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Birds, observed and collected by "De Nederlandse Spitsbergen Expeditie" in West and East Spitsbergen, 1967 and 1968-'69; second part

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ABSTRACT

The present article mainly concerns the birds of northern Edgeøya, where a Netherlands' expedition had residence for a consecutive period of thirteen months. In addition, information from Hornsund, Kvalpynten and Hopen, also visited by members of the Expedition, is given. Data concerning weight, food, moult, plumage and phenology are presented as well as measurements of the specimens collected.

Special attention has been paid to *Gavia stellata* (taxonomy), *Fulmarus glacialis* (colour phases), *Branta leucopsis* (breeding), *Stercorarius parasiticus* and *Stercorarius pomarinus* (plumages), *Sterna paradisaea* (breeding), *Cepphus grylle* (phenology) and *Plectrophenax nivalis* (taxonomy).

For the first part of this study, see: Korte, J. de (1972), Beaufortia, **19** (253): 113—150.

ACCOUNT OF THE SPECIES; CONTINUED

15. **Stercorarius pomarius** (Temminck, 1815). Pomarine Skua.

Material collected: 12 specimens; data in table XI.
ZMA No. 22794, 22795, ♀, ♂, 15.VIII.1967, Kapp Martin.
ZMA No. 22796, ♀, 17.VIII.1968, Sea east of Edgeøya.
ZMA No. 19835, ♀, 16.VIII.1969, Kapp Lee.
ZMA No. 19830, 19836, ♀, ♂, 19.VIII.1969, Kapp Lee.
ZMA No. 19834, 19863, 19845, 19864, 2 ♂, 2 ♀, 22.VIII.1969, Kvalpynten.
ZMA No. 19829, 19862, ♂, ♀, 24.VIII.1969, Kvalpynten.

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TABLE XI. *Stercorarius pomarinus*. Weights and measurements.

ZMA No.	Weight g	Wing mm	Tarsus mm	Culmen mm	Condition	Sexual cycle	
				MALES			
22795	—	341	52.7	38.0	fat	Sub-adult	
19836	655	343	51.5	38.9	„	„	
19834	685	358	55.4	39.6	very fat	„	
19863	605	347	53.7	37.1	fat	„	
19829	670	352	55.4	41.5	very fat	„	
				FEMALES			
22794	—	363	55.2	40.4	fat	Adult	Oviduct narrow
22796	—	370	52.5	40.5	„	Sub-adult	„
19835	690	369	55.6	40.2	very fat	„	„
19830	810	355	53.8	40.8	„ „	„	„
19864	730	364	54.5	39.0	„ „	„	„
19845	695	341	53.5	41.3	„ „	„	„
19862	760	349	52.6	40.7	„ „	„	„

The sexual variation in the Pomarine Skuas collected on Spitsbergen is shown in table XII.

TABLE XII. Sexual variation in *Stercorarius pomarinus*.

		Sex	Number	Range	S.d.	Mean ± s.d.m.	t
Weight	g	♂	4	605—685	34.7	653.8 ± 17.4	2.95
		♀	5	690—810	49.7	737.0 ± 22.2	
Wing	mm	♂	5	341—358	6.9	348.4 ± 3.1	2.05
		♀	7	341—370	10.8	358.7 ± 4.1	
Culmen	mm	♂	5	37.1—41.5	1.7	39.0 ± 0.7	1.75
		♀	7	39.0—41.3	0.7	40.4 ± 0.3	
Tarsus	mm	♂	5	51.5—55.4	1.7	53.7 ± 0.8	0.26
		♀	7	52.6—55.2	1.2	54.0 ± 0.4	

Females are heavier than males (83,2 g = 13 %) and larger in all respects. This is a well-known phenomenon in skuas, but according to my calculations these differences were not significant ($P > 0.01$).

Moult and plumage.

According to Witherby (1941), Dementiev (1951), and Gabrielson & Lincoln (1959) the Pomarine Skua acquires full adult plumage in its fourth calendar year, but according to Brooks (1939) in its third. Stresemann (1966) considers this still a controversial issue, though he presents evidence supporting the first view.

The Pomarine Skua changes feathers several times during its first three or four years. According to the authors mentioned above it is possible to determine the approximate age of the sub-adults, though the details of age variation still require refinement.

Pitelka et al. (1955) noticed a quantitative colour dimorphism between the sexes; this dimorphism is also apparent in our specimens. The males are somewhat more white on the lower breast and upper abdomen and darker on the lower abdomen than the females, but this difference is by no means constant and cannot be used as a sex criterion. According to Pitelka (1955), males show on average longer rectrices than females. This phenomenon was also noticed in our birds (table XIII). Age variation is superimposed on sexual variation.

TABLE XIII. *Stercorarius pomarinus*. Some sub-adult characteristics as represented in specimens from Spitsbergen: a — white and/or buff bars on feathertips of back, neck and mantle; b — blue gray spots on legs; c — underwing coverts and axillaries barred (percentage); d — flanks and lower tail-coverts barred; e — pale or buff fringes on crown; f — abdomen more or less barred; g — middle tail feathers extending in mm.

ZMA No.	Sex	a	b	c	d	e	f	g
19862	♀	+	+	100 %	+	+	+	49
19835	♀	+	+	100 %	+	+	+	14
19830	♀	+	—	100 %	+	+	+	50
19829	♂	+	+	100 %	+	+	+	45
19864	♀	+	+	100 %	+	+	+	33
22796	♀	+	+	100 %	+	+	+	56
19845	♀	+	+	50 %	+	+	+	13
22795	♂	—	+	100 %	+	+	+	53
19834	♂	+	—	50 %	+	+	—	79
19863	♂	—	+	50 %	—	—	+	66
19836	♂	—	+	10 %	—	—	—	51
22794	♀	—	—	0 %	—	—	—	82

Table XIII shows the age characteristics as represented in our series of 12 specimens. One specimen (ZMA No. 22794) is in full adult plumage. Eleven specimens show varying degrees of sub-adult plumage, including the middle rectrices, which are considerably longer than in juveniles, but shorter than in full adults. If we take into account the descriptions of sub-adults, given by Witherby (1941) and Dementiev (1951) it is not clear whether these eleven birds are in their second or third calendar year. Witherby, for instance, states that second calendar year birds have the same rectrices as juveniles, while in third calendar year birds only a few axillaries are sometimes barred. Seven specimens of our series however, have elongated rectrices in combination with completely barred axillaries (100 %, table XIII). Dementiev (loc. cit.) states that second calendar year birds retain remiges and rectrices from the juvenile plumage and that third calendar year birds do not show bars on back and mantle. Eight of our specimens, however, have elongated rectrices in combination with bars on back and mantle.

To elucidate this point, sub-adult specimens of this species in the museums of Leiden and Amsterdam were studied for comparison.

A bird from the middle of March 1927 (Gulf of Bengalen) showing a

juvenile plumage (first winter) was moulting remiges and rectrices (P_1 is innermost primary, R_1 is innermost rectrix): P_{1-3} new, P_4 half-grown, P_5 missing, P_{6-10} old; R_1 new, and as long as R_{2-6} old. A bird from June 1960 (coast New-South Wales) was moulting remiges: P_{1-8} new, P_9 half-grown, P_{10} missing. This bird showed several sub-adult characteristics; viz. white and buff bars on feathertips of back, neck and mantle. Flanks and upper tail coverts barred, light and darker buff edges on crown, which was not separated clearly from the rest of the head. Middle tail feathers (new) extending only 33 mm, blue-grey parts on legs Under-wing coverts, axillaries and abdomen, however, were not barred at all. According to Stresemanns' (1966) descriptions, this bird should be in its second calendar year, because only second calendar year birds should complete their moult as late as June or July. Older birds should have already completed their moult of primaries in April. Judging from plumage and colour pattern this bird and the first 9 specimens of table XIII are from the same age-class. In my opinion these ten birds differ too much from the juvenile bird from Gulf of Bengalen (first winter = second calendar year) to be classed in the same year. Second calendar year birds moreover are supposed to remain on the southern seas (Wynne Edwards, 1935; Stresemann, 1966).

Taking into account the observations on study-skins, I am inclined to classify the first 9 specimens of table XIII as third, and the next 2 as fourth calendar year birds, respectively. But it must be stressed that this question of age and plumage in general needs further study and I agree with Pitelka (1955) that the sequence of plumages, described by Witherby (1941) is in need of critical review. To do this it will be necessary to study specimens from all age classes, collected in every month of the year.

Some degree of moult of small body feathers, mostly over the whole body, was found in 11 of our specimens (not in ZMA No. 19836). According to plumage (11 specimens), and gonads (ZMA No. 22794) all specimens collected were non-breeders.

Stomach contents; 9 examined.

Of all stomachs 3 were empty, 4 contained fish (vertebrae and otoliths), 1 remains of a small bird, 1 cartilage, 3 plant remains (few) a.o. mosses *(Polytrichum, Timmia, Distichum).*

Field observations.

During August 1968 Pomarine Skuas were regularly seen on the sea east of Edgeøya.

In 1969, two birds of this species were seen on 23 June flying east through Freemansundet along the south coast of Barentsøya. They showed an adult plumage and had elongated and twisted tail feathers.

On 26 July a Pomarine Skua was seen flying south along Kapp Lee. From 6 August onwards birds of this species were seen daily near this place in increasing numbers until the end of this month. They mostly flew south in groups of 5 to 10 along the coast. It was regularly observed that they rested on ice floes.

On 21 and 22 August we saw at Kvalpynten and Ardalstangen on both

days 40 to 60 of these birds, most of them resting on the tundra. I observed three times a dark variant among them. Until 22 August I had not noticed birds with long, twisted tail feathers, and judging from the plumage, most of the Pomarine Skuas seen before this date were sub-adult birds.

On 23 August for the first time that autumn birds (2) with twisted tail feathers were seen; they were noticed near Halvmåneøya among tens of Pomarine Skuas that were coming from the east. On 24 August I counted on Hopen at one time 143 Pomarine Skuas, more than 60 % of them showing a sub-adult plumage.

This species was observed for the last time that year on 4 September, when 4 sub-adults were seen sitting on an ice floe near Kapp Lee, they flew south afterwards.

In 1967 I observed on 6, 13 and 14 August, 3, 4 and 4 Pomarine Skuas respectively, along the coast from Kapp Linné to Hornsund. None of these 11 birds showed twisted tail feathers.

According to field observations and the examinations of study-skins, there is some evidence that the majority of the Pomarine Skuas seen on Spitsbergen are sub-adult, non-breeding wanderers. Kolthoff obtained 6 birds of this species on Kong Karls Land during the summer of 1900. None of these had the sexual glands developed (Løvenskiold, 1963). The question arises whether breeding birds of this species do actually visit Spitsbergen on their autumn migration from their breeding grounds in Russia to the south.

The statements of Wynne-Edwards (1935) and Stresemann (1966) that non-breeding sub-adults no not visit the Arctic at all, but spend the summer in more southern waters is not supported by my observations. It is not likely, however, that the sub-adult June specimen from New South Wales (see: Moult and Plumage) should already have visited the Arctic that summer. At least part of the sub-adult population of Pomarine Skuas is to be found in the Arctic during summer; another part probably remains on the southern seas.

16. **Stercorarius parasiticus** (Linnaeus, 1758). Arctic Skua.

Material collected: 21 specimens; data in table XIV.
ZMA No. 22797, 22798, 22799, 2 ♂, ♀, 9.VIII.1967, Kapp Linné.
ZMA No. 22800, 22801, ♀, ♂, 11.VIII.1967, Kapp Linné.
ZMA No. 22802, ♀, 15.VIII.1967, Kapp Linné.
ZMA No. 22803, ♀, 20.VIII.1967, Isbjørnhamna.
ZMA No. 22804, ♀ juv., 26.VIII.1967, Isbjørnhamna.
ZMA No. 19823, ♀, 3.VI.1969, Kapp Lee.
ZMA No. 19798, 19799, ♂ ♀ (a pair), 20.VI.1969, Barentsøya.
ZMA No. 19860, ♂, 15.VII.1969, Diskobukta.
ZMA No. 19831, 19832, 2 ♀, 18.VII.1969, Diskobukta.
ZMA No. 19837, 19848, 2 ♀, 6.VIII.1969, Kapp Lee.
ZMA No. 19849, ♂ juv., 16.VIII.1969, Kapp Lee.
ZMA No. 19847, ♂, 2.IX.1969, Brimulen.
ZMA No. 19846, 19855, 19856, 2 ♂ juv., ♀, 4.IX.1969, Kapp Lee.

TABLE XIV. *Stercorarius parasiticus*. Weight and measurements.

ZMA No.	Weight mm	Wing mm	Tarsus mm	Culmen	Condition	Sexual cycle		Moult of small feathers
					MALES			
22797	—	311	44.1	33.7	fat	adult		whole body
22798	—	313	40.3	30.8	„	sub-adult		„ „
22801	—	316	40.2	32.8	„	sub-adult		„ „
19798	568	319	45.0	31.6	very fat	ad. small testis		none
19860	436	317	44.8	31.1	moderate	ad. small testis		none
19849	468	248	42.3	29.5	fat	juvenile		whole body
19847	474	315	43.2	31.3	„	adult		„ „
19846	477	251	45.4	28.1	moderate	juvenile		„ „
19855	417	240	44.0	28.1	„	juvenile		„ „
					FEMALES		Oviduct	
22799	—	324	45.3	31.8	fat	adult	swollen	„ „
22800	—	329	43.5	33.5	„	sub-adult	narrow	„ „
22802	—	331	45.4	32.3	very fat	adult	swollen	neck
22803	—	326	43.3	32.8	fat	adult	narrow	neck
22804	—	267	43.4	30.3	„	juvenile	narrow	back
19823	603	320	44.3	32.3	„	adult	sw. egg 4.9 mm	none
19799	697	—	—	—	„	adult	sw. egg 26.5 mm	„
19831	586	325	42.2	34.8	„	adult	narrow	„
19832	545	319	42.2	33.1	very fat	adult	narrow	„
19848	604	329	43.4	33.4	fat	adult	narrow	„
19837	551	326	43.8	32.8	„	sub-adult	narrow	„
19856	467	326	45.5	31.2	moderate	adult	swollen	„

The sexual variation in the specimens collected on Spitsbergen is shown in table XV.

TABLE XV. Sexual variation in *Stercorarius parasiticus*. Included ♂ and ♀ collected by van Oordt on Spitsbergen (1).

	Sex	Number	Range	S.d.	Mean ± s.d.m.	t
Weight g	♂	3	436—568	68.0	492.7 ± 39.2	1.82
	♀	7	467—697	70.3	579.0 ± 26.6	
Wing mm	♂	7[1]	311—320	3.2	315.9 ± 1.2	5.75
	♀	11[1]	319—331	3.7	325.3 ± 1.1	
Culmen mm	♂	6	30.8—33.7	1.1	31.9 ± 0.5	1.62
	♀	11[1]	31.2—34.8	1.0	32.8 ± 0.3	
Tarsus mm	♂	7[1]	40.2—45.0	2.0	43.0 ± 0.8	1.18
	♀	11[1]	42.2—45.5	1.2	44.0 ± 0.4	

Females exceed males in weight by 86.3 g (17 %) and are larger in all respects. This is well-known for skuas (see also above, *Stercorarius pomarinus*). In our Arctic Skuas only the difference in wing length (9.4 mm = 3 %) proved to be significant ($P < 0.01$). The weight difference agrees with records from Belopolskii (1957), who found that in summer birds from East Murmansk, females were 16 % heavier than males. Arctic Skuas from East Spitsbergen are considerably heavier than those from Murmansk, males weighing on the average 19 % more and females 21 %. According to Belopolskii (1957) this should point to the existence of better environmental conditions for the Arctic Skua on Spitsbergen.

Females show a slight tendency to lose weight in the course of spring and summer (fig. 22). This was also noted in Murmansk (Belopolski, 1957). Of a brood of two young, 18 or 19 days old, one weighed 410 g on 6 August. Both had fledged on 13 August. On 4 September two juvenile males, fledged for one or two days, weighed 417 and 477 g, respectively, their mother weighed 467 g, which is low compared with the average weight in early summer. These three birds were all in a moderately fat condition which is quite uncommon during summer, when most Arctic Skuas are fat or very fat (table XIV, fig. 22).

Moult and plumage.

None of the birds (6) collected in June and July showed any sign of moult. All male specimens (7) from August and September showed some degree of moult of small body feathers over the whole skin. Amoung the females from this period, the three specimens collected on Edgeøya in 1969 did not show moult, whereas all five from West Spitsbergen 1967 did (table XIV).

Four specimens showed more or less sub-adult characteristics: bars on breast, abdomen, under-wing coverts and under-tail coverts. A specimen (in ZMA) from the North Sea, dated 15 November 1915 was also sub-adult, showing more juvenile characteristics than our four specimens, but it was definitely not a bird in its first calendar year. Its central tail feathers were

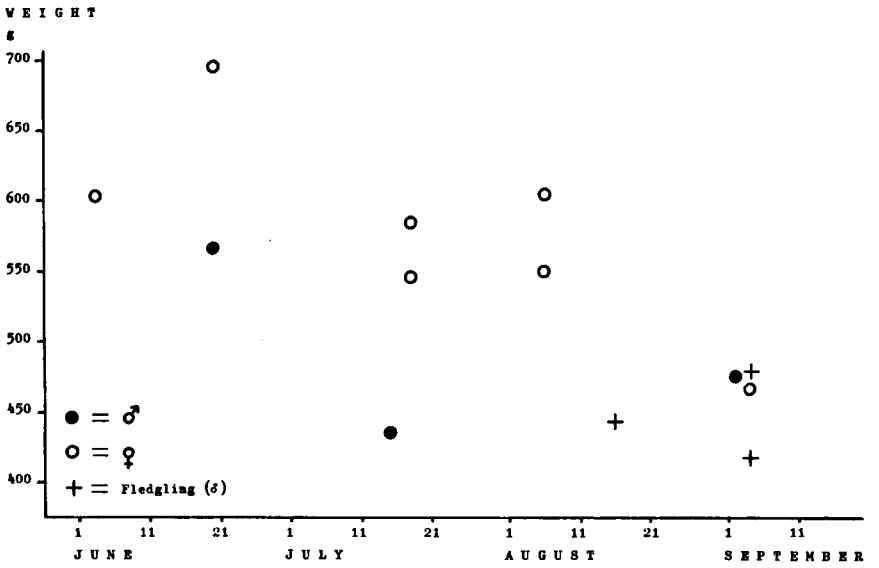

FIG. 22. *Stercorarius parasiticus*. Weights of males and females, collected near Kapp Lee from June to September 1969.

elongated and it had lost most of its brown and buff barred feathers on breast and abdomen. Our four sub-adults were more advanced in development, showing a much more pronounced cap and longer rectrices. Taking into account the descriptions of plumages at various age stages given by Walter (1962), I should like to classify our sub-adults (ZMA No. 19837, 22798, 22800, 22801) as third calendar year birds.

Leg colour.

The legs of the Arctic Skuas show different colorations: they are either bluish grey mixed with patches of black, or pure black. The specimens (22; included 2 additional specimens from Spitsbergen in ZMA) were divided into 4 categories, according to the sexual cycle. For each category the leg colour was ascertained (table XVI). From these figures it appears that in the course

TABLE XVI. *Stercorarius parasiticus*. Leg colour in percentages of specimens examined.

	Number	Spotted black	Pure black
Juveniles	4	100 %	—
Sub-adults	5	80 %	20 %
Adults, non-br.	7	29 %	71 %
Adults, breeding	6	—	100 %

of the development from fledging to adult breeding bird, the percentage of birds with pure black legs increases from 0 to 100 %. In birds that retain some blue, the patches of this colour become progressively smaller.

Colour phases.

TABLE XVII. *Stercorarius parasiticus*. Percentages of colour phases in Spitsbergen.

		All birds observed			Breeding birds only		
		Number	Light	Dark	Number	Light	Dark
Northern Edgeøya	July 1969	80	96 %	4 %	20	100 %	0
Kvalpynten	August 1969	70	95 %	5 %	—	—	—
Hopen	August 1969	80	95 %	5 %	—	—	—
Hornsund	August 1967	70	92 %	8 %	30	97 %	3 %

The Arctic Skua shows colour phases, which we can place in two categories (Southern, 1943): light and dark. The plumage of each phase has considerable variation, to such an extent that Williamson (1965) speaks of a progressive series between the lightest and the darkest birds.

Of 23 specimens collected on Spitsbergen in 1921, 1967 and 1969, 2 were dark (ZMA No. 22802, 22803) and 21 light. The light birds varied from birds without a dark breast-band to birds that in addition had a considerable part of their breast and abdomen covered with dark feathers. The proportion of dark and light birds in our series is by no means representative for the Spitsbergen population, as the two dark birds were collected by preference.

In 1967 and 1969 I made some counts on dark and light skuas near Hornsund and in East Spitsbergen (table XVII).

The percentage of dark skuas found in all birds observed is higher than in breeding birds only. The percentage in the latter category agrees fairly well with records from Spitsbergen given by Southern (1943) and Løvenskiold (1963).

There is some evidence (table XVII) that dark skuas are more numerous in South West than in East Spitsbergen.

The Arctic Skua is known to roam over considerable distances, and most of the dark birds in the category "all birds observed" may have come from more southern regions, where the dark forms are relatively more numerous. Provided this explanation holds true, the differences between West and East Spitsbergen become understandable, as dark birds are relatively more numerous in the Norwegian Sea than in the Barents Sea (Southern, 1943). According to Southern, records from Alaska, Jan Mayen and the British Isles may indicate a long term rise in proportion of dark birds. The relatively high proportion of dark birds we noted as compared with earlier observations in Spitsbergen (Southern, 1943; Løvenskiold, 1963) would reflect this long term change.

Stomach contents: 13 examined.

Of all stomachs examined, 4 were empty, 9 contained fish (mass), mainly Gadidae, 2 Gammaridae (including *Gammarus setosus*), 1 *Thysanoessa* spec., and 1 plant remains (*Poa* spec., *Papaver dahlianum*).

The Arctic Skua on Spitsbergen mostly gets its food by robbing other sea birds, Kittiwakes being its main victim. It also chases Black Guillemots, Glaucous Gulls, Arctic Terns and once we observed two skuas chasing a Fulmar. The Kittiwake is much more easily forced to regurgitate its food than any of the four last-named species. In two cases I managed to collect the food given up by Kittiwakes; it consisted of Gammaridae.

In the neighbourhood of the nest Pomarine Skuas were also chased, these always withdrawing. Ivory Gulls were chased when they met at a carcass, but these gulls behaved so agressively towards the Arctic Skuas, that the latter always had to give way.

We once observed a skua catching a Purple Sandpiper in flight above the sea. We also saw that a Little Auk, which was forced to alight on the tundra by a Glaucous Gull, was killed and eaten by a pair of Arctic Skuas, after the gull

had been chased away. Finally we saw Arctic Skuas eating the eggs of a pair of Red-throated Divers (once), as well as eating from Polar Bear and Seal carcasses.

Field observations (fig. 23).

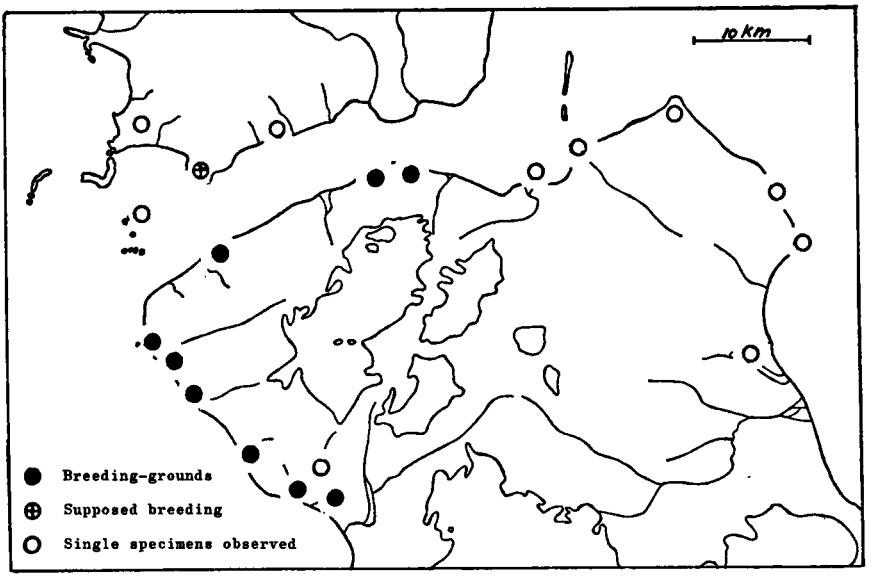

FIG. 23. *Stercorarius parasiticus*. The same symbols are also used in the other maps concerning the occurrence of the species.

In 1968 a pair of Arctic Skuas had residence on the tundra near the station. They reared one young, which fledged on 22 August and were seen there until 16 September. After that date we saw only adults, mostly flying south. On 28 September we saw our last skua of the year, attacking a fox on the new sea-ice. By that date minimum and maximum temperature were —12° and —8° C.

In 1969 the first Arctic Skua was observed on 3 June, when twice a bird of this species came from the south and flew along the coast of Rosenbergdalen. Temperatures were by then around freezing point. On 6 June a pair (one light and one dark) alighted on the tundra near the station, but they were not seen again. From this date onwards Arctic Skuas were seen every day along the coasts of Freemansundet, most of them flying east during the first half of June.

In the course of the summer of 1969 we ascertained 10 cases of breeding (figs. 23, 24). If we allow for an incubation period of 26 days and a fledging period of 26 days (Løvenskiold, 1963) we get the following approximate dates for completing the clutches in 1969: 23 June, Rosenbergdalen, 2 eggs; 29 June, Meodden, 2 eggs; 29 June, Meodden, 1 egg; (1 July 1968, Kapp Lee, 1 egg); 1 July Ardalstangen 1 egg; 3 July, Kapp Lee, 1 egg; 13 July

FIG. 24. *Stercorarius parasiticus*. A light Arctic Skua defending its young, 26 July, Meodden. Reindeer and helicopters that approached its nest were also attacked by the Arctic Skua. Photograph by the author.

Svingeldalen, 2 eggs; before 13 July, Visdalen, 1 egg; before 14 July, Blanknuten, 1 egg; before 18 July, Diskobukta, 1 egg; before 19 July, Diskobukta, 2 eggs. These data agree with those obtained from West Spitsbergen, though from this last area there are also records that give a markedly later date than the ones above, viz. the last week of July (Løvenskiold, 1963; personal observations 1966, 1967; van Olphen et al., 1969). Probably these late records concern replacement clutches. Comparably late clutches have not been recorded from East Spitsbergen.

The clutch-sizes we found on Edgeøya were compared with records on clutch-size from East and West Spitsbergen (Løvenskiold, 1963; pers. observations 1966, 1967; van Olphen, pers. comm.). From these records it appears that throughout Spitsbergen, the Arctic Skua lays either one or two eggs. The ratio of one-egg to two-egg clutches differs in different regions in this area (fig. 25). Possibly a few one-egg clutches had not yet been completed when found, so the percentages of clutches with two eggs may be slightly higher than is shown in this figure. It is noteworthy that mean clutch-size in East Spitsbergen (1.42) is similar to that in the South West (1.48), whereas in the North West (1.75) it is similar to that in the North (1.85). While East and South West combined (mean 1.45) differ considerably from North West

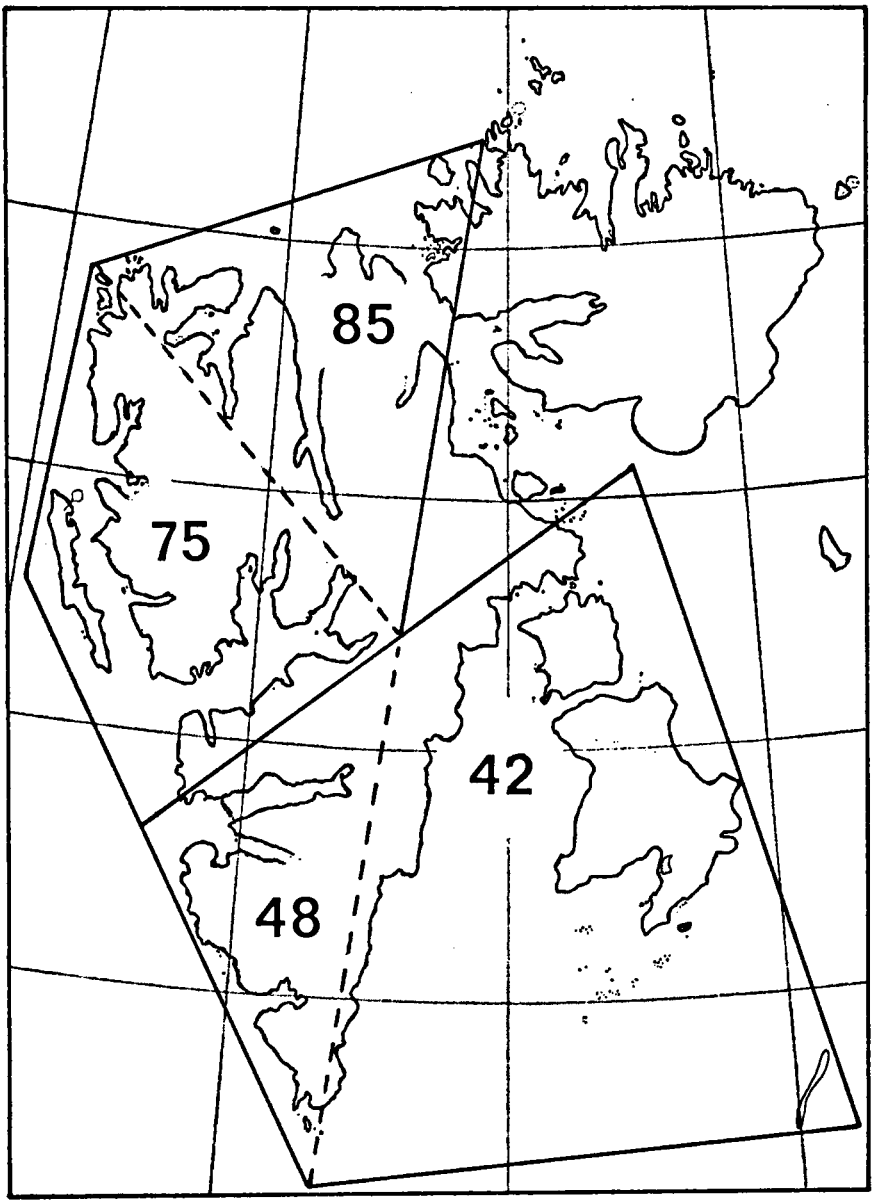

FIG. 25. *Stercorarius parasiticus*. Percentages of clutches with two eggs (two is maximum clutch-size) in North (13 nests), North West (28), South West (29) and East Spitsbergen (19).

and North combined (mean 1.78). A clutch-size of one egg is common in East and South Spitsbergen and not rare in the North-West. It is very rare at East-Murmansk (Belopolskii, 1957). The differences in clutch-size may reflect different environmental conditions. In East Spitsbergen the High Arctic regime is more extreme than on the West-coast and the relative cold current from the East also influences the South-West of Spitsbergen. The North-West and North are more influenced by relatively warm currents. The following observations may illustrate the big local differences that can exist in the High Arctic. On a survey trip in the second half of July 1969 around the northern part of Edgeøya, we counted 18 breeding Arctic Skuas and 30 to 40 non breeders along 60 km coast (N-W, Meodden to Diskobukta). Along another 60 km stretch of coast (N-E, Blåfjorden to Walter Thymensbukta) we saw only 7 Actic Skuas; none of them were breeders. At this eastern side of the island, sea-bird life was scarce, while the sea was covered with solid ice, stretching from the coast to some tens of kilometers to the east.

Compared with Murmansk the arctic regime in Spitsbergen is much more pronounced; in Spitsbergen egg-laying starts about a month later and the birds are forced to leave the freezing sea earlier in autumn. The birds they prey upon already start leaving the coasts of Spitsbergen in August.

Note on ringing.

One bird of the pair of Arctic Skuas that bred near the station in 1969 was ringed (Stavanger Museum No. 539521) on 17 August. On 22 August 1971 there were again two birds of this species at the same place, one of which was seen to have a ring (personal communication, E. Flipse).

17. **Stercorarius longicaudus** Vieillot, 1819. Long-tailed Skua.

Material collected: 1 specimen.

ZMA No. 198421, 18.VII.1969, Diskobukta: weight 352 g, wing 307 mm, culmen 31.0 mm, tarsus 43.7 mm, condition very fat.

This bird showed an adult plumage, but lacked the characteristic elongated tail feathers; it had bluish legs.

Stomach contents: remains of a mammal.

Field observations.

This species seen once, on 18 July 1969 in Diskobukta, when two birds were seen walking on the tundra. One was collected (see specimens collected), the other had very long middle tail feathers. After some time it flew to the west and was not seen again.

18. **Larus hyperboreus hyperboreus** Gunnerus, 1767. Glaucous Gull.

Material collected: 16 specimens; data in table XVIII.

ZMA No. 19121, ♀, 20.VIII.1966, Hornsund.

ZMA No. 22931, ♀, 11.VIII.1967, Kapp Linné.

ZMA No. 19932, ♀ 29.IV.1969, Kapp Lee.

TABLE XVIII. *Larus hyperboreus*. Weights and measurements.

ZMA No.	Weight g	Wing mm	Culmen mm	Tarsus mm	Condition	Sexual cycle	Moult of primaries
			MALES				
19931	2060	450	63.9	74.8	very fat		1 absent, 2—10 old
19922	2030	464	67.2	73.5	very fat		1—10 old
19925	1755	464	67.0	72.3	fat		1 absent, 2—10 old
			FEMALES				
						Oviduct	
19121	—	418	55.8	67.2	—	narrow	1—6 new, 7 absent, 8—10 old
22931	—	408	60.6	66.8	—	narrow	1—6 new, 7 absent, 8—10 old
19932	1410	457	57.9	66.6	fat	swollen	1—10 old
19919	1620	446	58.4	65.9	very fat	?	1—10 old
19920	1445	455	55.4	63.6	fat	?	1—10 old
19928	1635	447	63.1	71.5	fat	swollen	1—10 old
19929	1560	436	57.0	64.0	fat	narrow	1—10 old
19927	1375	419	57.5	66.0	fat	swollen	1—2 half grown, 3—10 old
19926	1760	437	56.9	68.5	very fat	sw. with complete egg	1—2 absent, 3—10 old
19921	1670	442	—	64.5	very fat	swollen	1—10 old
19924	1715	441	55.4	68.9	—	sw. with complete egg	1—10 old
19930	1330	464	58.4	67.9	fat	narrow	1—2 absent, 3—10 old
19923	1460	438	60.0	67.3	—	sw. egg foll. 8.3 mm	1 absent, 2—10 old

ZMA No. 19919, 19920, 2 ♀, 13.V.1969, Kapp Lee.
ZMA No. 19928, ♀, 15.V.1969, Kapp Lee.
ZMA No. 19929, ♀, 22.V.1969, Kapp Lee.
ZMA No. 19927, ♀, 26.V.1969, Kapp Lee.
ZMA No. 19926, 19931, ♀, ♂ 29.5.1969, Barentsøya.
ZMA No. 19923, ♀, 30.V.1969, Kapp Lee.

The sexual variation in the specimens collected on Spitsbergen is shown in table XIX.

TABLE XIX. Sexual variation in *Larus hyperboreus*. Included 3 males (1) and 8 females (2) of which only the weights were taken during summer 1969.

	Sex	Number	Range	S.d.	Mean ± s.d.m.	t
Weight g	♂	6(1)	1755—2060	125.4	1905.8 ± 51.2	7.16
	♀	19(2)	1225—1760	164.5	1450.5 ± 37.7	
Wing mm	♂	3	450— 464	8.1	459.3 ± 4.7	3.13
	♀	13	408— 464	16.2	439.1 ± 4.5	
Culmen mm	♂	3	63.9— 67.2	1.85	66.0 ± 1.06	6.37
	♀	12	55.4— 63.1	2.29	58.0 ± 0.66	
Tarsus mm	♂	3	72.3— 74.8	1.25	73.5 ± 0.72	7.16
	♀	13	63.6— 71.5	2.16	66.8 ± 0.60	

The differences between males and females are significant ($P < 0.01$) with respect to weight and all measurements taken. Males exceed females in weight by 455 g (31 %), in wing length by 20 mm (5 %), in culmen by 8.0 mm (14 %) and in tarsus by 6.7 mm (10 %). A similar but less pronounced sexual variation was found in Murmansk birds (Dementiev, 1951). In these series the males are recorded as being lighter in weight and the females heavier than in our Spitsbergen series.

In female Glaucous Gulls we found a significant ($P < 0.01$) seasonal difference in body weight. Birds collected in May (12 sp., average 1534.5 g) were 228 g (17 %) heavier than birds collected in June (7 sp., average 1306.4 g), see fig. 26. Considerable seasonal weight differences are known to occur in other gull species living in the Arctic (Belopolskii, 1957).

Moult.

Of 16 specimens 8 showed moult of primaries (table XVIII). All birds (5) collected in the period from 29 April to 22 May had all of their old primaries retained. Of the 9 birds collected between 26—30 May 6 had started to lose the first of their primary feathers. One of these birds already showed two half-grown new primaries (ZMA No. 19927). The specimens collected on 11 August and 20 August both had P_{1-6} new and P_{8-10} old (P_1 is innermost primary).

To elucidate the moult in this species, specimens in the Museum were studied. A Spitsbergen specimen from 9 July 1921 had P_{1-3} new, P_4 missing and P_{5-10} old. A Greenland specimen from 1 November 1908 had P_{1-9} new, but P_{10} though new, had grown for no more than 90 % of its length. Other

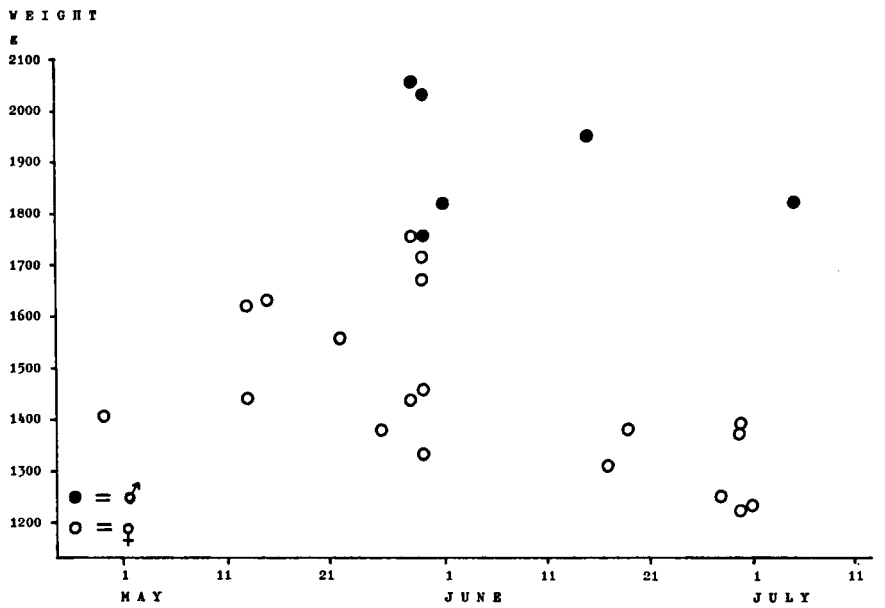

FIG. 26. *Larus hyperboreus*. Weights of males and females, collected near Kapp Lee in spring and summer 1969.

Greenland specimens from November and January had P_{1-10} complete and renewed.

Judging from these specimen data, the Glaucous Gull starts to moult its primaries in the second half of May. By August most of these feathers have been renewed and by November, five or six months after the onset, primary moult has been completed.

From the data obtained from study skins (table XVIII) it is probable that each pair of primaries requires about fourteen days for full replacement, the inner primaries being replaced in a somewhat shorter time than the outer ones.

Glaucous Gulls collected in the first week of June in Alaska had already renewed P_{1-2} or P_{1-3}. By the middle of July P_{1-6}, and by the middle of August P_{1-7} had been renewed (Johnston, 1961). Compared with our Spitsbergen specimens these Alaska-gulls were on average about three weeks earlier in their moult.

In the Glaucous Gull primary moult starts with the onset of the breeding season and continues throughout this period. This clearly is an exception to the rule among sea-birds, especially large gulls, that breeding and moult are mutually exclusive (Stresemann, 1966; Harris, 1971). It is usually assumed that adults need to be physically in optimum condition when feeding young. Obviously summer feeding conditions on the Arctic breeding grounds compared with winter conditions here or elsewhere are so much more favour-

able for Glaucous Gulls, that it is an advantage to start moult early. In this way the species is allowed to complete its moult and reproduction simultaneously. From fig. 26 can be seen that during the breeding period the females tend to lose weight (see above).

Stomach contents: 25 examined; see table XX.

TABLE XX. *Larus hyperboreus*. Food in totals and percentages of stomachs examined.

	Total (25)	Males (6)	Females (19)	Fem. May (12)	Fem. June (7)
Plants (few)	9 (36 %)	3 (50 %)	6 (32 %)	2 (17 %)	4 (57 %)
Birds	8 (32 %)	4 (67 %)	4 (21 %)	3 (25 %)	1 (14 %)
Crustacea	4 (16 %)	1 (17 %)	3 (16 %)	1 (8 %)	2 (29 %)
Offal	3 (12 %)	2 (33 %)	1 (5 %)	0	1 (14 %)
Empty	9 (36 %)	0	9 (47 %)	9 (75 %)	0

In the stomach contents we found the remains of several different plants a.o.: *Hylocomium splendens, Tortula ruralis, Cochleoria officinalis, Salix polaris, Tomenthypnum nitens, Drepanocladus uncenatus, Timmia austriaca, Pohlia cruda.* All these plants were represented by a few fragments only. Feathers and bones of small birds that were found in the stomachs belonged mostly to Snow-Buntings (*Plectrophenax nivalis*). Offal in the stomachs consisted of: reindeer hair, a fox tooth, seal blubber and refuse from the camp. The only crustacean-species found in the stomach contents was the littoral spider crab *Hyas araneus.*

In May we observed Glaucous Gulls feeding on adult Black Guillemots (*Cepphus grylle*) several times. In June and July we regularly saw them take the food (crustacean) disgorged by Kittiwakes (*Rissa tridactyla*), after these had been chased by Arctic Skuas. They also took eggs from Barnacle Geese, young from Brünnich's Guillemot (*Uria lomvia*) and adult Little Auks (*Plotus alle*). Once a Glaucous Gull was seen flying with an adult Brünnich's Guillemot in its beak. Carrion of seals and Polar Bear never failed to attract some tens of these gulls and a few were nearly always present near the refuse dump of the camp.

From table XX it appears that there are differences in stomach contents between males and females as well as between females collected in May and June respectively. Most remarkable is the difference in percentage of empty stomachs; they were only found in females.

Field observations (fig. 27).

In August 1968 Glaucous Gulls were seen near our station every day. From 3 September onwards, when 3 seal carcasses were brought to the station they numbered between 20 and 30 individuals, most of them juveniles of that year. After 13 September their number decreased gradually, the juvenile birds leaving last. This species was observed for the last time on 26 September, when one juvenile bird was seen flying south over the freezing sea. By that time minimum and maximum temperatures had fallen to —12° and —8° C.

In 1969 the Glaucous Gulls arrived in Longyearbyen on 24 March; the

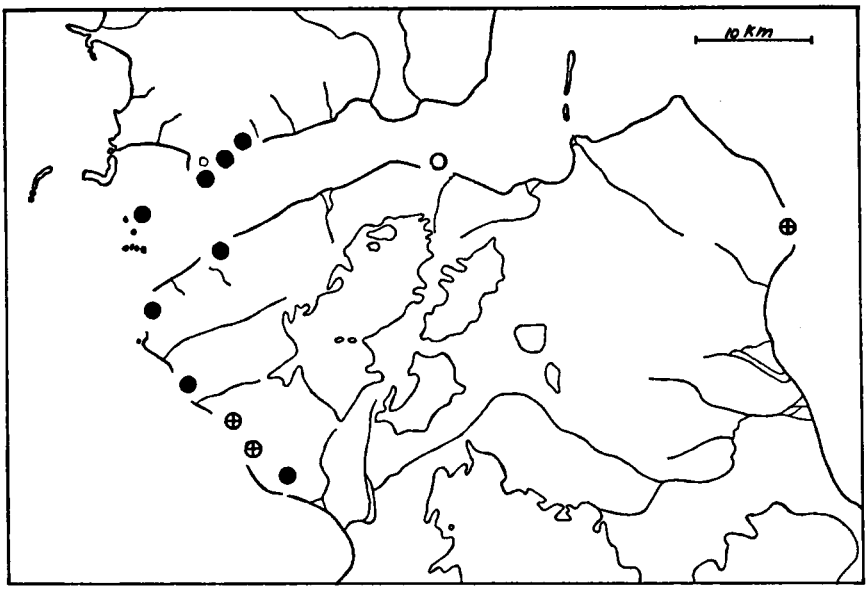

FIG. 27. *Larus hyperboreus*. (Legend in fig. 23).

first week after their arrival they kept to the refuse dumps of the village. In the Kapp Lee area they arrived about a month later; the first observation pertaining to two adults flying along the coast near the station on 19 April. By then minimum and maximum temperatures had risen to —8° and +3° C (fig. 4).

According to Løvenskiold (1963) this time of arrival is late; usually the main body of the Glaucous Gulls has arrived in West Spitsbergen in the first half of April.

After 19 April numbers increased gradually. During the first weeks only adults were observed. In the second half of May about 30 individuals, mostly adults, had residence in the neighbourhood of the station, feasting on a Polar Bear carcass and on seal carrion. Towards the end of May their numbers around the station started to decrease.

The first nest (2 eggs) was found on 27 May on Brimulen. Afterwards two nests were found near Svingeldalen (8 June) and another one on Barentsøya (9 June). Three Glaucous Gull nests were found on 14 June in the Barnacle Geese colony on Barentsøya (see 9: *Branta leucopsis*), two of the nests contained one egg each, and one three eggs.

The first young were found on 22 June, when a nest with 3 pulli was discovered near Kapp Lee. If we allow for an incubation period of 29 days (Løvenskiold, 1963) then this clutch must have been completed before 24 May.

Six more nests were found on 14 July between Timertfjellet and Blank-

FIG. 28. *Larus hyperboreus*. A juvenile bird ready to take wing, 2 September, Brimulen Photograph by E. Flipse.

odden. In the middle of July we counted between 30 and 40 Glaucous Gulls in a Kittiwake-colony in Diskobukta. Of the pairs with young, two had only one young and three had two. On the eastern side of Edgeøya we located only one nest viz. on 24 July, near Kapp Pechuel Lösche. A case of late fledging was noticed on Brimulen (fig. 28), where two young were still flightless on 2 September. They were ringed and two days later they were seen in the same place flying with their parents. But already earlier, by the first week of August, concentrations of Glaucous Gulls were noticed near Rosenbergdalen numbering up to 70 birds, 35 % of which were juveniles of the year.

To sum up: the total number of adult Glaucous Gulls having residence in the areas surveyed by us in summer 1969 is estimated between 120 and 140 individuals, 40 % of which were breeding birds.

Clutch-size varied from 1 to 3 eggs (mean 1.8), which was also found in Hornsund (calculated from records given by Løvenskiold, 1963, and personal observations 1966 and 1967). Possibly a few clutches had not yet been completed when found, so the mean clutch-sizes may be slightly higher. On Bjørnøya clutch-size was considerably larger (2 to 4 eggs, mean 2.5), indicating more favourable conditions for the Glaucous Gull in this place than in South and East Spitsbergen.

19. **Larus marinus** Linnaeus, 1758. Great Black-backed Gull.

Field observations.

This species was only observed in 1967 on the west coast of West Spits-

bergen. On 13 and 14 August one adult was seen among a group of about 20 Glacous Gulls at Kapp Martin.

In the period from 16 to 27 August a total of 6 adults was counted on Dunøyane on different dates. All these birds showed moult of primaries and were seen flying among the hundreds of Glacous Gulls inhabiting these islands.

20. **Pagophila eburnea** (Phipps, 1774). Ivory Gull.

Material collected: 8 specimens; data in table XXI.
ZMA No. 19821, 19991, ♂, ♀, 10.VII.1969, Kapp Lee.
ZMA No. 19996, ♂, 13.VIII.1969, Kapp Lee.
ZMA No. 19990, 19993,19994, 19995, 2 ♀, 2 ♂, 17.VIII.1969, Kapp Lee.
ZMA No. 19992, ♂, 18.VIII.1969, Kapp Lee.

TABLE XXI. *Pagophila eburnea.* Weights and measurements.

ZMA No.	Weight g	Wing mm	Culmen mm	Tarsus mm	Condition	Sexual cycle	
				MALES			
19821	589	341	36.6	39.2	fat	brood patch	
19996	522	341	35.0	40.3	moderate	—	
19994	559	343	37.9	38.1	moderate	brood patch	
19995	510	313	31.5	35.4	moderate	brood patch	
19992	554	352	38.3	39.8	fat	brood patch	
				FEMALES			Oviduct
19991	450	342	33.6	36.5	moderate	brood patch	swollen
19990	448	323	33.0	34.7	moderate	brood patch	swollen
19993	468	320	36.5	35.0	moderate	brood patch	swollen

The sexual variation in the Ivory Gulls collected is shown in table XXII.

TABLE XXII. Sexual variation in *Pagophila eburnea.* Included specimens in ZMA (1).

		Sex	Number	Range	S.d.	Mean ± s.d.m.	t
Weight	g	♂	5	510—589	31.4	546.8 ± 14.1	5.93
		♀	3	448—468	11.1	455.3 ± 6.4	
Wing	mm	♂	8(1)	330—358	9.0	344.1 ± 3.2	2.79
		♀	5(1)	320—342	10.4	328.4 ± 4.6	
Culmen	mm	♂	8(1)	31.5—38.3	2.50	35.1 ± 0.88	1.05
		♀	5(1)	32.9—36.5	1.47	34.0 ± 0.66	
Tarsus	mm	♂	9(1)	35.4—40.5	1.70	38.5 ± 0.57	4.46
		♀	5(1)	34.7—36.5	0.80	35.6 ± 0.36	

The differences in weight and tarsus length between males and females are significant ($P < 0.01$), males exceeding females by 91.5 g (20 %) and 3.0 mm (8 %), respectively. Wing and culmen are also larger in males, but the difference is not significant.

Moult.

Of our 8 specimens, only one (ZMA No. 19995) showed moult of body feathers and primaries, having P_{1-7} new, P_8 not present and P_{9-10} old. The other 7 specimens all had P_{1-10} new. Six specimens in the Zoologisch Museum of Amsterdam, collected in the period from 27 June to 14 Januari, had also all of their primaries new.

From these records and from those given by Stresemann (1966) it appears that by July most of the adult Ivory Gulls have completed their primary moult. Moult of body feathers also seems to have ended by this time.

Stomach contents: 8 examined.

Of all stomachs examined, 4 were empty, 3 contained fish, among which were Gadidae, 2 contained Gammaridae (*Gammarus sadachi, Gammarus wilkitzkii*) and 1 contained Cephalopods (beaks, eyelenses). Often Ivory Gulls were seen feeding on the remains of seals and birds. Once I observed an Ivory Gull snapping at flying insects (mosquitos or small flies).

Field observations.

In 1968 Ivory Gulls were seen occasionally from the day of our arrival on 16 August onwards. After 3 September, when some seal carcasses were brought to the station 7 adults and 1 juvenile were eating daily from the carrion (fig. 29). Their number decreased until 23 September, when for the last time that year one adult was observed. Maximum and minimum temperatures had by then fallen to —5° C and —10° C.

FIG. 29. *Pagophila eburnea*. Feeding on seal carrion, 5 September, Kapp Lee. Photograph by the author.

Our first observation in 1969 was on 20 May, when one Ivory Gull alighted on a seal carcass near the station. No others were observed until 11 June. After this date the gulls were regularly seen near our base, feeding on carrion.

On 24 July one Ivory Gull was observed on Blåfjordflya, feeding on the remains of a skinned bird. When attacked by two Arctic Skuas, it did not show fear and it drove the Skuas away (see also Longstaff, 1924).

Dalgety (1928) recorded an Ivory Gull colony in Diskobukta. Judging from his descriptions this must have been on Caltex-fjellet. In the middle of July 1969 we searched for this colony in the Diskobukta area, but did not observe a single Ivory Gull. Of 8 specimens collected near Kapp Lee in July and August, 7 had brood patches (see material collected), indicating that they were breeding birds. As they usually do not wander far away from the breeding places until the middle of August (Løvenskiold, 1963), they may have bred in the Kapp Lee area.

On a visit to an Ivory Gull breeding place on Agardhfjellet on 26 August, only one pair of these gulls with a half grown young was found. At this place a total of about 30 breeding pairs was counted and chicks of ca 10 days old were observed on 12 August 1963 (Flipse & de Roever, 1964).

According to Bateson & Plowright (1959) the peak period of hatching should be the beginning of August, with the last chicks appearing in the second half of this month. The fledging period should be not less than 5 weeks.

The first juveniles of the year are on the wing at the end of August, while most of the juveniles fledge in early September. In 1967 in Hornsund e.g. we observed for the first time that year a juvenile Ivory Gull on 30 August, it was seen together with an adult. In 1968 on Kapp Lee the first juvenile of the year was observed on 3 September.

Taking into account these data, it is unlikely that by 26 August all but one of the young of a colony of about thirty breeding pairs had fledged.

A decline in number of breeding pairs which was found in several other Ivory Gull colonies in Spitsbergen during this century (Bateson & Plowright, 1959; Birkenmajer, 1969) is probably the reason for the difference between the counts in 1963 and 1969 on Agardhfjellet.

21. **Rissa tridactyla tridactyla** (Linnaeus, 1758). Kittiwake.

Material collected: 17 specimens; data in table XXIII.
ZMA No. 23291, 23292, ♂, ♀, 5.VIII.1967, Longyearbyen.
ZMA No. 23293, 23294, 23295, 2 ♂, 1 ♀ juv., 20.VIII.1967, Isbjørnhamna.
ZMA No. 23296, ♂ juv., 22.VIII.1967, Isbjørnhamna.
ZMA No. 23297, ♀, 23.VIII.1967, Isbjørnhamna.
ZMA No. 19822, ♂, 18.V.1969, Kapp Lee.
ZMA No. 19868, ♂, 26.V.1969, Kapp Lee.
ZMA No. 19866, ♀, 3.VI.1969, Kapp Lee.
ZMA No. 19870, ♂, 16.VI.1969, Barentsøya.

TABLE XXIII. *Rissa tridactyla*. Weights and measurements.

ZMA No.	Weight g	Wing mm	Culmen mm	Tarsus mm	Condition	Sexual cycle		Moult of primaries
				MALES				
23291	—	312	36.8	33.6	—	adult		1—10 old
23293	—	315	33.7	34.6	fat	juvenile		1—10 new
23294	—	300	36.4	33.7	fat	juvenile		1—10 new
23296	—	300	34.0	35.4	very fat	juvenile		1—10 new
19822	500	329	41.6	34.4	fat	adult		1—10 old
19868	462	319	39.0	34.0	fat	„		1—10 old
19870	389	321	40.0	33.9	moderate	„		1—10 old
19865	375	321	36.2	34.4	fat	„		1—10 old
19772	410	320	38.1	34.4	fat	„		1—10 old
19815	415	327	38.3	34.4	fat	„		1—10 old
19817	415	318	38.8	35.7	fat	„		1—5 new, 6 absent, 7—10 old
19867	490	312	37.9	33.5	very fat	„		1—2 absent, 3—10 old
19869	498	328	39.6	33.0	fat	ad. brood patch		1—2 absent, 3—10 old
				FEMALES				
							Oviduct	
23292	—	306	34.5	32.5	fat	ad.	swollen	1—3 new, 4 half grown, 5—10 old
23295	—	300	34.6	33.0	fat	juv.	narrow	1—10 new
23297	—	301	36.5	33.0	fat	ad.	swollen	1—3 new, 4—10 old
19866	360	306	35.6	31.6	fat	ad.	narrow	1—10 old

ZMA No. 19865, ♂, 28.VI.1969, Kapp Lee.
ZMA No. 19772, 19815, 2 ♂, 29.VI.1969, Kapp Lee.
ZMA No. 19817, 19867, 19869, 3 ♂, 1.VIII.1969, Kapp Lee.

The sexual variation in the Kittiwakes collected is shown in table XXIV.

TABLE XXIV. Sexual variation in *Rissa tridactyla*. A specimen collected by van Oordt on Spitsbergen in 1921 is included (1).

		Sex	Number	Range	S.d.	Mean ± s.d.m.	t
Weight	g	♂	9	375—500	48.6	439.3 ± 16.2	5.12
		♀	1	360	—	360	
Wing	mm	♂	11(1)	312—329	6.3	319.9 ± 1.9	6.18
		♀	3	301—306	2.9	304.3 ± 1.7	
Culmen	mm	♂	11(1)	36.2—41.6	1.53	38.5 ± 0.46	4.02
		♀	3	34.5—35.6	1.00	35.5 ± 0.58	
Tarsus	mm	♂	14(1)	33.0—35.7	0.74	34.3 ± 1.97	4.56
		♀	4	31.6—33.0	0.66	32.5 ± 0.33	

The difference between males and females is significant ($P < 0.01$) in all measurements. Males on the average exceeding females in wing, culmen and tarsus length by 15.6 mm (5 %), 3.0 mm (8 %) and 1.8 mm (6 %), respectively.

As only one female (360 g) was weighed, sexual variation in weight could not be studied in the Spitsbergen Kittiwake.

Seasonal weight variation, though not significant ($P > 0.01$), was found in males (fig. 30); June birds (397 g) being on average lighter than birds

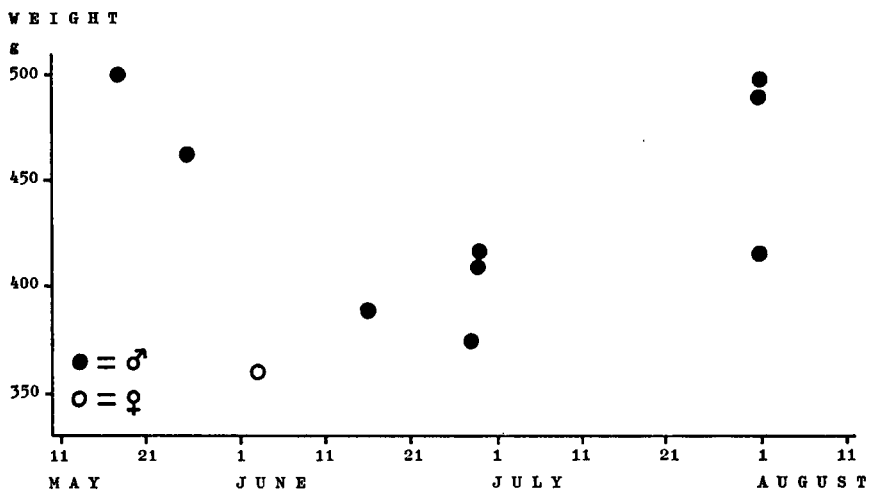

FIG. 30. *Rissa tridactyla*. Weights of males and females, collected near Kapp Lee in spring and summer 1969.

collected in May (481 g) and July (468 g). In Murmansk the same trend in seasonal weight variation was detected in males (Belopolskii, 1957). There Kittiwake males in summer were generally lighter than in Spitsbergen, 421.2 g vs. 439.3 g.

Moult.

All specimens (7) collected in May and June showed a complete set of old primaries. The adult specimens (7) from August had primaries as follows (see table XXIII): 1 August (3), P_{1-2} missing P_{3-10} old (2), P_{1-5} new P_6 missing P_{7-10} old; 5 August (2), P_{1-10} old, P_{1-3} new P_4 half grown P_{5-10} old; 21 August*), P_{1-6} new P_7 missing P_{8-10} old; 23 August, P_{1-3} new P_{4-10} old. From these data it is obvious that in Spitsbergen most of the adult Kittiwakes start the primary moult in July. By the middle of August about half the primaries have been replaced, although there is individual variation.

Moult of body feathers was not noticed in May and June specimens, while in August only 3 birds showed some degree of body moult (ZMA No. 23294, 23292, 23295).

Stomach contents: 10 examined.

Of all stomachs examined, 5 were empty (May and June), 3 contained fish, 2 *Thysanoessa inermis*, 1 Gammaridae (*Euthemisto lubellina*) and 1 plant remains (a.o. *Pohlia nutans*).

In one stomach parasites, viz. Cestodes, were found.

Field observations (fig. 31).

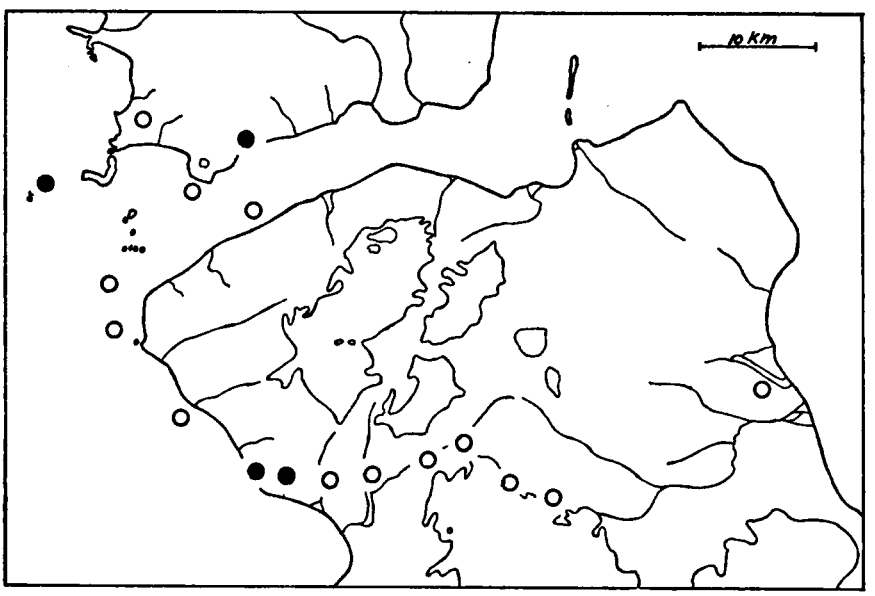

FIG. 31. *Rissa tridactyla*. (Legend in fig. 23).

*) Collected by van Oordt in 1921 on Spitsbergen.

In 1968 Kittiwakes were seen from the time of our arrival until 23 September, when 3 juvenile birds were observed flying south over the freezing sea. By then minimum and maximum temperatures had fallen to —10° C and —5° C (fig. 4).

In 1969 this species was observed for the first time in the Kapp Lee area on 20 April, when 4 Kittiwakes flew north over the station. Minimum and maximum temperatures had by then risen again to —10° C and —5° C. Thereafter they were seen daily, while their numbers gradually increased towards the end of May. They were seen flying both to the north and south, but mostly northwards.

A Kittiwake colony of about 40 nests was discovered on 9 June on Jakimovitsøyane. None of the nests contained eggs at this date. On the same day another colony was found on Barentsøya, half way between Taleveraflya and Skarpryttaren, near Freemansundet. This colony was situated just below the summit of a mountain at about 400 m above sea level. There were 47 nests, none of them containing eggs. The Kittiwakes were observed flying most of the day to and fro between their nests and a patch of waterlogged ground, some way inland. Here they fetched mud and plants, to build their nests with. When Kittiwakes left this colony for a longer time, they invariably headed west over frozen Freemansundet, and they always returned from this direction. Apparently they foraged somewhere there and did not visit possible feeding grounds in the east. On 15 June still no eggs were laid in this colony and the birds still behaved as described above.

Three small new colonies were discovered on 14 July between Visdalen and Diskobukta, north of the large colony near Blankodden (Løvenskiold, 1963). They had 62, 11 and 33 nests respectively and were situated near the top of the mountain Blanknuten at about 350 m above sea level.

The large colony near Blankodden is situated on both sides of a canyon of about 400 m long and 100 m deep. Thousands of Kittiwakes breed on the steep sides. All of the nests we could manage to look into (about 200) on 15 July, contained one or two eggs or young. We did not find clutches with three, which is often found at Murmansk (Belopolskii, 1957) and in Great Britain (Coulson, 1968). We must bear in mind however, that our observations possibly are not representative for the whole colony (see Coulson, 1968). Løvenskiold (1963) reports also that the normal clutch in Spitsbergen is one or two eggs. This low clutch size may be an indication that environmental conditions for the Kittiwake in Spitsbergen are less favourable than in more southern regions.

On 15 July about half of the young from the nests we could observe had hatched. Allowing for an incubation period of 24 days (Løvenskiold, 1963) we conclude that most of the eggs were laid here by 21 June. On 6 September in this colony about one third of all nests was occupied by adults with juveniles, the outer nests being for the most part already deserted, while the nests in the inner part of the canyon were generally still occupied. Here on the innermost cliff walls we found nests with young that could not fly.

Even on 9 September there were still some flightless young on these nests. If we reckon on a fledging period of 46 days (Keighly & Lockley, 1947) we can conclude that the last eggs that hatched were laid after 1 July.

The first juveniles of the year on wing were seen on 14 August near Kapp Lee. In this case eggs must have been laid before 5 June. On 24 August we observed near Hopen thousands of juveniles together with adults, resting on the sea. These juveniles must originate from eggs laid before 15 June.

From these dates and those given by Løvenskiold (1963) it appears that in East Spitsbergen the Kittiwakes lay eggs from the first week of June to the first week of July, with a peak in egg-laying in the middle of June.

In 1967 we noticed in Hornsund a rapid increase in the number of flying juveniles from 17 to 22 August. On a large breeding place at Sofiakammen most of the nests were still occupied by Kittiwakes with young on 28 August. As far as we could ascertain all of them could fly. So the last eggs that hatched in this colony must have been laid before 19 June. When we compare these dates with those given by Løvenskiold (1963) for Hornsund we may assume that most of the eggs in this area are laid in the second week of June. In North-West and North Spitsbergen the time of egg laying is mostly the first week of June (Løvenskiold, 1963), while on Bjørnøya most of the eggs are laid in the last week of May.

The Kittiwakes of the Blankodden colony foraged in the middle of June mostly in the narrow zone of open water between the sea-ice and the coast in Diskobukta. They were often chased by the Arctic Skuas that had residence between the colony and the sea. When we went from Diskobukta to Blåfjordflya on 19 and 20 July we saw Kittiwakes all the way, crossing Edgeøya from west to east and back (fig. 31), indicating that they foraged also east of Edgeøya. The distance between the colony and the open sea to the east was about 50 km.

Along the coast of Blåfjorden and North-East Edgeøya, where solid ice covered the sea up to the coast, we observed a Kittiwake only once. In the second half of August there was a marked southward migration of adult Kittiwakes along Kapp Lee. Here we saw Kittiwakes until we left on 11 September.

Note on ringing.

A total of 70 Kittiwakes was ringed in the Blankodden colony.

22. **Sterna paradisaea** Pontoppidan, 1763. Arctic Tern.

Material collected: 25 specimens; data in table XXV.

ZMA No. 16799, 19825, ♂, ♀, 5.VIII.1967, Longyearbyen.

ZMA No. 19800, 23560,23561, 23562, 23563, 4 ♀ juv., 1 ♂ juv., 17.VIII. 1967, Isbjørnhamna.

ZMA No. 19824, ♀, 4.VII.1969, Kapp Lee.

ZMA No. 20003, 20007, 20015, 3 ♂, 7.VII.1969, Kapp Lee.

ZMA No. 19793, 20002, ♂, ♀, 9.VII.1969, Kapp Lee.

ZMA No. 19794, 20008, 20009, 20012, 20013, ♂, 4 ♀, 9.VII.1969, Kapp Lee.
ZMA No. 20005, 20006, 20010, 20014, 20011, 4 ♂, ♀, 9.VIII.1969, Kapp Lee.
ZMA No. 20004, 20016, 2 ♂, 7.IX.1969, Kapp Lee.

TABLE XXV. *Sterna paradisaea.* Weights and *measurements.*

ZMA No.	Weight g	Wing mm	Culmen mm	Tarsus mm	Condition	Sexual cycle
			MALES			
19799	—	277	31.2	15.1	fat	adult
23563	—	219	24.1	14.5	fat	fledgling
20003	118	273	34.3	16.9	fat	adult
20007	113	263	31.1	15.8	fat	adult
20015	105	256	—	15.5	fat	adult
19793	110	254	31.1	14.7	fat	adult
19794	109	279	31.6	16.1	fat	adult
20005	97	279	31.3	15.5	moderate	ad. brood patch
20006	96	271	29.5	—	moderate	ad. brood patch
20010	97	272	31.4	14.8	moderate	adult
20014	115	267	31.7	16.0	fat	adult
20004	110	241	27.3	15.8	very fat	juvenile
20016	105	240	—	16.0	very fat	juvenile
			FEMALES			
						Oviduct
19825	—	263	31.8	15.5	fat	ad. swollen
23560	—	214	24.1	13.8	—	fledgling
23561	—	212	20.9	15.1	fat	fledgling
23562	—	209	22.3	14.4	fat	fledgling
19800	—	175	23.1	14.4	fat	fledgling
19824	109	272	31.6	15.8	fat	ad. sw. egg foll. 4.8 mm
20002	117	273	31.3	15.7	fat	ad. sw. egg foll. 4.9 mm
20008	113	271	30.5	15.2	fat	ad. sw. egg foll. 4.9 mm
20009	107	262	29.6	15.1	fat	ad. sw. egg foll. 2.7 mm
20012	115	269	29.9	15.6	very fat	ad. narrow
20013	112	264	29.4	14.2	very fat	ad. sw. egg foll. 4.3 mm
20011	105	274	32.1	15.4	fat	ad. swollen

The sexual variation in the adult specimens collected is shown in table XXVI.

Females are heavier than males, the latter exceed in wing, culmen and tarsus length. These differences are only small and not significant ($P > 0.01$).

The males show a slight tendency to lose weight from July to August (fig. 32).

Arctic Terns from Murmansk had in the same period of the year similar weights (average males 107.3, females 106.1 g; Belopolskii, 1957). Compared with these summer birds from the Arctic breeding grounds, moulting winter

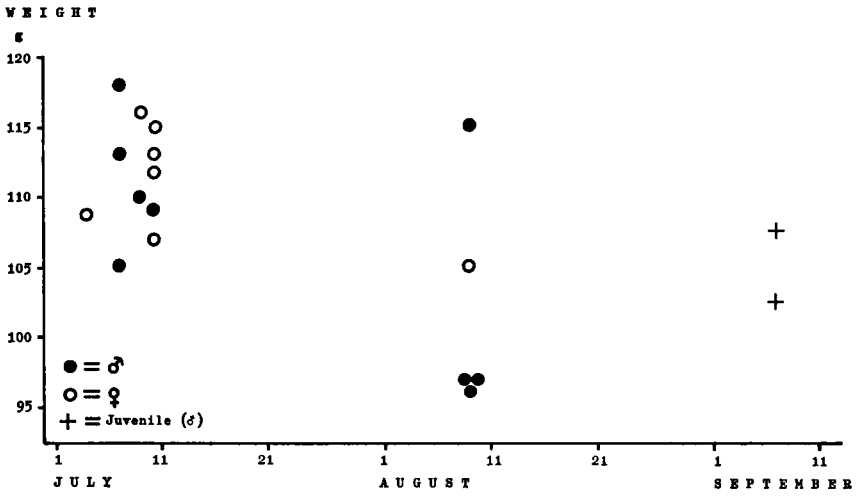

FIG. 32. *Sterna paradisaea.* Weights of males and females, collected near Kapp Lee in summer and autumn 1969.

TABLE XXVI. Sexual variation in *Sterna paradisaea.* Included one specimen collected by van Oordt in 1921 (1).

		Sex	Number	Range	S.d.	Mean ± s.d.m.	t
Weight	g	♂	11	96—113	7.6	106.8 ± 2.3	1.54
		♀	7	105—117	4.3	111.1 ± 1.6	
Wing	mm	♂	11(1)	254—281	9.2	270.2 ± 2.8	0.51
		♀	8	262—274	4.8	268.5 ± 1.7	
Culmen	mm	♂	10(1)	29.3—34.3	1.36	31.3 ± 0.43	0.83
		♀	8	29.4—32.1	1.06	30.8 ± 0.37	
Tarsus	mm	♂	12(1)	14.7—16.9	0.61	15.6 ± 1.74	1.31
		♀	8	14.2—15.8	0.51	15.3 ± 1.79	

birds in the Antarctic were heavy (2 males 140 and 145 g, 3 females 110, 125, 125 g; Bierman & Voous, 1950).

The measurements of these terns did not exceed those of the Spitsbergen and Murmansk birds, so we can conclude that this heavy weight was due to extra fat deposition.

The difference in wing length between Arctic Terns from Spitsbergen (mean males 270.2 mm, females 268.5 mm) and from Iceland (mean males 268.1 mm females 267.7 mm; ZMA 15 sp.) were not significant and very small, when compared with the differences found between high-arctic and sub-arctic populations in other sea-birds (Salomonsen, 1947; Storer, 1952).

Moult and plumage.

Only the two adults from West Spitsbergen (ZMA No. 19799, 19825) and

four of our six juveniles (ZMA No. 19800, 20004, 20016, 23562) showed some degree of moult of the small body feathers.

The five juveniles collected on 17 August 1967 at Isbjørnhamna had just fledged, one of them (ZMA No. 19800) still showing patches of down on head and neck. The two birds from 7 September 1969 (ZMA No. 20004, 20016) were at first sight considered as so-called "white-fronted" or "portlandica" Arctic Terns (see: Cullen, 1957; Norderhaug, 1964). They lacked the nuptial plumage, showing white foreheads, light underparts and dark beaks. The outer tail feathers were much shorter than in the adult summer plumage. When collected their relatively small size (wing and culmen; table XXV) and light-coloured legs proved that they were juveniles of the year.

Stomach contents: 18 examined.

Of all stomachs, 9 contained Gammaridae (*Gammarus locusta, Gammarus setosus, Gammaracanthus loricatus*), 2 contained *Thysanoessa inermis*, 7 were empty.

A difference in diet between the sexes was not found.

Obviously Gammaridae are the most important food item for the Arctic Tern in Spitsbergen. This is in accordance with data compiled by Løvenskiold (1963).

The Arctic Terns near Kapp Lee were seen foraging mostly in the shallow water of the lagoon and in the shallow bay (Stretehamna) in front of the station.

Field observations (fig. 33).

On 22 August 1968, 4 km south of Kapp Lee we found a breeding colony

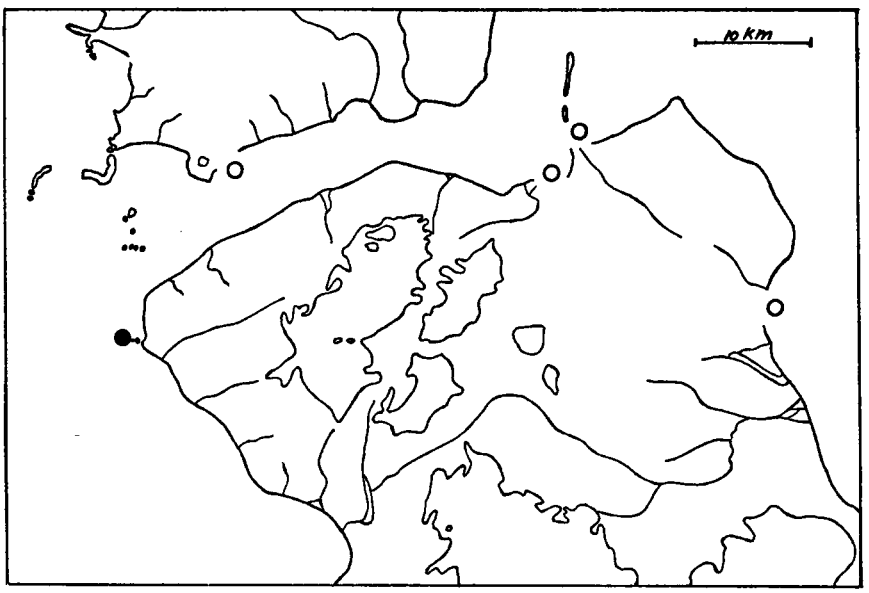

FIG. 33. *Sterna paradisaea.* (Legend in fig. 23).

of this species on an unnamed dolerite island, which we called Ternøya. Three days later we saw several young here. At this place Dalgety (1928) found on 21 August 1927 a young bird, which was about a week old.

On 2 September there were 24 adult Arctic Terns on Ternøya with young in different stages of development, including some fledglings. On 17 September most of these birds had left, only 4 pairs with flightless young still being present. By then minimum and maximum temperatures had fallen to —7.5 and —4.5. We did not visit Ternøya anymore that month, so it remains uncertain whether the young seen on 17 September became full-grown under these hard conditions.

In 1969 the first Arctic Terns of the year in the Kapp Lee area were seen on 21 June above Ternøya (4 birds) and on 24 June near Barentsøya (2 birds). Around Ternøya their number had increased to 12 on 28 June, to 18 on 29 June and to 26 on 30 June. They foraged in the lagoon and attacked the Arctic Foxes on the island ferociously (see above; 5 *Somateria mollissima*).

From the end of June to the middle of July, Ternøya was completely deserted by the terns from 11 p.m. to 5 a.m. By noon they were flying over the island, numbering between 50 and 60 birds. Females collected in this period (ZMA No. 19824, 20002, 20008, 20009, 20013) had egg follicles from 2.7 to 4.9 mm in diameter (table XXV), indicating that they were still not in breeding condition.

In the last week of July single specimens were observed near Blåfjorden (2 birds) and Åneset (6 birds taking a bath in a fresh water pool).

On 5 August we did not manage to find eggs on Ternøya and the terns did not behave agressively towards us. Two males (ZMA No.20005, 20006) collected on 9 August showed brood patches, indicating that they were breeding. On 15 August we found 7 nests with 1, and 4 nests with 2 eggs. Assuming that we had found all of the nests with eggs, the Ternøya population had a non-breeding percentage of more than 60 %. In 6 of the nests the young had hatched on 27 August; during the following days the other young hatched. If we allow for an incubation period of 21 days (Løvenskiold, 1963), the first eggs in this colony were laid before 6 August. On 22 August we found one pair of Arctic Terns breeding on an islet in one of the tarns at Årdalstangen. In this case breeding must have started after 1 August.

On 7 September, we found in the Ternøya colony only small young, all of them being smaller than the young seen on the same date a year earlier. Two flying juveniles (ZMA No. 20004, 20016; table XXV), collected on this date, did in my opinion not originate from this colony, but must have come from elsewhere (see above, moult and plumage). They were excellent flyers and were not guarded by adults, while until this date we had not seen large young at all on Ternøya.

On 9 August 1967 in a tern colony at Kapp Linné we found only a few nests with eggs left. Most of the young had hatched and were in various stages of development. A few were seen that had just taken wing. Most eggs in this colony must have been laid before 19 July and some already in the end of June.

In a colony at Isbjørnhamna only a few flightless young were left on 17 August 1967. On 20 August in a colony on Store Dunøya all young had taken wing.

Compared with these data from West Spitsbergen and with records given by Løvenskiold (1963), Norderhaug (1964) and Gullestad & Norderhaug (1967), the Arctic Terns nesting on Ternøya were late in all respects during the season 1969. They arrived about a fortnight later and egg-laying was about a month later than is usual in Hornsund, but only about a week later than on Bangenhukhalvøya (North Spitsbergen) in 1965 (Gullestad & Norderhaug, 1967). Probably the environmental conditions in the Kapp Lee area are harsher, thus postponing the onset of the breedind cycle (see Lack, 1933). So the terns in this area have to finish their cycle in a period (September) that the bulk of Spitsbergen Arctic Terns has already left for the south (Løvenskiold, 1963). It must be borne in mind, however, that depending on local weather conditions the time off egg-laying varies over a considerable period in different years in Spitsbergen (Norderhaug, 1964; Gullestad & Norderhaug, 1967). So the difference in timing found by us is perhaps exseptional.

That conditions are harder for these terns is perhaps reflected by their relatively small clutch-size; 64 % (7) had 1 egg, 36 % (4) had 2 eggs. On West Spitsbergen clutches of 2 eggs are more frequent than clutches of 1 (Løvenskiold, 1963). In 1965 in Hornsund 31 % (17) had 1 and 69 % (38) had 2 eggs; on Bangenhukhalvøya these figures were 43 % (18) and 57 % (24) (Gullestad & Norderhaug, 1967).

As the timing of the breeding season, clutch-size may also vary considerably in different years in the same regions in Spitsbergen (Norderhaug, 1964).

At Murmansk Arctic Terns had an average clutch-size of 2.01 egg (Belopolskii, 1957).

23. **Plotus alle alle** (Linnaeus, 1758). Little Auk.

Material collected: 14 specimens; data in table XXVII.

ZMA No. 23643, 23644, 2 ♂, 19.VIII.1967, Isbjørnhamna.

ZMA No. 23645, 23646, 2 ♂, 20.VIII.1967, Isbjørnhamna.

ZMA No. 23647, 23648, 23649, 23650, 23651, 5 ♂, 23.VIII.1967, Isbjørnhamna.

ZMA No. 20021, 20023, ♂, ♀, 30.VII.1969, Kapp Lee.

ZMA No. 20020, 20024, ♂, ♀ 6.VIII.1969, Kapp Lee.

ZMA No. 20022, ♂, 9.VIII.1969, Kapp Lee.

According to Løvenskiold (1963) it is possible that in the east of Spitsbergen *Plotus alle polaris* (Stenhouse, 1930) occurs. This form breeds on Fransz Jozef Land and is larger (wing 130—136 mm, culmen 17—17.5 mm; Dementiev, 1951) than *Plotus alle alle*. From table XXVII it can be seen that according to this description none of our adult specimens (wing 117—126 mm, culmen 12.3—16.1 mm) belongs to this form.

TABLE XXVII. *Plotus alle*. Weights and measurements.

ZMA No.	Weight g	Wing mm	Culmen mm	Tarsus mm	Condition	
			MALES			
23643	—	105	11.9	20.5	fat	
23644	—	121	16.1	20.5	fat	
23645	—	125	14.3	20.4	fat	
23646	—	120	15.2	20.2	fat	
23647	—	121	14.3	20.7	fat	
23648	—	126	14.9	20.9	fat	
23649	—	124	14.8	21.2	fat	
23650	—	122	14.8	21.0	fat	
23651	—	125	15.0	20.0	fat	
20021	147	117	15.0	19.9	moderate	
20020	163	125	15.0	22.1	fat	
20022	163	121	15.0	21.3	fat	
			FEMALES			
20023	152	124	13.9	21.5	fat	Oviduct narrow
20024	148	122	12.3	21.5	fat	swollen

At first sight there is a marked difference between males and females in culmen length, 14.3—16.1 mm and 12.3—13.9 mm, respectively. As our collection contained only two females, skins of winter-birds (in ZMA) were measured to compare a larger number of specimens of both sexes. The sexual variation is shown in table XXVIII.

From table XXVIII it can be seen that males and females are alike. The wing length is similar to that of Little Auks from the Norwegian Sea (116—129 mm; Dementiev, 1951). The weights are similar to those of 4 July birds from Jan Mayen (140—160 g; Schaanning, 1933), but they are low when compared with the weights of 2 Little Auks collected in March and April respectively on the North Atlantic (173 g and 180 g; coll. ZMA).

TABLE XXVIII. Sexual variation in *Plotus alle* collected in Spitsbergen in summer and in the Netherlands in winter.

		Sex	Number	Range	S.d.	Mean ± s.d.m.	t
Weight	g	♂	3	147—163	9.2	157.7 ± 5.3	1.34
		♀	2	148—152	2.8	150.0 ± 2.0	
Wing	mm	♂	22	115—126	3.3	121.4 ± 0.7	0.15
		♀	12	117—127	3.2	121.6 ± 0.9	
Culmen	mm	♂	20	12.6—16.1	0.75	14.7 ± 0.17	0.60
		♀	12	12.3—15.9	0.98	14.5 ± 0.28	
Tarsus	mm	♂	20	19.2—22.1	0.75	20.6 ± 0.17	0.50
		♀	9	19.6—21.7	0.80	20.8 ± 0.27	

Birds (7) wrecked in winter in the Netherlands were much lighter (100—113 g, mean 106.7 g; coll. ZMA). Their weight is obviously close to the minimum weight for this species.

It is striking that all of the 9 Little Auks collected in 1967 were males, while we found 3 males among the 5 specimens collected in 1969. All 14 specimens were collected on or near the breeding places.

Of 40 Little Auks shot in July 1896, among the ice north of Spitsbergen, 75 % were males (Collett & Nansen, 1899), Le Roi (1911) and Demme (1934) found on Spitsbergen and Fransz Jozef Land, respectively a sex ratio of 2 : 1 in favour of the males. In 22 wrecked winter-birds in the Netherlands (see above) the sex ratio was 1 : 1. In this case the greater activity of the males, which probably accounts for the abnormal sex ratios found near the breeding grounds (Belopolskii, 1957), makes no difference.

Moult.

All of our Spitsbergen specimens had a complete set of old primaries (latest specimen from 23 August). Winter specimens collected in the Netherlands, from 26 October and onwards, all had new primaries. It is very likely that in this species, just as in the arctic Alcidae *Cepphus* and *Uria* (Stresemann, 1966), these feathers are shed simultaneously in the month September.

Some degree of moult of the small feathers occurred in all of our adult males, mostly over the whole body. The 2 females and the juvenile male (ZMA No. 23643) did not show moult at all.

Stomach contents: 5 examined.

All stomachs were empty. The birds were all collected in the night, when they sat on the ledges.

Field observations.

In 1968 we did not observe this species near Kapp Lee after our landing on 17 August.

In 1969 the Little Auks arrived in Longyeardalen on 30 March but near Kapp Lee they were not heard before 9 April, when maximum and minimum temperatures had risen to —19° C and —26° C. According to Løvenskiold (1963) this is a rather late date, the majority of the Little Auks arriving in Spitsbergen in the first week of April under normal conditions.

In spring and summer some hundreds of Little Auks were seen in the dolerite formation on Leefjellet. We did not ascertain whether they were breeding there. On Timertfjellet we also found some tens of these birds and possibly they bred there. In summer we sometimes saw them arrive and disappear in the crevices of the mountain, with full crops.

During spring we noticed a diurnal rhythm in the arrival and departure of the Little Auks on Leefjellet. About noon the birds took off for the south; in the afternoon and evening the place was completely deserted. After midnight they started to return from the south. Often they flew very high when they came back, letting themselves fall like stones over a considerable distance when they were above Leefjellet.

These observations tally with those made by Nansen on Fransz Josef Land

in March 1896 (Collett & Nansen, 1899) In Thule, Ferdinand (1969) also noted a diurnal rhythm and flight to the sea, that was similar to our observations. Marshall (1938), however, could not detect a period of rest in the colonies on Spitsbergen he visited.

By the middle of August the Little Auks had already disappeared from Leefjellet, so it is not likely that they bred there.

In 1967 we observed in Isbjørnhamna a decrease of the number of Little Auks on the breeding places in the second half of August. A flying juvenile was collected on 19 August (ZMA No. 23643). On 30 August there were still many nests with young, of which the old birds came flying in with full crops during the whole day.

In this place we observed daily that Glaucous Gulls preyed upon adult Little Auks. These were mostly caught on the return flight from the sea to the breeding place. At first they were forced to alight on the tundra, where they were killed and eaten by the gulls.

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