SPRING MIGRATION OF EIDERS, OLDSQAWS AND GLAUCOUS GULLS ALONG OFFSHORE LEADS OF THE CANADIAN BEAUFORT SEA

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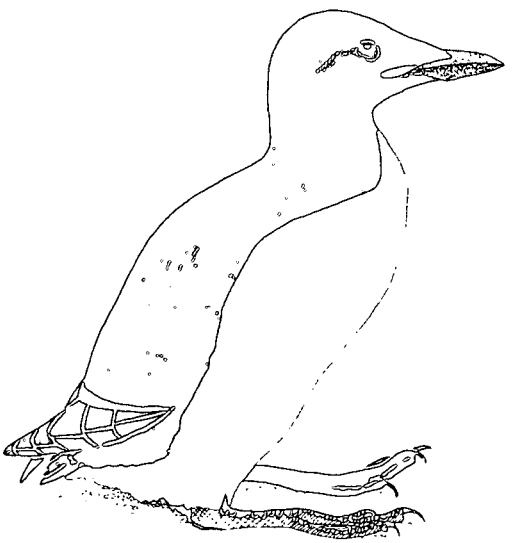

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ABSTRACT

Aerial surveys were flown for birds along offshore leads in the Canadian Beaufort Sea: two sets from Herschel Island to Cape Bathurst in early June, 1986; and five sets from Herschel Island to Banks Island between late May and late June, 1987. In 1987, surveys in the Banks Island area were often incomplete for logistical reasons.

The Pacific Eider was the most abundant species observed, followed by the King Eider and Oldsquaw, and the Glaucous Gull. A few other species were observed, notably scoters (white-winged and surf) and Red-throated Loons. Peak numbers of birds were as follows: 22 428 Pacific Eiders on June 9-10, 1986, and 27 372 on June 9-12, 1987; 7298 King Eiders on June 9-10, 1986, and 3908 on June 23, 1987; 7403 Oldsquaws on June 3, 1986, and 5728 on June 1-2, 1987; 249 Glaucous Gulls on June 9-10, 1986, and 2095 on May 26-29, 1987.

In the southern parts of the Beaufort Sea, Pacific Eiders, King Eiders, and Oldsquaws tended to be most abundant in offshore leads between the tip of the Tuktoyaktuk Peninsula and Cape Bathurst. This was most pronounced for Pacific Eiders. Oldsquaws tended to be more evenly distributed than either of the eiders. Glaucous Gulls were fairly evenly distributed, except for concentrations around Cape Parry.

In the Banks Island area, the King Eider was the most abundant species. Pacific Eiders were present in moderate numbers, whereas Oldsquaws and Glaucous Gulls were scarce, except for a gull concentration around southwestern Banks Island.

RESUME

Des relevés aériens concernant les oiseaux ont été effectués le long des chenaux côtiers de la mer de Beaufort : deux séries allant de l'île Herschel jusqu'au cap Bathurst au début de juin 1986, et cinq séries allant de l'île Herschel à l'île Bank sentre la fin de mai et la fin de juin 1987. En 1987, les relevés de la région de l'île Banks ont souvent été incomplets pour des raisons logistiques.

L'espèce qu'on a observée le plus fréquemment est l'Eider du Pacifique, suivie de l'Eider remarquable et du Canard kakawi et du Goéland bourgmestre. On a également observé quelques autres espèces, notamment des Macreuses à ailes blanches et d'autres à front blanc et des Huarts à gorge rousse. Less chiffres-records ont été enregistrés comme suit : pour les Eiders du Pacifique : 22 428 les 9 et 10 juin 1986, et 27 372 du 9 au 12 juin 1987; pour les Eiders remarquables: 7298 les 9 et 10 juin 1986, et 3908 le 23 juin 1987; pour les Canards kakawis : 7403 le 3 juin 1986 et 5728 les ler et 2 juin 1987; pour les Goélands bourgmestres : 249 les 9 et 10 juin 1986, et 2095 du 26 au 29 mai 1987.

Au sud de la mer de Beaufort, les Eiders du Pacifique, les Eiders remarquables et les Canards Kakawis étaient les plus nombreux le long des chenaux côtiers entre la pointe de la péninsule de Tuktoyaktuk et le cap Bathurst. C'étaît surtout le cas des Eiders du Pacifique. Les Canards kakawis sembiaient mieux répartis que les deux espèces d'eiders. Les Goélands bourgmestres étaient assez bien répartis, à part quelques concentrations autour du cap Parry.

Dans la région de l'île Banks, l'Eider remarquable était l'espèce la plus abondante. Le nombre d'Eiders du Pacifique était peu élevé, alors que les Canards kakawis et les Goélands bourgmestres étaient rares, à l'exception d'une concentration de goélands dans la partie sud-ouest de l'île Banks.

ACKNOWLEDGEMENTS

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1.0 INTRODUCTION

Starting in late April and continuing into June, hundreds of thousands of birds, particularly King Eiders (Somateria spectabilis), Pacific Common Eiders (S. mollissima v. nigra) (henceforth referred to as the Pacific Eider), and Oldsquaws (Clangula hyemalis), migrate east across the Beaufort Sea (Barry 1986; Woodby and Divoky 1982; Richardson and Johnson 1981; Searing et al. 1975). Most King Eiders choose a relatively straight, though wide path from Point Barrow, Alaska, to the offshore lead that runs parallel to Banks Island's west coast (Barry 1986). Large concentrations of eiders are found off Banks Island prior to snow and ice melt on the inland nesting grounds. Pacific Eiders, and probably also Oldsquaws, migrate along leads parallel to the mainland coast. Large concentrations of eiders and Oldsquaws can also occur along these leads but the consistency of occurrence is not well known, and likely highly influenced by variable ice conditions (Barry 1986; Searing et al. 1975).

This paper provides data on distribution and abundance of birds in Beaufort Sea offshore leads during spring, 1986 and 1987. The emphasis is on leads running between Herschel Island, Yukon Territory, and Cape Parry, Northwest Territories, but some information on leads through Amundsen Gulf and around Banks Island is included. The data were collected as part of a project to identify important migratory bird concentration areas in the Canadian Beaufort Sea (see Alexander et al. 1988).

2.0 METHODS

In the spring of 1986 and 1987, we conducted aerial surveys along the southern and eastern edge of the Beaufort Sea offshore lead. The study area extended from Herschel Island, Yukon Territory, to Cape Parry, and then north along the west side of Banks Island (Fig. 1).

We used a Cessna 185 on skis for surveys between Herschel Island and Cape Bathurst and for the first survey to Banks Island, and a twin-engine Britten-Norman Islander on wheels for all other areas. We conducted the surveys at 60 m above sea level, 100 to 200 m to the open-water side of the ice-edge. Ground speed averaged 150 km/hr but varied widely depending on the orientation of the aircraft to the winds. Two observers, one in the right front seat and one in the left back seat, recorded data on cassette tape recorders. Time of day, estimated wind speed and direction, wave condition, cloud cover, precipitation and visibility were noted at various points throughout the surveys. Birds that we observed within 200 m on either side of the aircraft were recorded as being "on transect", while those outside the 400 m strip were recorded along with their estimated distance from the aircraft. For each observation, we recorded the species and number.

We divided survey routes into five-minute segments. Position of the aircraft at the beginning of each five-minute segment was determined with a Global Navigation System in 1986 and an Omega navigational system in 1987.

In 1987, we made a concerted effort to estimate the proportion of males in flocks of both Pacific and King Eiders. If flocks were small enough to count each bird, then it was possible to obtain a true count of males and females. With large flocks, which accounted for the majority of birds seen, we made visual estimates of the proportion of males in each flock. Since it is impossible to differentiate between Pacific and King Eider females during aerial surveys, we recorded lone females as unidentified eiders, and females that were associated with males as conspecifics. In mixed flocks of King and Pacific Eiders, we assumed that female eiders were present in the flock in proportions similar to the males. Large flocks where females were clearly dominant to males were never encountered. No attempt was made to identify subadult males; however, apparently very few subadult birds enter the Beaufort Sea (Johnson 1971; Woodby and Divoky 1982).

3.0 RESULTS

3.1 Survey coverage

We conducted two sets of aerial surveys in 1986 and five sets in 1987. Survey routes, dates, and ice conditions are given in Figures 2 to 8. Weather during each survey is described in Appendix A.

For the purpose of analysis and presentation, we divided the southern part of the study area, from Herschel Island to Cape Parry, into ten regions (A to J in Figs. 2 to 8). Survey coverage was incomplete for the following dates and reasons: lack of open water due to heavy ice cover - Herschel Island, Yukon coast (A and B; June 3, 1986), Franklin Bay (I in 1986 and on May 26, 1987), and Parry Peninsula (J on June 3, 1986); fog - Herschel Island (A) on May 27, 1987; budgetary constraints - Herschel Island to Tuktoyaktuk (A to D), Franklin Bay (I), and Parry Peninsula (J) all on June 23, 1987.

We did not survey the Amundsen Gulf and Banks Island area in 1986, and in 1987 coverage was inconsistent between surveys and often incomplete, due to both adverse weather and budgetary constraints (K to N, N_O in Figs. 4 to 8). Region N_O was a series of transects flown June 1, parallel to region N and approximately 1 km into the open-water lead. Reasons for lack of coverage are as follows: lack of open water due to heavy ice cover - Thesiger Bay (M on May 26); fog - all areas north of Cape Parry (K to N on June 12); budgetary constraints - north of Cape Kellett (N on June 16). In addition, downdraughts from cliffs between Cape Lambton and Massik Pass (region L) on Banks Island prevented thorough coverage of this region.

The results presented herein on distribution and abundance are from on-transect data only. The densities of birds seen in each region and the distances flown are presented in Appendix B.

3.2 Abundance of birds in Beaufort Sea offshore leads, 1986 and 1987

The total numbers of birds seen during our surveys of Beaufort Sea offshore leads are presented in Tables 1 and 2. Relative densities (birds/km) for Pacific Eiders, King Eiders, Oldsquaws, and Glaucous Gulls (Larus hyperboreus) are presented in Figures 2 to 8.

3.2.1 Pacific Eiders

The Pacific Eider was the most abundant species observed from Herschel Island to Cape Parry (Table 1). In both 1986 and 1987, large numbers of Pacific Eider were present during our first surveys. In 1986, numbers had increased by June 9. In 1987, numbers had increased and also peaked by June 9 to 12. With only two surveys in 1986 a peak could not be identified. The decline in Pacific Eider abundance after June 12 coincided with the opening of large leads around western Victoria Island. However, since we did not survey any of the open water east of Cape Parry (except for one short excursion on June 12; see Fig. 6), we

Figure 1. Map of study area with place names.

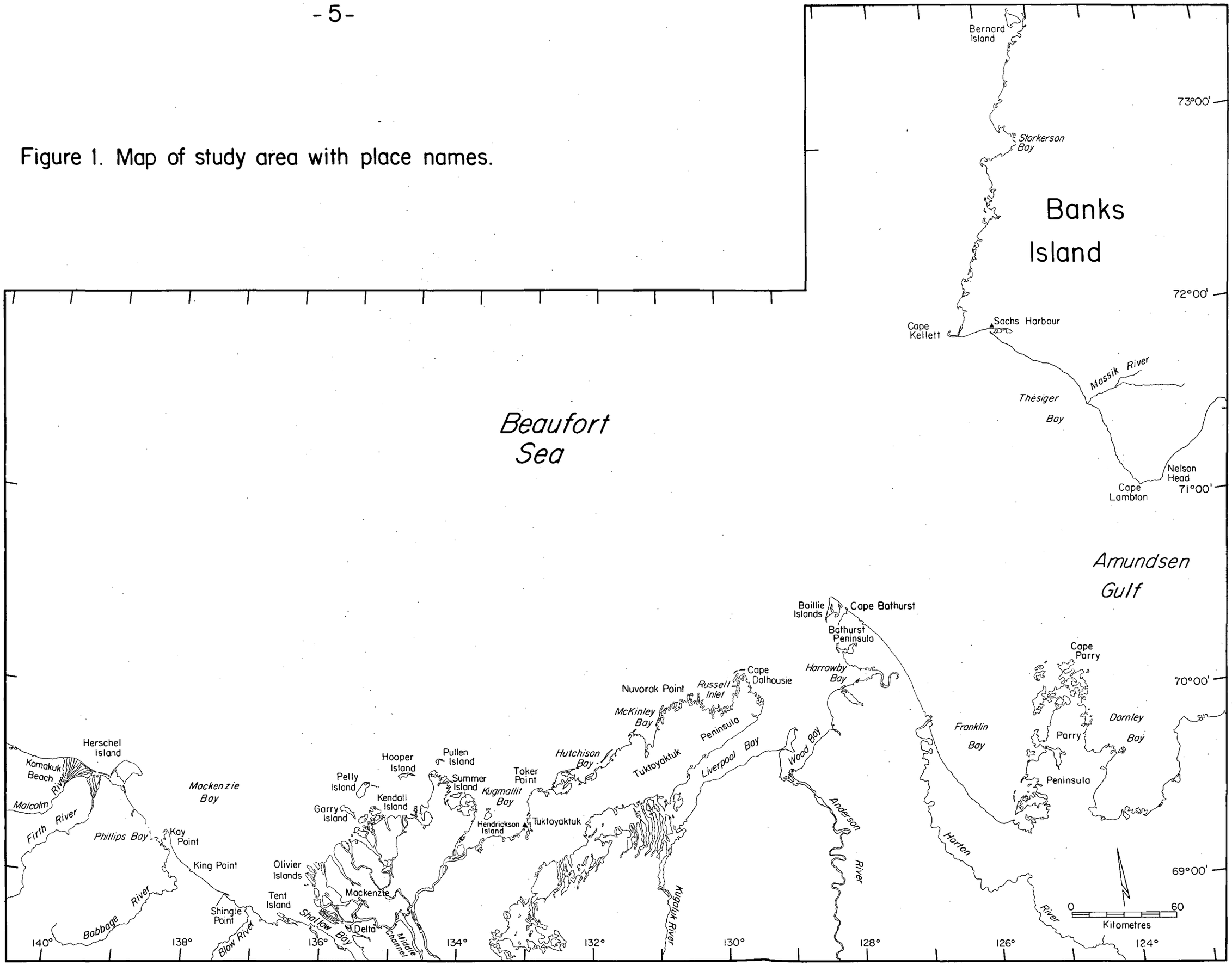

Figure 2. Survey route, ice conditions, and densities of the four most common bird species during an aerial survey of offshore leads in the Beaufort Sea, June 3, 1986.

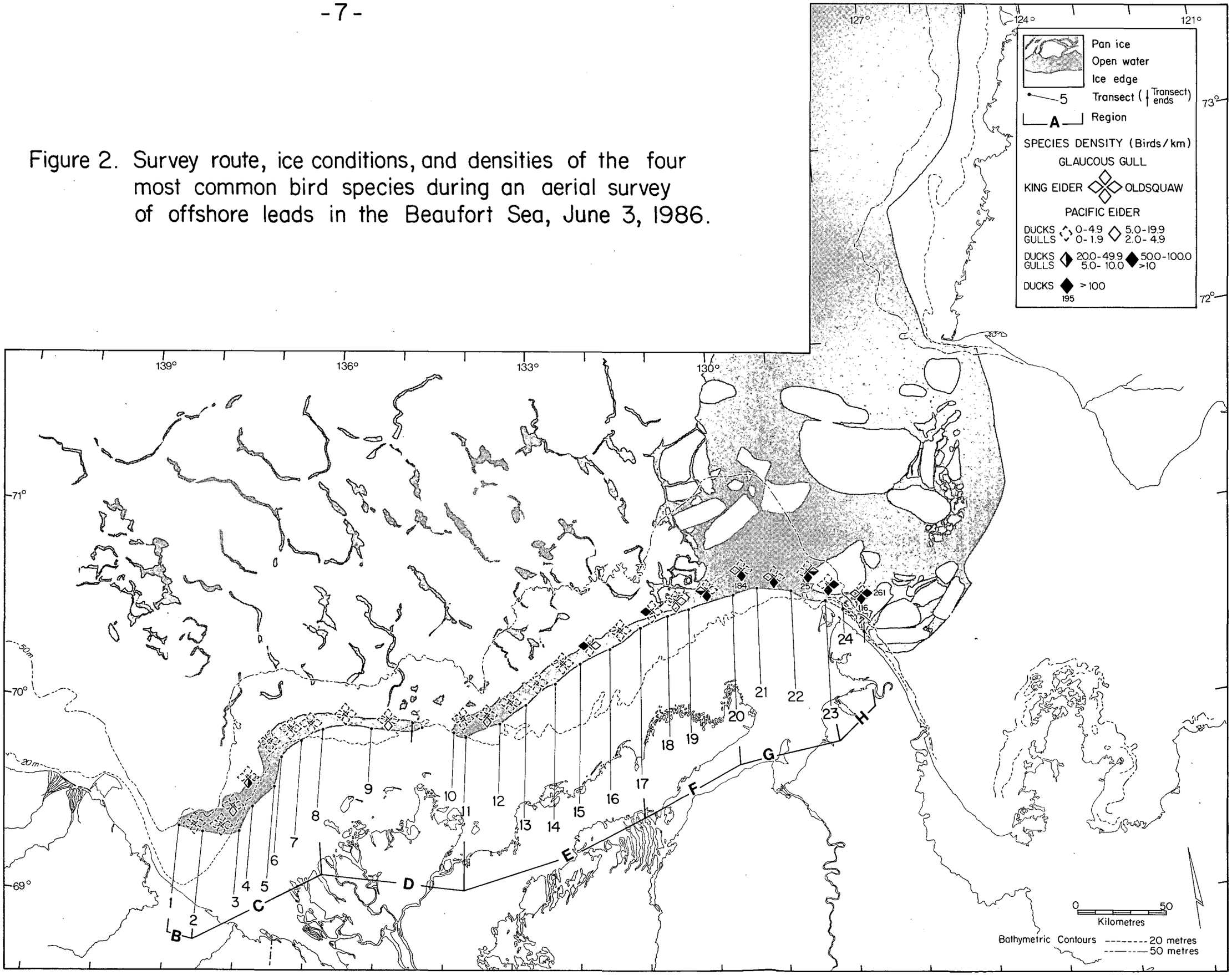

Figure 3. Survey route, ice conditions, and densities of the four most common bird species during an aerial survey of offshore leads in the Beaufort Sea, June 9 and 10, 1986.

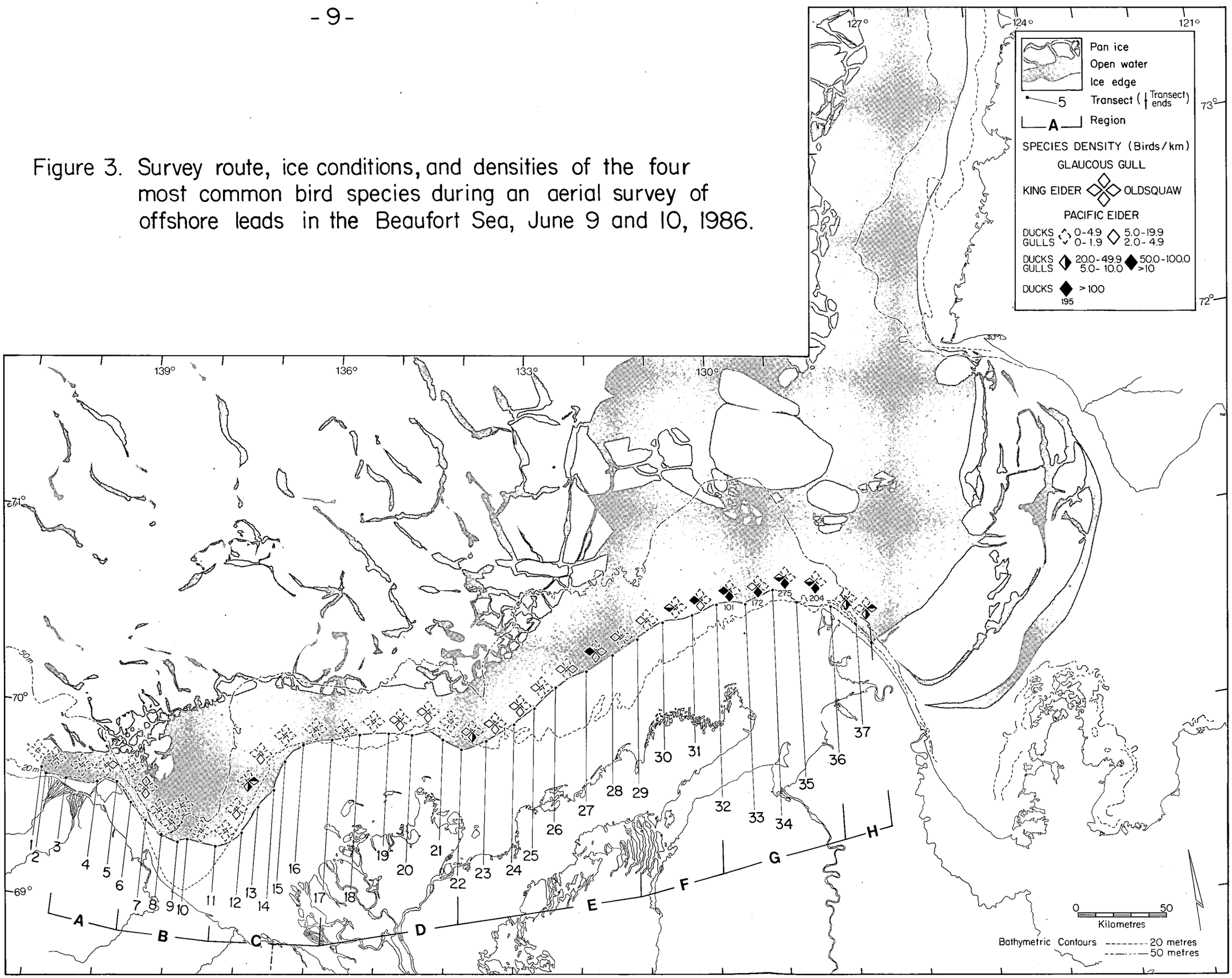

Figure 4. Survey route, ice conditions, and densities of the four most common bird species during an aerial survey of offshore leads in the Beaufort Sea, May 26, 27 and 29, 1987.

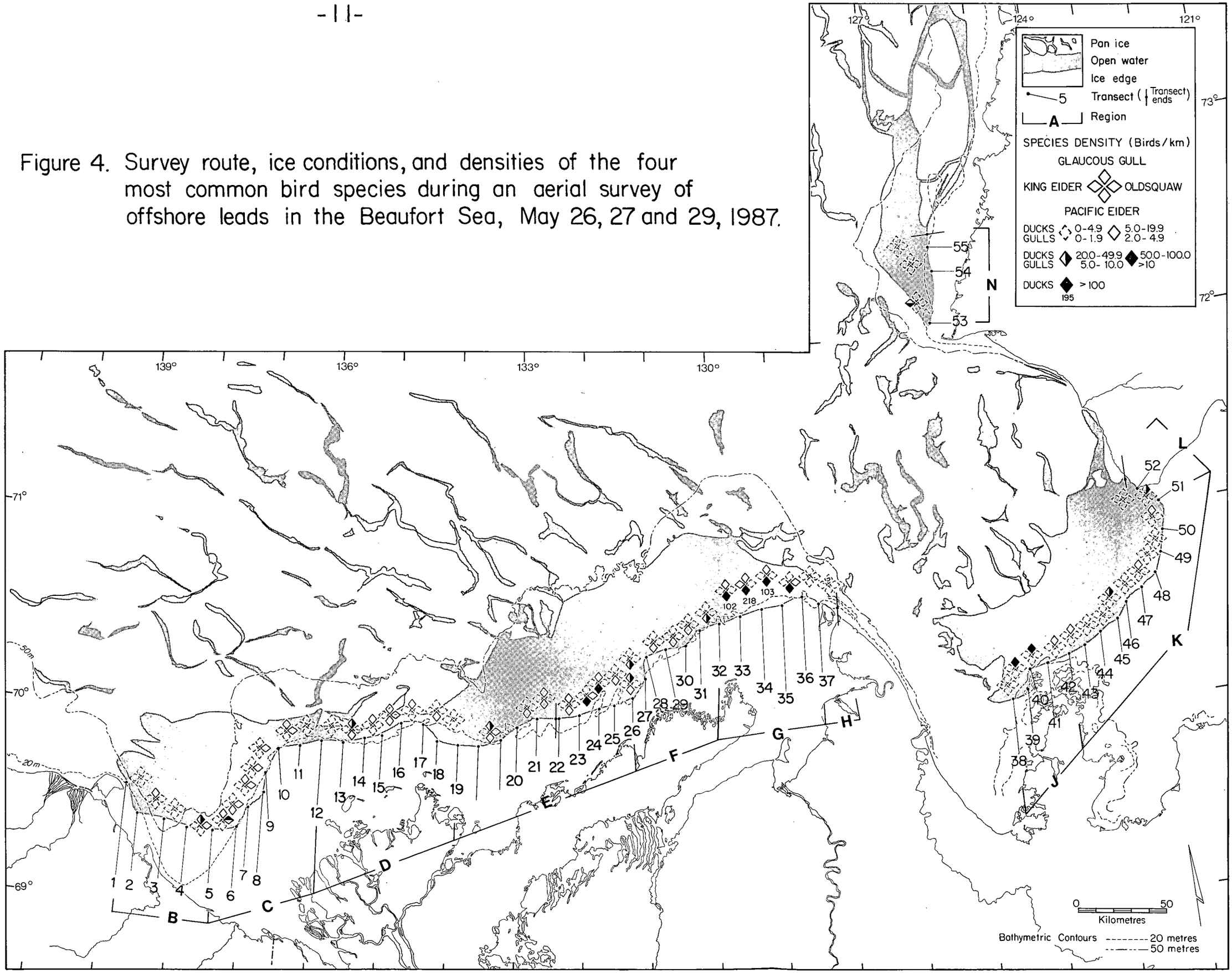

Figure 5. Survey route, ice conditions, and densities of the four most common bird species during an aerial survey of offshore leads in the Beaufort Sea, June 1 and 2, 1987.

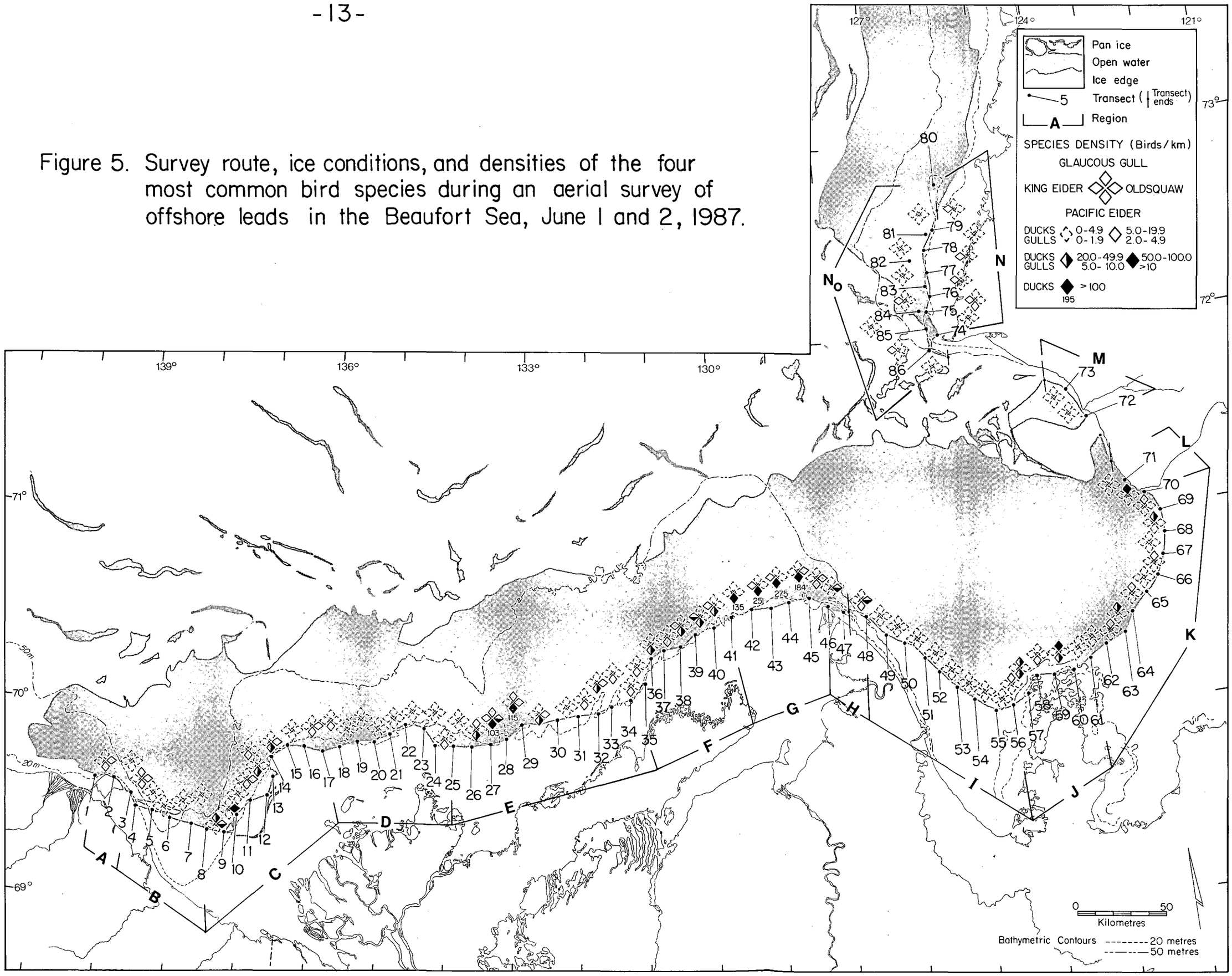

Figure 6. Survey route, ice conditions, and densities of the four most common bird species during an aerial survey of offshore leads in the Beaufort Sea, June 9 and 12, 1987.

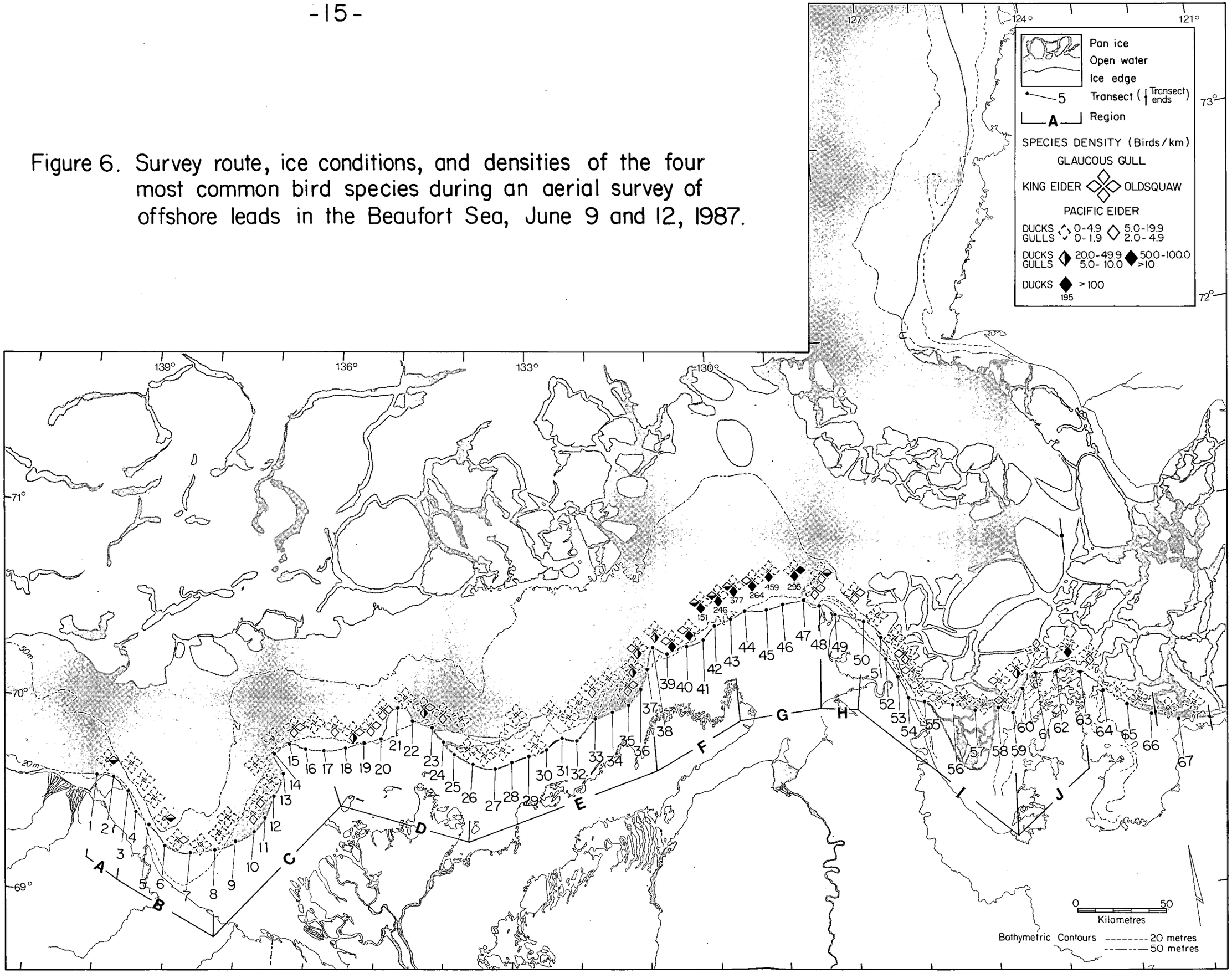

Figure 7. Survey route, ice conditions, and densities of the four most common bird species during an aerial survey of offshore leads in the Beaufort Sea, June 15 and 16, 1987.

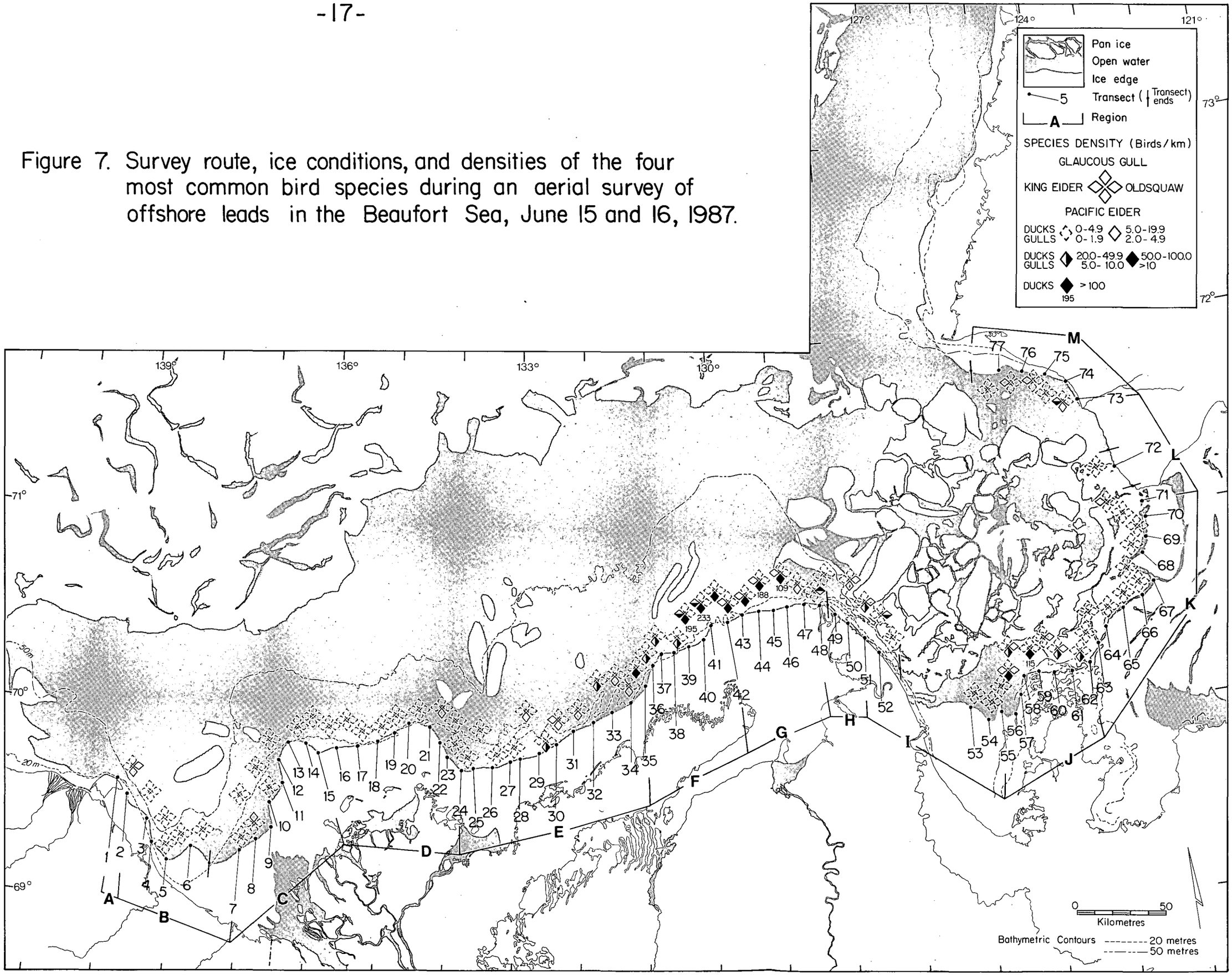

Figure 8. Survey route, ice conditions, and densities of the four most common bird species during an aerial survey of offshore leads in the Beaufort Sea, June 23, 1987.

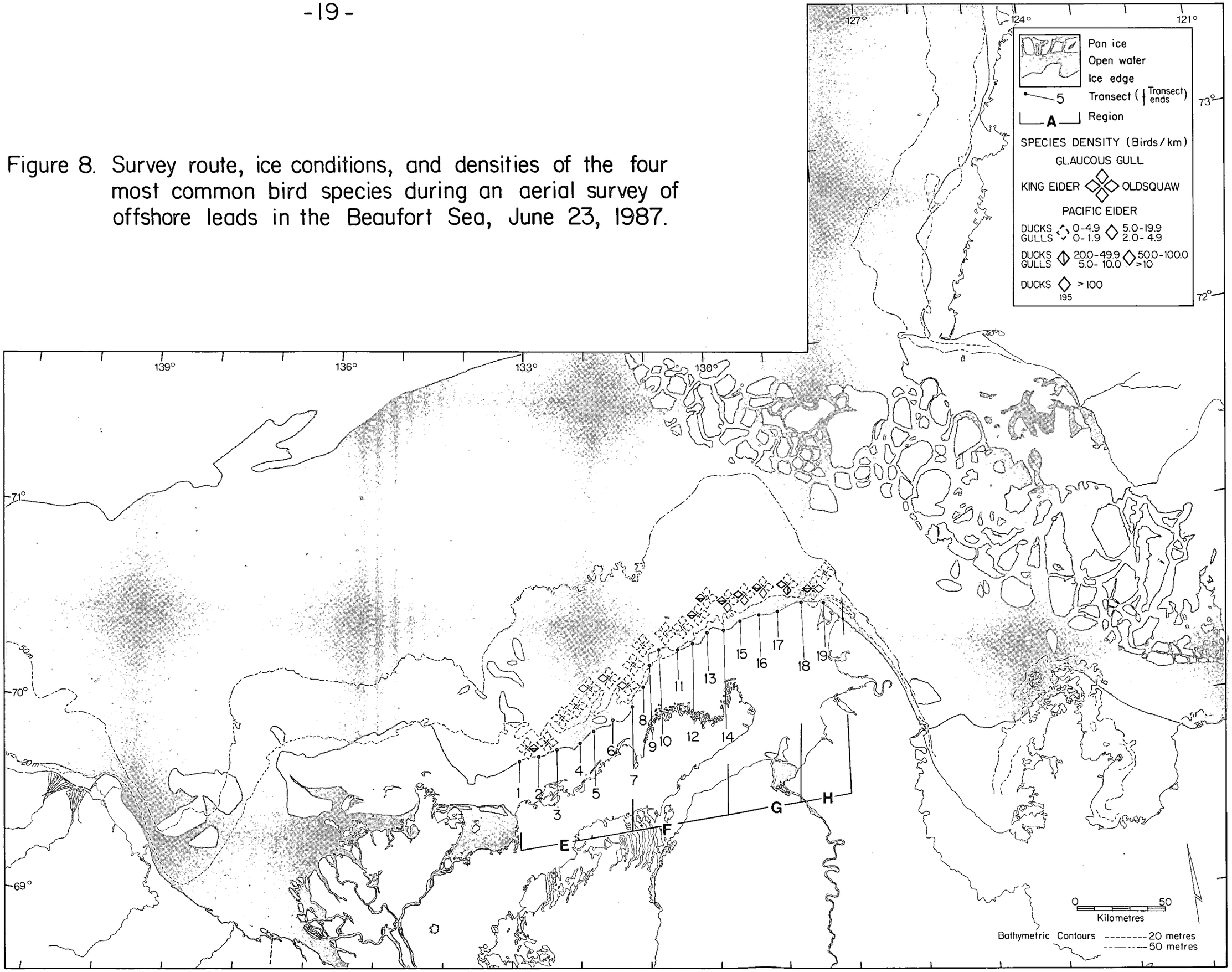

Table 1. Total numbers of birds observed during aerial surveys of Beaufort Sea offshore leads between Herschel Island and Cape Parry, spring 1986 and 1987.

Date		Pacific Eider	King Eider	Unid. Eider	Oldsquaw	Glaucous[a] Gull	Others	Total
1986:								
June 3	No.	15796	3479	914	7403	78	66	27736
	%	57.0 (82.0)[b]	12.5	3.3	26.7	0.3	0.2	100.0
June 9, 10	No.	22428	7278	146	1732	249	91	31944
	%	70.2 (75.4)	22.8	0.5	5.4	0.8	0.3	100.0
1987:								
May 26,27,29	No.	10832	234	320	2022	2095	15	15518
	%	69.8 (97.9)	1.5	2.1	13.0	13.5	0.1	100.0
June 1, 2	No.	20402	1211	784	5728	1435	54	29614
	%	68.9 (94.4)	4.1	2.6	19.3	4.9	0.2	100.0
June 9, 12	No.	27372	2339	665	3413	221	250	34260
	%	79.9 (92.1)	6.8	1.9	10.0	0.7	0.7	100.0
June 15, 16	No.	15947	1547	115	1790	229	768	20396
	%	78.2 (91.2)	7.6	0.5	8.8	1.1	3.8	100.0
June 23	No.	931	3908	624	370	4	1631	7468
	%	12.5 (19.2)	52.3	8.4	4.9	0.1	21.8	100.0

[a]For Glaucous Gull, values include birds observed in Amundsen Gulf.
[b]Values in parenthesis are the percent Pacific Eiders among identified eiders.

Table 2. Total numbers of birds observed during aerial surveys of Beaufort Sea offshore leads in Amundsen Gulf and off western Banks Island, spring 1987.

Date		Pacific Eider	King Eider	Unid. Eider	Oldsquaw	Glaucous[a] Gull	Others	Total
May 26	No.	20	1971	2020	7	8	20	4046
	%	0.5 (1.0)[b]	48.7	49.9	0.2	0.2	0.5	100.0
June 1	No.	201	1091	101	37	17	25	1472
	%	13.7 (15.6)	74.1	6.9	2.5	1.1	1.7	100.0
June 16	No.	463	1613	159	51	3	3	2292
	%	20.2 (22.3)	70.4	7.0	2.2	0.1	0.1	100.0

[a]For Glaucous Gull, values exclude Amundsen Gulf.
[b]Values in parenthesis are the percent Pacific Eiders among identified eiders.

are unable to determine whether or not the decline was in response to lead development. By June 23, numbers had dropped to 3% of the peak abundance.

Pacific Eiders were not as abundant through Amundsen Gulf or around Banks Island (Table 2). From Herschel Island to Cape Parry, Pacific Eiders accounted for 75 to 98% of the eiders observed (on June 23 only 19% of the eiders were Pacific Eiders) (Table 1). Around Banks Island, Pacific Eiders were relatively less abundant (1 to 22%) than King Eiders (Table 2).

Male and female Pacific Eiders appeared to be present in equal proportions during all surveys except the final one on June 23 (Table 3). At that time, males were clearly more abundant than females.

3.2.2 King Eiders

In the Herschel Island to Cape Parry area, King Eiders were considerably less abundant than Pacific Eiders (Table 1). In both 1986 and 1987, King Eider numbers increased from the first survey to the June 9 and 12 survey. In 1987, peak numbers (3908 birds) were seen on June 23. Most of these birds were males (Table 3) that were probably post-breeding or nonbreeding birds heading west to moulting grounds off western Alaska. Prior to June 23, males and females were present in roughly equal proportions. King Eiders were more numerous in 1986 than in 1987.

King Eiders were the most abundant birds around Banks Island (Table 2). On May 26, 1987, 2000 of the unidentified eiders were in a flock of predominantly King Eiders for which we had neglected to record the proportion of Pacific Eiders.

3.2.3 Oldsquaws

In the Herschel Island to Cape Parry area, the Oldsquaw was the third most abundant species observed in 1986 and second most abundant in 1987 (Table 1). We recorded the highest number (7403 birds) on June 3, 1986. Numbers dropped substantially by June 9 and 10, 1986. The pattern was similar in 1987: peak numbers (5728 birds) were recorded on June 1 and 2, and dropped steadily thereafter. We saw very few Oldsquaws in the Banks Island area (Table 2).

3.2.4 Glaucous Gulls

Glaucous Gull numbers were low during both surveys in 1986 (Table 1). In 1987, they were most numerous (2095 birds) in late May, and declined steadily thereafter (values in Table 1 for 1987 includes Amundsen Gulf). On June 23, only four birds were seen.

3.2.5 Other Species

In the two years of surveys, we identified 14 additional bird species. The numbers of individuals seen on each survey day are given in Table 4.

Table 3. Proportion of Pacific and King Eiders that were males during aerial surveys of Beaufort Sea offshore leads, spring 1987.

Date in 1987	Pacific Eiders		King Eiders	
	% males	Sample size	% males	Sample size
Herschel Island to Cape Parry				
May 26, 27, 29	54	6635	67	161
June 1, 2	50	15711	64	903
June 9, 12	50	18194	53	1758
June 15, 16	53	15313	65	1517
June 23	93	527	90	1724
Banks Island				
May 26	56	55	50	817
June 1	54	205	58	714
June 12	-	-	-	-
June 16	52	475	53	1218

Table 4. Bird species seen in small numbers during aerial surveys of Beaufort Sea offshore leads, spring 1986 and 1987.

Species	Survey Date*						
	1986		1987				
	June		May	June			
	3	9,10	26, 27, 28	1, 2	9, 12	15, 16	23
Pacific Loon	4	3	1		4	8	
Red-throated Loon	24	48	2	1	108	59	1
Yellow-billed Loon		5				2 3	
Loon sp.	3	7	4	39	97	58	4
Brant					3	4	
Snow Goose				22			
Scaup sp.					2		
White-winged Scoter			2	4	6	586	100
Surf Scoter						5	
Scoter sp.		13			5	5	1526
Red-breasted Merganser	34	10	6	2		1	
Rough-legged Hawk			1	2			
Parasitic Jaeger		1			1		
Jaeger sp.			5 14	4 1	2 1		
Sabine's Gull	1	3		4	3	40	
Arctic Tern		1					
Murre sp.					19		

*For May 26 to June 16, 1987, the left-hand column is for Herschel Island to Cape Parry and the right-hand column is for Amundsen Gulf and Banks Island.

Starting in early June, the Red-throated Loon (Gavia stellata) was common in leads between Herschel Island and the east side of the Mackenzie River delta. Pacific Loons (G. pacifica) and Yellow-billed Loons (G. adamsii) were present in small numbers.

Geese were uncommon. The 22 Snow Geese (Anser caerulescens) seen June 1 were all along southwest Banks Island and flying to the northeast. Brant (Branta bernicla), scaup (Aythya sp.), and Red-breasted Mergansers (Mergus serrator) occurred infrequently. In 1987, scoters were prevalent starting June 15. On that day, we recorded a total of 596 scoters (mostly White-winged Scoters (Melanitta fusca) and some Surf Scoters (M. perspicillata)) scattered between Herschel Island and McKinley Bay. On June 23, we recorded 1626 scoters between Tuktoyaktuk and McKinley Bay, most of which were males.

We saw one Parasitic Jaeger (Stercorarius parasiticus) in 1986. In 1987, the largest numbers (all unidentified) were seen on May 26 in Amundsen Gulf. Twelve of the 14 observed were in one flock. A few Sabine's Gulls (Xema sabini) were present both years. The largest single sighting was 40 birds along the Parry Peninsula, June 16, 1987. Only one Arctic Tern (Sterna paradisaea) was seen over the two years.

We observed Murres (presumably Thick-billed Murres (Uria lomvia)) at Police Point, near Cape Parry, on June 12 and 16, 1987. Rough-legged Hawks (Buteo lagopus) were observed on two occasions flying along the ice-edge through Amundsen Gulf.

3.3 Distribution of birds between Herschel Island and Cape Parry

3.3.1 Pacific Eiders

Figure 9 shows the relative distributions of Pacific Eiders. The densities (birds/km) for each survey transect are given in Figures 2 to 8. On June 3, 1986, 60% of the Pacific Eiders were concentrated (179.2 birds/km) between Cape Dalhousie and the Baillie Islands (region G), 21% around Cape Bathurst (region H) (93.7 birds/km), and 11% between McKinley Bay and Cape Dalhousie (region F) (34.1 birds/km). On June 9, 1986, most of the birds (83%; 265.0 birds/km) were between Cape Dalhousie and the Baillie Islands (region G).

The distribution of Pacific Eiders was somewhat different in 1987. Open water extended as far east as Cape Parry by the time of the first survey, providing birds with a greater area to be distributed within. However, on May 26, we saw only seven birds east of Cape Bathurst. The area between Cape Dalhousie and the Baillie Islands (region G) had the greatest number and density of birds (56% of the Pacific Eiders; 97.3 birds/km). Tuktoyaktuk to McKinley Bay (region E) had the second highest abundance (23%) and a lower density (22.5 birds/km).

Cape Dalhousie to Baillie Islands (region G) continued to be the most heavily occupied location on June 2 (56%; 197.9 birds/km) and June 9

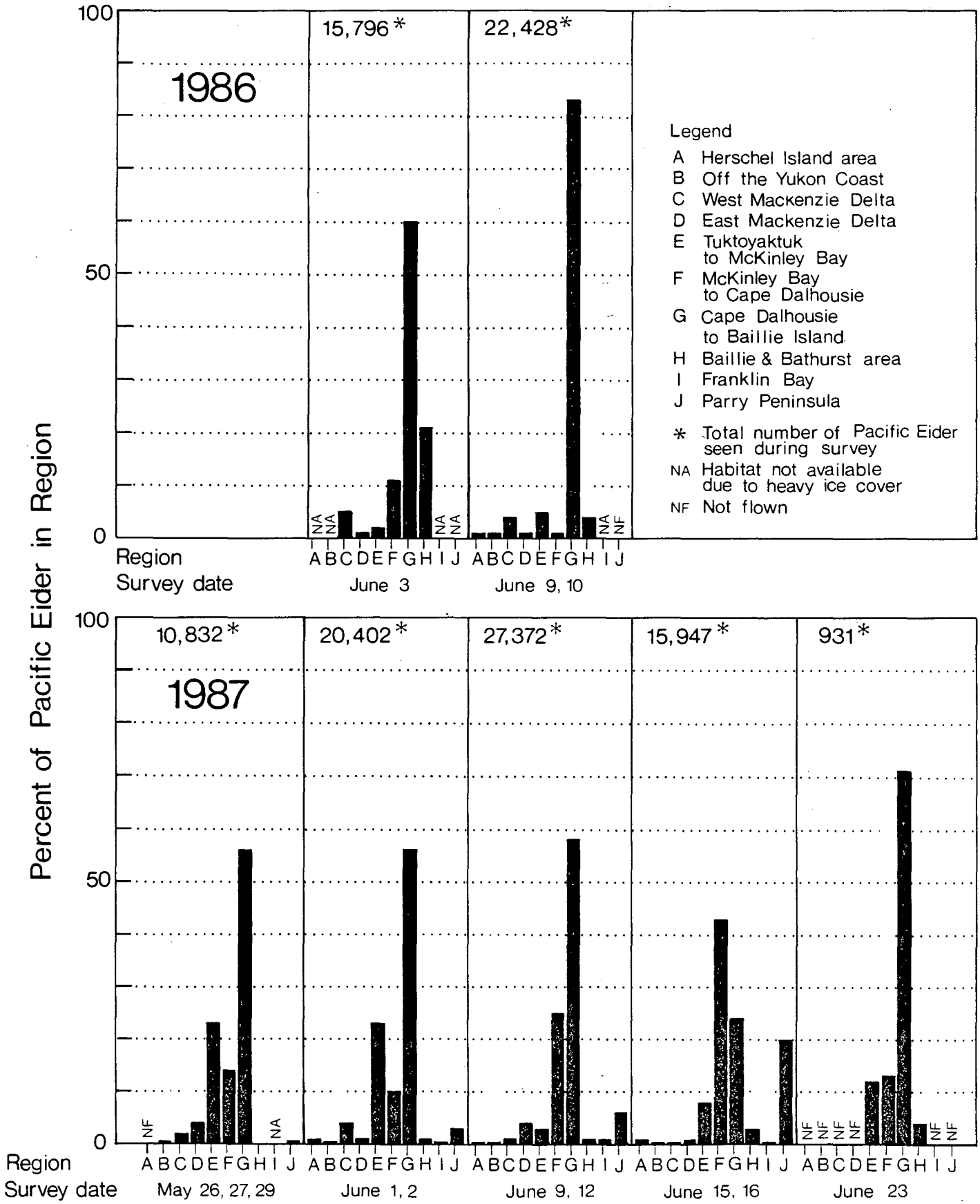

Figure 9. Histograms depicting the distribution of Pacific Eiders during aerial surveys of Beaufort Sea offshore leads between Herschel Island and Cape Parry, spring 1986 and 1987.

(58%; 280.9 birds/km). Pacific Eider attendance between Tuktoyaktuk and McKinley Bay (region E) declined to consistently low levels by June 9 (Fig. 9; Appendix B). On the other hand, the McKinley Bay to Cape Dalhousie area (region F) increased in relative importance to become the most heavily used location by June 15 (43%; 83.8 birds/km). On June 23, only 931 Pacific Eiders were observed, 71% of which were between Cape Dalhousie and the Baillie Islands (region G).

In contrast to 1986, we saw few birds during 1987 in the immediate vicinity of Cape Bathurst (region H; Fig. 9), likely a result of persistent strong winds blowing into the ice-edge causing rough water and the accumulation of brash ice.

Both relative and absolute abundance of Pacific Eiders increased steadily around Cape Parry (region J) from 7 birds on May 26 to over 3200 birds on June 16 (20%; 39.8 birds/km). Unfortunately we have no data for June 23. Nesting Pacific Eiders are far more abundant around the Parry Peninsula than around Cape Bathurst (Barry 1986); therefore, it is likely that we would have observed a further increase in the relative importance of the Cape Parry region, though not necessarily an absolute increase in abundance, had we surveyed there on June 23.

3.3.2 King Eiders

Figure 10 shows the relative distributions of King Eiders. The densities (birds/km) for each survey transect are given in Figures 2 to 8. King Eiders were distributed more evenly than Pacific Eiders, though both species had the same area of primary concentration between Tuktoyaktuk and the Baillie Islands (regions E, F, and G).

On June 3, 1986, 23% of the King Eiders (7.6 birds/km) were between Tuktoyaktuk and McKinley Bay (region E), and 56% (37.1 birds/km) were between McKinley Bay and Cape Dalhousie (region F). By June 9, King Eiders were spread out in similar abundances and densities between Tuktoyaktuk and McKinley Bay (37%; 21.9 birds/km), McKinley Bay and Cape Dalhousie (21%; 29.1 birds/km), and Cape Dalhousie and the Baillie Islands (34%; 35.7 birds/km) (regions E, F, and G respectively).

In 1987, on the first survey, nearly half (47%) of the 234 King Eiders counted occurred between Cape Dalhousie and the Baillie Islands (region G). On the next three surveys, from 41 to 56% of the King Eiders were between McKinley Bay and Cape Dalhousie (region F), while most other birds were in regions E, G, and on June 12, Franklin Bay (region I) (Fig. 10; Appendix B). As with Pacific Eiders, attendance in the Parry Peninsula area (region J) increased steadily throughout June, but to a somewhat lesser extent.

King Eiders in 1987 were most numerous on June 23 in spite of the reduced survey coverage. Most of the birds (63%) occurred between Cape Dalhousie and the Baillie Islands (region G). This was the highest density of King Eiders (51.5 birds/km) observed in both years, except for

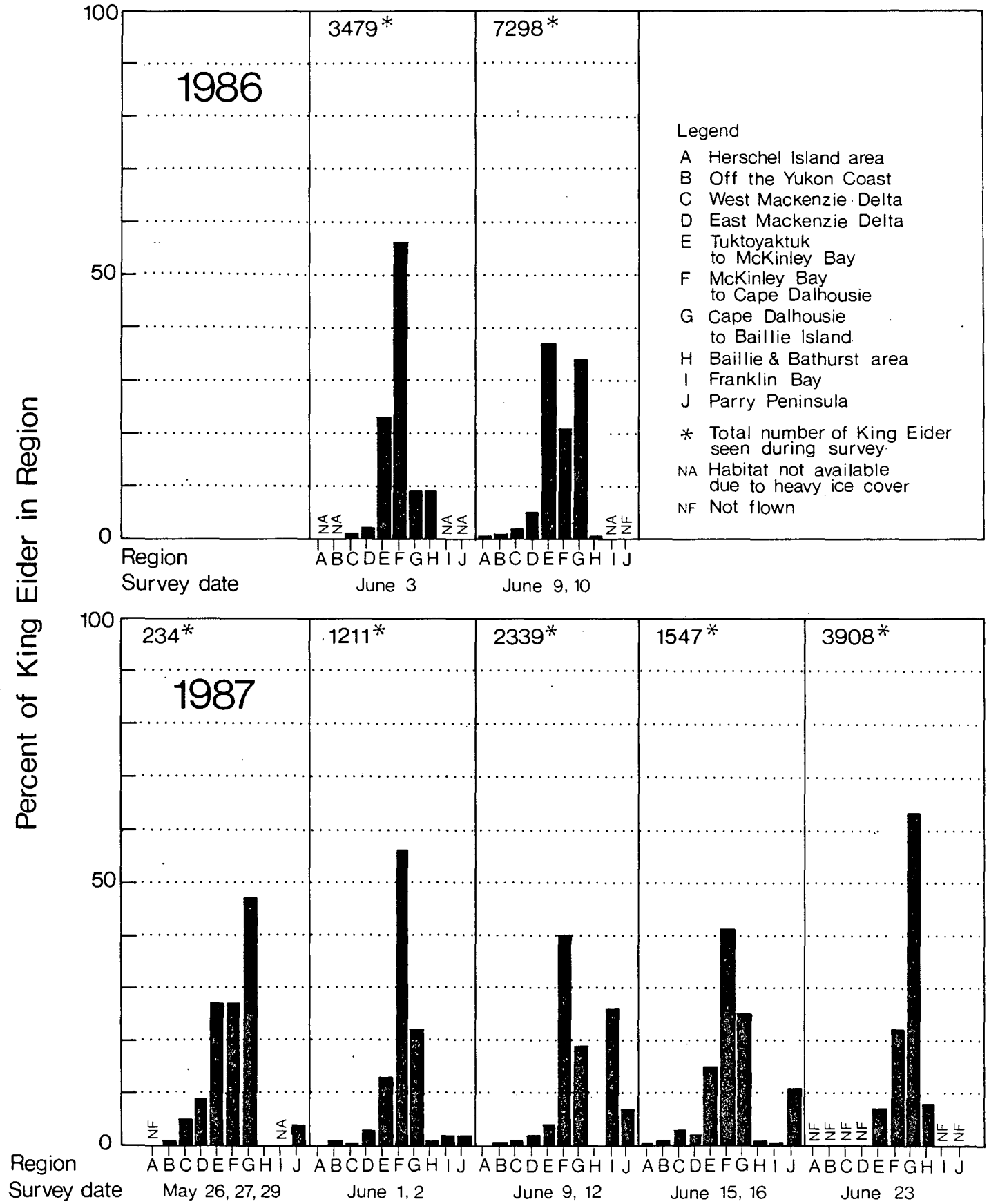

Figure 10. Histograms depicting the distribution of King Eiders during aerial surveys of Beaufort Sea offshore leads between Herschel Island and Cape Parry, spring 1986 and 1987.

in the lead stretching north from Cape Kellet, Banks Island, on May 26, 1987 (see section 3.4).

3.3.3 Oldsquaws

Oldsquaws tended to disperse fairly evenly between Herschel Island and Cape Parry (Fig. 11 and Figs. 2 to 8). During peak abundance in 1986, however, 82% (172.7 birds/km) of the birds were around Cape Bathurst (region H). By the second survey in 1986, they were distributed more evenly, though region H still contained the highest proportion (30%) and density (15.0 birds/km). Oldsquaws occurred off the west side of the Mackenzie Delta (region C) and between Tuktoyaktuk and McKinley Bay (region E) in similar proportions (25 and 22%) but lower densities (4.2 and 4.4 birds/km).

The pattern in 1987 was different from 1986 in that we did not observe striking abundances around Cape Bathurst (region H). Furthermore, there appeared to be a west-to-east shift in relative abundance over the first four surveys. In late May, most birds (73%) were west of Tuktoyaktuk, particularly off the west side of the Mackenzie Delta (region C) (51%; 10.8 birds/km). Very few birds were seen around Cape Parry (region J).

Unfortunately, during the survey on June 2, the tape deck for recording data on the lead-ward side of the aircraft malfunctioned for the first 24 transects (the first 26 transects cover regions A to D). Thus we underestimated the number of birds west of Tuktoyaktuk. During that survey, 58% of the Oldsquaws in transects 25 to 47 occurred within 200 m of the ice edge. Assuming this percentage was representative of the entire survey, it can be applied, as a correction factor, to the number of Oldsquaws observed along the ice edge in transects 1 to 24 to estimate the number of missed birds. The calculated addition is 1497 Oldsquaws. The graph for June 2 in Figure 11 contains this correction. We did not apply a similar correction factor to eider numbers because we saw so few birds in transects 1 to 24 on June 2, 1987.

The distributions of Oldsquaws were similar in late May and early June, 1987. The greatest change was an increase in attendance around Cape Bathurst (region H); relative abundance went from less than one percent to 11% (density increased from 0.5 to 28.3 birds/km). Relative abundance off the west side of the Mackenzie Delta (region C) was constant (51 to 49%) but density increased from 10.8 to 28.3 birds/km. Birds were more evenly dispersed on June 9. Relative abundance off the west side of the Mackenzie Delta (region C) declined to 8% (2.4 birds/km). Cape Dalhousie and the Baillie Islands (region G) had the greatest number of birds (25%; 15.0 birds/km). Highest density was again around Cape Bathurst (region H) (10%; 30.9 birds/km).

By June 15 and 16, though overall abundance was only 31% of peak abundance, Oldsquaws were more common east of Tuktoyaktuk (86%), including the Cape Parry region. Similar abundance occurred between Cape

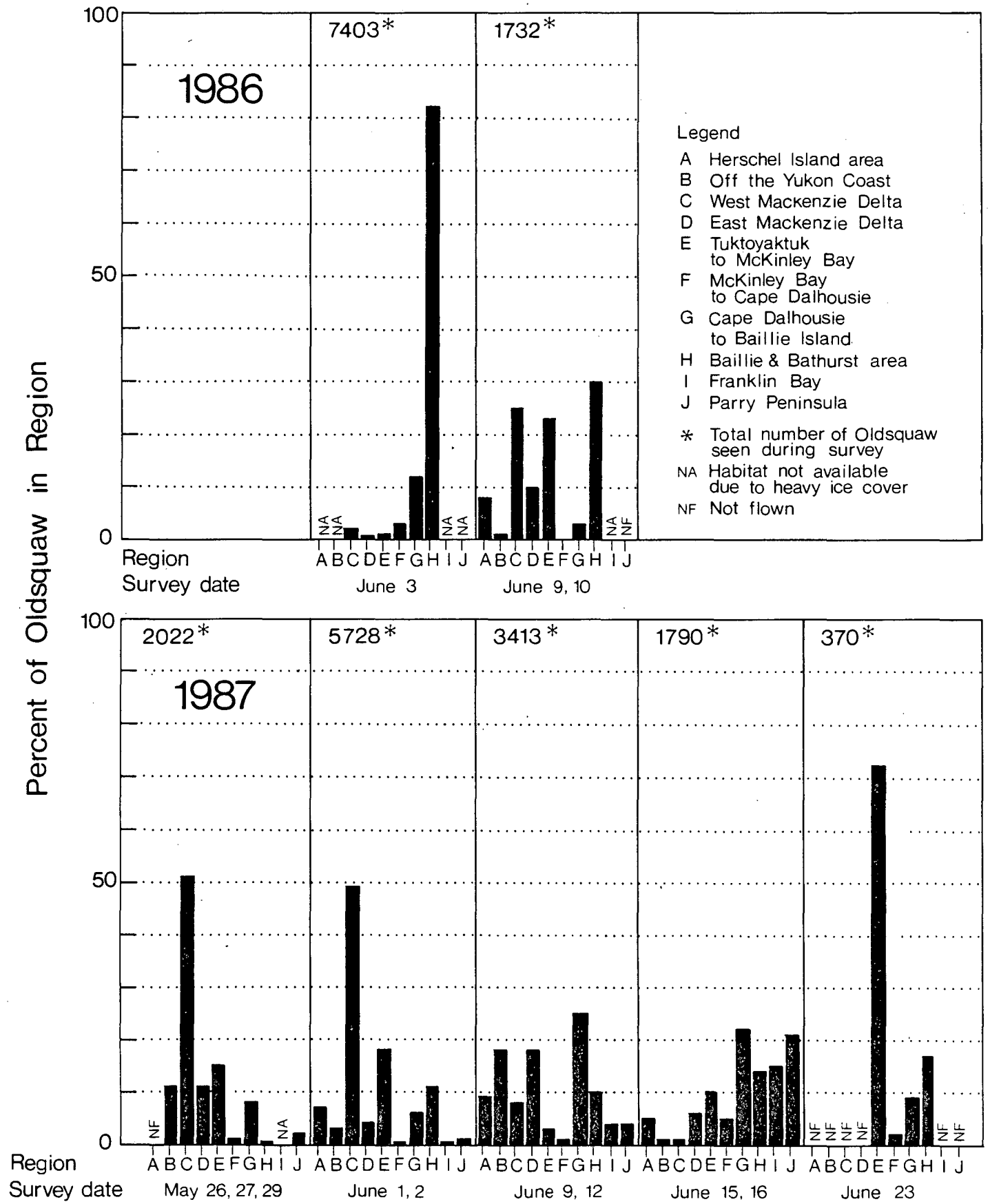

Figure 11. Histograms depicting the distribution of Oldsquaw during aerial surveys of Beaufort Sea offshore leads between Herschel Island and Cape Parry, spring 1986 and 1987.

Dalhousie and the Baillie Islands (region G) and around the Parry Peninsula (region J) (22% and 21%) but density was slightly higher at G (6.7 versus 4.6 birds/km). Highest density was around Cape Bathurst (region H) (14%; 11.6 birds/km).

The data for June 23, 1987, does not lend itself to comparison with previous surveys because of the lack of information for regions west of Tuktoyaktuk (A to D), and east of Cape Bathurst (I and J). However, between Tuktoyaktuk and Cape Bathurst (regions E to H), distribution of Oldsquaws appears similar to late May/early June in that birds were relatively more abundant between Tuktoyaktuk and McKinley Bay (region E) compared to regions east of McKinley Bay (F to H) (Fig. 11).

3.3.4 Glaucous Gulls

In 1986, Glaucous Gulls were relatively more abundant west of Tuktoyaktuk (Fig. 12 and Figs. 2 to 8). This was the case June 3 in spite of regions west of the Mackenzie Delta not being flown. For the first two surveys in 1987, Glaucous Gulls were abundant west of McKinley Bay (regions A to E), and around Cape Parry (regions J). In late May and very early June, 1987, Glaucous Gulls were also abundant through Amundsen Gulf and along southwest Banks Island (regions K and L). Few birds were seen between McKinley Bay and the Bathurst Peninsula (regions F, G, and H), during the first three suveys. By June 15 and 16, birds had dispersed into regions between McKinley Bay and the Baillie Islands but were still uncommon along the east side of the Bathurst Peninsula and through Franklin Bay.

3.4 Distribution of birds through Amundsen Gulf and off western Banks Island

The numbers of birds seen during our surveys in the Amundsen Gulf and Banks Island area are presented in Table 5 (densities are given in Appendix B). We were unable to survey this area thoroughly due to bad weather and budgetary constraints (see section 3.1); thus it is not meaningful to discuss regional distributions at length.

Eiders rarely occurred in Amundsen Gulf. Off western Banks Island, eiders (primarily King Eiders) were most abundant north of Massik River. The available habitat extended far north of the limit of our surveys, and much of this habitat is attractive to eiders (Barry et al. 1981; Barry and Barry 1982).

We rarely saw Oldsquaws anywhere north of Cape Parry. Glaucous Gulls, however, were common in Amundsen Gulf and along southwestern Banks Island (regions K and L) during the first two surveys. Glaucous Gulls were rare north of Massik River.

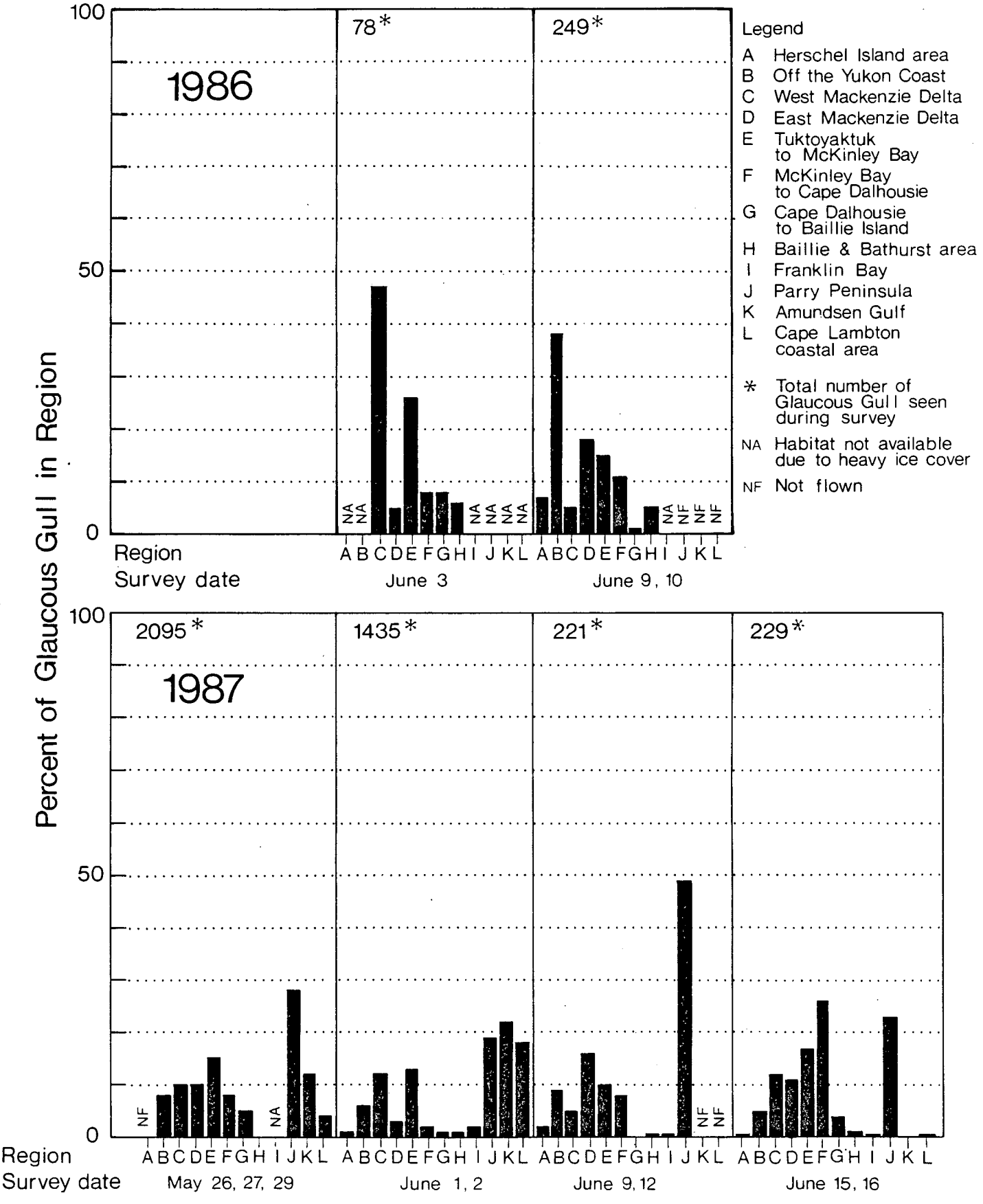

Figure 12. Histograms depicting the distribution of Glaucous Gulls during aerial surveys of Beaufort Sea offshore leads between Herschel Island and Nelson Head, Banks Island, spring 1986 and 1987.

Table 5. Numbers of Pacific and King Eiders, Oldsquaws, and Glaucous Gulls observed during aerial surveys of offshore leads off the southwest and west sides of Banks Island, and in Amundsen Gulf, spring 1987.

Region	Date		
	May 26	June 1	June 16
PACIFIC EIDERS			
K Amundsen Gulf	0	9	0
L Southwest Banks Island[1]	2	23	82
M Massik R. to C. Kellett	NA[3]	12	381
N Cape Kellett	18	148	NF
N_o[2]	NF[4]	18	NF
Total	20	210	463
KING EIDERS			
K Amundsen Gulf	2	9	0
L Southwest Banks Island[1]	5	8	92
M Massik R. to C. Kellett	NA	2	1521
N Cape Kellett	1966[5]	647	NF
N_o	NF	434	NF
Total	1973	1100	1613
OLDSQUAWS			
K Amundsen Gulf	2	10	0
L Southwest Banks Island[1]	0	4	0
M Massik R. to C. Kellett	-	0	51
N Cape Kellett	5	21	-
N_o	-	2	-
Total	7	37	51
GLAUCOUS GULLS			
K Amundsen Gulf	256	323	0
L Southwest Banks Island[1]	85	258	1
M Massik R,. to C. Kellett	-	4	3
N Cape Kellett	8	10	-
N_o	-	3	-
Total	349	598	4

[1]This region received incomplete coverage on all dates (see section 3.1).
[2]N_o was parallel to N but 1 km out into the open-water lead.
[3]Habitat not available due to heavy ice cover.
[4]Not flown.
[5]Plus one flock of 2000 eiders, primarily S. spectabilis.

4.0 DISCUSSION

4.1 Pacific and King Eiders

4.1.1 Distribution and timing of Pacific Eiders

From our 1986 and 1987 results, it appears that the Cape Dalhousie to Baillie Islands region is the most important concentration area for Pacific Eiders migrating through the Beaufort Sea. The McKinley Bay to Cape Dalhousie region may also be heavily used at times. Surveys by Searing et al. (1975) in 1974 tend to support this view. In that year, open-water was abundant between Cape Dalhousie and the Baillie Islands, but not elsewhere, by the time of their fourth survey set, flown May 21. At that time, they saw over 50 000 eiders, mostly Pacific Eiders. By their fifth survey set, May 29 and 31, the aforementioned lead had nearly closed and the numbers of eiders had dropped to a few thousand. Nonetheless, most birds were in the Cape Dalhousie to Baillie Islands region.

Barry (1986) makes similar mention of these concentration areas but further states that the degree of use is dependent on ice conditions. However, there are not enough data to enable us to predict alternate distributions based on ice conditions. In the extreme case where open-water is not available at all, the eiders will be forced to stage elsewhere. If other potential staging waters are also ice-covered, many eiders will likely starve, as was the case in 1964 (Barry 1968.

Results from a survey flown in 1980 by Barry et al. (1981) under conditions similar to those of 1986 and 1987, provide some evidence of the importance and consistency of use of the Cape Dalhousie to Baillie Islands region. On June 5, 1980, they saw 2786 Pacific Eiders throughout the study area (see Fig. C1). From off Tuktoyaktuk to the Baillie Islands, they recorded 1898 birds, 84% of which were east of Nuvorak Point. These are very small values in comparison with the results of our study and Searing et al. (1975). However, the region of highest use was similar in all studies.

The small numbers of Pacific Eiders observed in 1980 raise some uncertainty about the consistency of use of the Cape Dalhousie to Baillie Islands region. However, 1980 appears to have been a year of late migration. From June 6 to 19, 1980, Allen (1982) conducted migration watches in the small, recurring polynya at the interface between Dolphin and Union Strait and Coronation Gulf, referred to as the Lambert Channel polynya (Smith and Rigby 1981). Peak Pacific Eider abundance occurred between June 7 and 13. In a single 2-hour watch on June 10, she tallied 18 408 birds. The sum of three 2-hour watches on June 6 was 189 birds, whereas the average sums for the periods June 7 to 13, and June 14 to 19 were 10 857 and 826 birds, respectively (from appendix B1, Allen [1982]).

The buildup of birds at Lambert Channel started 2 days and peaked 5 days after the 1980 Beaufort Sea survey. The time difference between

the survey and the migration watches may have been long enough for the main migration front to move into both areas. Sudden and large migrational fluxes have been observed in spring at Point Barrow (Woodby and Divoky 1982). Birds may have been abundant in the Cape Dalhousie to Baillie Islands area after June 5 in 1980. Furthermore, there may have been a simultaneous buildup of birds at both locations.

The only other study to examine spring eider distributions was conducted on June 9, 1981, by Barry and Barry (1982). Ice conditions were quite different from the above four survey conditions. As in 1980, they observed small numbers of birds: 2677 Pacific Eiders were counted, 1595 of which were between Cape Dalhousie and the Baillie Islands, and only 65 were seen west of there. There is no information for the Victoria Island area from 1981. However, Figure C2 shows that there was extensive open-water starting just east of the Parry Peninsula and extending to Victoria Island and even into Dolphin and Union Strait. Thus migrants in early June had little water available to them in the Beaufort Sea but extensive habitat in eastern Amundsen Gulf. Eiders migrating on and prior to June 9, 1981, may have continued directly to the Victoria Island area, bypassing the eastern Beaufort Sea altogether. However, we have little indication of the timing of migration in 1981, and the paucity of eiders on June 9 may, as in 1980, be indicative of a late year for Pacific Eider migration. Barry and Barry (1982:21-22) elaborate on this second suggestion, intimating that Pacific Eiders may delay their departure from Alaskan waters upon encountering bad ice conditions to the east, while King Eiders press on regardless. On June 9, 1981, they observed 10 269 King Eiders, mostly off western Banks Island, but only 2677 Pacific Eiders.

The only other location within the study area to have been noted as a concentration area for Pacific Eiders during spring migration is around Cape Parry (Barry 1986). "In early June approximately 20 000 King Eiders, Common Eiders, and Oldsquaw ducks can be expected when the open water is close to Fiji Island, Canoe Island, and the west point (Police Point) of Cape Parry" (Barry and Barry 1982:35). In 1987 there was open water in the Cape Parry region during all surveys (Figs. 4 to 8); however, our maximum count of the three duck species was only 3788 birds on June 16, of which 3213 (85%) were Pacific Eiders. The conditions required to encourage these ducks to congregate around Cape Parry in large numbers are not known.

4.1.2 Distribution and Timing of King Eiders

During spring, most western King Eiders migrate around Point Barrow and fly roughly ENE across the pack-ice of the Beaufort Sea to the recurring lead off the west side of Banks Island (Barry 1986). Those birds nesting on Banks Island likely remain in the lead for pre-nesting feeding until the ponds and tundra of their inland nesting habitat have been cleared of winter's ice and snow. Others migrate further east to Victoria Island. This secondary eastward movement probably takes place as soon as open-water is available. Smith (1973) reports that in 1971 both King and Pacific Eiders had started to move into the Holman region

by May 18 to 21, and that the main eider hunting activity around Holman took place in the first two weeks of June (95% of the eider taken by hunters were King Eiders). Eiders in spring move south to southeast past Holman. Barry (1968) indicates that roughly 70% of the western King Eiders nest on Victoria Island. Thus the number of birds moving into leads along Victoria Island must be quite substantial. Unfortunately, the only surveys of this region were conducted between June 24 and 29, 1980 (Allen 1982), which is rather late for spring staging and pre-nesting King Eiders, and consequently, few birds were seen.

Smith (1973) also noted that the local Inuit believed that eiders moving south past Holman fly from near Cape Parry to Banks Island, and then east to Victoria Island. Some birds may indeed take this route, but results from the 1986 and 1987 surveys suggest that it would be only a very small proportion of the total. In 1987 we saw few birds through Amundsen Gulf (Table 5) either on the water or in flight. Furthermore, few King Eiders, relative to the estimated western population, were in the southern Beaufort Sea or around Cape Parry during either 1986 or 1987. The largest number, seen on June 9, 1986 (Fig. 10), represents just under 1% of the western population. This observation is supported by surveys in 1974, 1980, and 1981 (Searing et al. 1975; Barry et al. 1981; Barry and Barry 1982). In 1980, however, Barry et al. (1981) recorded 449 Pacific Eiders (16% of all Pacific Eiders sighted that day) and 82 King Eiders (1%) in the Amundsen Gulf region indicating that some birds do pass through Amundsen Gulf.

Barry et al. (1981) and Barry and Barry (1982) in their June 1980 and 1981 surveys of leads in both southern and northeastern parts of the Beaufort Sea found King Eiders to be most abundant in the lead off Banks Island. On June 5, 1980, of the 5855 King Eiders observed, 92% were north of Cape Kellet. On June 9, 1981, of the 20 169 birds seen, 16 461 (82%) were north of Cape Kellet. Our surveys in 1986 did not include Banks Island, and our 1987 coverage of this region was inadequate; thus we have little to add to the pattern derived from 1980 and 1981 surveys. Barry (1986) makes the additional remark that as many as 95 000 King Eiders have been observed at one time along the southern two-thirds of the Banks Island west coast.

Results from 1980, 1981, 1986, and 1987 indicate that the Cape Dalhousie to Baillie Island lead is the most important area for King Eiders in the southern part of the Beaufort Sea. On June 5, 1980, 68% of 335 King Eiders were between Nuvorak Point and the Baillie Islands; on June 9, 1981, 98% of 3708 birds were between Cape Dalhousie and the Baillie Islands. In both these years, most birds were off Cape Dalhousie. The pattern was very similar for 1986 and 1987 (Fig. 10). The region from McKinley Bay to the Baillie Islands, and to a lesser extent, areas off the Tuktoyaktuk Peninsula west of McKinley Bay, harboured most of the King Eiders. Abundance was skewed in favour of the western parts of the region.

On June 23, 1987, 81% of the King Eiders were observed in the eastern part of the region outlined above. Of the birds sexed, 90% were

males (Table 3); thus June 23 is more likely a record of the westward male moult migration than of spring migration. At Cape Bathurst in 1912, westward male migration started about June 30 and continued throughout July (Anderson 1913:465). King Eiders were dominant until July 18, after which Pacific Eiders became more numerous. The migration is best described by Anderson's own comments: "... large flocks of male Eiders were going west nearly every day during July." and "On the morning of July 11th for about three hours a large flock would pass every few minutes, and sometimes four or five flocks were in sight at once."

The only other observations of eiders at Cape Bathurst during the moult migration period come from Barry et al. (1981), Barry and Barry (1982), and Alexander et al. (1988). From one quick pass in an airplane over roughly the same area, these studies noted 2040 birds (mid-July 1980), 768 birds (early August 1981) and 688 birds (mid-August 1986). In late July 1985 only 89 eiders were seen (Alexander 1986).

4.1.3 Abundance of Pacific and King Eiders

In the preceding two sections, we identified Cape Dalhousie to the Baillie Islands as a region of the southeastern Beaufort Sea of primary importance to Pacific Eiders, and, to a lesser extent, King Eiders. The number of eiders sighted at one time has ranged from 30 376 to 50 000 (Searing et al. 1975). However, because there are no data available that indicate the duration of stay of eiders in the Cape Dalhousie to Baillie Islands area, we have no way of knowing whether we have documented an accumulation and subsequent dispersal of birds, or whether we have rather recorded a measure of the changes in intensity of migration. Therefore, we do not know the total number of birds using spring open-water areas in the southeastern Beaufort Sea.

During our surveys, we observed many birds floating on the water rather than flying; thus it is reasonable to assume that some eiders do stop in the area for at least short periods. Furthermore, Barry (1986) observed that eiders congregating in water 10-20 m deep frequently dove, whereas birds in deeper areas rarely dove. In 1980, 1986, and 1987 the parts of the landfast ice between Cape Dalhousie and the Baillie Islands had receded towards shore to lie over water in the 10 and 20 m contours (Figs. 2 to 8 and C1).

The lead off western Banks Island has been recognized as an important area for staging King Eiders, and, to a lesser extent, Pacific Eiders (Barry 1986). This lead is along side one of the western King Eider's primary nesting grounds (Barry 1968); therefore, it is likely important for pre-nesting feeding. Furthermore, it is the first area of shallow open-water encountered after the King Eiders leave the Barrow region. However, as in the southwestern Beaufort Sea, we do not have good indication of the total number of birds using the lead.

The following discussion outlines the status of our knowledge on western eider population sizes. Most of the data is imprecise; hence, so are the population estimates. Nonetheless, they provide us with an

indication of the potential numbers of eiders using spring offshore leads in the Beaufort Sea.

The best estimates of Pacific Eider and western King Eider populations have been obtained during migration watches at Point Barrow, Alaska. Thompson and Person (1963) from a daily 1-hour watch between July 14 and September 1, 1953, estimated a total of 800 000 westward moving adult eiders. They felt an additional 200 000 would account for birds passing before and after the July to September observation period. Unfortunately, they were unable to present estimates for Pacific and King Eiders separately. However, since they sampled only one hour each day, their estimates must be regarded with some scepticism.

Johnson (1971) made both spring and fall observations in 1970 but felt that his spring observations were inadequate for the purpose of estimating the size of passage. For the July 13 to September 7 period, Johnson estimated that 800 200 adult eiders, 95% King Eiders and 5% Pacific Eiders, passed by Point Barrow. Johnson found the same species ratio in native-hunter bag-checks. As assumed by Thompson and Person (1963), there were likely small numbers of male eiders passing prior to July 13, and perhaps substantial numbers of females following September 7.

Timson (1976) conducted observations at Point Barrow for three weeks from August 27 to September 16, 1975. Virtually no adult males were seen during her study. Passage was estimated at 113 160 birds. From hunter bag-checks, she estimated that 73% of the King Eiders were adult females while 16% were immatures and 11% juveniles. Timson stated that 97% were King Eiders and 3% Pacific Eiders; however, given the small number of migrating males and the difficulty differentiating between female eiders at the best of times, this species ratio is questionable.

Woodby and Divoky (1982) conducted spring observations from May 6 to June 4, 1976. For that time period they estimated a passage of 955 600 adult eiders, 153 100 of which were Pacific Eiders (16%). Approximately 99% of the Pacific Eiders were observed on the last day of observation, June 4, whereas 80% of the King Eiders had passed by May 27.

Our results indicate that in some years Pacific Eider numbers increase gradually from late May to the end of the second week in June (Fig. 9). At Point Barrow in 1970, migration of eiders was heaviest between May 9 and May 24, but there was a substantial passage from May 27 to June 12 (Johnson 1971). These observations encourage some question of the meaning of Woodby and Divoky's (1982) minimum estimate of 153 100 Pacific Eiders. If, indeed, the bulk of Pacific Eiders passed Point Barrow in 1976 after June 4, as Woodby and Divoky suggest, and if their method of estimating passage up to June 4 is reasonable, then the adult population of Pacific Eiders entering into Canada in 1976 would have been considerably higher than the 50 000 suggested by late summer migration studies (Johnson 1971; Timson 1976). T.W. Barry (as cited in Bellrose 1976) had at one time estimated the Pacific Eider population at 275 000 (one fourth of the 1 108 000 eiders estimated in Barry [1968]). However,

in a more recent paper, Barry (1986), citing Thompson and Person (1963), Timson (1976), and Woodby and Divoky (1982), indicates that 50 000 to 100 000 birds is a more acceptable estimate. The latter value still falls short of Woodby and Divoky's estimate. It could be that in 1976 most of the Pacific Eiders actually did pass Point Barrow on the one day. Woodby and Divoky did observe a tremendous mass movement of 360 000 King Eiders in a 10-hour period on May 26, which they attributed to a sudden change from unfavourable to favourable winds. Their method of extrapolation led them to conclude that nearly half the western Arctic population of King Eiders passed Point Barrow on that one day.

The largest single sighting of Pacific Eiders comes from aerial surveys by Searing et al. (1975)*. On May 21 to 27, 1974, they observd 56 280 Pacific Eiders and it appears that over 50 000 of these birds were in a lead between Cape Dalhousie and the Baillie Islands on May 21.

Barry (1986), pooling his own personal records of nesting Pacific Eiders with the scanty published accounts, estimates that in the Canadian Arctic there are approximately 81 500 breeding birds, and he believes this to be a minimum value. Of that total, only about 300 nest west of Cape Bathurst (Barry 1986; see also Alexander and Hawkings 1988)**. The Alaskan Beaufort coast also appears to be of minor significance to nesting Pacific Eiders with only 420 nests being found by Divoky (1978).

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*Searing et al. (1975), in Table 4 (page 20), reports 56 280 Pacific Eiders for the period May 21 to 27, seen both on and off transect. In their annotated list of species under Common Eiders (page 126) they state that "over 75 000 birds of this species were sighted on a large lead off Liverpool Bay" during offshore surveys on May 21, 1974. Barry (1976), in a summary report companion to Searing et al. (1975), uses the lower value. However, another value appears in the summary report (page 38): apparently "on one day in May, 1974, 175 000 Oldsquaw, eiders and loons were massed in the open water off Cape Dalhousie and Baillie Island". We suspect that both the 175 000 birds above and the 75 000 Pacific Eiders in Searing et al. (1975) are errors derived from the total number of loons, Oldsquaw, and eiders reported respectively in Tables 3 and 4 of the Barry and Searing et al. reports. This total is 74 774, or approximately 75 000 birds.

**Liverpool Bay has been listed by Prach et al. (1981) as a major breeding locality based on the following statement by MacFarlane (1891): "[The Pacific Eider] breeds in immense numbers on the shores of Franklin Bay; it is also very abundant on the coast and islands of Liverpool Bay." In the present day, only small numbers of Pacific Eiders are scattered throughout Liverpool Bay, with minor concentrations at the Baillie Islands and along the south shore by Harrowby Bay (Alexander et al. 1988; Barry 1986).

Thus we have three estimates of the size of the Pacific Eider adult population that moves through the Beaufort Sea: 40 000+ (Johnson 1971), 82 300 (Barry [1986] combined with Divoky [1978]), and >153 100 (Woodby and Divoky 1982). In addition, we have one minimum count of 56 280 (Searing et al. 1975). The low and high estimates span just six years and would represent an increase of well over 100 000 birds, or 200%. However, given the problems associated with the data, as discussed above, the variation in estimates is most likely attributable to sample error and incompatibility.

For western King Eiders there are two estimates, both from Point Barrow: 760 200+ (Johnson 1971) and 802 500 (Woodby and Divoky 1982). Here the discrepancy isn't nearly so striking (42 300 birds or 6%). Nonetheless, the sampling problems are the same.

The maximum number of Pacific Eiders observed by us in 1986 and 1987 represents anywhere from 18% to 68% of the North American Pacific Eider population. The count by Searing et al. (1975) represents from 37% to 100% of the North American population. Clearly there is not enough information to provide more precise estimates. Even the minimum proportion estimate is very imprecise given the uncertainty in Woodby and Divoky's (1982) population estimate, as discussed above. Nonetheless, it is safe to state that a large proportion of the population may be present on one day in parts of the southeastern Beaufort Sea during spring.

4.2 Oldsquaws

There are very few estimates of Beaufort Sea Oldsquaw numbers. In the fall, Oldsquaws migrate later than the period covered by most of the Point Barrow migration studies. Thompson and Person (1963) saw only 80 Oldsquaws between July 14 and September 1, 1953. Johnson (1971:28) recorded 1545 Oldsquaws between July 13 and September 7, 1970, all of which were seen during the last week of observations (August 31 to September 7). He estimated that nearly 21 000 Oldsquaws passed Point Barrow, heading southwest during that week.

The best estimate of Beaufort Sea Oldsquaw numbers comes from migration watches by Timson (1976) conducted between August 27 and September 16, 1975. She first noted migrating Oldsquaws on September 5, and tallied 14 894 birds from then until September 16. Timson estimated that 240 607 Oldsquaws passed Point Barrow during the three week observation period. This value is an underestimate because many birds migrate later into October (Gabrielson and Lincoln 1959; Flock 1973). During the third week of observations in 1975, Oldsquaws were migrating past Point Barrow at a rate of 442 birds per 1/2 hr. Timson suggests that if migration continued to late October, the passage may have been as high as 800 000 Oldsquaws.

Spring observations and estimates made by Woodby and Divoky (1982) are inadequate. They estimated a total passage of 32 141 Oldsquaws, from May 6 to June 4, 1976, 80% of which passed on their last day of observations.

Thus, we do not have precise estimates of how many Oldsquaws enter into the Beaufort Sea. Furthermore, many of these birds nest along the Alaskan Beaufort Sea coast and so the number of Oldsquaw migrating through the Canadian Beaufort Sea would be less than the number passing Point Barrow. The imprecision in population estimates makes it difficult to assess the importance of spring leads to Oldsquaws.

The maximum number of Oldsquaws seen in 1986 and 1987 (7403 birds) represents 3% of Timson's (1976) estimate of 240 607 Oldsquaws. The largest concentration (6078 birds) was observed around the Baillie Islands on June 3, 1986, and represents 2.5% of Timson's estimate. In 1974, Searing et al. (1975) recorded much larger concentrations of Oldsquaws, on May 21-27 they saw 17 454 (7.3%), and on May 29-31 they recorded 11 353 (4.7%), mostly between Cape Dalhousie and the Baillie Islands. Very few Oldsquaws were seen during surveys in 1980 and 1981 (Barry et al. 1981; Barry and Barry 1982).

The Oldsquaw is a common nesting bird all along the Beaufort Sea coast as well as on Banks and Victoria islands (Hawkings 1987; Parmelee et al. 1967; Manning et al. 1956). This is reflected in their somewhat scattered distribution in spring leads. These birds likely migrate to a point offshore of their nesting location and wait in the lead until snow and pond-ice melt has advanced far enough to provide some inland open-water. Small groups of Oldsquaws are often seen loafing on ice-pans in coastal lakes prior to nest initiation (D.L. Dickson pers. comm.). If the Oldsquaws are highly dependant on offshore leads, then yearly nesting distributions may be influenced by spring lead distributions (Richardson and Johnson 1981). However, some Oldsquaws follow overland migration routes (Richardson and Johnson 1981).

The fact that very few Oldsquaws, relative even to Timson's (1976) minimum estimate for the Point Barrow passage, have been seen during any single survey of offshore leads, and that few migrate near the coast, indicates that there is likely a large turnover of birds at many locations along the southern offshore lead. In other words, there may be open-water throughout areas that are utilized the migration period by substantial proportions of the Beaufort Sea Oldsquaws population but only by smaller numbers at any one time.

4.3 Glaucous Gulls

Glaucous Gulls appear to be constantly on the move. These birds are among the earliest migrants in spring (Searing et al. 1975), and their easterly passage along the coast is at low rates over extended periods (Richardson and Johnson 1981). During our surveys, Glaucous Gulls were usually flying east, though often they would be seen sitting on the ice-edge. There were two exceptions: Glaucous Gulls tended to congregate around the tip of the Parry Peninsula and near the cliffs along southwestern Banks Island. The Banks Island concentration area was adjacent to nesting areas along the cliffs (pers. obs.; Barry et al. 1981:37).

Glaucous Gulls were the most common species we observed throughout Amundsen Gulf. Often they congregated in small groups on the edge of the ice. Glaucous Gulls, being surface feeders and scavengers, would be less restricted to specific areas of shallower water, like the eiders and Oldsquaw; hence their more scattered distribution.

5.0 CONCLUSIONS

Hundreds of thousands of Pacific Eiders, King Eiders, and Oldsquaws migrate east across the Canadian Beaufort Sea each spring, using open-water in the recurrent offshore lead system as a place for resting and probably feeding. Some regions of the lead system harbour large concentrations of these birds most years. In particular, the lead off the Tuktoyaktuk Peninsula from around McKinley Bay to the Baillie Islands is heavily used by Pacific Eiders and Oldsquaws, while the lead off the west side of Banks Island is heavily used by King Eiders. The availability of these areas during spring is somewhat consistent from year to year (Marko 1975); however, in some years, the lead does not form in the heavily used areas, although it may open in other areas. We do not know how the birds respond in such situations; that is, whether they congregate in alternate regions, and if so which regions. In addition, we do not have accurate estimates of the numbers of birds involved, although we do know that the numbers are large.

Because of their tendency to congregate, the migrating eiders and Oldsquaws are particularly susceptible to natural environmental disasters (such as the lead system not forming [Barry 1968], and to man-induced disasters (such as oil spills [Vermeer 1976; Vermeer and Anweiler 1975]). However, it is difficult to assess the sensitivity of these sea ducks to environmental perturbations without adequate information on population sizes (for the Beaufort Sea in general and for specific areas), distribution patterns as influenced by ice conditions, and bird activities (such as feeding versus resting), coupled with information on disaster-specific mortality factors (see Wiens et al. 1984).

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Appendix A. Weather and ice conditions during aerial surveys of Beaufort Sea offshore leads, spring 1986 and 1987.

1986

June 3: (Fig. 2) Skies clear east and west of the Mackenzie Delta, overcast north of the Delta. Winds east at 10 to 15 knots (all wind speeds are visual estimates based on unsheltered wave conditions). West edge of lead extending south along the Bathurst Peninsula cluttered with small pan-ice and brash-ice. West of Baillie Islands, lead was convoluted giving rise to variable edge-ice and wave conditions. Small closure in lead north of Tuktoyaktuk.

June 9: (Fig. 3) Fog in the Bathurst Peninsula area but not obscuring. West of Baillie Islands, intermittant overcast, broken, and clear. Winds east at 15 to 20 knots. Lead was much more open than on June 3, but ice-edge conditions were similar.

June 10: (Fig. 3) Skies overcast. Winds northwest at 5 knots. West of Herschel Island, lead indistinct, giving way to large pan-ice with intermittent cracks of open-water.

1987

May 26: (Fig. 4) Skies predominantly clear; slight haze; some thin, non-obscuring fog. Winds in Amundsen Gulf east at 15 to 20 knots; Banks Island winds east at 5 knots.

Weak and crumbly pan-ice with some small, irregular leads and slushy areas in Franklin Bay from Baillie Islands south and east to Summers Harbour on the Parry Peninsula; north of there, lead well defined. North of Cape Parry to the Nelson Head, Banks Island, eastern lead-edge straight and clear of small ice-debris. Open water with white-caps to the west as far as one could see.

May 27: (Fig. 4) Skies overcast; wind northwest at 5 to 10 knots. Lead edge distinct in most locations. Large pans sloughing off land-fast ice created some narrow crack-leads several kilometers long.

May 29: (Fig. 4) The weather was not suitable for flying on May 28 so the completion of the first set of surveys had to be postponed until May 29. Skies clear from Tuktoyaktuk to just west of Baillie Island; low overcast east of there. Wind east at 10 to 15 knots. Wave conditions variable dependent on orientation of lead edge. Ice-edge was distinct but somewhat convoluted.

June 1: (Fig. 5) Skies clear; wind east at 15 to 20 knots. Franklin Bay lead along Bathurst Peninsula was heavily littered with small ice-pans and brash-ice; Amundsen Gulf lead-edge clear of debris. Lead distinct from Parry Peninsula to north of Cape Kellet. Cape Lambton to Massik Pass could not be surveyed because of strong down-draughts along cliffs.

June 2: (Fig. 5) Low overcast with intermittent fog from Herschel Island to north of Shallow Bay. Broken sky north of Mackenzie Delta; clear to east. Wind east at 20 to 25 knots. Wave and lead-edge ice conditions variable dependent on orientation of lead-edge.

June 9: (Fig. 6) Low overcast west of Mackenzie Delta; wind north at 5 knots; intermittent drizzle. East of Mackenzie Delta, clouds high and broken; wind east at 20 to 25 knots. Wave and lead-edge ice conditions variable dependent on orientation of the lead-edge.

June 6 to 11: (Fig. 6) Fog prevented flying from June 6 to June 8. On June 9 and 10, Cape Parry reported high east to northeast winds (30 to 35 knots), and freezing drizzle and snow. On June 11, winds around 6 knots but fog prevented flying.

June 12: (Fig. 6) Low overcast with intermittent fog patches; wind west at 5 to 10 knots. Lead-edge distinct only around Parry Peninsula. Large pan-ice cluttered Amundsen Gulf north of Cape Parry and likely as far east as Victoria Island. Many narrow and discontinuous leads of several orientations. Survey terminated in central Amundsen Gulf due to confused lead systems and fog.

June 15: (Fig. 7) Intermittent fog, wind west at 5 knots west of Shallow Bay. East of Shallow Bay, clouds high and broken; wind east at 10 to 15 knots. Lead-edge distinct, but wave and lead-edge ice conditions variable dependent on orientation of lead-edge.

June 16: (Fig. 7) Fog hampered survey from Cape Bathurst to near Parry Peninsula. Skies clear for remainder of survey except dense fog near Nelson Head. Winds east at 25 to 30 knots around Cape Parry. Cape Lambton to Massik Pass not surveyed due to strong downdraughts along cliffs.

June 23: (Fig. 8) Skies clear; winds east at 5 to 10 knots. Lead-edge distinct but wave and lead-edge ice conditions variable dependent on orientation of the lead-edge.

Appendix B. Densities (birds/km) of most common bird species observed within each region during aerial surveys of Beaufort Sea offshore leads, spring 1986 and 1987.

Date	Region	Densities (birds/km) Pacific Eider	King Eider	Oldsquaw	Glaucous Gull	Distance flown (km)
1986:						
June 3	A Herschel Island area	-	-	-	-	0.0
	B Yukon Coast	-	-	-	-	0.0
	C West Mackenzie Delta	6.8	0.3	1.0	0.4	105.6
	D East Mackenzie Delta	1.8	0.6	0.3	0.0	105.6
	E Tuktoyaktuk to McKinley Bay	3.8	9.1	1.2	0.2	88.0
	F McKinley Bay to Cape Dalhousie	34.1	37.1	3.5	0.1	52.8
	G Cape Dalhousie to Baillie Island	179.2	5.7	17.0	0.1	52.8
	H Baillie and Bathurst area	93.8	9.2	172.7	0.1	35.2
June 9, 10	A Herschel Island area	2.7	0.0	3.0	0.4	43.8
	B Yukon Coast	2.1	0.6	0.2	1.2	76.6
	C West Mackenzie Delta	8.2	1.4	4.2	0.1	103.9
	D East Mackenzie Delta	2.7	4.2	2.0	0.5	87.5
	E Tuktoyaktuk to McKinley Bay	8.4	21.9	3.2	0.3	122.3
	F McKinley Bay to Cape Dalhousie	6.0	29.1	0.0	0.5	51.7
	G Cape Dalhousie to Baillie Island	265.0	35.7	0.8	0.0	70.6
	H Baillie and Bathurst area	29.5	1.2	15.0	0.4	34.4
1987:						
May 26, 27, 29	A Herschel Island area	-	-	-	-	0.0
	B Yukon Coast	0.8	0.0	3.6	2.7	61.2
	C West Mackenzie Delta	2.0	0.1	10.8	2.2	96.1
	D East Mackenzie Delta	6.0	0.3	2.9	2.7	77.7
	E Tuktoyaktuk to McKinley Bay	22.5	0.4	2.7	2.7	112.8
	F McKinley Bay to Cape Dalhousie	19.9	0.5	0.3	2.1	76.7
	G Cape Dalhousie to Baillie Island	97.3	1.8	2.6	1.9	62.2
	H Baillie and Bathurst area	0.0	0.0	0.5	0.0	12.9
	I Franklin Bay	-	-	-	-	0.0
	J Parry Peninsula	0.1	0.2	0.9	12.0	49.2
	K Amundsen Gulf	0.0	0.0	0.0	2.3	110.7
	L Southwest Banks Island	0.1	0.2	0.0	3.5	24.6
	M Massik River to Cape Kellett	-	-	-	-	0.0
	N Cape Kellett	0.4	45.6	0.1	0.2	43.1

Appendix B. Continued.

Date		Region	Densities (birds/km) Pacific Eider	King Eider	Oldsquaw	Glaucous Gull	Distance flown (km)
1987:							
June 1, 2	A	Herschel Island area	9.9	0.0	16.3	0.7	23.5
	B	Yukon Coast	1.9	0.3	3.0	1.6	54.8
	C	West Mackenzie Delta	8.9	0.1	28.5	1.7	99.2
	D	East Mackenzie Delta	3.2	0.5	2.7	0.5	85.2
	E	Tuktoyaktuk to McKinley Bay	35.0	1.2	7.8	1.4	132.1
	F	McKinley Bay to Cape Dalhousie	25.7	8.9	0.3	0.4	75.4
	G	Cape Dalhousie to Baillie Island	197.9	4.5	6.3	0.3	58.1
	H	Baillie and Bathurst area	7.5	0.4	28.3	0.6	22.4
	I	Franklin Bay	0.8	0.2	0.1	0.2	105.0
	J	Parry Peninsula	10.4	0.3	1.0	4.7	57.4
	K	Amundsen Gulf	0.1	0.1	0.1	2.9	110.7
	L	Southwest Banks Island	0.9	0.3	0.2	9.7	26.5
	M	Massik River to Cape Kellett	0.4	0.1	0.0	0.1	30.9
	N	Cape Kellett	1.8	8.0	0.3	0.1	80.4
	N_o		0.2	4.5	0.0	0.0	97.3
June 9, 12	A	Herschel Island area	0.2	0.0	12.1	0.2	25.4
	B	Yukon Coast	0.3	0.1	9.0	0.3	68.0
	C	West Mackenzie Delta	3.7	0.3	2.4	0.1	111.9
	D	East Mackenzie Delta	10.9	0.6	6.3	0.4	101.0
	E	Tuktoyaktuk to McKinley Bay	7.1	0.8	0.9	0.2	124.7
	F	McKinley Bay to Cape Dalhousie	101.8	13.7	0.3	0.3	68.8
	G	Cape Dalhousie to Baillie Island	280.9	7.9	15.0	0.0	56.3
	H	Baillie and Bathurst area	17.2	0.0	30.9	0.1	10.9
	I	Franklin Bay	2.7	4.5	1.1	0.0	134.4
	J	Parry Peninsula	21.4	2.1	1.7	1.4	74.5
	K	Amundsen Gulf	1.8	0.4	0.1	0.0	73.2
	L	Southwest Banks Island	-	-	-	-	0.0
	M	Massik River to Cape Kellett	-	-	-	-	0.0
	N	Cape Kellett	-	-	-	-	0.0
June 15, 16	A	Herschel Island area	12.0	0.5	6.7	0.1	12.1
	B	Yukon Coast	0.7	0.3	0.3	0.2	56.2
	C	West Mackenzie Delta	0.1	0.5	0.2	0.3	102.7
	D	East Mackenzie Delta	1.3	0.3	1.1	0.2	102.1
	E	Tuktoyaktuk to McKinley Bay	9.6	1.8	1.4	0.3	135.2
	F	McKinley Bay to Cape Dalhousie	83.8	7.8	1.1	0.7	81.2
	G	Cape Dalhousie to Baillie Island	78.1	7.7	7.8	0.2	49.4
	H	Baillie and Bathurst area	19.8	1.0	11.6	0.1	21.0
	I	Franklin Bay	0.6	0.2	5.8	0.0	46.7
	J	Parry Peninsula	39.8	2.1	4.6	0.6	80.7
	K	Amundsen Gulf	0.0	0.0	0.0	0.0	109.4
	L	Southwest Banks Island	2.6	2.9	0.0	0.0	32.0
	M	Massik River to Cape Kellett	5.1	20.3	0.7	0.0	74.8
	N	Cape Kellett	-	-	-	-	0.0

Appendix B. Continued.

Date	Region	Densities (birds/km) Pacific Eider	King Eider	Oldsquaw	Glaucous Gull	Distance flown (km)
1987:						
June	A Herschel Island area	-	-	-	-	0.0
23	B Yukon Coast	-	-	-	-	0.0
	C West Mackenzie Delta	-	-	-	-	0.0
	D East Mackenzie Delta	-	-	-	-	0.0
	E Tuktoyaktuk to McKinley Bay	1.5	3.7	3.7	0.0	72.0
	F McKinley Bay to Cape Dalhousie	1.4	10.0	0.1	0.0	84.0
	G Cape Dalhousie to Baillie Island	13.8	51.5	0.7	0.0	48.0
	H Baillie and Bathurst area	1.7	13.6	2.7	0.0	24.0

Appendix C. Figures depicting survey routes, bird densities (birds/km^2), and ice conditions during aerial surveys of Beaufort Sea offshore leads, spring 1980 and 1981.

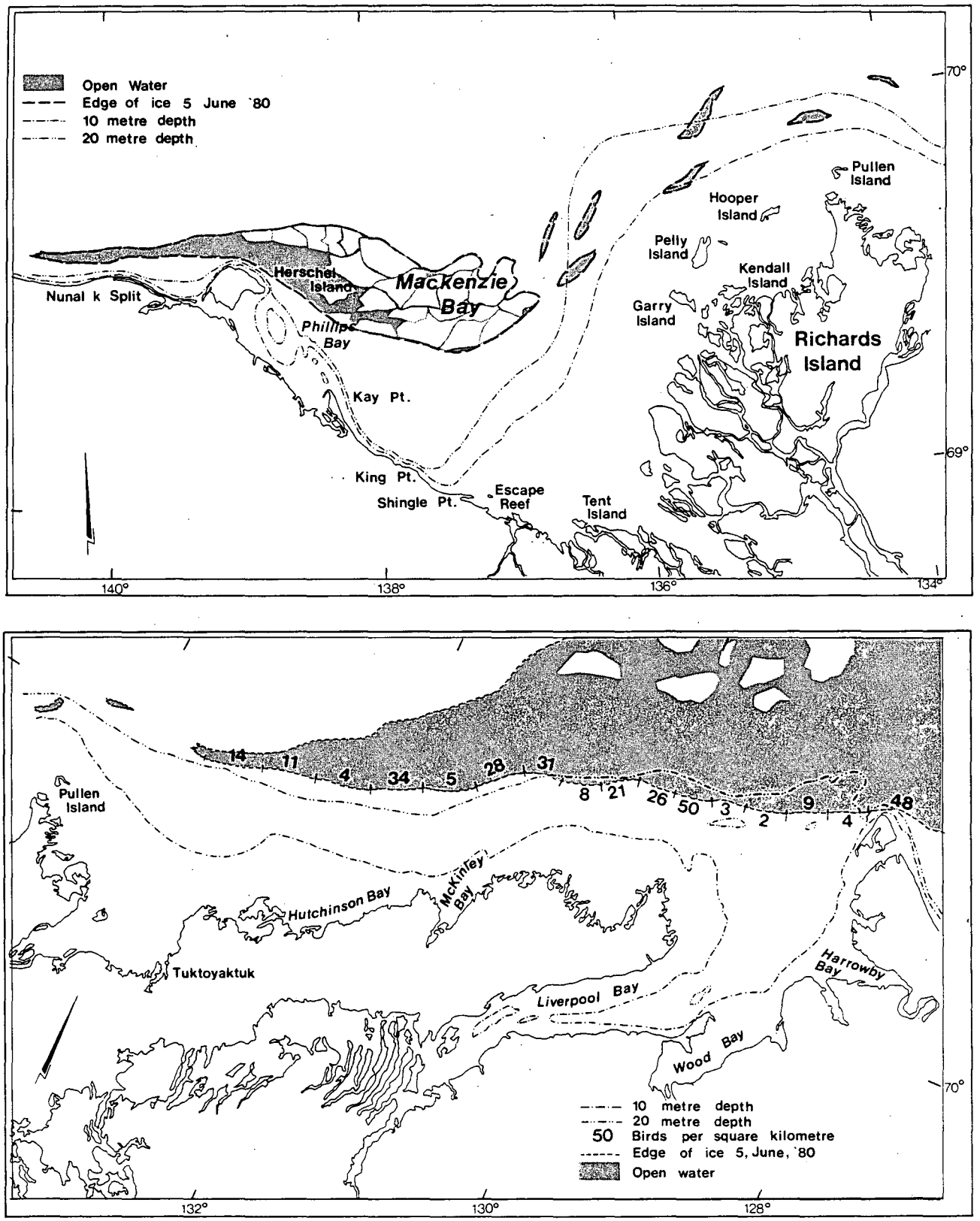

Figure C1. Bird densities (birds/km^2) and ice conditions observed during aerial surveys of Beaufort Sea offshore leads, June 5, 1980. Figures reprinted from Barry et al. (1981).

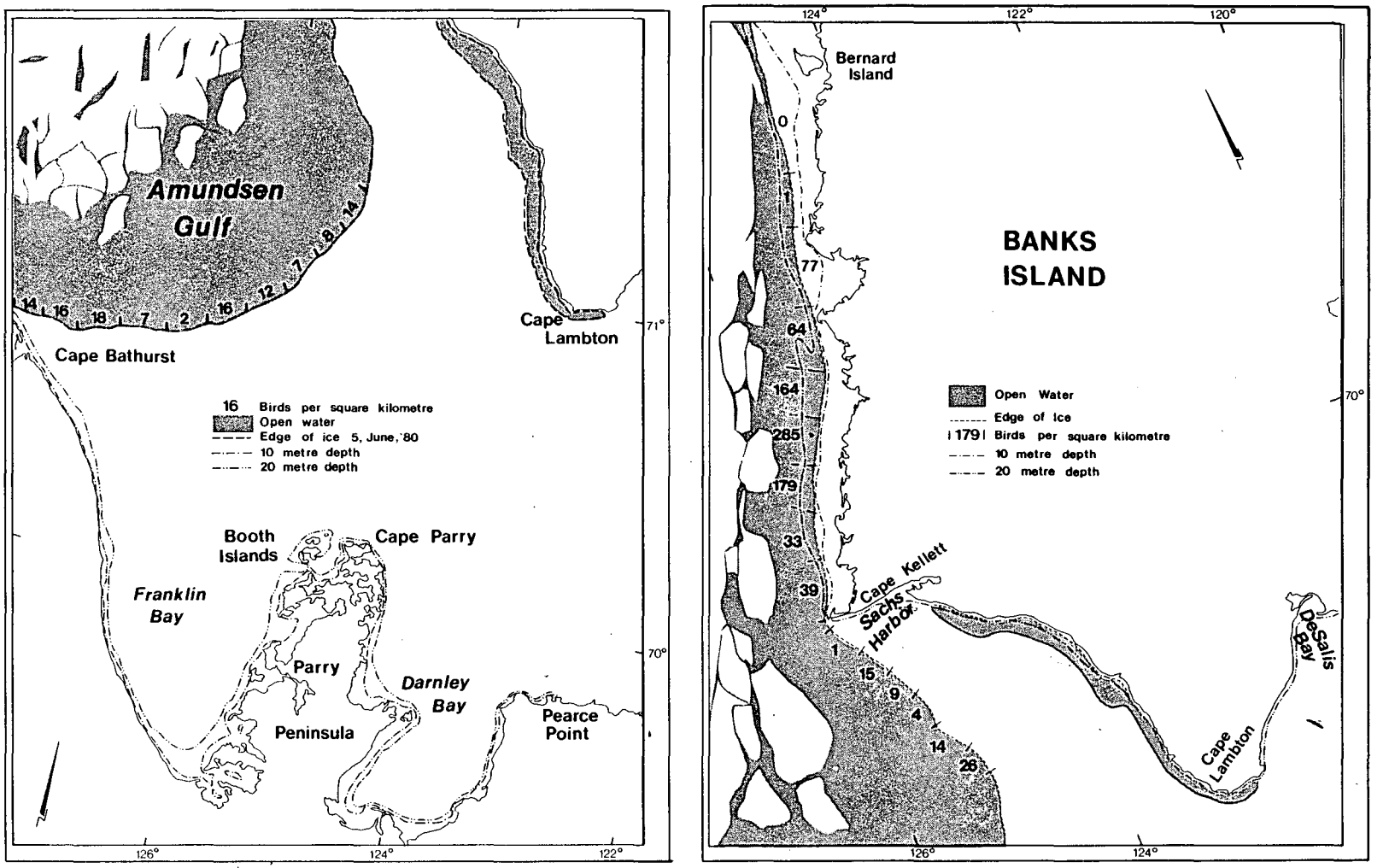

Figure C1. Continued.

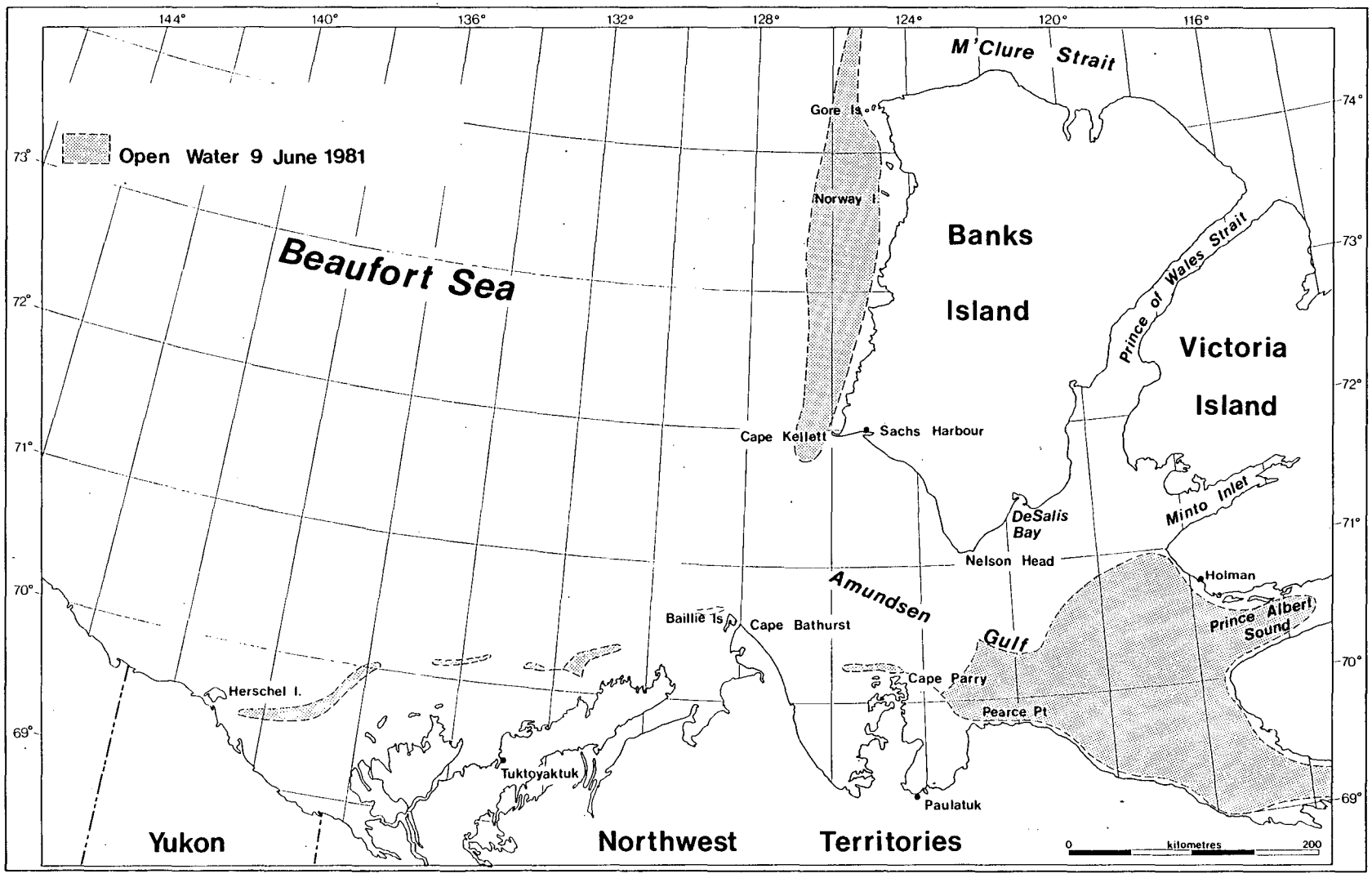

Figure C2. Ice conditions observed during aerial surveys of Beaufort Sea offshore leads, June 9, 1981. Reprinted from Barry and Barry (1982).