BEAUFORTIA

SERIES OF MISCELLANEOUS PUBLICATIONS
INSTITUTE OF TAXONOMIC ZOOLOGY (ZOOLOGICAL MUSEUM)
UNIVERSITY OF AMSTERDAM

No. 261 Volume 20 September 28, 1972

Birds, observed and collected by "De Nederlandse Spitsbergen Expeditie" in West and East Spitsbergen, 1967 and 1968-'69; third and last 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 species 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 and second parts of this study, see: Korte, J. de (1972), Beaufortia, **19** (253): 113—150, and Beaufortia, **19** (257): 197—232.

ACCOUNT OF THE SPECIES; CONTINUED

24. **Uria lomvia lomvia** (Linnaeus, 1758). Brünnich's Guillemot.

Material collected: 9 specimens; data in table XXIX.
ZMA No. 19896, 19897, 19904, 19905, 19906, 19907, 19908, 19898, 7 ♂, 1 ♀, 24-VII-1969, Hopen.
ZMA No. 19909, ♀, 10-IX-1969, Kapp Lee.

The weight of the 7 males collected on Hopen ranged from 810 to 1080 g (average 956 g). The female collected here weighed 900 g. A female in poor condition collected near the station weighed 758 g, which is very light.

The weight of the males is similar to that of those from Murmansk (average 965 g) and Nova Zembla (average 1026 g) in August (Belopolskii, 1957). Eight July birds from Jan Mayen (average males 1425 g, females

Received: April 28, 1972

1345 g; Schaanning, 1933), which showed a similar wing length (211—220, average 211,6 mm), were much heavier than the Spitsbergen and Russian birds. This could be an indication that living conditions for this species in Jan Mayen are more favourable than in Spitsbergen and northern Russia.

Stomach contents: 9 examined.
Of the 8 specimens collected on Hopen 6 had empty stomachs; the other 2 stomachs contained nothing but poorly digestible material (hair, bones, otoliths). This indicates that these birds, which were collected in the

TABLE XXIX. *Uria lomvia lomvia.* Weights and measurements.

ZMA No.	Weight g	Wing mm	Culmen mm	Tarsus mm	Condition	Sexual cycle
			MALES			
19896	905	206	38.5	38.0	fat	breeding
19897	1080	—	—	—	very fat	breeding
19904	985	—	—	—	very fat	breeding
19905	810	206	36.2	35.1	very fat	breeding
19906	980	218	40.7	35.9	very fat	breeding
19907	892	207	39.8	36.8	very fat	breeding
19908	1040	207	40.4	36.0	very fat	breeding
			FEMALES			
19898	900	208	39.0	35.0	fat	breeding
19909	758	211	37.1	37.4	moderate	ov. swollen

afternoon, had been on the ledges for a considerable time already and had not eaten recently. The stomach of the bird collected at Kapp Lee was full of Gammaridae.

Moult.
All of our specimens had a complete set of primaries. The 8 breeding birds from Hopen (24 August) all showed moult of small feathers over the whole body. The specimen collected at Kapp Lee (9 September) also showed some moult of the small body feathers.

Field observations.
In 1968, when sailing along Kvalpynten on 14 August, we observed many Brünnich's Guillemots with young on the sea, which was nearly completely ice-free at this place.

In 1969 the first birds of this species were seen on 27 June, when two foraged in the open water between the sea-ice near Ternøya. In the first half of July groups of 30 to 70 of these birds were daily observed flying low over the sea along the coast, probably on their way to and from searching for food in the cracks among the ice north of Kapp Lee. On 25 July we saw a group of 24 birds flying from west to east through Freemansundet near Kapp Höglin.

On Hopen there were on 24 August still a lot of young on the ledges on the west side of the island. In view of Løvenskiold's (1963) data this is very late, as generally most of the young have left the breeding places by the middle of August. Of 8 adults collected on the ledges of Hopen in the afternoon, 7 were males (table XXIX). This remarkably high proportion of males does not seem to have been caused by males being less attentive to danger than females, as found by Belopolskii (1957), but by the virtual absence of females at that moment.

A difference in diurnal rhythm may account for the unequal sex-ratio at that time of the day (see also Cullen, 1954).

On 9 September one adult was seen on the sea in front of the station.

In 1967 at Sofiakammen in Hornsund we saw young Brünnich's Guillemots leaving the breeding places as late as the end of August. Here the ledges were not located directly above the sea. The young birds had to cross about one hundred metres of tundra from the foot of the breeding cliff to the water. They were observed doing this in the night only, a time that cannot be called dark at this latitude in August. Several times we saw Glaucous Gulls attacking these young on their way to the sea.

25. **Cepphus grylle mandtii** (Mandt, 1822). Black Guillemot.

Material collected: 23 specimens; data in table XXX.
ZMA No. 19109, ♀, 12-VIII-1966, Hornsund.
ZMA No. 19110, ♂, 19-VIII-1966, Hornsund.
ZMA No. 19781, 19782, 2♀ juv., 28-VIII-1967, Hornsund.
ZMA No. 19770, 19796, 2♂, 25-IV-1969, Kapp Lee.
ZMA No. 19771, 19778, 2♀, 25-IV-1969, Kapp Lee.
ZMA No. 19774, 19901, 2♀, 2-V-1969, Kapp Lee.
ZMA No. 19776, 19816, 19899, 19797, 2♂, 2♀, 14-V-1969, Kapp Lee.
ZMA No. 19777, 19818, 19902, 19910, 3♀, ♂, 29-V-1969, Kapp Lee.
ZMA No. 19819, 19900, 19775, 19903, 2♂, 2♀, 27-VI-1969, Kapp Lee.
ZMA No. 19911, ♂ juv., 9-IX-1969, Kapp Lee.

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

The females are heavier than the males, but have a smaller wing, culmen and tarsus length. However, none of the differences found, proved to be significant ($P > 0.01$).

Black Guillemots from Spitsbergen and Nova-Zembla, belonging to the form *C.g. mandtii*, and those from Murmansk, *C.g. grylle* (Linnaeus, 1758) show wing length differences which are statistically insignificant (Storer, 1952; Belopolskii, 1957; Vaurie, 1965). The weights of the birds from Spitsbergen (table XXXI) and Nova Zembla (average males 391, females 412 g) recorded by Belopolskii (1957) were similar, but Murmansk birds (average males 431, females 435 g; Belopolskii, 1957) are considerably heavier than ours. Judging from weight, which may be different, while wing length is similar, Black Guillemots live in these regions under different environmental conditions,

TABLE XXX. *Cepphus grylle*. Weights and measurements.

ZMA No.	Weight g	Wing mm	Culmen mm	Tarsus mm	Condition	Sexual cycle		Per cent white in outer primary
					MALES			
19110	—	164	29.8	31.5	very fat	adult		38.2
19770	426	165	32.6	31.2	very fat	adult		30.0
19796	398	171	31.2	31.1	fat	adult		46.2
19774	378	172	31.4	29.9	fat	adult		28.2
19901	367	176	32.1	30.9	fat	adult		37.3
19776	386	165	30.3	28.7	fat	adult		26.4
19816	369	172	33.1	30.1	fat	adult		26.8
19910	379	170	31.5	30.9	fat	adult		35.2
19819	335	168	29.9	30.9	moderate	adult		36.6
19900	389	168	32.8	31.9	moderate	adult		37.8
19911	340	—	—	—	very fat	juvenile		—
					FEMALES		Oviduct	
19109	—	166	30.4	31.1	very fat	adult	—	37.7
19781	—	145	24.5	31.2	fat	juvenile	narrow	22.0
19782	—	150	26.2	28.4	fat	juvenile	narrow	29.0
19771	407	161	30.4	31.0	fat	adult	swollen	41.1
19778	—	165	29.0	27.7	fat	adult	swollen	47.1
19899	418	171	32.1	30.4	fat	adult	swollen	40.8
19797	384	171	31.0	31.1	fat	adult	swollen	51.1
19777	412	160	31.0	31.9	fat	adult	sw. egg foll. 6.4 mm	43.8
19818	382	160	33.1	31.0	moderate	adult	swollen	52.4
19902	387	164	30.8	31.3	fat	adult	swollen	39.1
19775	388	162	32.6	29.9	moderate	adult	sw. egg foll. 5.6 mm	37.3
19903	387	162	29.4	28.7	moderate	adult	sw. egg foll. 5.7 mm	28.6

TABLE XXXI. Sexual variation in *Cepphus grylle*. (1)Included specimens collected by van Oordt in Spitsbergen, 1921.

	Number	Sex	Range	S.d.	Mean ± s.d.m.	t
Weight g	9	♂	335 —426	24.7	380.8±8.2	1.53
	8	♀	382 —418	14.2	395.5±5.0	
Wing mm	12(1)	♂	162 —176	4.1	168.3±1.2	2.35
	10(1)	♀	160 —171	4.1	164.2±1.3	
Culmen mm	12(1)	♂	29.8— 33.1	1.08	31.5±0.31	0.95
	10(1)	♀	29.0— 33.1	1.31	31.0±0.41	
Tarsus mm	12(1)	♂	28.7— 31.9	0.94	30.6±0.27	0.28
	10(1)	♀	27.7— 31.9	1.30	30.4±0.41	
% white in outer primary	12(1)	♂	26.4— 47.7	7.21	34.9±2.08	2.42
	12(1)	♀	28.6— 52.4	6.45	41.7±1.86	

which seem to influence their weight directly, but not their size. Obviously conditions for this bird in Murmansk and to a lesser degree in Nova-Zembla, are more favourable than in East Spitsbergen.

Our adult specimens were collected between 25 April and 27 June. Birds from the period 25 April-14 May (average males 387, females 403 g) were heavier (not significantly, $P > 0.01$) than those from 29 May-27 June (average males 368, females 391 g), indicating weight loss during spring before the onset of breeding (fig. 34).

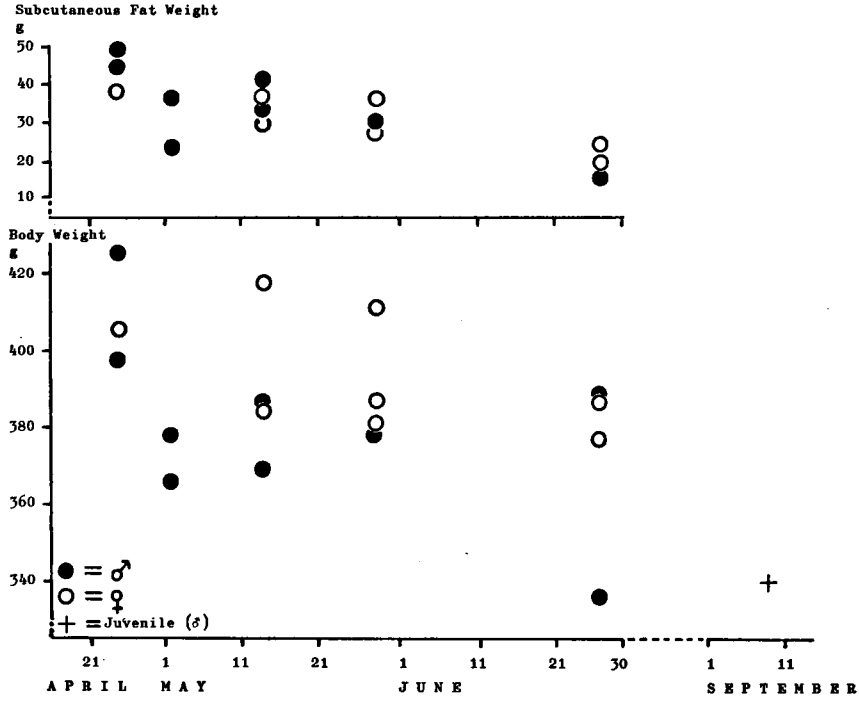

FIG. 34. *Cepphus grylle*. Body weight and subcutaneous fat weight of males and females, collected near Kapp Lee in spring and summer 1969.

In order to get a relative measure of the adiposity of our birds, the weight of the subcutaneous fat deposits was calculated by subtracting the weights of de-greased skins from uncleaned skins (fig. 34). In Black Guillemots from the period 25 April-24 May we found a more extensive subcutaneous fat layer (average males 38, females 35 g of fat) than in those from 29 May-27 June (average males 24, females 27 g of fat), though the differences were not significant ($P > 0.01$). The relative difference is, however, much greater than that in body weight. This was also found by Belopolskii (1957) in Murmansk birds.

Moult and plumage.

All specimens collected had a complete set of old primaries, which was to be expected, as the Black Guillemot sheds these feathers immediately after the breeding period (Stresemann & Stresemann, 1966). Moult of small body

feathers was only found in one male from 19 August (ZMA No. 19110) and three females from 29 May (ZMA No. 19777, 19902) and 12 August (ZMA No. 19109), respectively.

The Black Guillemot shows a considerable geographical and sexual variation in the amount of white on the outermost primary (Salomonsen, 1944; Storer, 1952). Two measurements of the outermost primary were taken, described by Salomonsen (1944) as "b" and "c" and shown in fig. 35, in

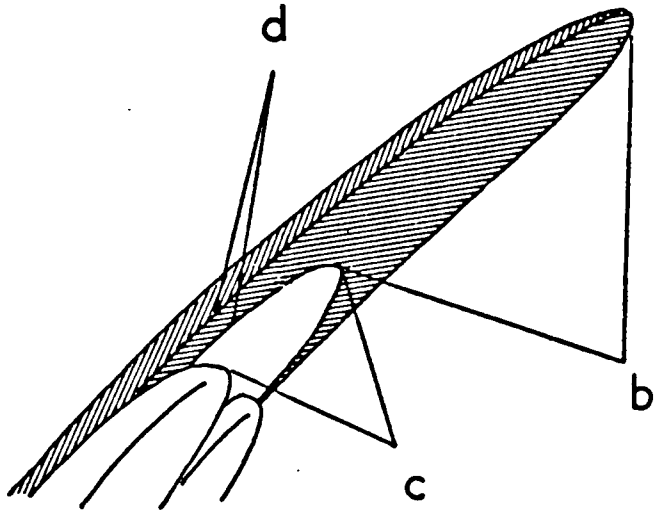

FIG. 35. *Cepphus grylle*. Measurements of the amount of white of the outermost primary. After Salomonsen (1944).

order to calculate the value $\frac{100\ c}{b+c}$ and this was used as a quantitative means of comparing males and females (table XXXI). Females had more white than males on average, though the difference was not significant ($P > 0.01$). This agrees with the findings of Storer (1952) in other populations of this species.

Table XXXII shows that our values agree fairly well with those for 17 Spitsbergen Black Guillemots found by Storer. This indicates that our measurements are comparable to his, so that, when necessary we may total both series.

The amount of white on the primaries increases from south to north in different populations of Black Guillemots on both sides of the Atlantic Ocean (Salomonsen, 1944; Storer, 1952). According to Storer the populations of *Cepphus grylle ultimus* Salomonsen, 1944 have more white (16—57 per cent) than those of *Cepphus grylle mandtii* (22—45 per cent). In table XXXIII we compared our data on Spitsbergen birds (*C.g. mandtii*) with

TABLE XXXII. *Cepphus grylle*. Per cent of white in outer primary in birds from Spitsbergen.

		Number	22—24	25—27	28—30	31—33	34—36	37—39	40—42	43—45	46—48	49—51	52—54	55—57
Males	Coll. ZMA	12	—	2	3	—	1	4	—	—	2	—	—	—
	Storer (1952)	8	—	—	—	3	4	—	1	—	—	—	—	—
	Total	20	—	2	3	3	5	4	1	—	2	—	—	—
Females	Coll. ZMA	12	—	—	1	—	—	4	3	1	1	1	2	—
	Storer (1952)	9	—	1	1	1	1	2	2	1	—	—	—	—
	Total	21	—	1	2	1	1	6	5	2	1	1	2	—

TABLE XXXIII. *Cepphus grylle*. Geographical variation in % of white on outermost primary.

		Number	Range	S.d.	Mean ± s.d.m.	t
Males	Spitsbergen (ZMA)	12	26.4—47.7	7.21	34.9±2.08	0.13
	Etah (Storer)	23	25 —46	6.15	37.9±1.5	
Females	Spitsbergen (ZMA)	12	28.6—52.4	6.45	41.7±1.86	0.03
	Etah (Storer)	23	28 —52	7.53	42.5±1.8	

Storer's from Etah, N.W. Greenland (*C.g. ultimus*); the differences found are small and not significant ($P > 0.01$).

Stomach contents: 19 examined.
Only 2 contained some food remains consisting exclusively of Gammaridae. One on these (ZMA No. 19900) was collected on 27 June at the breeding place; the other (ZMA No. 19903) on 9 September at sea.

In August we often saw Black Guillemots bringing fish to the nesting holes.

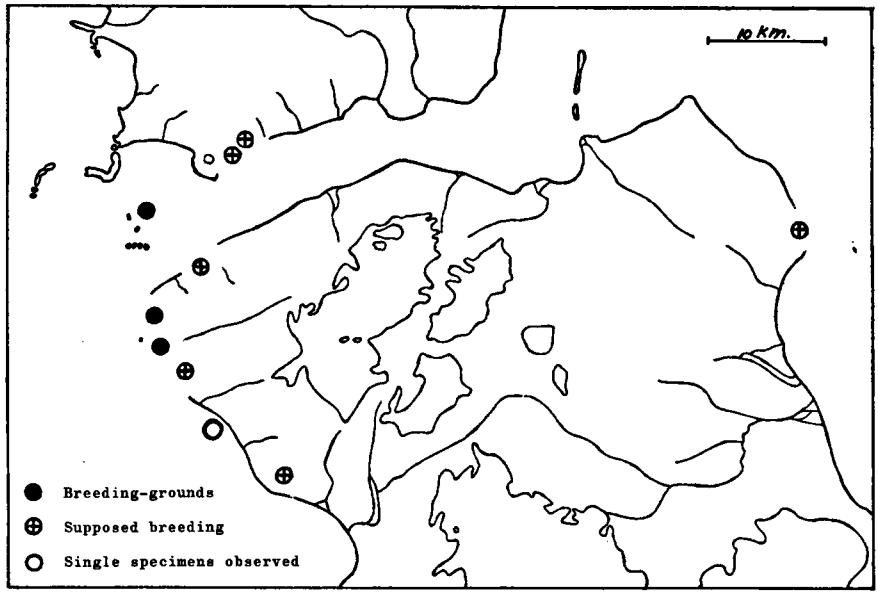

FIG. 36. *Cepphus grylle*. The same symbols are used also in the other maps concerning the occurrence of the species.

Field observations.

After we had arrived on 16 August at Kapp Lee we found this species nesting in the dolerite formations on Leefjellet. Black Guillemots also bred in a dolerite cliff, which we called "Xanthoria-rock", just north of Rosenbergdalen along the sea. Adults were observed for the last time that season on 2 September, juveniles until the middle of that month, when minimum and maximum temperatures had fallen to —7° and —4°C.

In 1969 Black Guillemots reappeared on Leefjellet on 9 April, when minimum and maximum temperatures had risen to —26° and —19°C. In the middle of April single birds and small groups (5—10) were at times seen flying north over frozen Storfjorden.

On 25 April we observed Black Guillemots (about 40) for the first time on Brimulen (fig. 37), a dolerite island at the entrance of Freemansundet.

On the Xanthoria-rock, where they had bred previously, they were noticed

FIG. 37. Brimulen, a breeding place of Black Guillemots, at the end of May 1969. In the middle and to the right is frozen Freemansundet, in the background Barentsøya. Photograph by E. Flipse.

for the first time on 30 April. Afterwards it turned out that all birds inhabiting this cliff, which is about 200 m long and 20 m high, probably had arrived on the same date. Later in the season the numbers counted on 30 April (between 30 and 40) did not increase any more.

In the last week of April we noticed that the whole of the dolerite ridge on Leefjellet, from our station to Kapp Lee and further east (extending over ca 6 km), was occupied by Black Guillemots as far as there were crevices in the rocks.

In West Spitsbergen the normal time for the birds to arrive is the middle of March. When the sea remains frozen for a very long time they may not arrive before April or even the beginning of May (Løvenskiold, 1963). Storfjorden was completely frozen until the end of May (fig. 6). This situation must account for the late arrival of the Black Guillemots in the Kapp Lee area.

In the last week of April we noticed on Leefjellet and Brimulen, that the Black Guillemots were present in the morning, while they were absent in the afternoon. The Xanthoria-rock, inhabited by a total of between 34 and 42 Black Guillemots was chosen for daily observations on the diurnal rhythm of these birds from 1 May until 18 June, a period of seven weeks (fig. 38). We found that the birds left the cliff every day between 1 p.m. and 4 p.m. In the first weeks of May the place was deserted in the afternoon and at night, the first birds starting to return some hours after midnight. In the course of the season they returned progressively earlier and by the end of

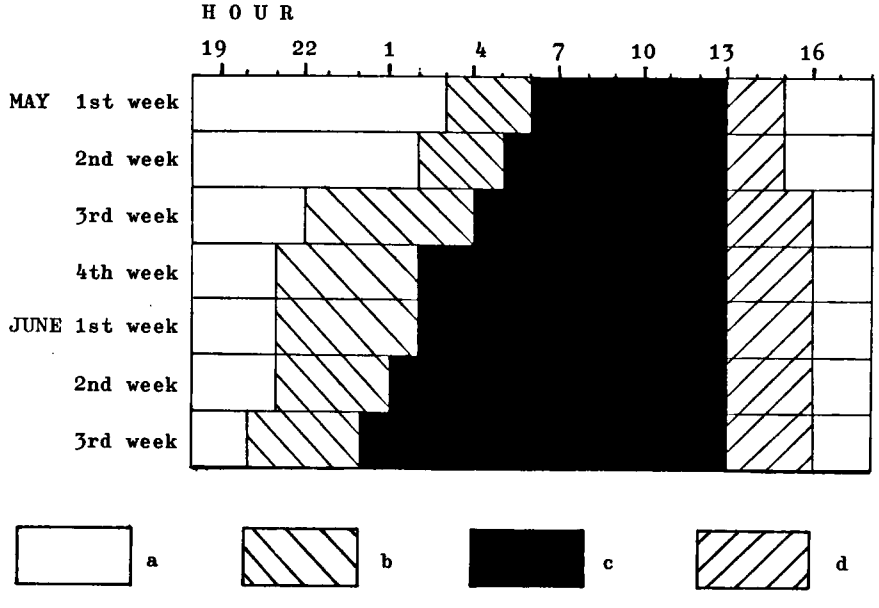

FIG. 38. *Cepphus grylle*. Diurnal rhythm at a breeding place near Kapp Lee in spring 1969: a — place deserted, b — birds return, c — all birds present, d — birds leave.

June there were Black Guillemots at the cliff continuously throughout the day. Fig. 38 shows that the longer visits towards the end of the observation period were due to an earlier return and not to a later departure.

The records on diurnal rhythm of the Black Guillemots on Nordaustlandet given by Keith (1937) differ from ours. There the birds had already returned to the breeding places by 10 March. They arrived every night and left early in the morning. Gradually they began to arrive earlier and to leave later. By the end of April they stayed at the cliff throughout the day.

When leaving the cliff our Black Guillemots invariably headed south, returning from the same direction. Upon their arrival they often flew so high that they were not observed until they were well on the way down to the cliff. While descending they let themselves fall like stones over a considerable distance.

By the middle of May the whole of Storfjorden and Freemansundet was still frozen with solid ice (fig. 6). The nearest open water to the south was beyond the line Kvalpynten-Kvalvågen. Probably our Black Guillemots foraged in this open water and therefore had to fly at least 140 km daily. All Guillemots collected at their arrival after their daily absence on Leefjellet, where the same rhythm was noticed as on the Xanthoria-rock, had empty stomachs (see: Stomach contents). This is an indication that they had been flying long enough to digest their food on the way back. To the north there was some open water in Heleysundet at about 70 km from Kapp Lee (fig. 6). On 22 May about 30 Black Guillemots were seen foraging there (pers. comm. B. Johansen). Possibly these had come from Northern Barentsøya, where Black Guillemots had been observed that time sitting on the cliffs (pers. comm. B. Johansen).

From Greenland it is also known that Black Guillemots fly distances of more than 100 km between their breeding place and the open sea (Salomonsen, pers. comm. 1970).

That the daily foraging flights were strenuous is perhaps reflected by the fat loss of the birds in the course of spring (fig. 34).

The earlier daily return of the birds towards the end of our observation period can be explained by the gradual breaking up of the sea ice in southern Storfjorden reducing the flying distance between the breeding place and the open water. By the end of June open water was to be found in the vicinity of the colony too. The guillemots foraged here and flew to and fro, arriving throughout the day, and no longer leaving the colony deserted.

Soon after their arrival on the Xanthoria-rock at the end of April, the Black Guillemots were courting most of the time of their daily stay at the breeding place. In the second week of May it was obvious that pairs had been formed, and copulations were seen daily during this month. Thereafter they copulated less frequently until the end of June. Courtship and successive copulations mostly took place during the first hours after the birds had returned to their cliff. Copulations were carried out mostly on the same spots on successive days. On 16 May I saw a pair copulate three times, with twenty minutes intervals. The last hours of their daily stay the birds were

FIG. 39. *Cepphus grylle*. Middle of May on the breeding place near Kapp Lee. Photograph by the author.

sitting quietly or occasionally squeaking (fig. 39) near the entrance of those crevices, which later turned out to be nesting holes.

When Glaucous Gulls passed along the cliff, the Black Guillemots often took wing and settled only after some minutes. Several times in spring we observed Glaucus Gulls devouring adult Black Guillemots on the sea-ice.

On the Xanthoria-rock there were 16 pairs and 10 un-paired Black Guillemots in the spring. However, we later found only 9 nests with eggs. Assuming that we had found all of the nests with eggs and that none of the prospecting breeding birds had died, this cliff-population had a non-breeding percentage of just more than half. On 27 June we found one nest with two eggs; 8 additional nests were reached on 6 July. All nests except one contained two eggs. The exception had one egg and probably belonged to a clutch of two of which one egg had become lost, as we found an empty egg shell beneath the breeding site. Judging from the behaviour of the birds by the end of June, all these eggs must have been laid before 1 July.

On 21 July all young had hatched; allowing for an incubation period of 24 days (Løvenskiold, 1963), all eggs must have been laid before 28 June. According to Løvenskiold this time of egg-laying is usual; most of the eggs of the Spitsbergen Black Guillemot are probably laid in the last two-thirds of June.

One female (ZMA No. 19777) collected on 29 May had an egg-follicle of 6.4 mm. Compared with this situation, two other females (ZMA No. 19775, 19903), collected on 27 June had unexpectedly small follicles: 5.6 and 5.7 mm, respectively. These females therefore may have either belonged to the non-breeding part of the population, or may already have completed their clutch.

On Barentsøya Black Guillemots were seen in the dolerite formations along Freemansundet. Judging from their behaviour in June they were breeding there.

In the middle of July we noticed Black Guillemots in a Kittiwake colony at Diskobukta and on the ledges of the mountains at Kapp Pechuel Lösche.

On the Xanthoria-rock the last young had left for the sea by 3 September. After this date adults were not seen near this place any more; juveniles were seen at sea until 9 September. On Brimulen, where about 40 Black Guillemots had residence during the summer, we still found one pair of adults on 2 September. These came with fish to a crevice and therefore were apparently still caring for young. On 27 August 1971 E. Flipse (pers. comm.) observed here two adult birds coming in with fish. At this time only juveniles were to be seen at sea in front of the cliff.

In 1967 in Hornsund we observed on 16 August some juveniles on the sea. The folowing days their number increased gradually, while towards the end of this month the numbers of adults decreased, so that by the first week of September more juveniles than adults were seen on the water. The last adults of that season were observed on 3 September in Sassenfjorden.

Judging from our observations in different years of the time adults and juveniles leave the nesting sites, and from records given by Løvenskiold (1963), it seems clear that the adult birds move out of the breeding area to the sea, deserting their young, by the end of August.

26. **Fratercula arctica naumanni** Norton, 1901. Puffin.

Material collected: 3 specimens; data in table XXXIV.
ZMA No. 23764, 23765, 23766, 3 ♂ ad., 3-IX-1967, Sassenfjorden.

TABLE XXXIV. *Fratercula arctica.* Measurements of adult males from Spitsbergen. Culmen is measured from the posterior edge of the raised rim at the base of the bill.

ZMA No.	Wing mm	Culmen mm	Tarsus mm	Condition	Moult of small feathers
23764	187	48.3	28.0	fat	neck
23765	183	56.2	30.7	fat	whole body
23766	181	50.5	28.5	fat	none

The Puffin shows a clinal geographical variation, affecting only size which increases with latitude (Vaurie, 1965). Our measurements tally with those given by Vaurie (1965) for 24 Spitsbergen males belonging to the form *F.a. naumanni* (wing 177—195, mean 185 mm; culmen 51—59, mean 55.4). Measurements of other forms were considerably smaller: 20 Iceland males, *F.a. arctica*, wing 163—177, mean 170 mm; culmen 45—54, mean 50, and British Isles males, *F.a. grabae*, wing 152—164, mean 159; culmen 44—49, mean 46 (Vaurie, 1965).

Field observations.

This species was observed only once in 1969, when on 10 July one Puffin was seen flying south over the sea in front of the station.

In 1967 we saw it in the second half of August in Hornsund. When visiting

Sofiakammen on 28 August, Puffins flew to and from their nesting holes on the mountain. On 4 September there were still many Puffins on the breeding places near Diabasodden in Sassenfjorden. Here 3 specimens were collected without obtaining the stomach contents.

27. **Nyctea scandiaca** (Linnaeus, 1758). Snowy Owl.

Field observations.

This species was observed once, when on 10 September 1968 a Snowy Owl was seen flying in Rosenbergdalen; it was not seen again.

This bird is a fairly regular visitor to Spitsbergen and has been seen on Edgeøya on several occasions (Løvenskiold, 1963; Norderhaug, 1969).

28. **Turdus pilaris** (Linnaeus, 1758). Fieldfare.

Material collected: 2 specimens.
ZMA No. 20052, 20052, sex ?, ♂, 21-VIII-1968, Kapp Lee.

The male measured: wing 149 mm, culmen 24.0 mm. We found this bird, which was completely mummified, in an old trappershut near the station. The other specimen, of which only legs and tail were left, was found on the hill behind the station.

Both specimens showed new feathers, indicating that they must have arrived during the autumn, as the fieldfare moults from July to September (Dementiev, 1951). Judging from their state of mummification our 2 specimens definitely had not arrived in the autumn of 1968, but must have come the year before or even earlier.

This species has been recorded in Spitsbergen on several occasions (Løvenskiold, 1963). All observations on living Fieldfares pertain to birds that had arrived in autumn.

29. **Plectrophenax nivalis nivalis** (Linnaeus, 1758). Snow Bunting.

Material collected: 14 specimens; data in table XXXV.
ZMA No. 23767, ♀ juv., 3-IX-1967, Sassenfjorden.
ZMA No. 20042, ♀, 23-IX-1968, Kapp Lee.
ZMA No. 20041, 20043, 20044, 20045, 20046, 20047, 20049, 20051, 8 ♂, 21-IV-1969, Kapp Lee.
ZMA No. 20050, ♂ juv., 25-IV-1969, Kapp Lee.
ZMA No. 20048, ♂ juv., 29-IV-1969, Kapp Lee.
ZMA No. 20039, ♀, 11-V-1969, Kapp Lee.
ZMA No. 20040, ♂, 29-V-1969, Barentsøya.

Weights and measurements of our collection of 11 Snow Bunting males can be summarized as follows: weight 34—45, average 38.5 g; wing 107—114, average 111.5 mm; culmen 10.0—11.5, average 10.8 mm; tarsus 20.0—22.2, average 20.9 mm.

The wing length is slightly smaller than that given by Salomonsen (1931)

TABLE XXXV. *Plectrophenax nivalis*. Weights and measurements.

ZMA No.	Weight g	Wing mm	Culmen mm	Tarsus mm	Condition
			MALES		
20041	38	114	11.3	21.4	very fat
20043	45	111	11.3	21.1	very fat
20044	34	112	10.5	20.0	fat
20045	37	107	11.0	21.0	fat
20046	36	114	10.1	21.0	fat
20047	40	111	10.0	22.2	very fat
20049	43	112	10.1	20.7	very fat
20051	39	114	11.3	20.9	fat
20050	37	108	10.5	20.7	fat
20048	37	111	11.4	20.8	fat
20040	38	113	11.5	20.0	fat
			FEMALES		
23767	—	91	8.3	19.1	fat
20042	36	110	—	—	fat
20039	52	115	11.7	20.8	very fat

for *Plectrophenax nivalis subnivalis* Brehm, 1826, inhabiting North-East Greenland; males (54) 107—119 mm, average 112.9 mm. It is somewhat larger than that given for *Plectrophenax nivalis nivalis* from Scandinavia; males (23) 104—114 mm, average 108.2 mm.

All our Snow Buntings collected in spring were fat or very fat (table XXXV), indicating that the birds can provide for themselves under hard conditions of winter and long-sustained migration.

As the April birds were collected from a flock that had arrived at our station one day earlier (see field observations), we may assume that they were fat on arrival after their northward oversea spring migration. The only female collected in spring (ZMA No. 20039) was very fat, and very heavy (52 g) when compared with our males and with females weights given by Dementiev (1951): 28.5—42.0 g, average 34.6 g.

Moult and plumage.

None of the 12 specimens collected in spring showed any moult. The 2 specimens collected in September (ZMA No. 20042, 23767) showed some moult of small feathers over the whole body.

The adult males (9) collected in April were still all in "winter plumage", having more or less broad ochre-rufous feather fringes on crown and neck, cheeks, auriculars and upper parts. In the male from 29 May (ZMA No. 20040) these feather fringes had worn to such an extent that his plumage can readily be called a "summer plumage".

According to Salomonsen (1931) the pattern of black and white on the rectrices (R) is different in Snow Buntings from Scandinavia (*P.n. nivalis*) and those from North-East Greenland (*P.n. subnivalis*), see fig. 40.

Two (ZMA No. 20045, 20048) of our 14 specimens had lost some of their

rectrices so the pattern could not be seen. Two (ZMA No. 20040, 20046) showed a pattern similar to that of *P.n. subnivalis* with R_4 having much white on the inner web (fig. 40). The remaining 10, all had a pattern similar to that of *P.n. nivalis* with R_4 having little white on the inner web (fig. 40). The colour pattern of primaries, secondaries and primary coverts shows considerable variation in both subspecies (Salomonsen, 1931). In our series there was also some variation. On the whole they were similar to *P.n. nivalis*, though some had certain characteristics of *P.n. subnivalis* in showing more white on the feathers.

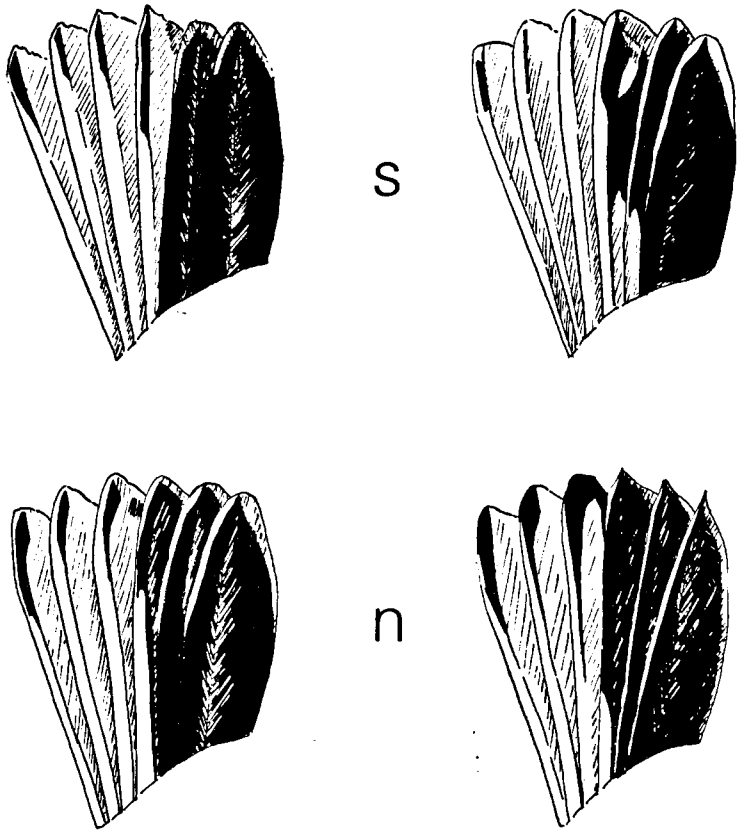

FIG. 40. *Plectrophenax nivalis*. Geographical variation of colour-pattern of rectrices: s — *P. n. subnivalis* (♂ and ♀) from N.E. Greenland, n — *P. n. nivalis* (♂ and ♀) from Scandinavia. After Salomonsen (1931).

We may only conclude that the Snow Bunting in Spitsbergen belongs to the nominate form. The occurrence of some *subnivalis* features is undeniable however. Whether this is inborne or the result from gene-exchange with *subnivalis*-populations from North East Greenland is unknown.

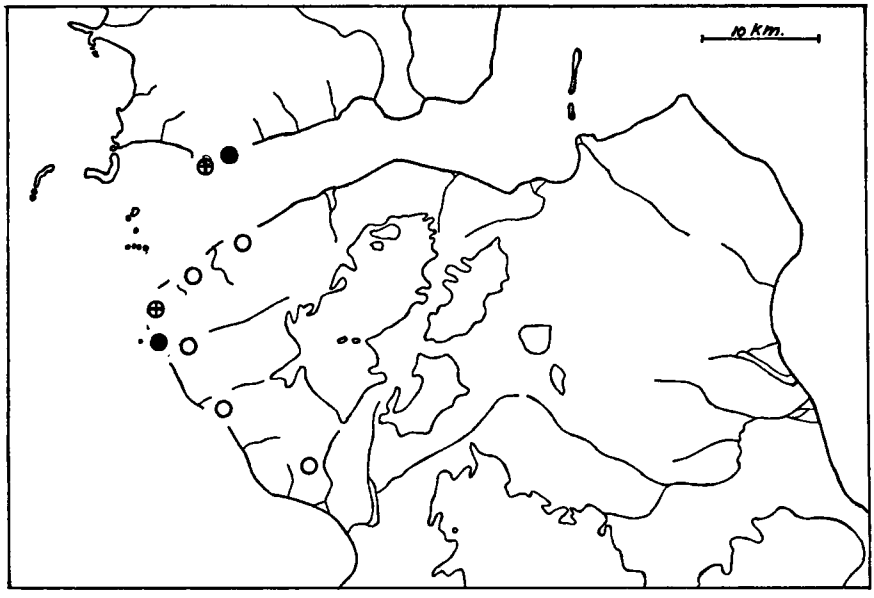

FIG. 41. *Plectrophenax nivalis*. (Legend in fig. 36).

Stomach contents: 12 examined.
The contents of the 10 stomachs collected in April 1969 were put together. The total mass consisted of sand (about 50%), stem fragments, buds and roots of *Salix polaris* (about 40%), lichen, mosses, grasses and a few insect remains. Two stomachs from May 1969 contained: sand (about 50%), buds of *Salix polaris*, and a lot of undeterminable plant material.

In October and November 1968, and April 1969 the birds came to the pelsifood (dried fish remains, prepared for furred animals) which we threw on the tundra near the station.

Field observations.
In August 1968 Snow Buntings were daily present in the neighbourhood of the station, foraging mostly on the tundra. In September they were seen near the station and in Rosenbergdalen in flocks numbering up to 30. On 27 September we still counted 47 Snow Buntings on the tundra near the station, but the next day there were only 8, all of which stayed there until 26 October. On 30 October they had diminished to 5, on 4 November to 3 and on 7 November only 2 were left. Our last Snow Bunting of the year was seen on 10 November, when minimum and maximum temperatures had fallen to —27° and —23°C. During the last two months of their stay the birds had been foraging on the tundra, which in spite of the advanced season was mostly free of snow as a result of frequent storms.

Løvenskiold (1963) lists the last observation dates of Snow Buntings in

October and November over 17 different years and gives but one later date than ours, viz. 22 November. Our observation on 10 November 1968 is therefore remarkably late.

In 1969 Snow Buntings were back at Kapp Lee on 9 April, when minimum and maximum temperatures had risen to —26° and —19°C. That day there were 3 males foraging on the tundra near the station. On 19 April there were 7 and on 20 April 61. In Rosenbergdalen there were only a few buntings by then.

On 24 April it was obvious that the males had spread over a larger area and some were to be seen near certain fixed spots, where they had residence most of the day.

On 28 April the typical lark-like Snow Bunting song was heard for the first time. On the same day we noted the first females of the year, which had arrived 19 days later than the first males. As appears from the collected material (ZMA No. 20050) first year males also had arrived earlier than the females and it is probable that they arrived together with the other males.

The time of arrival noticed by us in April is normal for Snow Buntings in Spitsbergen (Løvenskiold, 1963).

In summer these birds were seen in many places (fig. 41). In June we found them breeding on Barentsøya, in Rosenbergdalen and at several places near the station. Here a nest with 5 young fledged on 10 July. If we allow for an incubation and fledging period of together 25 days (Løvenskiold, 1963) we may assume that this clutch was completed by 15 June, which is a normal time of egg-laying in Spitsbergen (Løvenskiold, 1963).

General conclusions and discussion

The food of Spitsbergen birds.

Of 163 birds, belonging to 18 species, the stomach was preserved. Of 5 species (*Clangula hyemalis, Somateria mollissima, Branta leucopsis, Phalaropus fulicarius, Stercorarius longicaudus*) only one or two stomachs were obtained. Of 3 species (*Plotus alle, Uria lomvia, Cepphus grylle*) all or nearly all of the stomachs of the birds were empty. Food from 5 or more stomachs per species could be studied of 2 species of land-birds (*Calidris maritima, Plectrophenax nivalis*) and 8 species of sea-birds (*Gavia stellata, Fulmarus glacialis, Stercorarius pomarinus, Stercorarius parasiticus, Larus hyperboreus, Pagophila eburnea, Rissa tridactyla, Sterna paradisaea*). Of the latter the main results of the study of 108 stomach-contents are shown in table XXXVI. The birds from this table fall into three ecological groups (see Hartley & Fisher, 1936).

Divers: Red-throated Diver.

Surface feeders: Fulmar, Glaucous Gull, Ivory Gull, Kittiwake, Arctic Tern.

Scavengers, pirates, predators: Fulmar, Pomarine Skua, Arctic Skua, Glaucus Gull, Ivory Gull.

TABLE XXXVI. Frequency (in percentage) of the occurrence of kinds of food in the stomachs of 8 sea-bird species, collected near Edgeøya in spring and summer 1969 (in brackets number of stomachs examined).

	Fish	Crustacea	Cephalopoda	Polychaeta	Waste	Birds	Plants
Gavia stellata (5)	100	40	—	—	—	—	20
Fulmarus glacialis (20)	20	30	80	20	10	—	—
Stercorarius pomarinus (9)	44	—	—	—	11	11	33
Stercorarius parasiticus (13)	69	23	—	—	—	—	8
Larus hyperboreus (25)	—	16	—	—	12	32	36
Pagophila eburnea (8)	38	25	13	—	—	—	—
Rissa tridactyla (10)	60	60	—	—	—	—	10
Sterna paradisaea (18)	—	61	—	—	—	—	—

For the Red-throated Diver, which is exclusively a diver, and the Kittiwake and Arctic Tern which are exclusively surface feeders, only fish and crustacea are represented. The occurrence of plant material, which does not seem to be actually nutritious in these birds can be explained by the accidental swallowing of nest material. The Arctic Skua parasitises the surface feeders, notably the Kittiwakes, which is reflected in the stomach-contents, as in both species we found the same types of food. Therefore the Arctic Skua can be considered an additional surface feeder, its food being largely influenced by the same factors that influence that of its principal victim. The time of egg-laying of the Kittiwake is later in East Spitsbergen than in North-West Spitsbergen (see 21. *Rissa tridactyla).* For the Arctic Skua we did not find a similar difference in timing between these regions; however, a difference in clutch-size, with on average smaller clutches in East Spitsbergen was detected (see 16. *Stercorarius parasiticus).*

The Fulmar has a similar diet to that of the Ivory Gull; both are surface feeders and scavengers. The Glaucous Gull and to a lesser degree the Pomarine Skua apparently live to some extent as predators (mainly on birds). The predatory habits of the Arctic Skua are considerably less developed (see also Løvenskiold, 1963, and own field observations).

It is quite peculiar that in this part of the High Arctic the bird fauna lacks a real bird of prey. In almost every other region of the High Arctic the Gyrfalcon (*Falco rusticolus*) and Snowy Owl (*Nyctea scandiaca*) brood. On Spitsbergen, however, there are no rodents (Lemmings, Voles, Hares very few if any; Lønø, 1960) as elsewhere (Greenland, Arctic Northern America) and this probably accounts for the absence of birds of prey. In addition, the sea-birds and Ptarmigans do not seem to be sufficient to support the Gyrfalcon during the winter.

In different places the diet of a bird species can be different (Belopolskii, 1957). Four of our sea-birds also figure in the studies of Belopolskii. His

results are compared with ours in table XXXVII. The most important difference in food between Spitsbergen and Murmansk is that in Spitsbergen Crustacea are relatively more important and fish less so. This difference can probably be attributed to the presence of glacier feeding-zones in Spitsbergen with a very rich crustacean fauna (Scott, 1936; Hartley & Fisher, 1936). In Spitsbergen as well as in Murmansk the stomach-contents of the Arctic Skua

TABLE XXXVII. Occurrence of different food categories (in percentage) among 4 sea-bird species at Edgeøya compared with those at the Murmansk coast.

		Fish	Crustacea	Waste	Birds	Plants
Arctic Tern	Edgeøya	—	61	—	—	—
	Murmansk	65	24	—	—	5
Kittiwake	Edgeøya	60	60	—	—	10
	Murmansk	68	10	—	—	34
Arctic Skua	Edgeøya	69	23	—	—	8
	Murmansk	61	2	—	12	54
Glaucous Gull	Edgeøya	—	16	12	32	36
	Murmansk	33	14	17	44	36
Four species combined	Edgeøya	32	40	3	8	14
	Murmansk	55	13	4	14	32

reflect those of the Kittiwake. However, in both regions the food ratio fish--crustacea in the Arctic Skua, when compared with the Kittiwake, has changed in favour of fish (with a factor 3 in Spitsbergen and a factor 4 in Murmansk).

Of the two land-birds of which more than two stomachs were available, the Purple Sandpiper also plays a small part in marine ecology. It feeds to some extent on crustacea (in 42% of all stomachs) in the intertidal zone (see above 13. *Calidris maritima*). Terrestrial material (Diptera, Collembola, plants), however, predominates. The Snow Bunting is exclusively a terrestrial bird, living on insects and other arthropods, plants (seeds, buds).

Seasonal variation in weight and adiposity in Spitsbergen birds.

In the sea-bird species of which we collected specimens in different months (*Fulmarus glacialis, Stercorarius parasiticus, Larus hyperboreus, Sterna paradisaea, Cepphus grylle*) we noticed a tendency to lose weight from May to September. This was most apparent in the females and the difference was significant ($P < 0.01$) in the female Glaucous Gulls only. Birds of species only taken shortly after their arrival in spring (*Somateria mollissima, Branta leucopsis, Phalaropus fulicarius, Plectrophenax nivalis*) invariably had very thick subcutaneous fat layers. Correspondingly thick layers were not found in species collected only later in the season (*Gavia stellata, Clangula hyemalis, Calidris maritima, Pagophila eburnea, Plotus alle, Uria lomvia*). Taking into account these data it is probable that in general the Spitsbergen breeding

birds are heaviest at, or shortly after, their arrival in spring and lose weight in the course of the season. We expected a difference in the seasonal weight fluctuations between breeders and non-breeders, but our material proved to be too scanty to go into this detail.

Geographical size variation.

It is a well-known phenomenon that many arctic mammals and birds tend to grow larger than their southern congeners (Bergmann's rule). When we compare our Spitsbergen specimens with conspecific ones from the southern parts of the Barents Sea (Belopolskii, 1957; Schaanning, 1933) this tendency is apparent in the Arctic Skua and the Puffin. In other species we could not detect a size difference (Red-throated Diver, Fulmar, Glaucous Gull, Kittiwake, Arctic Tern). A few species (Brünnich's Guillemot, Black Guillemot) are actually smaller in Spitsbergen, probably indicating that they have reduced their food demands in order to occupy where food would otherwise be too scarce or even prohibiting their occurrence (see Salomonsen, 1958).

Reproductive cycle and moult of primaries in Spitsbergen birds.

In different species the moult and renewal of the primaries (primary moult), which demands a great deal of energy and which is a handicap to flight, takes place in different periods of the year. Fig. 42 shows in which time of the year primary moult and reproduction occur in 12 species, studied in the Kapp Lee area. The moult data are derived from specimens collected by us and from additional specimens in ZMA, and from data in the literature, mainly from: Bierman & Voous, 1950; Salomonsen, 1958; Stresemann & Stresemann, 1966; Bauer & Glutz von Blotzheim, 1966, 1968 and 1969. The moult periods given in fig. 42 pertain to breeding birds; in the Common Eider only to the breeding females. The duration of moult and breeding cycles pertains to the population of the species in question rather than to an individual bird. So for one bird these periods are of course shorter than for the population as a whole. Let us now consider the species of fig. 42 and start with the earliest moulters of the year.

The Arctic Skua and the Arctic Tern moult in their southern winterquarters. Here they have completed their moult before starting their return journey. As the Arctic Tern has to fly further (Antarctic seas; Salomonsen, 1967) than the Arctic Skua (southern Atlantic; Wynne-Edwards, 1935) the actual wintering period of the Arctic Tern is shorter and accordingly the moult is speeded up (2 months) compared to the Arctic Skua (4 months).

The Ivory Gull, with very restricted migratory habits, starts primary moult in March, when it lives on the Northern Atlantic near the borders of the pack-ice. It has mostly finished this moult after 3 or 4 months by the end of June, which is at the onset of their breeding season.

The Glaucous Gull, also a mainly non-migratory species, starts to moult in the second half of May simultaneously with the onset of breeding. Not before

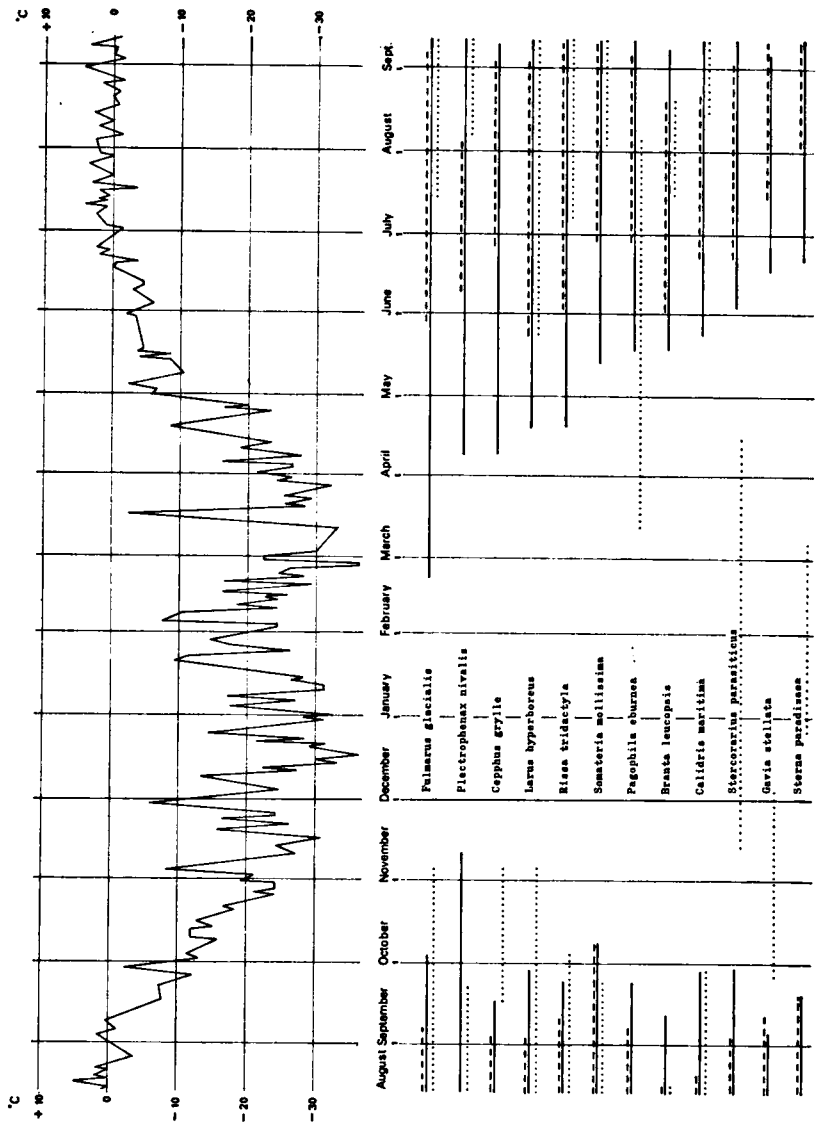

FIG. 42. Upper part. Daily variation (approximate) of minimum temperature at Kapp Lee, 1968—1969. Lower part. Presence in the Kapp Lee area (a), reproductive cycle (b) and moult of primaries (c) of 12 bird-species in the course of the season.

five months have all primaries been renewed, the renewal proceeding slowly and the extra energy demand being gradually distributed over the reproductive cycle.

The Kittiwake and the Fulmar begin to moult in July after the eggs have been laid, but before the hatching of the young. In the Kittiwake moult takes nearly 3 months, in the Fulmar nearly 4.

The Barnacle Goose (like the Brent Goose and the Pink-footed Goose) loses its primaries (simultaneously) shortly after the young have hatched in the middle of July.

Its new primaries have grown after about one month, having regained the power of flight by the same time that its young fledge.

The Common Eider (female) also loses her primaries shortly after the young have hatched. The hatching dates in the Common Eider vary more than in the Geese but are mostly later in the season. Consequently the onset of moult varies much more and ends correspondingly later. Flightless Eider ducks with young can be seen as late as the second half of September.

The Snow Bunting, a real migrant, changes feathers very fast after having completed the breeding cycle in the first half of August. The complete moult takes just over a month and in this period Snow Buntings are only capable of fluttering short distances. They have developed new primaries before the start of the autumn migration.

The Purple Sandpiper starts the primary moult at the end of the breeding cycle in the middle of August. It has completed this moult towards the end of September. During the moult period it is handicapped, but not nearly as flightless as in the Snow Bunting.

The Black Guillemot leaves its still flightless young at the beginning of September to shed its primaries (simultaneously) in that month, having new primaries just over a month later.

The Red-throated Diver sheds its primaries simultaneously, as in ducks and geese and does so some time after having completed the breeding cycle. This happens in the winter quarters, sometimes as early as the end of September, but also as late as in November.

According to the pattern of moult, we can distinguish between slow moulters (primaries renewed one after another) and fast moulters (greater part of primaries or all primaries shed simultaneously).

The slow moulters moult before the start of the breeding cycle (Arctic Skua, Arctic Tern, Ivory Gull) or their moult begins during and is extended for a certain time after that period (Glaucous Gull, Kittiwake, Fulmar, Purple Sandpiper). The fast moulters moult only during the last part of the reproductive cycle (geese, eiders) or after the completion of the cycle (Snow Bunting, Black Guillemot, Red-throated Diver).

The moulting pattern of the Ivory Gull and the Glaucous Gull (just before and simultaneously with the onset of breeding, respectively) is peculiar when compared with other North Atlantic gulls, which start to moult towards the end of the breeding cycle or later (Stresemann & Stresemann, 1966; Harris, 1971). This pattern is also remarkable in comparison with other sea-bird

species of Spitsbergen. Possibly these two gull-species, with their rather omnivorous diet, have more possibilities to build up energy in early spring, when ice covers the sea, than other more specialized sea-birds.

Phenology of birds in the Kapp Lee area.

Manner and dates of arrival (fig. 42).

The first species observed to arrive in 1969 was the Fulmar, which was seen for the first time on 23 February. The species that arrived next were the Snow Bunting, the Black Guillemot and the Little Auk, more than one month later (9 April). The other species arrived in the following sequence: Glaucous Gull (19 April), Kittiwake (20 April), Common Eider (14 May), Turnstone (18 May), Ivory Gull (19 May), Barnacle Goose (19 May), Purple Sandpiper (23 May), Pink-footed Goose (25 May), Arctic Skua (3 June), Brent Goose (4 June), Grey Phalarope (7 June), King Eider (7 June), Long-tailed Duck (17 June), Red-throated Diver (17 June), Ringed Plover (19 June) and Arctic Tern (21 June). The difference in time between the first (Fulmar) and the last arrivals (Arctic Tern) was nearly four months.

In the autumn of 1968, the last species to be observed were the Fulmar (3 October), the Common Eider (8 October), and the Snow Bunting (10 November), all others having disappeared in the course of September (fig. 42). The difference in time of departure between the earliest (Barnacle Goose) and the latest (Snow Bunting) was about 2 months.

Norderhaug (1971) lists the date of arrival of some birds at Ny Ålesund, Tjuvfjorden and Ryke Yseøyane (see fig. 1, first part) in 1969. His data are compared with ours in table XXXVIII, where also the minimum and maximum temperatures measured on the nearest meteorological stations at the given date are presented (from Norsk Meteorologisk Årbok, 1970). The distance from Kapp Lee to Tjuvfjorden and Ryke Yseøyane and from Ryke Yseøyane to Tjuvfjorden is about 100 km. The distance from Ny Ålesund to Tjuvfjorden and Ryke Yseøyane is about 300 km. In comparing the arrival dates at the four places we see that, in general in the sea-birds, Kapp Lee differs more from Tjuvfjorden and Ryke Yseøyane than both of these from Ny Ålesund, so obviously other factors than the distance the bird has to fly northwards are involved. Ny Ålesund on the West coast of West Spitsbergen has, in spite of its most northern situation, the mildest conditions, due to the influence of the North Atlantic Drift. Open water is mostly found within some tens of kilometres throughout the year and temperatures in spring and summer are higher on the west coast than in the east, where the other three places are located.

The sea near Ryke Yseøyane and Tjuvfjorden, which lies more to the south, is for the greater part of the year covered with ice, but some open water can be expected throughout the year and is certainly found in spring (see fig. 6, first part). Conditions here are less severe than at Kapp Lee, where the sea is completely covered with ice over a distance of 70 kilometres in every direction until May. This ice-cover must account for the relatively

TABLE XXXVIII. Date of arrival of 15 bird species at 4 different places in Spitsbergen 1969, with temperatures (in °C) measured on the nearest meteorological station at the date of arrival. (1) Observed in Longyearbyen.

	Arrival	Isfjord		Arrival	Hopen		Arrival	Hopen		Arrival	Kapp Lee	
	Ny Ålesund	T.min.	T.max.	Tjuvfjorden	T.min.	T.max	Ryke Yseøyane	T.min.	T.max.	Kapp Lee	T.min.	T.max.
Gavia stellata	—	—	—	—	—	—	7—VI	—9	—1	17—VI	—2	+0
Fulmarus glacialis	6—II	—5	—1	9—II	—7	—0	16—II	—10	—5	23—II	—24	—13
Somateria mollissima	—	—	—	7—IV	—20	—15	9—IV	—25	—17	14—V	—4	+6
Anser fabalis	26—V	—5	+0	22—V	—2	+1	—	—	—	25—V	—3	+2
Branta bernicla	—	—	—	14—VI	—4	—0	17—VI	—1	+1	4—VI	—5	—3
Branta leucopsis	—	—	—	3—VI	—6	—3	10—VI	—4	—3	19—V	—4	+2
Arenaria interpres	5—VI	—5	—1	—	—	—	—	—	—	18—V	—1	+2
Stercorarius parasiticus	8—VI	—1	+2	9—VI	—5	—2	5—VI	—7	+2	3—VI	—5	+0
Pagophila eburnea	—	—	—	—	—	—	18—III	—10	+1	19—V	—4	+2
Larus hyperboreus	24—III[1]	—30[1]	—20[1]	—	—	—	17—III	+1	+2	19—IV	—8	+3
Rissa tridactyla	—	—	—	7—IV	—20	—15	17—IV	—20	—15	20—IV	—10	—5
Sterna paradisaea	5—VI	—5	—1	13—VI	—5	—2	6—VI	—4	+2	21—VI	+0	+5
Plotus alle	30—III[1]	—25[1]	—19[1]	—	—	—	—	—	—	9—IV	—26	—19
Cepphus grylle	—	—	—	—	—	—	5—II	—6	—2	9—IV	—26	—19
Plectrophenax nivalis	—	—	—	—	—	—	20—IV	—6	+0	9—IV	—26	—19

late appearance of some sea-bird species in the Kapp Lee area. Temperature by itself seems to be of minor importance (fig. 42) though it has probably some effect on local movements (see below: Discussion of arrival time).

Discussion of arrival time of 15 species observed at Kapp Lee (details in table XXXVIII).

Gavia stellata. Arrived 10 days earlier at Ryke Yseøyane than at Kapp Lee, while temperatures were higher at Kapp Lee on the day of arrival than they were at Ryke Yseøyane. This species requires open fresh water to nest at and open sea to feed in. These conditions are found earlier on Ryke Yseøyane than near Kapp Lee.

Fulmarus glacialis. Little difference in the arrival time at Ny Ålesund and Tjuvfjorden. The arrival coincided with a relatively warm period in February (T. min. > —10°C, Isfjord, 5 days; Hopen, 7 days, NMÅ, 1970; see also fig. 4, which is roughly an indication of the variation in temperatures over the whole of Spitsbergen). At Ryke Yseøyane the Fulmar arrived a week later and at Kapp Lee it took still another week. By then temperatures had again fallen to a normal level. The Fulmar is a surface feeder and while foraging can easily cover large distances from one open spot in the ice to another. It has been observed in every month of the year in Spitsbergen waters (Løvenskiold, 1963).

Somateria mollissima. The arrival date in April at Tjuvfjorden and Ryke Yseøyane differs by only 2 days. Temperatures were by then at a normal level. At Kapp Lee this species was seen more than a month later in a much milder period (figs. 4, 42). The temperature was of little significance in this case, as the Common Eider needs open water close inshore, where it takes food from the bottom (Vibe, 1967). This bird does not make long foraging flights from the breeding grounds to open water; so it stays away from completely frozen areas. The birds seen at Kapp Lee in May were either reconnoitring the place or on migration to open water in the North.

Anser fabalis brachyrhynchus, Branta bernicla, and *Branta leucopsis.* Unlike the arrival dates of most of the sea-birds those of the geese do not differ much, neither in different places, nor in different years (Løvenskiold, 1963). The onset of spring migration is dependent on factors in the wintering area far to the south. After a long flight, partly over the sea, the geese arrive in their breeding area whether they find favourable conditions there or not. The geese do not arrive at the same time. The sequence of arrival observed at Kapp Lee (table XXXVIII) seems to be the normal one (Løvenskiold, 1963).

For their food the geese are dependent on snow-free areas, where they graze on old grass and new shoots of plants, developing at the edges of melting snow fields. To attain these conditions the maximum temperatures must be above freezing. In normal years this is the case in the second half of May and later (figs. 4, 42). The arrival of Barnacle Goose and Brent Goose at Tjuvfjorden and Ryke Yseøyane is very late. Maybe the birds seen

there were non-breeding wanderers, which came from a breeding population elsewhere.

Arenaria interpres. Like the geese this species is a terrestrial bird, which migrates in probably one long flight from the continent to Spitsbergen, where it forages in the intertidal zone and inland, feeding on insects. Availability of food is dependent on temperatures around freezing or higher; so we cannot expect this bird before the middle of May.

Stercorarius parasiticus. Arrives late in spring, much later than its main victim, the Kittiwake. The harsh conditions of early spring, with low temperatures and seas completely covered with ice do not occur anymore in June. The time of arrival differs consequently little in different places throughout Spitsbergen (table XXXVIII; Løvenskiold, 1963). The Arctic Skua endures in autumn much lower temperatures before its departure than in spring (fig. 42), so we may conclude that it is not the low temperature that prevents it from returning earlier but rather the abundance of food to feed both the Kittiwake and itself. Moreover it has to cover a large distance from its winter quarters in the southern Atlantic to the north.

Pagophila eburnea. This species was observed two months later at Kapp Lee than at Ryke Yseøyane. The appearance at Kapp Lee is very late indeed when compared with records given by Løvenskiold (1963). Ivory Gulls live at the border of the pack ice in winter and spring, where they feed in the open water and on the remains of Polar Bear food on floating ice. The completely ice-covered sea near Kapp Lee, where Polar Bears were scarce in the spring of 1969, must account for the late arrival of this species. The arrival at Ryke Yseøyane coincided with a mild period in March (T. max. $>$ 0°C, Hopen, 6 days; see figs. 4, 42).

Larus hyperboreus. At Ryke Yseøyane it arrived a week earlier than in Longyearbyen, where the birds live on the refuse dump of the village and where they are not dependent on the food that the sea provides. At the time of their arrival temperatures were at a normal level. At Ryke Yseøyane they arrived just like the Ivory Gull in a relatively warm period in March (Hopen, T. min. $>$ 0°C, 1 day; T. max. $>$ 0°C, 6 days). At Kapp Lee they arrived about one month later, also in a mild period (figs. 4, 42). This gull is still more omnivorous than the Ivory Gull, being not only a scavenger, but a predator as well. So it can return to places where the sea is still completely ice-covered. It does not have to make long foraging flights as the Fulmar and the auks have to do, but rather stays in the neighbourbood of its breeding grounds, but therefore it has to arrive later than these birds do.

Rissa tridactyla. The Kittiwake is a real migratory bird, which arrives in April. Its arrival does not differ much in different places and different years (Løvenskiold, 1963). After its arrival at the nesting sites it makes long foraging flights to reach open water. Whereas at Tjuvfjorden and Ryke Yseøyane it arrived when temperatures were normal, at Kapp Lee it arrived in a relatively warm period (figs. 4, 42).

Sterna paradisaea. It is one of the latest of the summer birds to arrive, its time of arrival not differing much at different places and in different years

(Løvenskiold, 1963). Its winter range is more distant (Antarctic Seas) than in any other species of bird. As can be seen from table XXXVIII local conditions influence the actual time of arrival. Where the sea is still locally ice-covered, as at Kapp Lee in 1969, they stay away and make their appearance later than in a neighbouring area, where conditions are more favourable.

Plotus alle. This species arrived 10 days later at Kapp Lee than in Longyearbyen, though in both places temperatures were at a normal level. The Little Auk is a real migratory sea-bird, wintering along the west coast of Greenland, but some may winter near Spitsbergen, when open water is to be found there (Norderhaug, 1967). Little Auks can carry out long foraging flights, and they are not hampered too much by an extensive sea-ice near their breeding places, usually arriving a long time before the ice breaks.

Cepphus grylle. This species was seen more than two months later at Kapp Lee than at Ryke Yseøyane. The arrival at Ryke Yseøyane on 5 February was the earliest date of observation in 1969 of all birds in Spitsbergen except the Ptarmigan and coincided with a relatively warm period (February, Hopen, T. min. > —10°C, 7 days). When it arrived at Kapp Lee temperatures where there at a normal level (figs. 4, 42). Black Guillemots winter in Spitsbergen waters, whenever there are open holes (Løvenskiold, 1963). The birds seen at Ryke Yseøyane, where open water was in the neighbourhood, had been possibly wintering there. They arrived much later on the breeding places at Kapp Lee. Like Little Auks they make daily long foraging flights when the sea is still ice-covered, being able to provide for themselves even under hard conditions.

Plectrophenax nivalis. A migratory land-bird whose arrival dates do not differ much from one another, locally or annually, whatever the conditions on the breeding grounds may be. Local movements occur, however, under influence of changing weather conditions. It arrived at Kapp Lee, when temperatures were on a normal level (figs. 4, 42). At Ryke Yseøyane they arrived eleven days later in a relatively warm period in April (Hopen, T. min. > —10°C, 4 days). The Snow Bunting feeds in early spring on plant material left from the previous summer. Therefore upon its arrival it needs at least some snow-free areas for foraging. Both temperatures and snowfall influence the date of its departure. In November 1968 the last Snow Buntings left Kapp Lee in a period of sharply falling temperatures (10 November, T. min. —27°C, T. max. —23°C; see figs. 4, 42), when there was practically no snowcover at all.

The breeding birds of Edgeøya arranged according to different migratory habits.

a. Resident: Rock Ptarmigan.
b. More or less resident (depending on availability of open water): Black Guillemot (hardiest), Fulmar, Glaucous Gull, Ivory Gull, Long-tailed Duck, Common Eider (least hardy).
c. Migratory sea-birds: Brünnich's Guillemot, Little Auk, Kittiwake, King

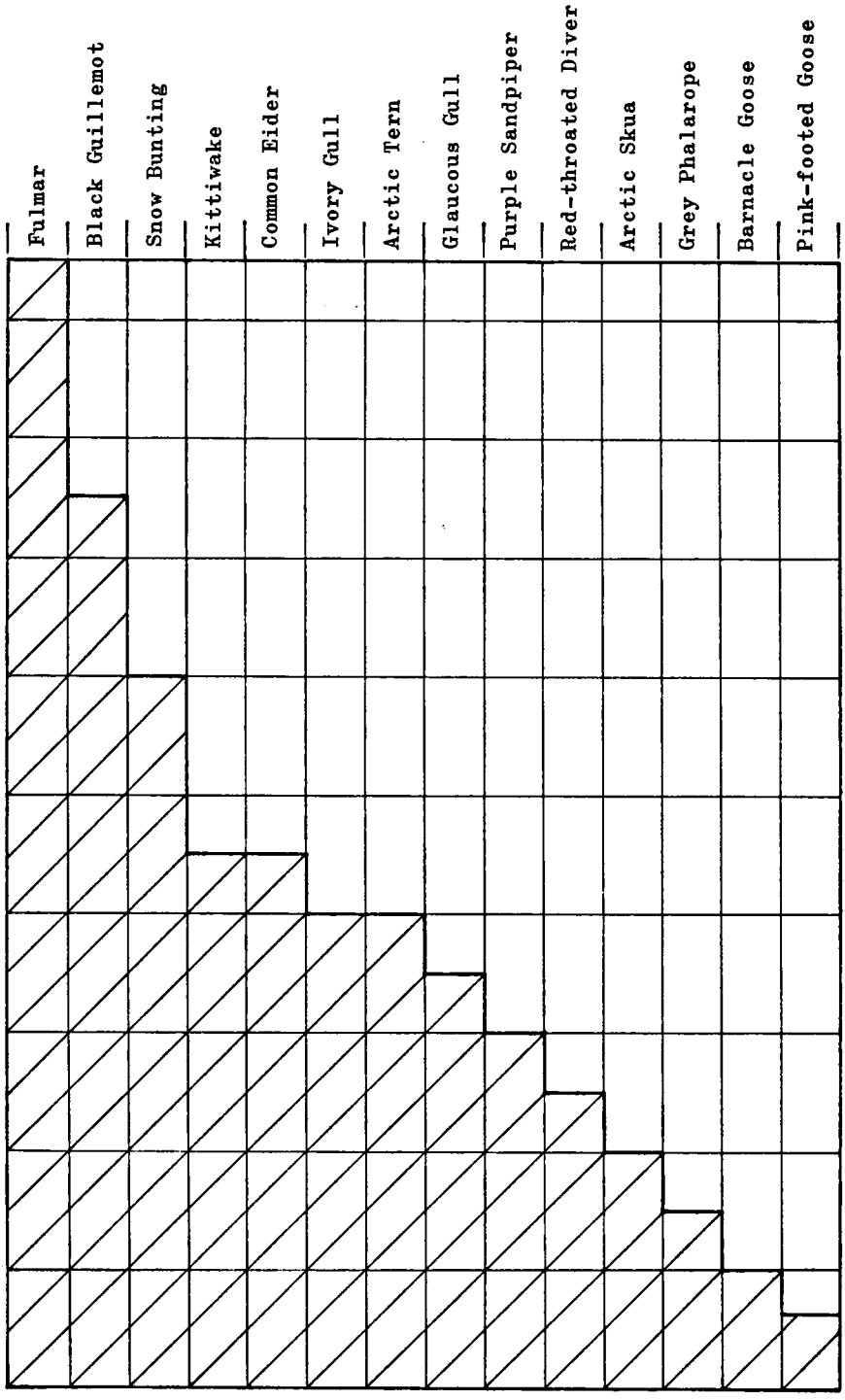

FIG. 43. Pre-nesting period of 14 bird-species in the Kapp Lee area in 1969.

Eider, Red-throated Diver, Arctic Skua, Grey Phalarope, Arctic Tern (furthest migration).

d. Migratory land-birds: Snow Bunting, Barnacle Goose, Pink-footed Goose, Brent Goose, Turnstone (furthest migration).

The border between category b and c is arbitrary, as Brünnich's Guillemots and Little Auks have been seen sometimes wintering in small numbers in Spitsbergen waters (Løvenskiold, 1963; Norderhaug, 1967).

The well-known Altman rule, stating that the shorter the distance between the breeding and wintering grounds, the earlier and more protracted the arrival, and vice versa (Belopolskii, 1957), is well illustrated by our sea-bird species; the Black Guillemot and the Arctic Tern being the extremes.

Pre-nesting period and spring behaviour in the Kapp Lee area.

The pre-nesting period is defined as the time between the appearance of the first individuals at a specific breeding ground and the laying of their first eggs (Belopolskii, 1957). In the birds studied in Spitsbergen the pre-nesting periods varied considerably (figs. 42, 43). In the early arrivals it was generally longer than in the late ones, the latter finding more favourable conditions immediately upon arrival. The Arctic Tern is clearly an exception to this rule as its pre-nesting period was even longer than that of the Glaucous Gull (fig. 43) which had arrived two months earlier and which was the first of all species to start egg-laying (fig. 42). In this case the Arctic Terns were prevented from egg-laying by the Arctic Foxes, which had easy access to the breeding places over the ice until the middle of July (see 22. *Sterna paradisaea*).

As a rule retarded arrivals postpone the beginning of egg-laying and at the same time shorten the pre-nesting period (Belopolskii, 1957). When we compare our dates of arrival and lengths of pre-nesting periods with those given by Belopolskii (1957) for Frans Josef Land (Black Guillemot, Ivory Gull, Little Auk, Glaucous Gull, Common Eider, Fulmar) we find that in Frans Josef Land the arrival time was earlier and the pre-nesting period longer than at Kapp Lee. The Fulmar, however, was an exception, generally arriving in Frans Josef Land as late as the first half of April and showing there a pre-nesting period of only about 30 days.

In the geese we find very short pre-nesting periods (fig. 43). They are paired upon arrival and in spite of their long migration they have retained a heavy fat layer and therefore can start egg-laying almost immediately. In addition geese do not pay prospecting visits to the breeding places to any extent, as do several early arriving sea-birds.

The pre-nesting periods given in fig. 43 are only approximate and vary annually (Belopolskii, 1957; Løvenskiold, 1963). But, however much this period may differ, it cannot be extended far into the summer, for there is little time left for the reproductive cycle to be completed before the onset of winter. Whenever a species is forced by bad environmental condition to prolong its pre-nesting period, this may result in no breeding that year at all.

Sammendrag

Fugler observert og innsamlet av den Nederlandske Svalbardekspedisjon i 1967 og 1968—'69.

Det foreliggende arbeid behandler vesentlig fuglelivet på Edgeøyas nordre del, der den nederlandske ekspedisjonen arbeidet i tretten måneder. I tillegg omtales endel observasjoner fra Hornsund (Vest-Spitsbergen), Kvalpynten (Edgeøya) og Hopen.

Artikkelen omfatter data vedrørende vekt, ernæring, fjærskifte, fjærdrakt og fenologi, samt mål av de innsamlede individer. Spesiell oppmerksomhet er viet *Gavia stellata* (taksonomi), *Fulmarus glacialis* (farge-faser), *Branta leucopsis* (hekkeforhold), *Stercorarius parasiticus* og *Stercorarius pomarinus* (fjaerdrakt), *Sterna paradisaea* (hekkeforhold), *Cepphus grylle* (fenologi), og *Plectrophenax nivalis* (taksonomi).

РЕЗЮМЕ

Птицы, исследованные и собранные „Голландской экспедицией в Шпицберген" в западном и восточном Шпицбергене в 1967 и 1968-69гг.

Статья главным образом относится к птицам северной части о. Эдж, где голландская экспедиция провела 13 месяцев подряд. Кроме того автор дает и сведения из Хорсунна, м. Квальютена и о. Надежды, где члены экспедиции тоже побывали. Автор дает данные о весе, о питании птиц, о линьке, об оперении и о фенологии как и о размере собранных экземпляров. Особенное внимание уделено таксономин Краснозобой Гагары (*Gavia stellata*), цветовым фазам Атлантического глупыша (*Fulmarus glacialis*), гнездовому поведению Бепощекой Казарки (*Branta leucopsis*), оперению Поморника (*Stercorarius parasiticus*) и Средного Поморника (*Stercorarius pomarinus*), гнездовому поведению Полярной Крачки (*Sterna paradisaea*), фенологии Обыкн. Чустика (*Cepphus grylle*) и таксономии Пуночки (*Plectrophenax nivalis*).

Acknowledgements

The author is much indebted to Miss B. Plesch (Amsterdam) for kindly correcting the English, to Mrs. T. Steenhart (Amsterdam) for drawing some of the figures, to Prof. Dr. L. Vlijm (Vrije Universiteit, Amsterdam) for reading the manuscript and to Prof. Dr. K. H. Voous (Vrije Universiteit, Amsterdam) for his wise counsel. Finally I would like to thank Dr. J. Wattel (Zoölogisch Museum, Amsterdam) for his constant support, which was invaluable during the preparation of the typescript.

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