Status of Pacific Black Brant *Branta bernicla nigricans* on Wrangel Island, Russian Federation

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Abundance, distribution, and habitat selection of breeding and moulting Pacific Black Brant were studied on Wrangel Island in 1989-91. Two nests and <10 family flocks of Brant were found during ground searches in previously known nesting areas. The breeding population has declined from 1000-2000 pairs to probably <100 pairs. An estimated 4200 ± 50 (CI) moulting Brant were counted during the first aerial and photographic survey of the island in 1990. This population includes moult migrants from Alaska and mainland Russia. Most (67%) of the moulting flocks were concentrated in freshwater lakes and usually within 2 km of the coast. Lakes with low relief shorelines and adjacent preferred grasses were important habitats used by moulting birds. Breeding and moulting populations of Wrangel Island Brant are dependent on Izembek Lagoon, Alaska, in autumn and disperse over the rest of eastern Pacific Flyway in winter and spring.

Little is known about the Pacific Black Brant *Branta bernicla nigricans* that nest and moult along the arctic coasts of northeastern Russia. Solitary pairs or small colonies of brant are scattered from the northcentral Taimyr Peninsula eastward to the Chukotka Peninsula and Anadyr River Delta (Uspenski 1960, Portenko 1981, Eldridge *et al.* 1991). Moulting brant concentrate on Wrangel Island and the New Siberian Islands (Owen 1980). Numbers of Brant declined sharply by the 1970s and 1980s, prompting the Soviet Union to give this goose endangered species status in 1983 (Ler 1989). Nevertheless, the size of nesting and moulting populations remains largely unmeasured.

Wrangel Island is one of the most important areas used by Brant in this portion of its range (Uspenski 1960). The island was essentially uninhabited until 1926, when the village of Ushakovskoye was established on the southern coast and became a base for marine mammal harvest. Changes that followed included increased numbers of Arctic Fox *Alopex lagopus*, commercial and subsistence harvest of hundreds of thousands of goose eggs and, in 1948 and 1954, introduction of domestic Reindeer *Rangifer tarandus*, whose population expanded from 150 to 7000 animals by 1978. Bousfield & Syroechkovskiy (1985) explained how these changes affected the island's Snow Goose *Anser caerulescens caerulescens* population, but their impacts on Brant have not been evaluated.

Mineev (in Portenko 1981) was one of the first to report thousands of Brant nesting on Wrangel Island. In 1964, Uspenski (1965) estimated that the island supported "at least 1000-2000 pairs" of breeders and 10,000 failed breeding and non-breeding Brant during the moult period. The Brant nested mainly in large river valleys, usually in the Snow Goose colony or close to nests of Snowy Owls *Nyctea scandiaca*. By the early 1970s, however, only several tens of nesting pairs were counted (Litvin *et al.* 1985 in Stishov & Marukhnich 1988). Between 1974 and 1985, only 18 nests and 30 eggs were observed (Stishov *et al.* 1991). We do not know whether the moulting population also declined during recent decades.

The origin of the birds that moult on Wrangel Island was unclear, as was their wintering destination, although some evidence from ring recoveries suggested that the island's Brant wintered along the coasts of North America and Mexico (Uspenski 1960). These questions were the focus of a three-year (1989-91) U.S.-Russian Federation population study on Wrangel Island, which was timed to coincide with other Brant research along the eastern Pacific Flyway (i.e. the west coast of North America).

In this paper we assess the abundance, dis-

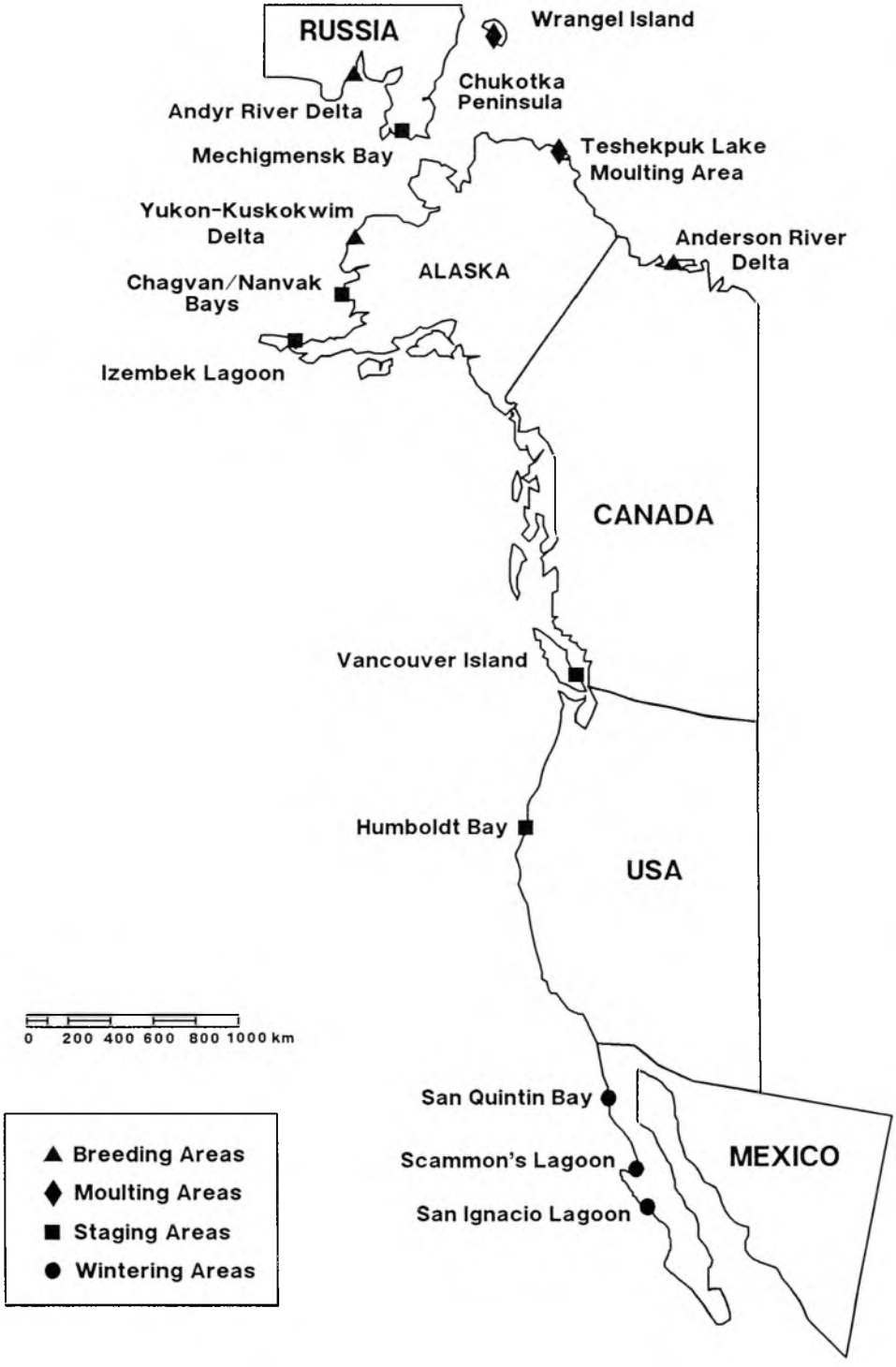

Figure 1. Locations of breeding, moulting, staging, and wintering areas for Brant in eastern Russia and the eastern Pacific Flyway.

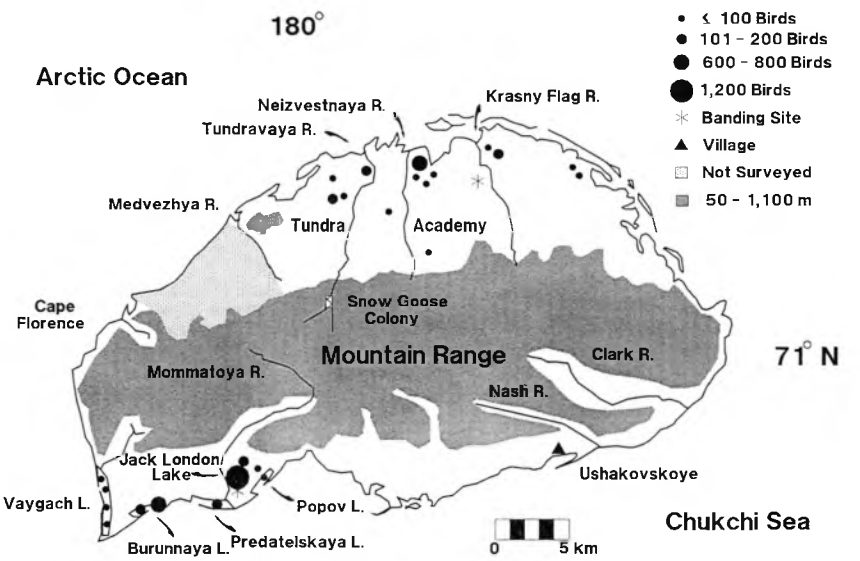

Figure 2. Abundance and distribution of moulting Brant flocks on Wrangel Island during 20-27 July aerial survey, 1990.

tribution, and demographics of Black Brant moulting and nesting on Wrangel Island, describe the types of habitat used by moulting Brant, and present new evidence that Brant marked on Wrangel Island winter in the eastern Pacific Flyway.

Study area

Wrangel Island is located 170 km north of the Chukotka Peninsula at 71° N and 180° (Fig. 1). The 796,000 ha island is divided latitudinally by a range of mountains that rise to 1100 m, with an average elevation of about 500 m (Fig. 2). To the north lies an extensive wetlands complex of numerous ponds and lakes, known as the Tundra Academy, that with minimal relief slopes gently to the sea. The tundra to the south of the mountains is drier, narrower, and higher in elevation, but includes the island's largest lake, Jack London Lake. The perimeter of the island contains a series of coastal spits and barrier islands which form protective lagoons used by Brant and other waterfowl.

Methods

Opportunistic searches for Brant nests were made during July in 1989, 1990 and 1991 in previously known breeding areas along the Nash and Tundravaya rivers and along the Mommatoya River in 1990 and 1991. Since Brant on Wrangel Island typically breed near Snowy Owls, we concentrated our searches near their nests.

The abundance and distribution of Brant on Wrangel Island were determined from an aerial survey made over four days between 20 and 27 July 1990. Timing of the census coincided with the middle of the brood-rearing period and the peak of moult for non-breeding birds. The survey was comprehensive and covered all coastal lagoons and adjacent lakes (≤10 km from the coast) except between Cape Florence and the Medvezhya River (Fig. 2). Areas further inland were not searched because of the known lack of suitable habitat (water bodies) for moulting geese and the few sightings of moulting birds during ground observations before the aerial survey (V. Baranyuk and M. Stishov pers. obs.). Three to five observers flew in a MI-8 helicopter at 100-200 m altitude until a flock of geese was spotted. The helicopter then dropped to 40-60 m altitude so that the flock could be

counted, plotted on a 1:200,000 scale topographic map, and photographed with a 35 mm camera. A population estimate with 95% CI was derived from the totals of the visual and photographic counts using a combined ratio estimator (Cochran 1963:64).

Flightless Brant were caught using drive traps on Jack London Lake in 1989-91 and on two lakes near the Krasny Flag River (Fig. 2) in 1990. Most birds were marked with metal and/or red plastic leg rings inscribed with a 3-digit alpha-numeric code. Age and sex were determined by plumage and cloacal examinations, respectively. Eight adults (2 M; 6 F (all with brood patches)) and one second-year female in 1989 and ten adults (5 M; 5 F (4 with brood patches)) in 1990 were selected from flocks of non-breeding and failed breeding birds and fitted with back-pack transmitters using a modified Dwyer (1972) harness. Additionally, we trapped a brood flock in 1991 and attached a transmitter to an adult female known to have bred on Wrangel Island.

Radio- and colour-marked Brant were monitored during migration and at wintering sites along the west coast of North America by us and other collaborators. Tracking of radio-marked birds occurred almost daily from the air and/or ground during autumn (September to November) staging at Izembek Lagoon, Alaska, (Fig. 1) and infrequently (<5 times) during winter (November to March) in Washington, Oregon, California, and Mexico in all years. Observations of colour-marked birds were made using 10-120X spotting scopes during autumn at Izembek Lagoon in all years, during winter in Mexico in 1990-91, and during spring (March to May) at Humboldt Bay, California (Fig. 1) in 1991.

Vegetation communities, relief, and moisture content of the shorelines of Jack London Lake and adjacent ponds used by Brant were evaluated. Percent plant cover and identification of vegetation communities along the shoreline were determined on the ground and by interpretation of a Satellite Pour l' Observation de la Terre (SPOT) multispectral scanner scene recorded on 24 August 1986.

Results

Nesting

No nests were found during ground searches in July, 1989 and 1990. Two brood flocks, each with three goslings, were discovered along the Mommatoya River in both years. Two goslings were observed in a moulting flock during the 1990 aerial survey. In 1991, two nests were found <45 m from Snowy Owl nests in a moist grass-sedge ravine near the Mommatoya River. Each nest successfully hatched four goslings, one on 12 July and the other between 14 and 17 July. Five additional brood flocks, each with three or four goslings, were seen near the Mommatoya River in 1991.

Abundance and distribution of moulting birds

On the July 1990 aerial survey, the population of Brant moulting on Wrangel Island was estimated at 4200 ± 50 birds (95% CI) (Table 1). The median flock size was 67 birds (range = 10-1152); however, 18 of 28 flocks (64%) contained <100 birds. Freshwater lakes supported about 67% of the population while remaining flocks were in lagoons (33%). Nearly 90% of the Brant used lakes within 2 km of the coast.

The majority (63%) of the population was observed along the southwest coast of the island in four freshwater lakes and four lagoons, while the remainder (37%) were dispersed among 14 lakes in the northcentral portion of the island (Fig. 2). The greatest number of moulting Brant (1152) was observed on Jack London Lake. This lake has consistently supported large numbers of moulting Brant since the early 1970s. Based on ground counts during ringing drives in all

Table 1. Estimate of the moulting population of Brant on Wrangel Island during 20-27 July 1990.

Habitat	*n*	Flock size		Population size	
		Median	Range	Estimate	95% CI
Freshwater lakes					
0-2 km from the coast	12	100	10-1152	2500	2450-2550
>2 km from the coast	4	54.5	47-150	300	250-350
Lagoons	12	59.5	10-725	1400	1375-1425
Total	28	67	10-1152	4200	4150-4250

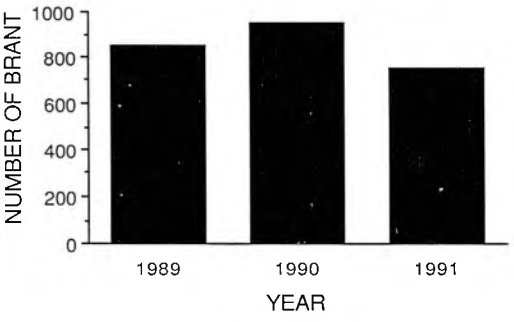

Figure 3. Number of moulting Brant found during ground counts on Jack London Lake, July 1989-91.

three years, the most birds on Jack London Lake occurred in 1990 and fewest in 1991 (Fig. 3). Burunnaja Lagoon, with 900 birds in 1990, was the most important estuary used by Brant.

Age and sex composition of moulting birds

A total of 1095 Brant were ringed in 1989-91, including 1018 (93%) at Jack London Lake and 77 (7%) near the Krasny Flag River in 1990. After-second-year Brant comprised ≥74% of the birds examined in all years (Table 2). In two of three years non-breeding females were more abundant than failed breeding females, as indicated by the absence or presence of a brood patch, respectively (Table 2). The proportion of males and females varied between age classes and among years (Table 3). Among second-year Brant, males exceeded females (55% vs 45%, respectively), but there were fewer males than females among after-second-year birds (43% vs 58%, respectively) (Table 3).

Origin of moulting geese

Of 75 Brant recaptured in ringing drives, 23 (31%) were birds previously marked on Wrangel Island during the study period. Foreign recaptures were birds marked in breeding areas on the Yukon-Kuskokwim Delta (YKD)(n = 45; 60%) and Anderson River (n = 2; 3%), and from the Teshekpuk Lake moulting area (TLMA) in northern Alaska (n = 5; 7%). Recaptures of marked birds from the YKD included nine (22%) second-year birds and seven colour-marked adults (4 M; 3 F (1 with a brood patch)) that were observed earlier in the same year during the nesting period on the YKD. Two birds from the Anderson River, one male and one female with a brood patch, had been previously marked as juveniles at their natal colony; however, because these two birds could have dispersed from their natal area, it is not clear whether birds that breed on the Anderson River also moult on Wrangel Island. The breeding origins of birds marked in non-breeding and failed breeding flocks from the TLMA or Wrangel Island are uncertain.

We compared the number of Wrangel Island recoveries of after-second-year Brant that had been ringed on Wrangel Island and the YKD in 1989 and 1990 (Table 4). A significantly greater proportion of birds returned from Wrangel Island than the YKD in 1990 and 1991. This suggests that moulting birds have a degree of site fidelity, not only to Wrangel Island but to a particular area of the island.

Habitat characteristics of Jack London Lake

Jack London Lake resembled Class V wetlands found on the coastal plain of north-

Table 2. Proportion of second-year (SY), after-second-year (ASY), and ASY female Brant with a brood patch moulting on Wrangel Island, 1989-91.

	n	% SY	% ASY	n	% ASY females with brood patch
1989	231	26.0	74.0	70	57.1
1990	388	15.9	84.1	231	26.4
1991	476	16.2	83.8	211	31.3

Table 3. Proportion of male and female Brant banded on Wrangel Island, July 1989-91.

	Second-year			After-second-year		
	n	male	female	n	male	female
1989	60	55.0	45.0	171	59.1	40.9
1990	61	62.3	37.7	327	29.4	70.6
1991	77	49.4	50.6	399	46.9	53.1
Total	198	55.1	44.9	897	42.8	57.2

Table 4. Comparison of recaptures of after-second-year Brant on Wrangel Island that were ringed on the Yukon-Kuskokwim Delta (YKD) and Wrangel Island. A goodness of fit test was used to test differences between the marked populations.

Banding location	Banded *n*	Recaptured *n*	Level of significance
Marked in 1989 and recovered in 1990			
YKD	1339	8	$P<0.01$
Wrangel Is.	200	5	
Marked in 1989 and recovered in 1991			
YKD	1339	5	$P<0.001$
Wrangel Is.	200	9	
Marked in 1990 and recovered in 1991			
YKD	1394	1	$P<0.001$
Wrangel Is.	388	9	

ern Alaska (Bergman *et al.* 1977) because of its' large surface area (51 ha), shallow water depth (<80 cm), and lack of emergent vegetation.

Flightless Brant mainly foraged <100 m from the shorelines of Jack London Lake and adjacent ponds. Three vegetation communities were found within this border (Fig. 4, Table 5). The largest (58% of the total) and most heavily grazed community was a moist moss zone. The low relief (<20 cm above the level of the water) of this zone allowed birds easy access to the lake and unobstructed views for early detection of predators. Mosses were the dominant cover in this zone. *Dupontia fischeri* and *Festuca rubra* were dispersed throughout the zone and were foraged extensively by Brant. *Senecio congestus* was the dominant forb. A drier sedge-grass zone (25% of the total area), which varied from 10 to 150 cm above the surface of the lake, was used sporadically by Brant. Although dominated by sedges and grasses, this zone contained a mixture of shrubs (*Salix rotundifolia*), forbs (*Potentilla hyparctica, Petesites frigidus*), and an understorey of mosses and lichens (Table 5). The most abundant grasses were *Deschampsia caespitosa* and *Dupontia fischeri*, and the most common sedge was *Carex* sp. Brant were observed grazing in this zone but much less frequently than in the moss zone. The third community, a sparsely vegetated zone, was characterized by cracked and uplifted tundra. Most (71%) of this zone was bare ground, but where the tundra was undisturbed, grasses and sedges were the dominant vegetation. A few droppings found in this zone indicated that it was used occasionally by Brant.

Detection during migration and the winter period

Excluding one radio-tagged Brant that was shot in Mechigmensk Bay on the Chukotka Peninsula (Fig. 1) in 1990, 14 of 19 (74%) radioed birds, including one bird marked from a breeding flock, were found during autumn staging at Izembek Lagoon, 1989-91. Mean arrival dates at Izembek were 23 ± 3 September ($n = 4$) in 1989 and 11 ± 5 September ($n = 5$) in 1990 for the failed breeding and non- breeding birds, and between 20 September and 3 October in 1991 for the one breeding bird. Using the earliest possible arrival date of 21 September 1991 for the breeding bird, it arrived about two weeks later than the first moulting birds from Wrangel Island.

Departure dates of failed breeding and non-breeding radio-tagged birds from Izembek Lagoon ranged from 2-10 November and typically coincided with migration of other marked populations of Brant (D. Ward unpubl. data). In 1991 the breeding bird de-

Table 5. Percentage of vegetation cover and soil moisture characteristics of three types of Brant habitat along the shoreline of Jack London Lake, Wrangel Island.

	Vegetative cover types						
Habitat zones	Moss	Lichen	Sedge-grass	Forbs	Shrub	Bare ground	Soil moisture
Moss zone	79	3	10	7	0	1	wet to moist
Sedge-grass zone	14	8	36	9	15	18	moist to dry
Sparsely-vegetated zone	2	2	13	8	4	71	dry

Table 6. Number of individual colour-marked Brant that were ringed on Wrangel Island and observed during migration and winter periods in 1989-90 and 1990-91.

	1989-90 (n = 96)[a]		1990-91 (n = 387)[a]	
Season/location	n	%	n	%
Autumn				
Izembek Lagoon, Alaska	11	11.5	17	4.4
Winter[b]				
San Quintin Bay, Mexico	-		34	8.8
Scammon's Lagoon, Mexico	-		2	0.5
San Ignacio Lagoon, Mexico	-		3	0.8
Spring[b]				
Humboldt Bay, California	-		10	2.6

[a]Number of birds colour-marked in previous summer.
[b]No observations of colour-marked birds were made during winter or spring 1989-90.

parted Izembek Lagoon between 10 and 14 November, about one week later than the main exodus of Brant. Length of stay of moulting birds monitored from arrival to departure was 39 days (n = 1) in 1989 and 56 ± 6 days (n = 4, range = 48-60 days) in 1990.

Three radio-tagged birds were relocated after migrating from Izembek Lagoon. One bird was found during January at San Quintin Bay, Mexico, and two others were detected during spring migration (May) at Humboldt Bay, California (Fig. 1). The few detections (3 of 19; 16%) of radio-tagged birds after their departure from Izembek Lagoon was, in part, due to transmitter failure (D. Ward unpubl. data).

Sightings of colour-marked birds further corroborated recoveries of radio-tagged Brant and the use of staging and wintering areas in the eastern Pacific Flyway (Table 6). Brant ringed on Wrangel Island were found in all areas searched in 1989-91. During winter of 1990-91, 9% of these birds were observed in San Quintin Bay and 1% in Scammon's and San Ignacio lagoons, Mexico (Fig. 1). During spring of 1991, 3% were resighted in Humboldt Bay, California.

Discussion

The 1990 survey was the first aerial and photographic survey of Brant made on Wrangel Island. Fog and low ceilings during one day of the aerial survey resulted in incomplete coverage of the island (Fig. 2). However, we believe that this did not affect the overall estimate because few birds (<50) are known to occur in the western portion of the Tundra Academy (M. Stishov pers. obs.).

Based on the aerial survey in 1990, Wrangel Island contains the largest known concentration of non-breeding and failed breeding Black Brant outside of the TLMA (Derksen *et al.* 1979, King & Hodges 1979) and the YKD (Pacific Flyway Study Committee 1992, J. Sedinger pers. comm.). The composition of this population includes moult migrants from breeding colonies in Alaska and very likely from mainland Russia (Uspenski 1960, This Study). The majority (>74%) of Brant that used the island were non-breeding adults, some of which may never breed (Derksen *et al.* 1992).

Our results confirm a continuing downward trend in the Brant breeding population on Wrangel Island, which has decreased from estimates of thousands prior to 1940 (Mineev in Portenko 1981) to 1000-2000 pairs in 1964 (Uspenski 1965) to probably <100 pairs in 1991 (This Study). Anecdotal evidence indicates that the nesting population was already reduced to the current level by the late 1970s (Stishov *et al.* 1991, Stishov & Marukhnich 1988).

The causes of this decline in the breeding population are uncertain; the change may have occurred because of increased hunting, egg collecting, and levels of natural predation on Wrangel Island during a time of poor nesting success. These same factors are believed to be the main causes for precipitous declines in the populations of Wrangel Island Snow Geese (Syroechkovskiy 1972, Bousfield & Syroechkovskiy 1985) and YKD Brant (Lensink 1987, King & Derksen 1986, J. Sedinger pers. comm.).

After preserve status was granted the island in 1976 and local hunting and egging ceased, Brant were still hunted during migration along the coast of the Chukotka Peninsula, despite a ban (M. Stishov and V. Baranyuk pers. obs.). A legal harvest of Brant also occurred during migration and wintering

in North America (Pacific Flyway Study Committee 1992). Concomitantly, the Arctic Fox population increased on Wrangel Island following cessation of trapping that had resulted in an annual harvest of 200-600 animals (Bœusfield & Syroechkovskiy 1985). This may have contributed to increased predation of Brant nests and lower reproductive success, as has been observed on the YKD (Anthony *et al.* 1991). Low numbers of nests on Wrangel Island in the last decade, despite available habitat and reduced harvest levels of Brant (Pacific Flyway Study Committee 1992), suggest that natural predation may be the key factor preventing an increase in the breeding population.

Trends in the moulting population are less clear, because a ground survey in 1964 that revealed ≥10,000 birds (Uspenski 1965) was the only previous estimate of the number moulting on Wrangel Island. It is not known if our 1990 count of 4200 birds, less than half the 1964 estimate, reflects a long term decline, a temporary change in response to annual fluctuation in population size, or simply a difference in survey techniques. Derksen *et al.* (1992) determined that the TLMA Brant population varied by 7 to 96% between annual surveys over a ten year period. By comparison, ground counts on Jack London Lake, the most important moulting site on Wrangel Island, varied only slightly (16 to 27%) between 1989-91 and were actually lower in 1989 and 1991 than in 1990 (Fig. 3).

Fluctuations in the numbers of moulting Brant on Wrangel Island may be affected by 1) the overall number of Brant breeding in colonies which use Wrangel Island, 2) the number of non-breeding and failed breeding birds, or 3) a shift to other moulting areas.

During the past two decades the breeding population has decreased on Wrangel Island and mainland Russia (Ler 1989, This Study), and has been reduced >60% on the YKD, where >80% of the Brant nest (Lensink 1987, J. Sedinger pers. comm.). Since 1987, increased nesting success on the YKD (Pacific Flyway Study Committee 1992) has probably resulted in fewer non-breeders and failed breeders moulting on Wrangel Island. It is not known whether Brant have made shifts in moulting locations, as has been observed in Greylag Geese *Anser anser* (Zijlstra *et al.* 1991), but recoveries in the TLMA in 1991 of eight 1990 colour-marked birds from Wrangel Island (Derksen *et al.* 1992) indicate some interchange between moulting sites.

Derksen *et al.* (1979) reported that in the TLMA

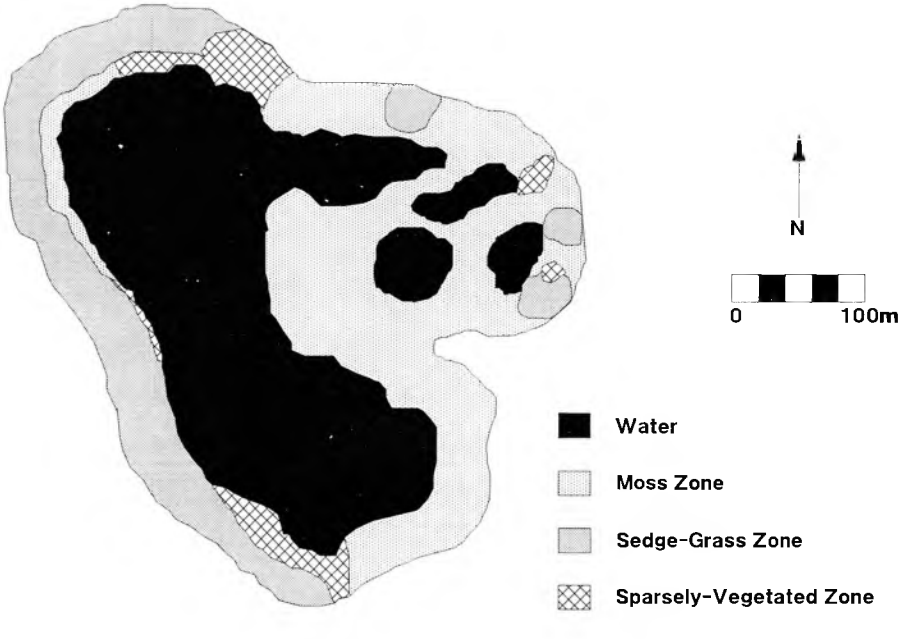

Figure 4. Three vegetation communities within 100 m of the shoreline of Jack London Lake and adjacent ponds as determined from a 24 August 1986 SPOT scene.

96% of the Brant moult on freshwater lakes. Brant moulting on Wrangel Island use both freshwater lakes (67%) and coastal estuaries (33%). Geomorphology and habitat characteristics favored by Brant at Jack London Lake were similar to those of high use lakes in the TLMA (Derksen *et al.* 1979, Derksen *et al.* 1982). Greater use of coastal lagoons on Wrangel Island may be because of the paucity of suitable moulting habitat inland. The majority of the lakes on the island are found in the Tundra Academy, yet only 37% of the moulting population used this area. Although the quality of the habitat may be a limiting factor on the north side of the island, ground and aerial observations suggest otherwise. Perhaps a more important reason for the low numbers may be the potential for increased levels of disturbance from Snow Geese and Arctic Foxes which concentrate in the Tundra Academy. Habitat on Wrangel Island seems to have a greater carrying capacity for moulting Brant than is currently being used, but this needs further study.

It is now clear that the Wrangel Island Brant population is dependent on Izembek Lagoon in autumn and the rest of the eastern Pacific Flyway in winter and spring. During migration to Izembek, Wrangel Island Brant probably use coastal lagoons along the Chukotka Peninsula and western Alaska such as Mechigmensk, Nanvak, and Chagvan bays (Fig. 1) (Portenko 1981, Palmer 1976). At Izembek Lagoon geese from Wrangel Island mix with other populations of Brant (Reed *et al.* 1989, D. Ward unpubl. data) and remain for one to two months. From December to March Wrangel Island Brant join >80% of the eastern Pacific Flyway population and winter in Mexico (Conant *et al.* 1992, This Study). During spring Humboldt Bay, California and Vancouver Island, British Columbia (N. Dawe pers. comm.) are important staging areas for geese from Wrangel Island.

Our study corroborates the hypothesis of Uspenski (1960) that Brant which moult and breed east of the Kolyma River Delta winter along the west coast of North America. Ring returns of YKD breeding Brant on the Anadyr River Delta further substantiate this interchange (C. Lensink unpubl. data). A small (<6,000 birds) population of Brant winters along the west coast of Japan, Korea, and China (Owen 1980, Y. Miyabayashi pers. comm.). It remains to be determined whether Wrangel Island Brant also use this flyway. The conservation of this goose requires multinational research and management effort.

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