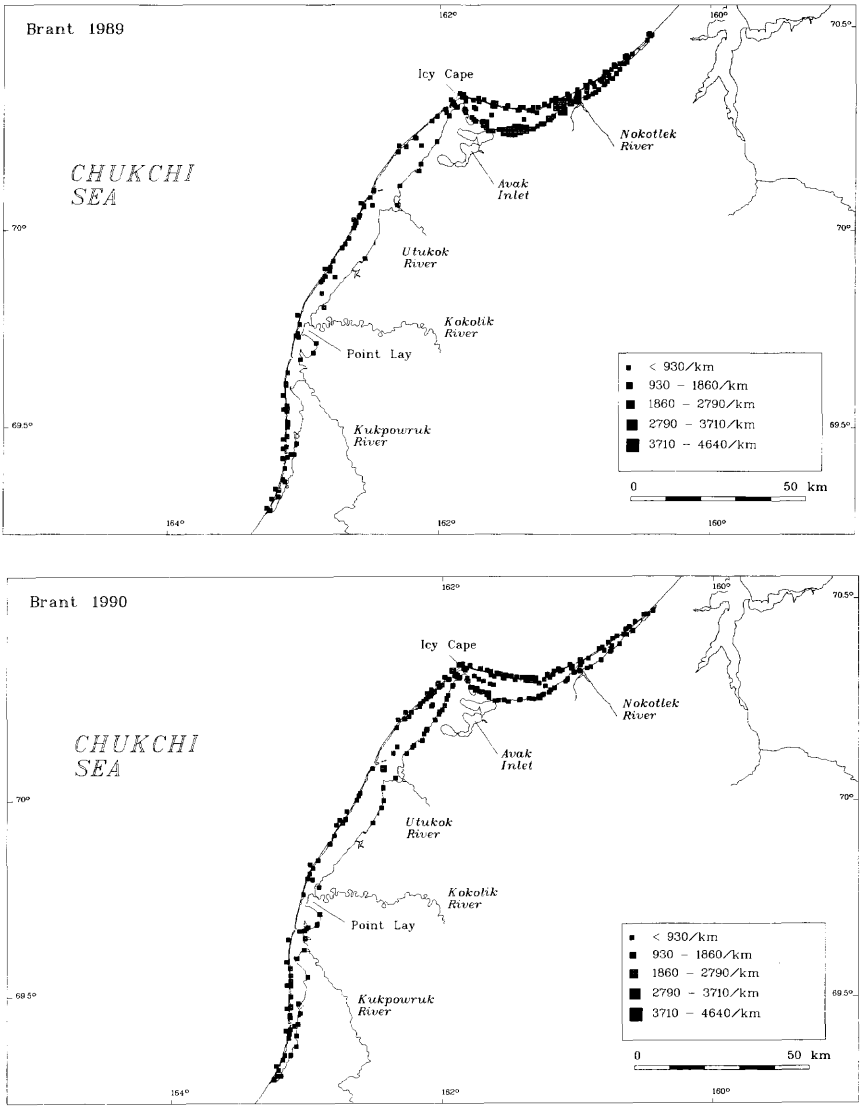

FIGURE 2. Summaries of Brant densities (geese/km) on 1-min transect segments in Kasegaluk Lagoon, Alaska, July–September 1989–1991.

Beaufort Sea coast (Derksen et al. 1979, King 1970). As few Brant were seen migrating along the coast north of Kasegaluk Lagoon, Lehnhausen and Quinlan (1982) speculated that the last part of this migration was primarily by an overland route.

It is currently unclear whether the autumn migration of Brant from

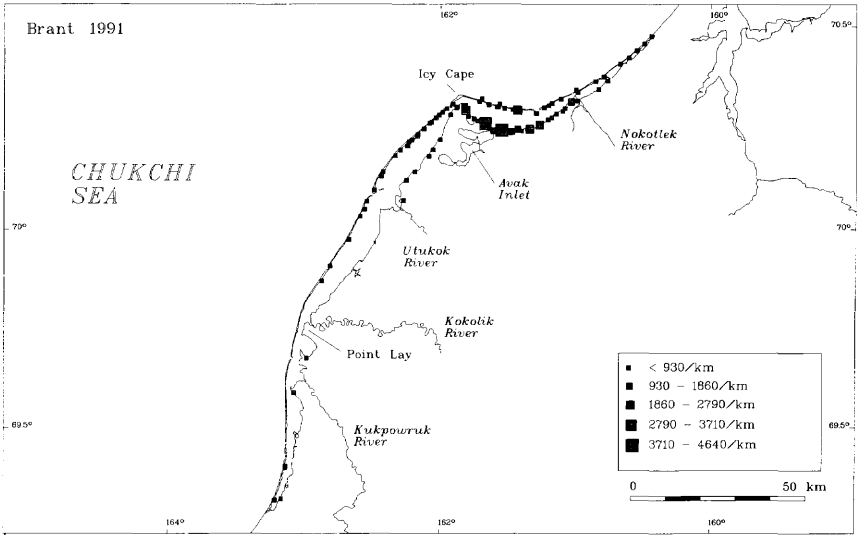

FIGURE 2. Continued.

the Beaufort Sea is entirely along a coastal route, or whether some or all of the birds cut overland to the Chukchi Sea coast. Jensen (1990) showed that at least some autumn migrant Brant moved westward along the Beaufort Sea coast after leaving molting areas. Field work along the Chukchi Sea coast about 125 km northeast of Kasegaluk Lagoon (Gill et al. 1985) indicated that over 20,000 Brant moved through the area during mid- to late August 1983 (R. E. Gill and P. C. Connors, pers. comm.). In contrast, we saw several large flocks of Brant (250–500 birds/flock) totalling several thousand birds in a region of large lakes about 75 km inland from Icy Cape on 23 Aug. 1990. The Brant appeared to be migrating southwest toward the Chukchi Sea coast. Thus, at least during some years, a portion of the autumn migration of Brant from the Beaufort Sea may be via an overland route.

There was strong evidence from this study that in 1989 and 1991 large quantities of food attracted Brant to northeastern Kasegaluk Lagoon. Although no ground-based sampling was conducted, it appeared during the aerial surveys that green algae was very abundant in these years in the same areas where Brant were most abundant, i.e., along the mainland shoreline between the Nokotlek River and Icy Cape. In contrast, Brant were less abundant and algae appeared to be less abundant in this area in 1990. Little is known of the distribution and productivity of green algae in this part of the Chukchi Sea, but algae samples that we collected along the beach and in the shallow waters of Transect 1102 in August 1990 were *Ulva,* probably *U. fenestrata* (Tanner 1979; C. E. Tanner, pers. comm.). Lehnhausen and Quinlan (1982:106) also noted Brant

feeding on *Ulva* and *Enteromorpha* in Kasegaluk Lagoon near the mouth of Avak Inlet in mid-September 1981, and Bailey (1948:157) reported Brant aggregating to feed on "seaweed" near Icy Cape in early September 1921. Brant are known to eat *Ulva* spp. at other coastal locations in North America and Europe, and in some instances they show a preference for it over other foods (Summers 1990; N. Dawe, pers. comm.).

Results from this study demonstrate that Kasegaluk Lagoon is an important autumn staging area for Pacific Flyway Brant. Brant are known to be sensitive to some development-related disturbances, such as aircraft overflights in their staging areas (Derksen et al. 1992, Ward and Stehn 1989). Marked shifts during the 1950s through 1960s in the winter distribution of Pacific Flyway Brant, from Washington, Oregon and California to Western Mexico (Einarson 1965, Smith and Jensen 1970), are thought to have been the result of development activities in the bays and estuaries where Brant overwintered. So far there has been little industrial development in key Brant nesting and staging areas in Alaska, including Kasegaluk Lagoon. Recent interest and activity in oil leases in the Chukchi Sea adjacent to Kasegaluk Lagoon (François and Gächter 1992, Gould et al. 1990) may add a new challenge to the management of Pacific Flyway Brant.

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LITERATURE CITED

BAILEY, A. M. 1948. Birds of Arctic Alaska. Popular Ser. No. 8, Colorado Mus. Nat. Hist., Denver, Colorado. 317 pp.

BARTONEK, J. C. 1992. Waterfowl harvests and status, hunter participation and success, and certain hunting regulations in the Pacific Flyway and United States. U.S. Fish Wildl. Service, Portland, Oregon.

BELLROSE, F. C. 1980. Ducks, geese and swans of North America. Stackpole Books, Harrisburg, Pennsylvania. 540 pp.

BOYD, H., L. S. MALTBY, AND A. REED. 1988. Differences in the plumage patterns of Brant breeding in High Arctic Canada. Can. Wildl. Service Prog. Note 174:1–9.

BRADSTREET, M. S. W. 1979. Thick-billed Murres and Black Guillemots in the Barrow

Strait area, N.W.T., during spring: distribution and habitat use. Can. J. Zool. 57: 1789–1802.

DAU, C. P. 1989. Pacific Brant and Emperor Goose census, production and family group counts, Izembek NWR, Fall 1989. U.S. Fish Wildl. Service, Cold Bay, Alaska.

———. 1990. Pacific Brant and Emperor Goose census, production and family group counts, Izembek NWR, Fall 1990. U.S. Fish Wildl. Service, Cold Bay, Alaska.

———. 1991. Pacific Brant and Emperor Goose census, production and family group counts, Izembek NWR, Fall 1991. U.S. Fish Wildl. Service, Cold Bay, Alaska.

———. 1992. The fall migration of Pacific Flyway Brant *Branta bernicla* in relation to climatic conditions. Wildfowl 43:80–95.

DERKSEN, D. V., M. W. WELLER, AND W. D. ELDRIDGE. 1979. Distributional ecology of geese molting near Teshekpuk Lake, National Petroleum Reserve-Alaska. Pp. 189–207, *in* R. L. Jarvis and J. C. Bartonek, eds. Management and biology of Pacific Flyway geese. Oregon State Univ. Bookstores, Corvallis, Oregon.

———, K. S. BOLLINGER, D. ESLER, K. C. JENSEN, E. J. TAYLOR, M. W. MILLER, AND M. W. WELLER. 1992. Effects of aircraft on behavior and ecology of molting Black Brant near Teshekpuk Lake, Alaska. U.S. Fish Wildl. Service, Anchorage, Alaska.

EINARSON, A. S. 1965. Black Brant, sea goose of the Pacific coast. Univ. Washington Press., Seattle, Washington. 142 pp.

FRANÇOIS, D. K., AND R. A. GÄCHTER. 1992. Alaska update: February 1990–April 1992, outer continental shelf oil and gas activities. OCS Information Report, MMS 92-053. U.S. Minerals Manage. Service, Herndon, Virginia.

GOULD, G. J., R. M. KARPAS, AND D. L. SLITOR. 1990. Alaska update: September 1988–January 1990, outer continental shelf oil and gas activities. OCS Information Program, MMS 90-0012. U.S. Minerals Manage. Service, Herndon, Virginia.

GILL, R. E., C. M. HANDEL, AND P. C. CONNORS. 1985. Bird utilization of Peard Bay and vicinity. Pp. 244-323, *in* P. J. Kinney, ed. Environmental characterization and biological utilization of Peard Bay. BLM/NOAA, OCSEAP, Environ. Assess. Alaskan Cont. Shelf. Final Rep. Prin. Invest. 35:97–440.

———, C. A. BABCOCK, C. M. HANDEL, W. I. BUTLER, JR., AND D. G. RAVELING. Migration, site fidelity, and use of fall staging grounds in Alaska by Cackling Canada Geese. *In* D. Rusch, D. Humberg, and M. Samuel, eds. The Canada Goose. The Wildl. Society and Internat. Canada Goose Symp. Milwaukee, Wisconsin, in press.

JENSEN, K. C. 1990. Responses of molting Pacific Black Brant to experimental aircraft disturbance in the Teshekpuk Lake Special Area, Alaska. Ph.D. thesis. Texas A & M University, College Station, Texas.

JOHNSON, S. R., AND D. R. HERTER. 1990. Bird migration in the Arctic: a review. Pp. 22–43, *in* E. Gwinner, ed. Bird migration: physiology and ecophysiology. Springer-Verlag, Berlin.

———, D. A. WIGGINS, AND P. F. WAINWRIGHT. Late-summer abundance and distribution of marine birds in Kasegaluk Lagoon, Chukchi Sea, Alaska. Arctic, in press.

KING, J. G. 1970. The swans and geese of Alaska's Arctic Slope. Ann. Rep. Wildfowl Trust 21:11–17.

KING, R. J., AND K. S. BOLLINGER. 1992. Teshekpuk Lake Special Area molting goose surveys, 1990 and 1991. U.S. Fish Wildl. Service, Fairbanks, Alaska.

———, AND W. I. BUTLER. 1990. Teshekpuk Lake Special Area molting goose survey, 1989. U.S. Fish Wildl. Service, Fairbanks, Alaska.

LEHNHAUSEN, W. A., AND S. E. QUINLAN. 1982. Bird migration and habitat use at Icy Cape, Alaska—1981. U.S. Fish Wildl. Service, Anchorage, Alaska.

MCLAREN, P. L. 1982. Spring migration and habitat use by seabirds in Eastern Lancaster Sound and Western Baffin Bay. Arctic 35:88–111.

OWEN, M., AND N. GULLESTAD. 1984. Migration routes of Svalbard barnacle geese *Branta leucopsis* with a preliminary report on the importance of the Bjørnøya staging area. Norsk Polarinstitutt Skrifter 181:67–77.

PATTERSON, L. A. 1974. An assessment of the energetic importance of the North Slope to Snow Geese (*Chen caerulescens caerulescens*) during the staging period in September, 1973. Arctic Gas Biol. Rep. Series 74:1–44.

REED, A., M. A. DAVISON, AND D. K. KRAEGE. 1989a. Segregation of Brent Geese *Branta bernicla* wintering and staging in Puget Sound and the Strait of Georgia. Wildfowl 40: 22–31.

———, R. STEHN, AND D. WARD. 1989b. Autumn use of Izembek Lagoon, Alaska, by Brant from different breeding areas. J. Wildl. Manage. 53:720–725.

SEDINGER, J. S., AND K. S. BOLLINGER. 1987. Autumn staging of Cackling Canada Geese on the Alaska Peninsula. Wildfowl 38:13–18.

SMITH, R. H. AND G. H. JENSEN. 1970. Black brant on the mainland coast of Mexico. Trans. North Am. Wildl. Nat. Resour. Conf. 35:227–241.

SUMMERS, R. W. 1990. The exploitation of beds of green algae by Brent geese. Estuar. Coast and Shelf Sci. 31:107–112.

TANNER, C. E. 1979. The taxonomy and morphological variation of distromatic ulvaceous algae (Chlorophyta) from the northeast Pacific. Ph.D. thesis, Univ. British Columbia, Vancouver, British Columbia.

WARD, D. H., AND R. A. STEHN. 1989. Response of Brant and other geese to aircraft disturbance at Izembek Lagoon, Alaska. U.S. Fish Wildl. Service, Anchorage, Alaska.

———, T. L. TIBBITTS, J. D. MASON, A. L. SEIDL, T. J. FENSKE, J. A. PRATT, K. S. BOLLINGER, D. V. DERKSEN, J. L. AGUILAR R., F. HEREDIA U., AND A. GERARDO. 1992. Migration patterns and distribution of Brant subpopulations in Mexico. U.S. Fish Wildl. Service, Anchorage, Alaska.

WYPKEMA, R. C. P., AND C. D. ANKNEY. 1979. Nutrient reserve dynamics of Lesser Snow Geese staging at James Bay, Ontario. Can. J. Zool. 57:213–219.

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