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RESULTS FROM SCIENTIFIC CRUISES TO FRANZ JOSEF LAND

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Cover photo by Ian Gjertz:
R/V POMOR at Hooker Island, Franz Josef Land

INTRODUCTION

In 1992 the Norwegian Polar Institute published its first report, (Environmental studies from Franz Josef Land, with emphasis on Tikhaia Bay, Hooker Island, *Norsk Polarinstitutt Meddelelser 120*), from the joint Russian-Norwegian-Polish cooperation in Franz Josef Land. This cooperation has continued and more results are presented in this issue.

The cooperative parties are Murmansk Marine Biological Institute (Russia), Institute of Oceanology (Gdansk, Poland) and the Norwegian Polar Institute (Oslo). Many people have so far taken part in this cooperation, but two persons deserve special mention. If it had not been for the efforts of Professor Gennady Matishov (Murmansk) and dr. Jan Marcin Weslawski (Gdansk) it is doubtfull if this cooperation had existed.

The topics presented in this issue are:

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Walrus studies in the Franz Josef Land archipelago during August 1992

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Introduction

The Norwegian Polar Institute has carried out walrus studies in the Svalbard archipelago since 1989. These studies show that some male walruses migrate between Svalbard and Franz Josef Land (Gjertz & Wiig 1993). There are indications that the two areas are populated by a common population of walruses, and that geographical segregation occurs between the sexes (Gjertz & Wiig 1993). This is based on the fact that mostly males are observed within Svalbard. Females and calves have, however, been observed in larger numbers around Kvitøya in the northeastern part of Svalbard (Gjertz & Wiig 1993.). On the other hand, the literature indicates that observations of females with calves are common in the Franz Josef Land archipelago (Gjertz *et al.* 1992).

Since the beginning of the 1930's, Franz Josef Land has, for military reasons, been more or less closed to foreigners. This together with adverse ice conditions during most of the year, explains why we know very little about walruses in the Franz Josef Land archipelago.

This report gives results from the 1992 joint Russian-Norwegian-Polish expedition to Fanz Josef Land, where biologists from the Norwegian Polar Institute deployed 5 satellite transmitters on walruses, and surveyed walruses in the archipelago.

Material and methods

In the period between 14. August and 5. September the southern and eastern parts of the Franz Josef Land archipelago were surveyed. This was mainly conducted from the Russian vessel "Pomor" and partly from Zodiacs.

The survey area is indicated in Figure 1 and Figures 2 A & 2B. As Pomor is not registered for going in ice, we were restricted to open water and loose drift ice. Due to few qualified observers and long periods with hard work from Zodiacs, transit between working areas was not always utilized for systematical observations. Observations were intensified only in potential walrus feeding areas, with depths less than 100 meters, where we hoped to find walruses that could be immobilized when hauled-out.

For immobilization of walruses, we were especially searching for terrestrial haul-out sites. All potential terrestrial haul out sites mentioned in the literature (Gjertz *et al*. 1992) and which could be reached with Pomor or by Zodiacs were therefore investigated. Figure 2A & 2B shows localities that were investigated.

When walruses were observed in the water, or if a hauled-out walruses had tusks too small for attachment of a satellite transmitter or were otherwise unsuitable for immobilization, we tryed to collect a skin biopsy for analyses of environmental pollutants and DNA analyses. This was done using a cross-bow with special arrows attached to a line so they could be reeled in. The samples were wrapped in aluminium foil and put in a sealed container, and frozen within a few hours.

For immobilization of walruses we used the method described by Born & Knutsen (1990) and Griffiths *et al*. (1993), using the agonist Ethorphine HCI (9.8 mg/ml) and the antagonist Diprenorphine HCI (12 mg/ml). The agonist was injected intramuscularly from a CO2 powered dart gun (Dan-inject), at distances between 15 to 35 meters. A second gun loaded with antagonist was kept ready if the animal escaped into water. Normally the antagonist was injected immediately after approaching the animal, in order to reduce the apneautic period. This injection was preferably done sublingually. A small dose of antidote was injected subcutanously, in order to prevent renarcotication from potential unmetabolized depots of Etorphine HCI, before leaving the animal.

Time of first effect, loss of breath (apnea) and safe immobilization, as well as times of injection of Diprenorphine HCI and times of first breath and the regaining of mobility, were recorded. In addition indicators of physiological condition , such as breathing rate, heart-beat rate and response to pain, were recorded during immobilization. Due to malfunction of the thermometer, rectal temperatures were not recorded.

Handling of the immobilized animal was given the following priority: A file was used to make small grooves in the tusks where the steel band (Band-it, Houdaille, Denver) for attachment of the transmitter should fit. The satellite transmitter was attached. Flipper tags were attached to both hind flippers. Standard body length and axillary girth were measured. If the animal was laying on its side or on the belly, standard length was estimated. If possible, axillary girth was measured using a strong nylon string placed round the animal. Length (along frontal curvature) and circumference of the tusks at gum line were also measured.

Results

Immobilization

A total of 5 adult walruses (No's 2, 3, 4, 7 and 8) were successfully immobilized during this study (Tables 1 and 2). Each of the animals received a satellite

transmitter. Three other adult females, all accompanied by calves, were also immobilized, but woke up before transmitters could be attached. These animals received similar doses of anesthetic relative to animals that were successfully immobilized (Tab. 2). The one female that was successfully immobilized (No. 7), differed from the other females in that she was immobilized immediately after hauling, and in that she was not accompanied by calves or other animals.

Of the total 8 animals captured, only one was hauled-out on land when immobilized, the rest of the animals were hauled-out on ice floes.

All animals immobilized in this study made satisfactory recoveries and no irregular symptoms were observed in the period after regaining mobility.

Animal No. 1, an adult female accompanied by a 2 year old calf, appeared calm and reacted little to our presence before immobilization. A dart with salt water did not provoke the animals into the water. However, when the dart with anaesthetic was fired, they immediately escaped into water when hit. A dart with antidote was fired immediately after, but did not hit the animal. The animals dove and surfaced 100 meter away after about 3 minutes. Then the animal was a characteristic state of tonus in its back, its head was submerged, it was not breathing and hence strongly affected by the drug (Born & Knutsen 1990). A second attempt to inject antidote was done by a hand held syringe. However, due to difficulties in injecting the drug into its shaking muscles and the difficult position of the animal, only an unknown amount of drug was injected. Now the animal was pulled by its back flippers to a close by ice floe, its tusks were lifted up onto the ice, and the animal sublingually received a proper dose of antidote . After 6 minutes the animal opened its eyes and started to breath regularly. The accompanying young had all the time been barking and tryed to push its mother into the sea. After another 4 minutes, the two went into the water and dove powerfully. Thee minutes later they came up some 50 meters away and the female hauled out on to a ice floe. She was then breathing deeply with no irregularities. After another 10 minutes she took off again, swimming and diving, and appeared healthy for the next two hours while we were able to observe them .

Animal No. 2, a large adult male, hauled out on a ice floe, was shot from a distance of about 30 meters. However, only 4 cm of the dart needle was inserted, and the drug had most likely been injected into fatty tissue. The animal achieved satisfactory anesthesia after about 28 minutes, but woke up after another 8 minutes. Due to risks of anesthetic depots and renarcotication, a large amount of antidote was given, some of it in fatty tissue in order to slow down the absorption.

Animals No. 3, 4, 6 & 8 all males apart from #6 an adult female,

were immobilized without any irregularities and recovered normally.

Animals No. 5 & 7 adult females accompanied by calves, and part of a social group of walruses, both woke up and went into water during assumed deep immobilization. Attempts to attach satellite transmitters had to be aborted. No. 5 hauled out again on an icefloe close by, where it fell back into a drowsy light immobilization, but could not be worked on. Two hours after it was still hauled-out but appeared alert and fully able to perform coordinated movements. No. 7 stayed in the water, but was resting with its tusks hooked on to a ice floe. 24 hours later the animal was observed some hundred meters away laying in shallow water by the beach of Appolonoff Island. The animal was fully mobile, but appeared very drowsy and still affected by the drug treatment.

Attachment of transmitters

Animal No's 2,3,4,6 and 8 all received satellite transmitters (Tab. 1). No's 4 and 6 received circular ST-6 transmitters, while the other ones were of the older ST-3 type (Tab. 1). In order to improve the attachment, polyurethan (Sikaflex) was used between the transmitter and the tusk in all animals.

Walrus observations

A total of 420 walrus observations were made during the expedition. Of these, 174 were swimming, 203 were hauled-out on ice, while only 43 were hauled-out on land (Appolonoff Island).

In a total of 359 observations where age and sex could be estimated, 13 % (n=47) were calves of the year or 1 year old (no visible tusks), 16 % (n=56) were juvenile (2,5 - 7,5 cm tusks), 33 % (n=119) were subadults (10 - 20 cm), 23 % (n=82) were adult females, and 15 % (n=55) were adult males (Tab. 3).

Observations were made in four main areas and almost no walruses were observed in areas between. These areas are: around Hooker Island in the central part of the archpelago, around Cape Flora at Northbrook Island in the southern part, the area around Hayes Island in the east, and in the northeast around the islands of Kuna and Appolonoff (Fig 2a & b). Table 3 gives the highest number of walruses observed during one survey in each of the areas, and represents a minimum estimate.

The northern parts of the archipelago, along with the western parts around Alexandra Land, were not accessible due to ice conditions. Areas checked for tracks or signs after terrestrial haul-out activity are indicated in Fig. 2A & 2B.

In the area around Cape Flora, Gunter Inlet and along the southern coast of Northbrook Island there was open water and only occasional ice floes during our three visits. A relatively large number of walruses were observed feeding in the area. Adult females with calves appeared to dominate. The highest minimum of animals

observed during one survey in the area was 49 individuals (Tab. 3). A terrestrial haul-out site has been reported in Gunter Inlet on Northbrook Island (Gjertz *et al.*, 1992). When inspected, we found a beach blocked by ice and saw no animals. However, we found very old skeleton parts from about 10 animals, old tracks and excrements apparently from last year.

Few walruses were observed in the area east of Hayes Island. Two adult males (No. 3 and 4) were immobilized in the area. The old haul-out site at the Komsomol Island (Gjertz *et al.* 1992) were inspected, but due to land ice along the entire coast, no beach was accessible. The crew at Hayes Island meteorological station did not know about this haul-out site, but reported that in August of 1991 about 10 walruses had been hauled out on the beach of a small island some hundred meters from the station. This beach was covered by ice during our stay and no walruses were seen. Fresh tracks from walruses were seen on the beach close to a hunters cabin at the south-western tip of Wiener-Neustadt Island on 20. August 1992 (Jon Opheim pers. comm.). When inspected on 27. August, snow was covering the beach and no signs of walruses were seen.

The sound between Kuna Island and Kane Island, appeared to be a favoured spot for walruses. The highest number observed during one survey was 38 individuals on 22. August (Tab. 3). Other potential haul-out beaches were present in the area, but more or less covered by ice. The most remarkable observation during this expedition was done on 29. and 30. August, when about 212 walruses were observed in the area of Appolonoff Island, just 5 nm north of Kuna Island. Most of the walruses were hauled-out on ice floes around the beach at the north tip of the island. Only 43 animals were hauled-out on the beach and about 25 were observed swimming.

Skin biopsy samples
A total of 38 skin biopsy samples were collected from walruses during this study. Samples were taken from both hauled-out and swimming animals.

Discussion

Due to the apneutic effect of Etorphine on walruses, the antidote Diprenorphine HCl has to be injected before handling of the animal can start. This initiates a state when the animals start to breath, but still are immobilized and safe to handle (Born & Knutsen 1990, Griffiths *et al.* 1993).

The immobilizations of 4 male walruses in this study were done without major problems. As far as I know, no other study has yet reported results on immobilizing of adult females in the field. According to my experience, such work may be connected with complications. Of the 4 females immobilized, 3 woke up shortly after injection of Diprenorphine, and never went into a state when they could be safely worked on. The fourth female however, was workable long enough to attach a satellite transmitter. All animals

were exposed to the same drugging routine, and I suggest that the stress caused by barking calves and surrounding animals has stimulated the three females to wake up. This is supported by the fact that all 5 animals (4 males + 1 female) which were successfully immobilized, were not socially established in a group or accompanied by calves, and hence not exposed to communicating sounds that might trigger their flight or fright response. It is known from the literature that animals immobilized with Etorphine, which are heavily stressed, may be stimulated to wake up (Ebedes 1975).

In this study, all but one animal was hauled-out on ice when immobilized. When on ice, the animals more easily can enter the water before being totally immobilized and potentially drown. Working space on a floe is often limited and normally the dart has to be fired from a moving boat. Hence, I consider ice floes as being a less favorable working platforms compared to beaches.

The relatively long and thick tusks in males are a much better medium to attach satellite transmitters relative to the thinner tusks of females. I think that both types of transmitters used in this study have to be modified when being used on the thinner tusks of females. In order to increase the friction area between the tusk and the transmitter, I prefered the old ST-3 transmitter which are somewhat more ergometrical shaped than the circular ST-6.

The surveys in this study were not performed systematically, but I believe the concentrations of walruses shown in Figures 2A & 2B, are representative for the area.

The sex and age distribution in Table 3 are all estimated numbers based on tusk sizes and body characteristics. These figures support the theory that females and calves are numerous in Franz Josef Land. However, the observed fraction of adult males does not diverge significantly from what could be expected in an isolated population. The general patchy distribution and relatively few observations of walruses in this study make this speculative.

Of the 6 terrestrial haul-out sites indicated for Franz Josef Land in the literature (Gjertz *et al*. 1992), 2 were visited without result during this study (Fig. 2A & 2B). I believe this may be caused by ice blocking the beaches and thereby making them inaccessible to the walruses. The summer of 1992 was regarded as being particularly cold. Almost no ice was blocking the beach of Appolonoff Island where hauled-out walruses were found (Fig. 2b).

According to maps, the areas north of Appolonoff Island consist of large shallow sea banks, and should hence be a potential feeding ground for walruses. Based on droppings, tracks and wear at the beach, I believe Appolonoff Island functions as an important haul-out ground for walruses in the area.

Summary

Five walruses were immobilized successfully and received satellite transmitters. Three additional female walruses woke up during immobilization before transmitters could be attached possibly due to the influece of calves and other accompanying walruses. A total of 420 walruses observations were made, however 315 individuals represent the sum of highest single count within each of the areas. As a total, the distribution between sexes and age classes did not appear to differ from what could be expected in an isolated population. A haul-out site was discovered at Appolonoff Island, in the northeastern part of the archipelago. A total of 212 walruses, mostly females, subadults and calves, were seen either on the beach or on ice floes in the vicinity of the beach.

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Table 1:

Informations of markings and physical dimensions of Atlantic walruses immobilized in Franz Josef Land (Russia) during August 1992.

Date 1992	No.	PTT no.	Type PTT	Pos. of PTT (R/L tusk)	Flipper tag no. Right	Flipper tag no. Left	Sex (F/M)	Body Length (cm)	Body Ax. girth (cm)	Tusk Length (cm) Right	Tusk Length (cm) Left	Tusk Circumf. (cm) Right	Tusk Circumf. (cm) Left
19. Aug.	1	-		-	-	-	F	260*	-	38*	38*	14*	14*
19. Aug.	2	14755	ST3	R	3422	-	M	330*	-	50.5	51	22.5	20.0
20. Aug.	3	14756	ST3	L	3423	3424	M	324	-	39	39	-	-
21. Aug.	4	14752	ST6	L	3425	3426	M	325	-	37,5	34	20.5	21.0
29. Aug.	5	-		-	-	-	F	-	-	40*	40*	15*	15*
30. Aug.	6	14753	ST6	L	3427	3428	F	278	268	37	38	12.5	12.5
30. Aug.	7	-		-	-	-	F	-	-	38*	40*	15*	15*
30. Aug.	8	14754	ST3	L	3429	3430	M	314	347	32	38	19	19

*: values are estimated.

Table 2:

Dose size of Etorphine HCl and the antidote Diprenorphine HCl, and times of injection and effects during immobilization of 8 Atlantic walruses in Franz Josef Land in August 1992.

ID code	Etorphine HCl (I.M. mg)	Effect (min:sec) after inj. of Etor.			Dipren. HCl (I.M. mg)	Site of injection	Time of inj. after Etorph.	Effect (min:sec) after inj. of Etor..		
		First effect	Safe	Apnea				First effect	Breathing	Mobile
1	8	3:00	4:00	3:00	13.2	Miss	0:10	16:00	17:00	21:00
					13.2 Δ	Middle back	5:00			
					13.2	Subling.	11:00			
2	10*	17:40	28:00	22:28	14.4	Bounced off	15:00	35:00	40:00	36:00
					14.4	Middle hip	25:30			
					12	Sublingual	31:00			
					6	Skin	40:00			
3	7	4:00	5:30	6:00	13.2	Sublingual	9:00	17:00	23:00	52:00
					3.6	Skin	12:00			
					4.8	Skin	59:00			
4	7	3:34	5.00	4:50	13.2	Sublingual	8:00	14:50	15:30	1:52:00
					8.4	Sublingual	59:00			
5	6	4:56	5:06	5:00	8.4	Sublingual	9:14	12:00	16:00	12:00
					9	Sublingual	15:07			
6	7	1:15	3:00	3:00	12	Sublingual	8:00	14:00	25:26	37:00
					6	Sublingual	24:50			
					2.4	Skin	1:30:00			
7	7	4:00	4:00	4:00	10.8	Sublingual	11:30	16:00	22:00	19:00
					6	Sublingual	18:00			
8	7	4:17	5:00	5:00	12	Sublingual	10:50	17:40	18:30	1:00:00
					4.8	Skin	1:05:00			

*: Dose propably injected into fatty tissue

Δ: Unknown amount was injeceted.

Table 3:

Highest count of walruses during one survey within each of the areas (Highest single count) and estimated sex and age distribution of total observations (X) . X represent all observations where age and sex were estimated. Percental values are given as percent of X.

Area	Highest single count	Estimated sex and age distribution of X					
		Baby (Δ) 0 cm	JUV. 2,5-7,5cm	SUBAD. 10-20cm	ADULTS: Females	Males	Total sum X
Hooker Island	12	1 (6%)	6 (38%)	2 (12%)	2 (12%)	5 (32%)	16
Northbrook Island	49	11 (17%)	4 (6%)	17 (27%)	18 (29%)	13 (21%)	63
Hayes Island	4	0 (0%)	0 (0%)	2 (40%)	0 (0%)	3 (60%)	5
Kuna Island	38	3 (5%)	6 (10%)	26 (41%)	9 (14%)	19 (30%)	63
Appolonoff Island	212	32 (15%)	40 (19%)	72 (34%)	53 (25%)	15 (7%)	212
Total	315	47 (13%)	56 (16%)	119 (33%)	82 (23%)	55 (15%)	359

*: Walruses occured in large groups and sex and age disrtribution could only be estimated.

Δ: Due to some problems in differing between 0 and 1 year old youngs they are grouped in one group.

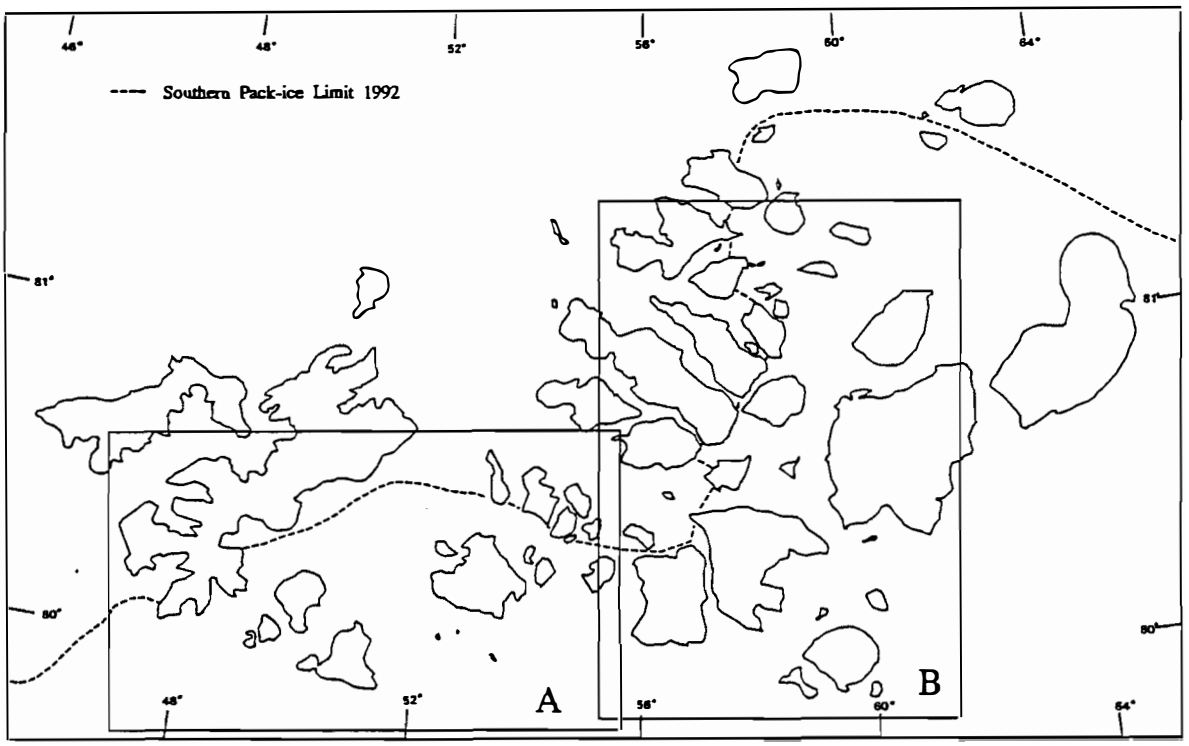
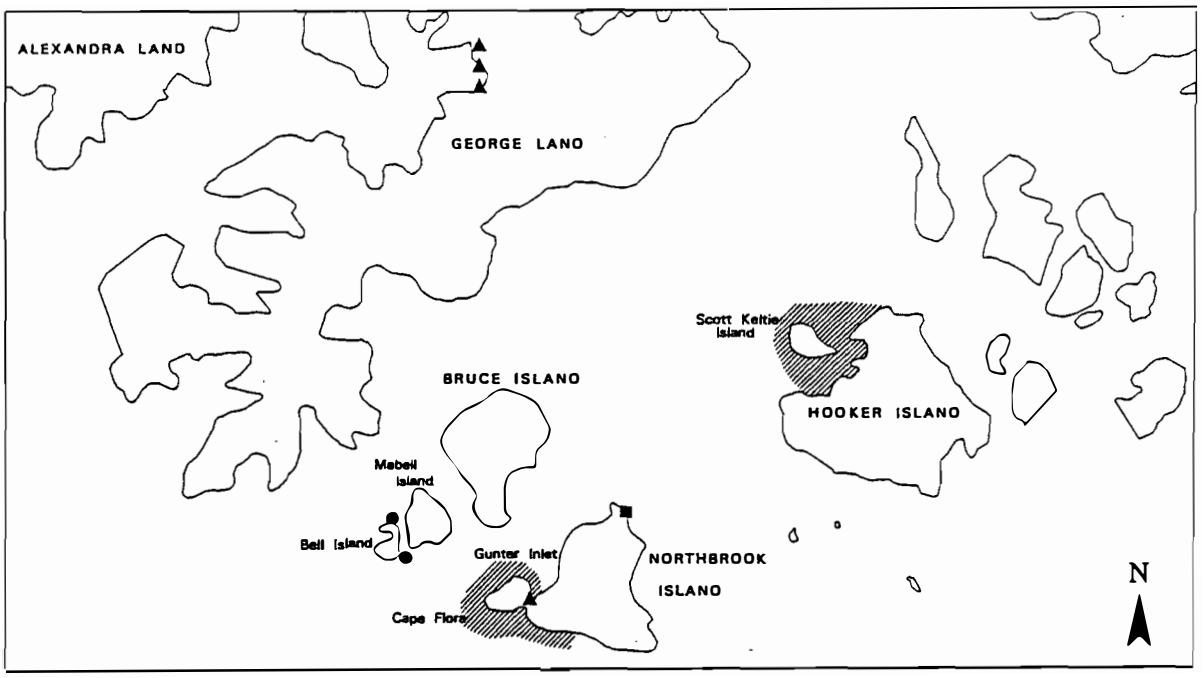
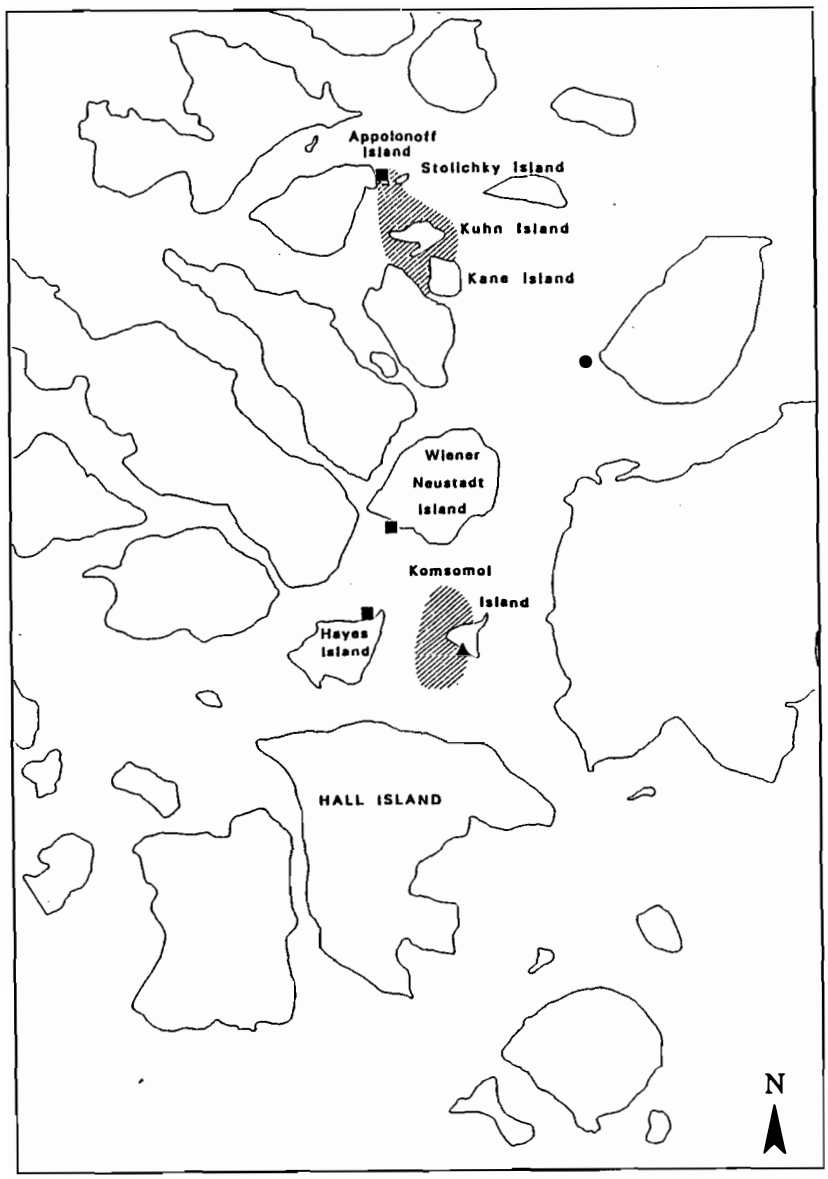


Figure 1: Reference map of Franz Josef Land with the approximate ice limit (according to satellite map and local observations). Area A and B refer to Figures 2A and 2B.



A



B

Figure 2A & 2B: Detailed maps of areas surveyed for walruses.Observations from shaded areas are given in Table 3.

Dots indicate single walrus observations.

Squares denote potential terrestrial haul-out grounds that were checked during the survey.

Triangles denote haul-out grounds reported in Gjertz *et al.* (1992).

Ornithological Notes from Franz Josef Land, Russia, Summers 1991 and 1992.

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Three members of the Norwegian Ornithological Society participated on three different cruises to Franz Josef Land in August-September 1991 and 1992, in order to search for seabird colonies suitable for future monitoring. This note describes all seabird colonies visited and also all bird species observed. The Great Skua *Stercorarius skua* and the Puffin *Fratercula arctica* were found for the first time at Franz Josef Land and the Pomarine Skua *Stercorarius pomarinus* was found breeding for the first time.

Three different cruises to Franz Josef Land.

B. Frantzen participated on the cruise with the Russian ship "Pomor" 24. august to 3. September 1991., with departure and arrival from Longyearbyen, Svalbard. Frantzen was a guest of Murmansk Marine Biological Institute (MMBI). H. Strøm participated on a cruise with the same ship between 11. august and 8. September 1992, also from Longyearbyen, as a member of the Norwegian Polar Institute's biological team. J. Opheim participated on the third cruise, on which the MMBI's ship "Dalnie Zelentsy" was used. This cruise departed from Murmansk 15. August 1992 arriving back in Murmansk 5. September 1992. Ice conditions in Franz Josef Land are severe and ships with low ice classification are only able to work in the area for a short period, normally from medio august and a month or more. The ornithological work had low priority on the cruises, and seabird colonies could only be visited in combination with work of higher priority.

The seabird cliffs in Franz Josef Land.

The archipelago is poorly studied and only a few ornithological expeditions have been undertaken. during the last hundred years. The ornithofauna of Franz Josef Land is therefore inadequately mapped. There are many seabird colonies in the archipelago, but only some of these have been studied.

The maps over seabird cliffs in Franz Josef Land (Table 1, Figures 1A & 1B) (see also Uspenskij & Tomkovitch 1986) only indicate some of the bird cliffs in Franz Josef Land. If flat and stony islands are excluded, it is our experience that most islands have one or more

seabird cliffs. These colonies are predominantly small, i.e. probably less than 100 birds.

The Brünnich's Guillemot *Uria lomvia* and Kittiwake *Rissa tridactyla* are linked to the open waters in the south and are less common in the north. Their colonies are small compared to the colonies in Svalbard and Novaya Semlja. The Black Guillemot *Cepphus grylle* and the Little Auk *Alle alle* are found throughout the whole archipelago and the latter are numerous (Norderhaug *et al.* 1977). It is possible that an important part of the Barents Sea population of little auks breed in Franz Josef Land.

In total, 15 seabird colonies were visited (Table 3). Often we only had from 10 minutes to a couple of hours at each colony. We therefore only had time for making simple estimates at the sites visited. All counts were conducted from land using binoculars.

Future monitoring and ringing
None of the cliffs visited are of such a construction that all the breeding species were accessible. The cliffs are steep and filled with loose stones. Working in such places may therefore be dangerous. We have listed the locations were monitoring and ringing could be carried out quite easily (Tab. 2). The little auk is the only species that in general is easily accessible.

The Bird Species Observed

In total, 22 species were observed, of which two were new for the archipelago (Great Skua and Puffin), and one was new breeding species (Pomerine Skua).

Red-throated diver *Gavia Stellata*
One pair was observed in a small lake on Klagenfurt Island and two pairs were seen at two different small lakes on SW Wilczek Island 24.08.92.

Fulmar *Fulmarus glacialis*
A very common bird on the open sea and also north in the sounds between the islands. Of the 225 Fulmars that were counted at sea, 96 were dark phased. Fulmars probably bred at seven of the visited seabird cliffs, and the northernmost of these was at Brosh Island.

Goose sp. *Anser sp*
We observed excrement and tracks from geese in the vegetation under the bird cliffs on NE Wilczek Island 29.08.91, and on Klagenfurt Island 24.08.92

Pink-footed Goose *Anser brachyrhynchus*
One individual was observed at a freshwater pond at Cape Flora 16.08.92. Some days later one individual was observed at Rubini Rock (J.M. Weslawski pers. comm.).

Brent Goose *Branta bernicla*
One individual at Wiener-Neustadt Island 27.08.92

Eider *Somateria molissima*
Three females with 10 big young were observed on NE Wilczek Island 29.08.91. Three females with 17 young were observed at Kane Island 28.08.92. Three old nests and

60-70 adult eiders (only one adult male) were observed at Etteridge Island 18.08.92. Two old nests were found and two females were also observed on the northern side of the island 30.08.92. At Komsomol Island 34 adult females and one male were observed 20.08.92. Two females were observed at northern Kuna Island 22.08.92, and on female at SW Wilczek Island 24.08.92.

Purple Sandpiper *Calidris maritima*
Single individuals were found at five different locations. On Komsomol Island 15 individuals were observed 20.08.92, and at Cape Flora four individuals were observed 26.08.91. They were feeding both in fresh and in sea water. One alarming bird was observed at Cape Flora 26.08.91.

Great Skua *Stercorarius skua*
One individual was observed at Tikhaia Bay, Hooker Island 30.08.91. Had also been seen two times the week before (I. Gjertz pers.comm.) These are the first observations of Great Skua from Franz Josef Land (Frantzen 1992). One individual was mobbed by Pomarine Skuas at Komsomol Island 20.08.92.

Pomarine Skua *Stercorarius pomarinus*
At NE Wilczek Island the Pomarine Skua was found breeding 29.08.92. About 40 adult birds and six already flying young were observed in an inland area free from vegetation, covered by sand and a flat glacier. The birds were found at small lakes or ponds. Some of the birds were aggressive towards other pomarines (Frantzen 1992). Breeding outside lemming (*Lemmus lemmus)* areas is only known once before, from Tusenøyane on Svalbard. Both the Pomarine Skua and the Long-tailed Skua.

The pomarines were quite common as single birds or small flocks up to five individuals were found at ten of the visited localities. Pomarine Skuas were less common than the Arctic Skua in Franz Josef Land.

Arctic Skua *Stercorarius parasiticus*
Single birds or small flocks (2-4 individuals) seen at most of the localities. At the northernmost location, Stolichky Island, eight individuals were observed 22.08.92. One pair with two young were observed at Bell Island 26.08.91. The most common of the skua species on Franz Josef Land.

Long-tailed Skua *Stercorarius skua*
Some individuals were observed at sea south of Franz Josef Land, but not in the archipelago.

Glaucous Gull *Larus hyperboreus*
Often breeding in or near bird cliffs. Single birds or small flocks were observed all over the visited area, also at sea.

Ross's Gull *Rhodostethia rosea*
Five adult birds were observed at Wiener-Neustadt Island 27.08.92, and three 2K birds were observed feeding together with Arctic Terns (*Sterna paradisaea*) and Kittiwakes in the sound between Stolichky and Pajera Islands 30.08.92.

Ivory Gull *Pagophila eburnea*
Were seen as soon as we came close to the ice. Singles and flocks, up to three individuals, were seen occasionally. At the Arctic station on Hayes Island 10-20 birds were feeding on garbage from the enormous waste dump. More than 10 pairs with flying young were observed here in late August 1991.

Kittiwake *Rissa tridactyla*
Observed at all visited localities. Both years the young left the nest in late August or early September.

Arctic Tern *Sterna paradisaea*
Found breeding on Bell and Wilczek Islands in 1991 and probably breeding on Etteridge Island in 1992. At Komsomol Island we observed many birds, and probably there was a big colony there. Observed regularly at sea and between the islands.

Brünnich's Guillemot *Uria lomvia*
Both years the young jumped from medio August to the first week of September. In September 1991 many young were killed in the drift ice south of Franz Josef Land when hard wind started to press the ice together. The adults jumped up on the ice, but most of the young were squeezed in the ice. For hours afterward wailing adults were heard sitting on the ice calling for their young. Small groups of guillemots were observed all the way between Svalbard and Franz Josef Land, and also between Novaja Semlja and Franz Josef Land.

Black Guillemot *Cepphus grylle*
Single birds and small flocks were observed at most of localities visited on Franz Josef Land, and also at sea.

Little Auk *Alle alle*
Common bird on Franz Josef Land. At Tikhaia Bay almost full grown chicks were observed 28.08.92. Also observed at sea between Svalbard and Franz Josef Land.

Puffin *Fratercula arctica*
One bird was observed flying near Cape Flora 16.08.92. This is the first observation of a Puffin at Franz Josef Land.

Snowy Owl *Nyctea scandiaca*
One individual was observed at Cape Flora 16.08.92, and three birds were seen at the same place on 26.08.92. One bird was observed in the bird cliff at Klagenfurt Island 24.08.92. Between Hooker and Northbrook Islands one individual was observed sitting on the ice 18. and 24.08.92. Feathers and pellets were found on Bell Island 23.08.92.

Redwing *Turdus iliacus*
One dead bird, probably from 1991, was found at Cape Flora 16.08.92.

Snow Bunting *Plectrophenax nivalis*
Observed on most localities that were visited in both years.

Acknowledgment
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Table 1: Seabird colonies visited on Franz Josef Land 1991-1992 (see Fig. 1A & 1B)

Colony name	Visitor[1]	Described in Uspenskij & Tomkovitch (1986)	Description
1. Cape Grant, George Land	HS	Yes	a bird cliff
2. Bell Island	BF	Yes	the area around the old house
3. Bell Island S	HS	No	a bird cliff
4. Cape Flora	BF,HS	Yes	
5. Etheridge Island	HS	Yes	two small, flat Islands
6. Tikhaia Bay, Hooker Island	BF,JO,HS	Yes	
7. Cape Albert Markam, Hooker Island	HS	Yes	
8. SW Wilczek Island	JO	Yes	an inland walk and a bird cliff
9. NE Wilczek Island	BF	No	an inland walk and a bird cliff
10. Cape Tegetthof, Hall Island	HS	No	
11. Klagenfurt Island	JO	No	an inland walk and a bird cliff
12. SSW Wilczek Land	JO	No	a kittiwake colony seen from Klagenfurt Island
13. WSW Wilczek	JO	Yes	bird cliff
14. Komsomol Island	HS	Yes	a small, flat island, invest. from from inflateable
15. Hays Island	BF,JO,HS	Yes	the area around the arctic station
16. S Champ Island	JO	Yes	bird cliff
17. SW Wiener-Neustadt	JO;HS	Yes	a beach and the surroundings
18. SW Kane Island	HS	No	a beach and the surroundings
19. Brosh Island	HS	No	bird cliff
20. Stolichky and Appolonoff Isls	HS	No	two rel. flat islands with a 30m cliff int the south, a walk and a bird cliff

1) BF - Bjørn Frantzen, JO - Jon Opheim, HS - Hallvard Strøm

Table 2. Bird cliffs suitable for monitoring and ringing

Colony name	Species accessible	Landing possibilities	Comments
16. S. Champ Island	Kittiwake	Good	Much ice in the fiord
1. Cape Grant	Little Auk	Uncertain	-
3. S. Bell Island	Little Auk	Good	-
4. Cape Flora	Little Auk	Good	-
7. Cape Albert Markham	Little Auk	Good	-
13. WSW Wilczek Land	Little Auk	Good	Very small
19. Brosh Island	Little Auk	Good	-

Table 3. Number of birds in seabird colonies on Franz Josef Land visited 1991 and 1992. Numbers are for individual birds.

Colony	Visited	Brünnich's Guillemot	Little Auk	Black Guillemot	Kittiwake	Glaucous Gull	Fulmar
1. Cape Grant	26.08.92	10.000	3.000	500	7.000	B	PB
3. S. Bell Island	23.08.92	8.000*	2-3.000	5-600	6.000	B	PB
4. Cape Flora	16.08.92	10-12.000					
6. Tikhaia Bay	14.08.92	see Skakuj 1992 for details on birds here					
7. Cape Albert Markham	15.08.92	some	nume-rous	nume-rous	some	PB	PB
8. SW Wilczek Isl.	24.08.92	-	-	25	-	B	-
9. NE Wilczek Isl.	29.08.91	-	-	-	100-1.000	B	-
10. Cape Tegetthof	20.08.92	-	500-700	100	-	15-20	PB
11. Klagenfurt Isl.	24.08.92	-	500-1000	>100	-	B	PB
12. SSW Wilczek Land	24.08.92	-	-	-	Numerous	-	-
13. WSW Wilczek Land	27.08.92	-	100	5	-	-	-
16. S. Champ Island	26.08.92	-	2	-	3-5.000	PB	PB
19. Brosh Island	22.08.92	-	1.000-1.100	100	1.100p	B	PB
20. Appolonoff Isl.	22.08.92	-	500-1000	100-200	-	-	-
20. Stolichky Isl.	22.08.92	-	2.000-3000	200-300	500	30-40	-

B - breeding, PB - probably breeding, * - most young already jumped

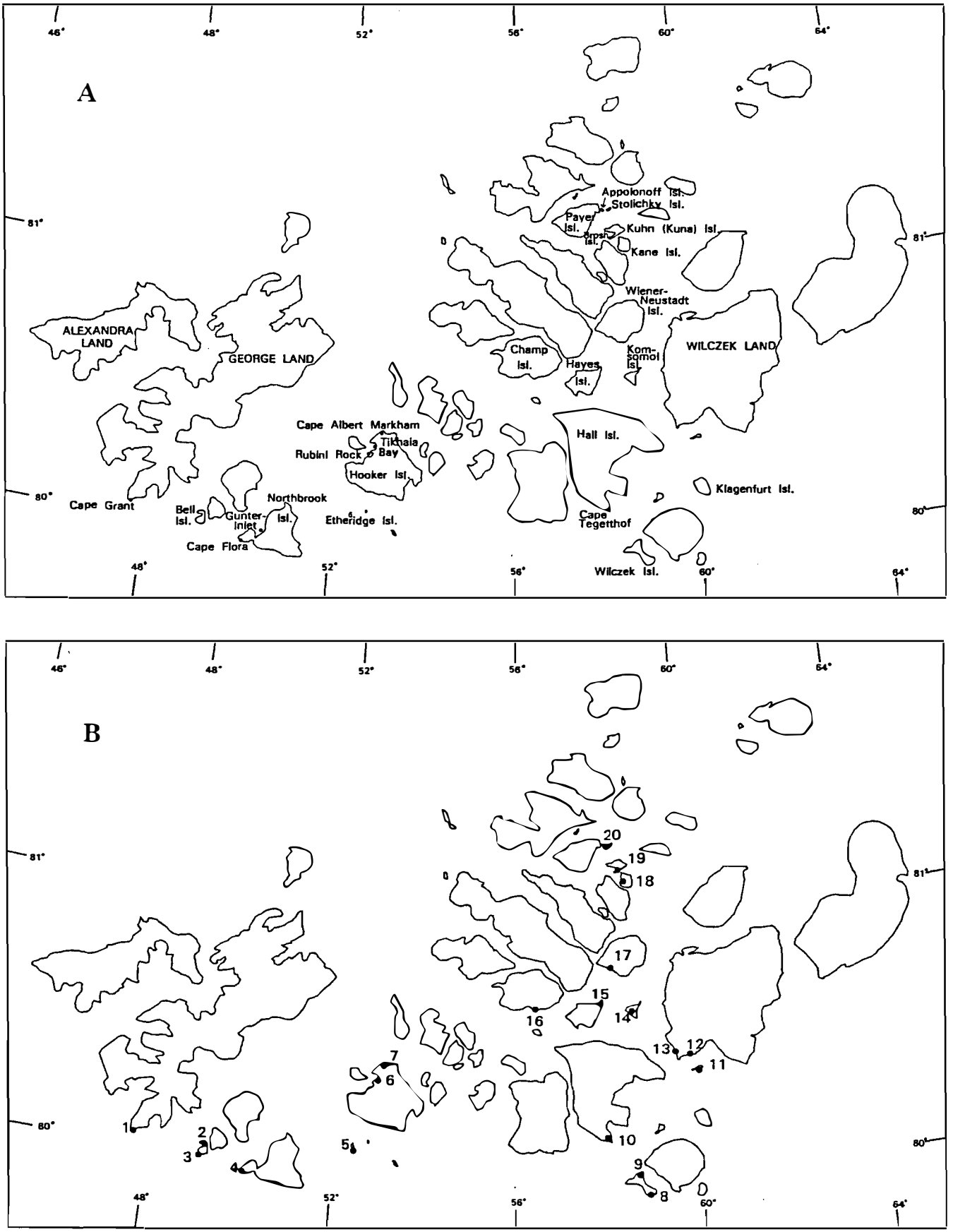

Figure 1 A & B: Map of Franz Josef Land with bird cliffs, listed in Table 1, indicated.

Snailfishes (Scorpaeniformes: Liparididae) from areas of Franz Josef Land, to the north of Svalbard and the adjacent continental slope

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The Northern parts of the Barents Sea have been poorly researched ichthyologically. In 1979-1984 ships from the Polar Institute of Fishery and Oceanography studied the regions nearest to the south of the Franz Josef Land, to the north of Svalbard and on continental slope between the two archipelagos. Preliminary ichthyological results have been published earlier (Borkin, 1983) and included a list of 33 fish species which have been found here. In this publication we present data of a detailed study of the snailfish family Liparidida. This group is difficult to study and poorly researched (Burke, 1930), intensive investigations have begun only in recent years (Stein 1978; Able & McAllister 1980; Andriashev 1986; Chernova 1988, 1991).

Material and methods

A total of 68 bottom -and 5 pelagic samples were collected from the research vessels "Varzuga" (September - October 1979), "Serebryanka" (August-September 1980) and "Georgievsk" (August - September 1984) using otter-trawls (mesh size 10-12 mm). Fish were collected by I.V. Borkin. Particular data on areas and hydrobiological conditions have been published earlier (Borkin, 1983).

Fish measurements were made according to standard methods (Able & McAllister 1980; Chernova 1991). The number of fin rays and vertebraes were counted on x-ray film. The coudal-fin ray formula (C) was done according to Stein (1978) and Andriashev (1986).

Results and discussion

There are snailfish of 7 species of 4 genera in our samples.

1. ***Liparis gibbus*** (Bean, 1881) - Dusky snailfish

Material: 4 specimens from 2 stations (Fig. 1).

Station 1: Northern part of the Barents Sea (79°57'N, 36°33'E) at a depth of 120 m, 2 specimens, total lengths (L) 139,0 and 88,5 mm.

Station 2: Svalbard (80°12'N, 17°07'E) at 280 m depth, on sand , mud, gravel bottom; 2 specimens, total lengths (L) 187,0 and 138,9 mm.

Dorsal-rays: 41, 43, Anal-rays: 35, 36, vertebraes 11+ (35, 37) = 46, 48, C 3+5, 5+1=14, *pyloric caeca* 30-34.

The colour is typical for the Spitsbergen-Barents Sea population, with small dark-brown spots on pale background fusioned in a net-like pattern.

2. ***Liparis fabricii*** (Kröyer, 1847) =*Liparis koefoedi* (Parr, 1932) - gelatinous snailfish.

Material: 680 specimens. from 54 stations (Fig. 2).

Counts (n=43): Dorsal-rays 43-49, frequently the first ray of dorsal fin is shorter (n=14); Anal-rays 37-40; vertebraes 10-11 (12) + 38-42 =49-53; more often C 2+4, 5+1=12: upper secondary rays 2-3, upper primary 4, lower primary 4-5, lower secondary 1-2. Frequency of distribution of Dorsal-fin and Anal-fin rays and vertebraes are given in Figures 1-3. *Pyloric caeca* 17-30 (Fig. 4).

Colour brownish-black, with 4-5 broad bands on the Dorsal and Anal fins. Small spots (less than eye diameter) on the tail part of the body fuse into a net-like pattern. The peritoneum is usually intensive black, but some specimens have this with a pale background, seen through densely placed melophores.

Males have total lengths (L) up to 159,0 mm, standard length (SL) 137,6 mm; Females - 147,5 mm L, 129,0 mm SL. Gonads are of the II-III stages of maturity. Male-female ratio is 5:4. The relation between the total and standard length is L=1,16 SL.

L. fabricii is the most common and numerous (often up to a few hundred specimens per trawl) snailfish in the area studied. It is found almost everywhere and caught at depths ranging from 70-600 m, most often at 200-400 m. In the most northerly trawl haul *L. fabricii* was caught at depths from 768-880 m. *L. fabricii* was found mainly on mud bottom with water temperature ranging from -0,8° to +1, 55°.

3. ***Careproctus reinhardti*** (Kröyer, 1862) - Reinhardt's tadpole

Material: 88 specimens. from 3 stations (Fig. 3).

Counts (32-39 x-ray photographs): Dorsal-rays 53-59, Anal-rays 48-53, vertebraes (9) 10-11 + 48-65; more often C 1+4, 5+1=11 (n=28), more rarely with 2 upper secondary rays (n=3). Usually the interneurale of the first Dorsal-ray is between 3rd and 4th neural spines (position III-IV), and there is one free interneurale (n=21). In a few cases the first Dorsal-ray is shorter and has position II-III (n=3).

Live specimens are uniform rose in colour, preserved specimens are colourless yellowish. All specimens, large and small alike, have small needle like prickles on the skin.

Females are larger than males: females lengths: 193,5 mm L and 174,0 mm SL; male lenghts: 177,0 mm L, 164,0 mm SL. The relationship between total and standard length is L= 1,2 SL (n=38, L 58-194 mm). The male-female ratio is 1:1. Gonads were of maturity stage II. The ovarium is double, closed with a central cavity. Females 100-164 mm in length (SL) have 1115-4200 oocytes of early trophoplasmatic stage with diameter of 0,3-1,7 mm.

There is no differentiation of the size groups among the oocytes, as is found later in the II-IV stages of maturity, therefore the data above only give an approximation of the fecundity.

Measurements of two size groups of this species are given in Table 1. The relative eye diameter and disk-anus distance decrease relative with increasing fish lengths, while the width and heigth of the head, the maximal heigth and heigth above the Anus, the preanal length and the distance from the anus-anal fin all increase. In most cases the length of the lower pectoral lobe increases: from 25,4 to 34% of SL.

Preliminary results show specimens 50 mm SL were 2 years old, Females 80-95 mm were 3 years old, 100-120 mm were 4 years, 135-140 mm were 5 years, 160-170 mm were 6 years, 186-200 mm at least 7 years old; Males 70-90 mm SL were 3 years old, 100-140 mm were 4-5 years, about 150 mm were 6 years, 160-170 mm at least 7 years.

Stomach contents included Pandalidae, Gammaridae, more seldom fish (*Triglops sp., Boreogadus saida*).

C. reinhardti is widely distributed in the area mentioned, though it is caught in less amounts than *L. fabricii*. It is found at depths ranging from 120-690 m, most often at 200-400 m, mainly on mud or mud with stones, sand or clay bottom. The northernmost specimens are from 81°07'N, 44°22'E.

4. ***Careproctus ranula*** (Goode & Bean, 1880)

One specimen was found north-west of Spitsbergen at 79°59'N, 07°16'E (Fig. 1), at a depth of 698 m, on a bottom consisting of mud with stones, sand and gravel. This specimen was a female lengths: 84,6 mm L, 77,0 mm SL and had gonads of the II stage of maturity.

Dorsal-rays 56 (the first Dorsal-ray is shortened), Anal-rays 49, vertebraes. 62, *pyloric caeca* 11.

5. ***Careproctus micropus*** (Günther, 1887)

One specimen was caught north-west of Franz Josef Land at 81°07'N, 44°22'E (Fig. 1), at a depth of 250 m on stoney bottom. This

was a male with lengths: 87,0 mm L, 78,0 mm SL and had gonads of the III stage of maturity.

Dorsal-rays 53, Anal-rays 48, vertebraes 60, *pyloric caeca* 11.

6. ***Paraliparis bathybius*** (Collett, 1879)

Material: 11 specimens. from 4 stations (Fig. 1). All fish were caught on the continental slope in the area 81°47'N-81°53'N, 35°10'E-36°22'E, at depths between 750-1150 m and with water temperatures ranging from -0,3°C to +1,3°C.

Dorsal-rays 57-58, Anal-rays 50-54, vertebraes. 63-66, *pyloric caeca* 5-6. Total lengths (L) 184, 0-219, 0 mm.

7. ***Rhodichthys regina*** (Collett, 1879)

One specimen, total length (L) 187,0 mm was caught at 81°47'N, 35°10'E (Fig. 1), at a depth of 1080-1090 m.

Dorsal-rays 60, Anal-rays 54, vertebraes 68, *pyloric caeca* 8.

Only 3 of 7 species mentioned above were previously known from the study area: *L. fabricii* (as *L. koefoedi*), *C. reinhardti*, and *P. bathybius* (Andriashev 1964; Borkin 1983). The *L. fabricii* is a common Arctic species with a circumpolar distribution (Able 1990; Chernova 1991). During underwater work at a ice-drift station in the central Arctic basin juveniles of this species were several times seen living cryopelagicly at ocean depths of more than 2000 m (Tsinovsky & Melnikov 1980). That is why the *L. fabricii* as well as *Boreogadus saida*, were considered cryopelagic fish species (Andriashev *et al*. 1980).

C. reinhardti is also a common and numerous snailfish in the Franz Josef Land area and in the northern parts of the Barents Sea. Its distribution area includes the western North Atlantic (Able & McAllister 1980) and the Eurasian Arctic (Chernova 1988, 1991).

P. bathybius was previously known from the deep waters of the Norwegian Sea (Stein & Able 1986). Recently it has been found in the Central Arctic Basin to the north of the East-Siberian Sea (Tsynovsky 1980). In the area dealt with in the present study it was previously recorded from the continental slope (Borkin 1983).

Four species have not been recored in this area previously. *L. gibbus* was described from the Bering Sea (Bean 1881). Recently it was found to be widely distributed in the Canadian Arctic (Able & McAllister 1980) and in the Bering Sea. In the last area it was confused with *L. tunicatus* and *L. liparis* (Able 1990; Chernova 1988, 1991. The *L. gibbus* is very common in the west Spitsbergen waters (Chernova 1987) and probably may penetrate into the northern parts of the Barents Sea with the West Spitsbergen current. Specimens from near Nordaustlandet, Svalbard are the most northern ever recorded for this species. *C. ranula* was known earlier only from the North-west Atlantic (Able & Irion 1985) and has recently been

found in the Barents Sea (Chernova 1988, 1991). *C. micropus*, described from the Faroes Trough (Günther 1887), were recorded also in Denmark and the Davis Strait (Lütken 1898), recently it has been found also in the Barents Sea (Chernova 1988,1991). The specimen from north-west of Franz Josef Land (81°07' N) is the northernmost recorded for this species. The deep-sea species *R. regina* was known from the Norwegian and Baffin Seas (Stein & Able, 1986). A juvenile specimen of this species has been recorded from the Laptev Sea (Andriashev 1954) in Eurasian Arctic.

Thus, the snailfish fauna of the Franz Josef Land area and the northern parts of the Barents Sea seem to be richer and more diverse than previously thought, and includes at least 7 species of 4 genera. The ichthyofaunal list of the area in question must therefore be increased by 4 species: *L. gibbus*, *C. ranula*, *C. micropus*, *R. regina*. For *L. gibbus* and *C. micropus* the specimens refered to are the northernmost on record.

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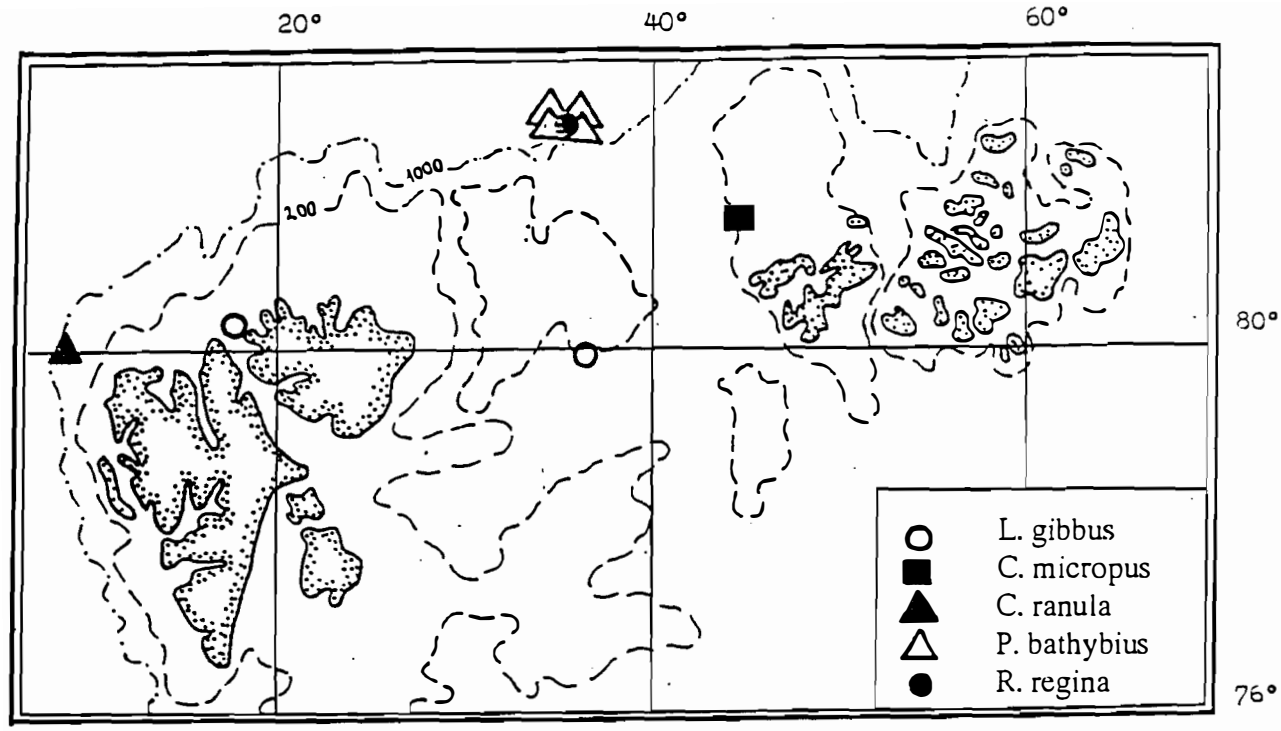

Figure 1 Map of collection sites of *L. gibbus, C. ranula, C. micropus, P. bathybius, R. regina* in Franz Josef Land, Svalbard and adjacent continental slope areas.

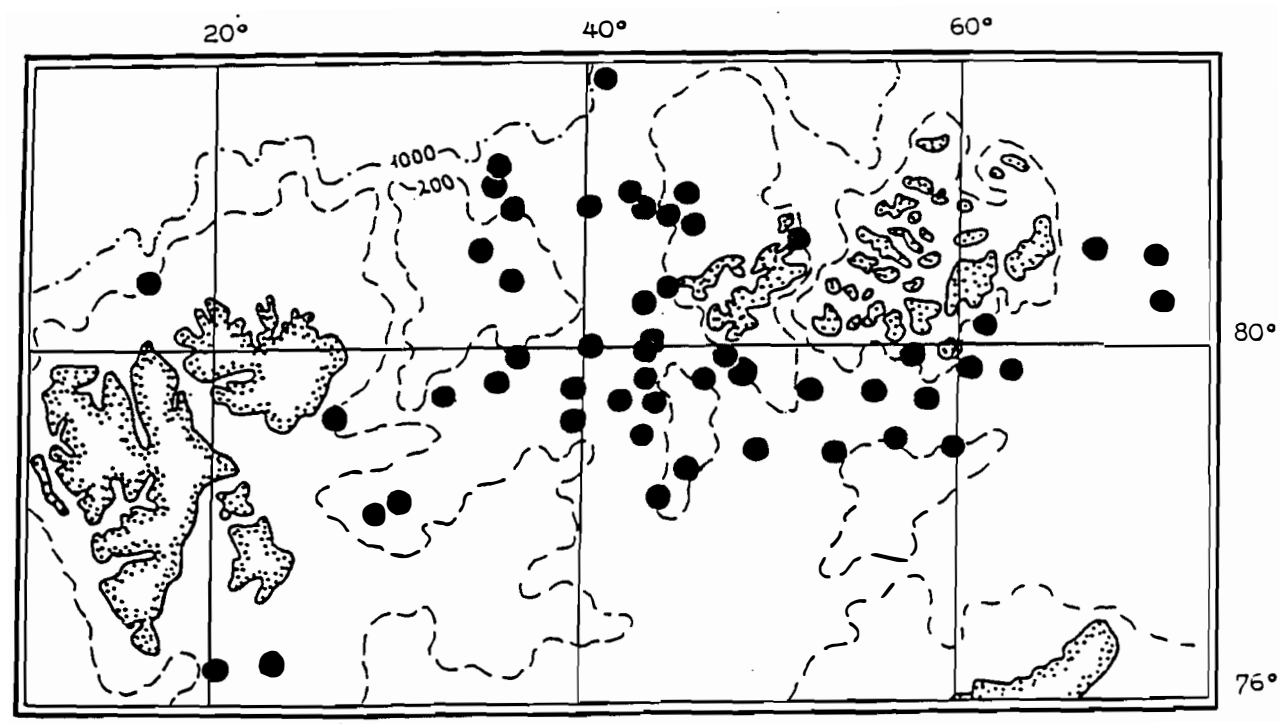

Figure 2 Sample sites from the study area where *L fabricii* were found.

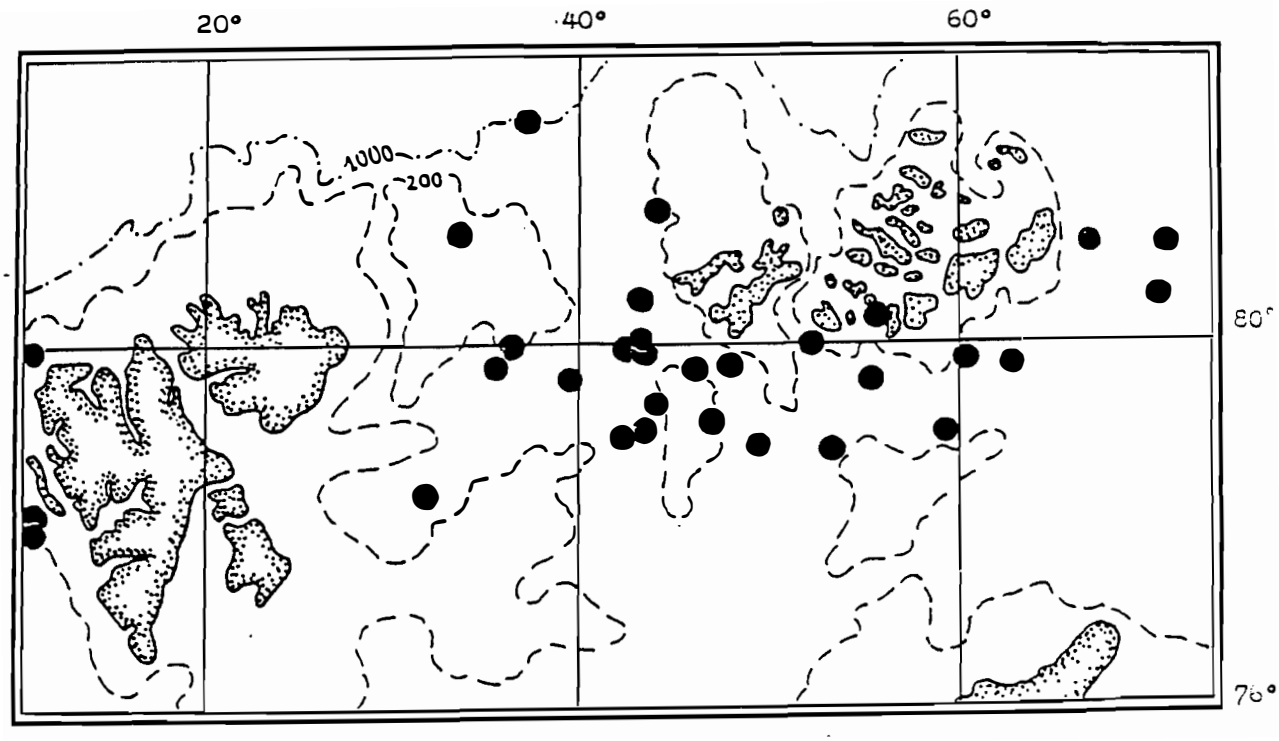

Figure 3 Sample sites from the study area where *C. reinhardti* were found

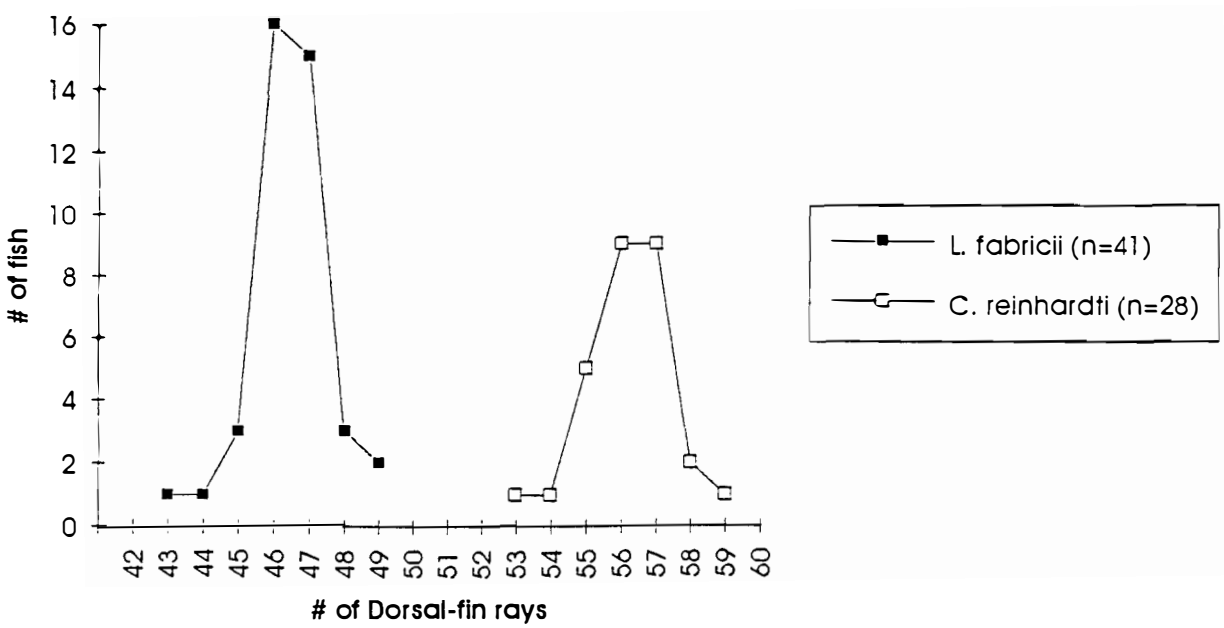

Figure 4 Dorsal-fin ray distributions of *L. fabricii* and *C. reinhardti.*

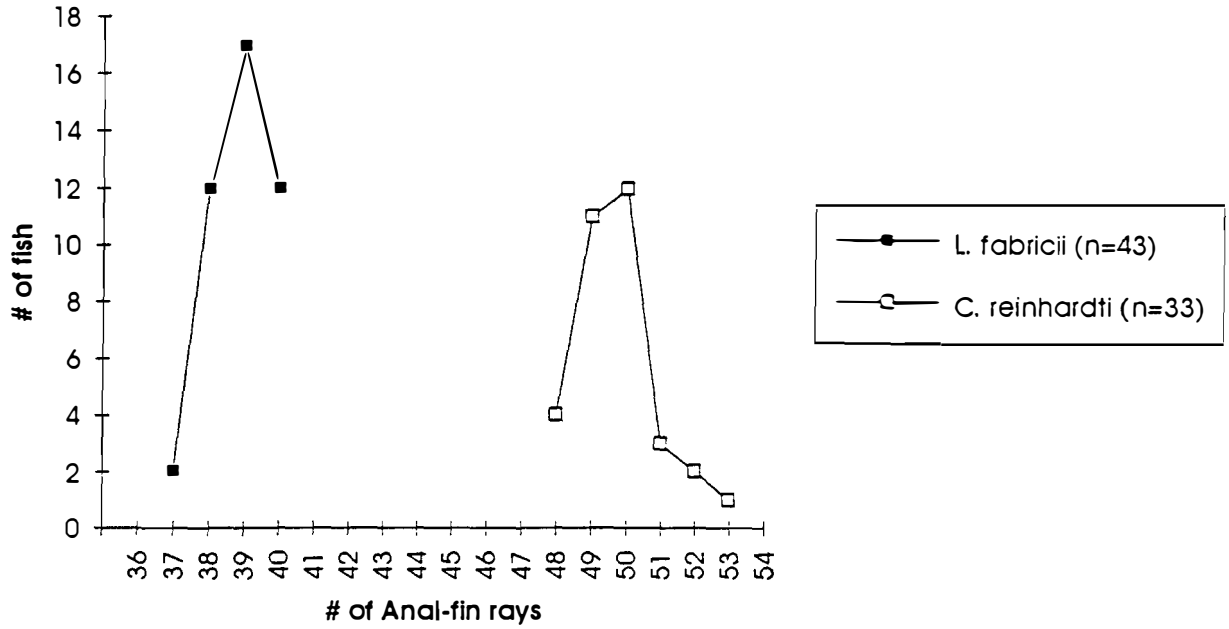

Figure 5 Anal-fin ray distributions of *L. fabricii* and *C. reinhardti.*

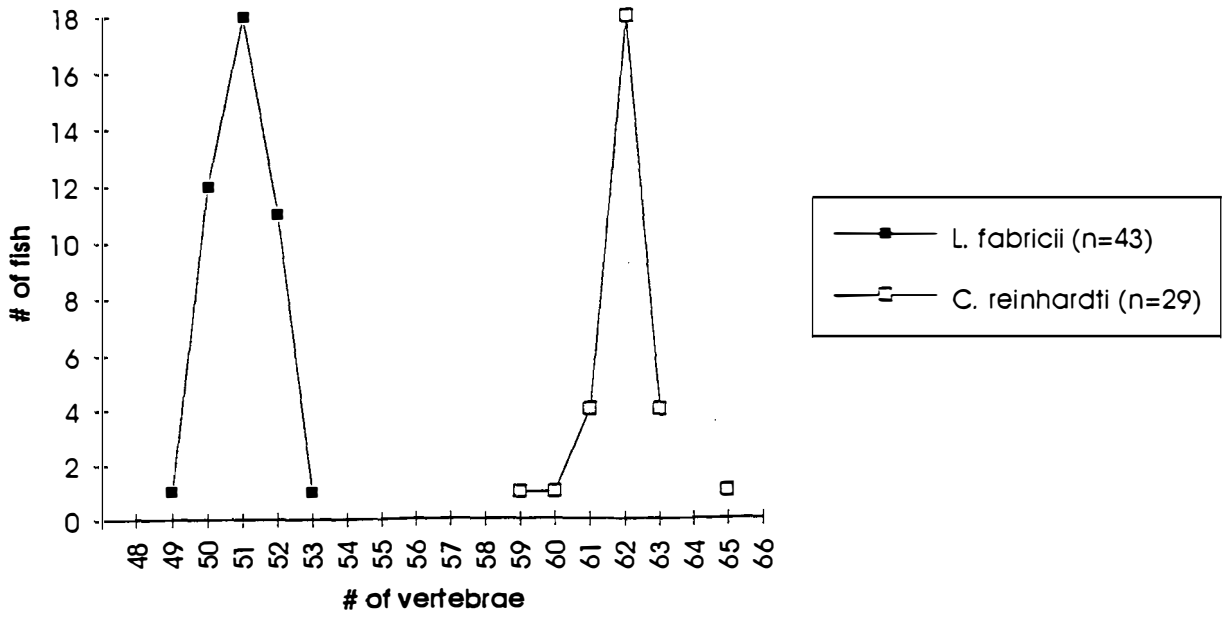

Figure 6 Vertebrae numbers in *L. fabricii* and *C. reinhardti.*

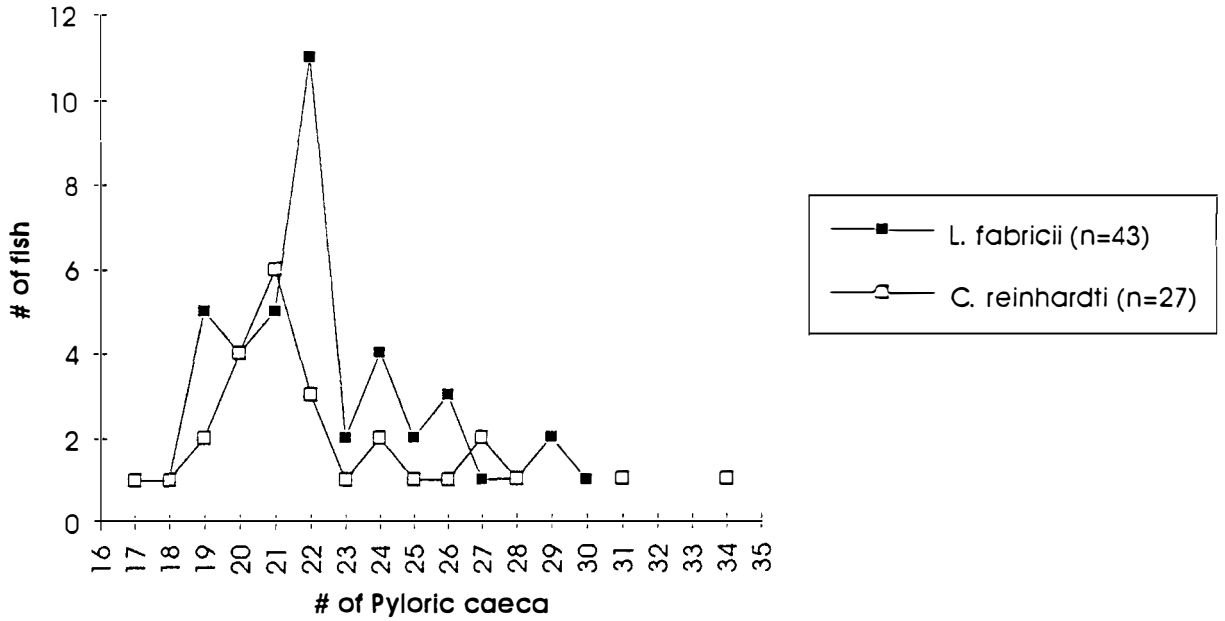

Figure 7 Distributions of *Pyloric caeca* in *L. fabricii* and *C. reinhardti.*

Table 1 Proportional measurements (in % SL) of two size groups of *C. reinhardti*

	n=7-10			n=3-4		
	Interval	Mean	S n-1	Interval	Mean	S n-1
Total length, mm	96,0-146,0	127,4	14,50	155,0-193,0	173	
Standard length(SL), mm	90,0-94,7	91,4	1,47	89,0-92,7	91	1,78
in SL %						
Head length	25,5-29,9	27,7	1,55	25,3-29,9	28,1	2,44
Snout length	8,3-11,8	10,3	1,17	9,2-12,2	10,7	1,44
Eye diameter	5,5-6,9	6,1	0,52	4,6-5,8	5,2	0,55
Posteye length	12,0-15,4	13,7	1,26	12,8-15,6	14,3	1,49
Head width	13,6-21,4	16,8	2,19	17,2-20,7	18,7	1,49
Head height	20,7-25,0	22,1	1,72	23,9-26,0	24,6	0,99
Maximal height	23,0-25,9	24,7	0,94	26,1-30,5	27,6	2,05
Height above disk	14,9-21,6	17,9	2,19	15,2-19,5	17,7	1,9
Height above A-origin	20,0-22,7	21,2	0,73	21,7-25,6	23,7	1,62
Predorsal length	26,7-30,3	28,4	1,3	24,4-29,3	27,6	2,22
Preanal length	35,1-40,2	37,6	1,78	40,0-46,3	43,4	2,59
Mandible to anus	15,9-27,7	19,5	3,17	18,3-19,6	19	0,57
Mandible to disk	9,1-12,6	10,2	1,45	9,4-11,6	10,5	0,91
Disk length	5,6-6,7	6,1	0,43	5,2-6,1	5,7	0,38
Anus to A-origin	20,3-27,7	22,5	2,11	24,6-28,3	25,9	1,67
Disk to anus	0,1-1,8	0,9	0,66	0,17	0,17	
Pectoral length:						
Upper lobe rays	11,8-17,8	15,4	1,83	14,0-16,9	15,1	1,55
Shortest ray	5,9-11,8	8,5	1,92	7,1-11,7	8,9	2,22
Lower lobe ray	20,4-33,3	25,4	3,99	28,3-39,0	34	4,47
Interorbital width	10,2-12,2	11,1	0,71	7,99-13,0	11,1	2,14
Gill slit length	6,5-8,9	7,5	0,9	7,3-8,6	8,2	0,75
Length of C	8,8-11,7	10,4	1,03	9,8-12,1	10,8	1,03
Length of dorsal overlap of caudal	3,5-5,2	4,3	0,9	4,0-6,1	4,9	1,11
Length of anal overlap of caudal	4,7-6,3	5,3	0,75	3,7-5,4	4,7	0,89