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Fish biology

STUDIES ON FOOD AND FECUNDITY OF *NOTOTHENIA GIBBERIFRONS* LÖNNBERG, 1905 (*PISCES, NOTOTHENIOIDEI*) OFF SOUTH GEORGIA

BADANIA NAD POKARMEM I PŁODNOŚCIĄ ŻÓŁTEJ NOTOTENII, *NOTOTHENIA GIBBERIFRONS* LÖNNBERG, 1905 (*PISCES, NOTOTHENIOIDEI*) Z REJONU POŁUDNIOWEJ GEORGII

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The food of sympatric, immature and mature (longer than 37.5 cm l.t.) individuals of *Notothenia gibberifrons* is very diversified, the most important items being the *Polychaeta, Euphausia superba,* the *Isopoda,* and the *Echinodermata.* Ovaries of mature individuals contain two generations of eggs differing in their size and stage of development. The absolute fecundity (large eggs of the older generation considered only) was found to range from 26.349 to 113.436. The relative fecundity ranged within 33.91–101.66 eggs/g with a mean of 73.8±18.667 eggs/g.

INTRODUCTION

Notothenia gibberifrons is an economically important species in the western Antarctic region. Owing to its abundance, the species plays also a considerable role in ecosystems of the area. Fecundity and reproduction of the species were studied by, i.a., Permitin and Silyanova (1971), Lisovenko and Silyanova (1979), and Silyanova (1981). The species food was studied by, i.a., Naumov and Permitin (1973), Krzeptowski et al. (1976), and

Linkowski and Rembiszewski (1978). Owing, however, to the still inadequate knowledge on *N. gibberifrons* biology, further studies are imperative.

The present paper is aimed at gaining further insights into the reproduction and feeding of *N. gibberifrons*.

MATERIALS AND METHODS

The materials for the study were collected NE of South Georgia (Fig. 1) in late March and in May, 1977, during the Second Polish Antarctic Expedition. The fish were caught with a 20 mm mesh size bottom trawl operating at the depth range of 220–290 m. Fish length (l.t.) was measured to 0.5 cm. Gonad stages were determined according to Maier's scale. Stomach filling was assessed visually according to a 5-score (0–4) scale. Stomachs were preserved in 4% formaldehyde. Ovaries (all at the Maier's scale stage 6) were preserved either in 4% formaldehyde or in formaldehyde-ethyl alcohol solution.

Further detailed examinations were made on land. The stomach contents were sorted, identified – the state of digestion permitting – to the lowest taxon possible, and weighed to 0.005 g. Frequency of various food items was detemined relative to the number of individuals with "full" stomachs. The filling index was calculated as in the formula

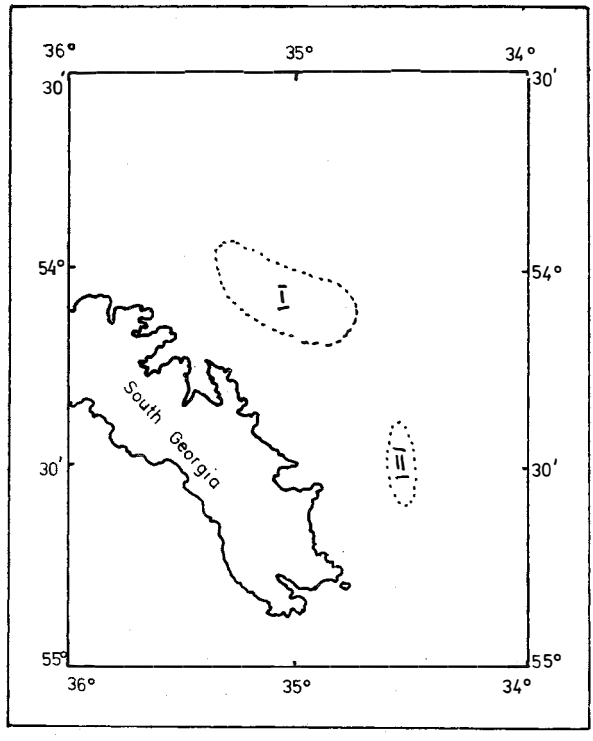

Fig. 1. Sampling locations. I "NE of Cumberland Bay", II NE of Cape Charlotte

$$\text{mean filling index} = \frac{\Sigma \text{ stomach content weight}}{\Sigma \text{ individual fish weight}} \cdot 10^4$$

When calculating the index, weights of individuals with both "empty" and "full" stomachs were used. As it was impossible to weight the fish at sea, the weights were calculated using the formula given by Skóra (1979):

$$W = 0.006037\, L^{3 \cdot 1787}$$

where: W = total weight (g)
L = total length (cm)

Fecundity was assessed by weight. Following a thorough rinsing, in the running water, of each pair of ovaries and breaking them down, the eggs were separated from the ovary tissue and dried on blotting paper. All the dried eggs from one individual were weighed to 0.05 g. Subsequently, three samples were taken and weighed to 5×10^{-4} g, and the number of eggs in each (large eggs of the older generation only) was counted under a stereo microscope, the number found being then converted to the number of eggs per the pair of ovaries. A number of eggs per sample ranged from 72 to 334. The diameter of preserved eggs was measured, prior to drying, under a microscope fitted with a micrometric screw.

Table 1 summarises the materials obtained and procedures used.

RESULTS

FOOD AND FEEDING

Feeding intensity

Table 2 presents numbers of fish with variously filled stomachs. The mean degree of filling varied widely, from 0.40 to 3.91. The limited amount of materials, however, does not allow drawing any far-fetching conclusions, but it seems that the variation in filling does not depend on the time of the day. The highest mean degree of filling (3.81) was recorded in the fish caught on May 18 between 12.42 and 14.57 hours. On the other hand, the lowest degree was observed in the fish caught on May 24 more or less at the same time, between 12.28 and 16.23 hours. The fishing ground was, however, different, so there are possibly spatial differences in feeding intensity. Certain differences in the mean degree of filling could be observed in fish belonging to various length classes, but no clear-cut trend in this respect was discernible. Stomachs showing a high degree of filling were observed in small fish on some occasions and at another time in large or medium-size individuals (Table 2).

The stomach filling indices (Table 3) show a pattern similar to that of the degree of filling in terms of the filling being in dependent of the time of day; no clear-cut trend is evident here as well. On the other hand, mean indices for small fish were usually lower

Table 1

Materials collected and analyses performed

No.	Position	Mean depth of catch (m)	Date of catch	No. of individuals in analysis					
				Sex and gonad maturity	Egg diameter	Fecundity	Stomach filling	Food item frequency	Weighing of stomach content
1.	54°06'S; 36°07'W	280	22.III	23	–	–	–	8	8
2.	53°58'S; 36°03'W	280	23.III	23	–	–	–	12	12
3.	54°33'S; 36°31'W	290	6.V.	52	–	–	–	22	22
4.	54°25'S; 35°34'W	280	9.V.	54	–	–	–	21	24
5.	54°04'S; 36°01'W	280	10.V.	28	–	–	–	18	21
6.	54°04'S; 36°09'W	280	11.V.	49	351	9	–	29	30
7.	54°07'S; 35°47'W	240	17.V.	57	–	–	57	22	–
8.	54°03'S; 35°49'W	240	18.V.	63	–	–	62	–	–
9.	53°55'S; 36°17'W	220	19.V.	26	–	–	11	–	–
10.	54°04'S; 36°19'W	280	23.V.	28	–	–	29	5	–
11.	54°29'S; 35°31'W	270	24.V.	42	–	5	36	–	–
12.	54°29'S; 35°30'W	275	26.V.	43	351	6	–	14	5
		Total		488	702	20	195	151	122

Table 2

Stomach filling of *N. gibberifrons* on South Georgia shelf in May 1977

Date of catch	Fishing ground	Time of day (local time)	Fish length (l.t.) (cm)	No. of ind with stomach filling from 0 to 4					Total. no. of fish	Mean degree of filling
				0	1	2	3	4		
17.05	"NE of Cumberland Bay"	$6^{37}-9^{32}$	<30	2	1	2	3	3	11	2.36
			30.0 – 39.5	2	1	11	11	10	35	2.74
			>39.5	–	2	1	3	5	11	3.00
			total (14.5 – 47.5)	4	4	14	17	18	57	2.72
18.05	– " –	$12^{42}-14^{57}$	<30.0	–	–	1	–	14	15	3.87
			30.0 – 39.5	–	–	–	3	30	33	3.91
			>39.5	–	–	2	3	9	14	3.50
			total (17.0 – 47.5)	–	–	3	6	53	62	3.81
19.05	–"–	$15^{05}-15^{40}$	<30.0	1	–	–	4	–	5	2.40
			30.0 – 39.5	–	4	–	–	–	4	1.00
			>39.5	–	2	–	–	–	2	1.00
			total (18.5 – 41.5)	1	6	–	4	–	11	1.64
23.05	–"–	$8^{35}-13^{30}$	<30.0	–	–	1	–	1	2	3.00
			30.0 – 39.5	1	1	5	5	6	18	2.78
			>39.5	1	3	2	–	3	9	2.11
			total (26.0 – 46.5)	2	4	8	5	10	29	2.59
24.05	"NE of Cape Charlotte"	$12^{28}-16^{23}$	<30.0	4	–	1	–	–	5	0.40
			30.0 – 39.5	11	3	2	–	–	16	0.44
			>39.5	8	6	1	–	–	15	0.53
			total (23.0 – 49.5)	23	9	4	–	–	36	0.47

Table 3

N. gibberifrons stomach filling indices

Date of catch	Time of day (local time)	Fish length class (l.t.)					
		30 cm		30.0–39.5 cm		> 39.5 cm	
		Index of stomach fill.	No. of indiv. examined	Index of stomach fill.	No. of indiv. examined	Index of stomach fill.	No. of indiv. examined
"NE of Cape Charlotte"							
6.V.1977	$10^{57}-14^{44}$	32.98	4	34.84	8	84.73	11
9.V.1977	$8^{03}-14^{03}$	83.27	12	100.98	7	253.74	4
26.V.1977	$5^{13}-9^{28}$	–	–	–	–	47.14	5
Total		72.76	16	69.64	15	110.14	20
"NE of Cumberland Bay"							
22.III.1977	$7^{35}-12^{23}$	15.86	1	412.44	6	287.14	1
23.III.1977	$10^{10}-11^{45}$	77.97	1	305.27	7	205.95	4
10.V. 1977	$8^{51}-13^{41}$	28.61	2	133.96	14	68.93	5
11.V. 1977	$4^{59}-9^{14}$	138.15	10	74.45	12	291.67	8
Total		109.12	14	192.57	39	206.92	18

than those for individuals of larger length classes. Generally speaking, those fish caught in the fishing ground of "NE of Cumberland Bay" showed better-filled stomachs.

FOOD COMPOSITION

As seen from Table 4, the *N. gibberifrons* food spectrum is very wide. The diversification of food is evident when the frequency of stomachs containing a given item is considered (Figs. 2 and 3). There were very few items that occurred more than in 45% of the "full" stomachs. Polychaetes were such organisms NE of Cumberland Bay. They were less common NE of Cape Charlotte, the fish caught in this fishing ground, particularly those within 30.0–39.5 cm and $>$ 39.5 cm length classes, pretty frequently containing the *Isopoda* and *Euphausia superba.* The two items were presumably present, too, in those individuals of the $<$ 30 cm class, as evidenced by a high frequency of unidentified *Crustacea,* a category comprising strongly digested chitinous fragments (presumably remains of isopods and *E. superba*). Of the remaining food items, it was only the *Macrura natantia* and *Mysidacea* that their frequency exceeded, at times, 20% (Fig. 3).

The analysis of food composition (expressed as % of the stomach content weight; Figs. 2 and 3) proves *E. superba* and polychaetes to be the most important items which – taken together – make up from a half to two thirds of the total stomach content weight. It was only NE of Cumberland Bay that stomachs of several individuals of the $\geqslant$ 39.5 cm class were found to contain large amounts of echinoderms (mostly the *Ophiuroidea*). They made up 37.8% of the stomach content weight in the length class mentioned. Also the *Macrura natantia* and isopods were of some importance on both fishing grounds, while the remaining invertebrates made up a small part of the food weight.

Apart from various invertebrates, the food of *N. gibberifrons* was found to contain – albeit sporadically – the fish identified as *Muraenolepis microps* Lönnberg; 1905; *Patagonotothen larseni* (L önnberg, 1905); and *Champsocephalus gunnari* Lönnberg, 1905. The presence of fish eggs in the food of *N. gibberifrons* is interesting to note. They were found in stomachs of four individuals caught in March and May. A 31 cm long individual caught NE of Cumberland Bay on March 23 was found to contain 15.9 g eggs (about 2 mm diameter) in its stomach. Eggs were found again in stomachs of three individuals (16.5; 32.0; and 43.5 cm long) caught in the same fishing ground on May 17. The catches on that day contained, apart from *N. gibberifrons,* large amounts of *N. rossi* Richardson, 1844, most individuals of the latter species being ready to spawn or already spent. Hence the eggs found that day in stomachs of *N. gibberifrons* can be suspected to have been produced by the other species.

Table 4

List of taxa found in stomachs of *N. gibberifrons* off South Georgia.+ present in stomachs; – absent from stomachs

Food items	"NE of Cumberland Bay"	"NE of Cape Charlotte
Spongia	+	–
Hydroidea	–	+
Siphonophora:	+	–
Physophora	+	–
Actiniaria	+	+
Polychaeta:	+	+
Errantia:	+	+
Aphroiditidae	+	+
Sedentaria:	+	+
Maldanidae	+	+
Priapulida	+	+
Echiurida	+	+
Crustacea:	+	+
Euphausiacea:	+	+
Euphausia superba	+	+
Euphausia sp.	+	–
Amphipoda:	+	+
Parathemisto gaudichaudi	+	–
Isopoda	+	+
Mysidacea	+	+
Decapoda:	+	+
Macrura natantia	+	+
Brachyura	+	–
Tanaidacea	+	–
Stomatopoda	+	–
Bivalvia	+	+
Cephalopoda:	+	+
Octopoda	+	–
Decapoda	+	–
Echinodermata:	+	+
Crinoidea	+	–
Ophiuroidea:	+	+
Gorgonocephalus sp.	+	–
Holothurioidea	+	–
Asterioidea	+	–
Salpae	+	+
Ascidiae	+	–
Pisces:	+	+
Muraenolepis microps	–	+
Patagonotothen larseni	+	–
Champsocephalus gunnari	+	–
Ova	+	–

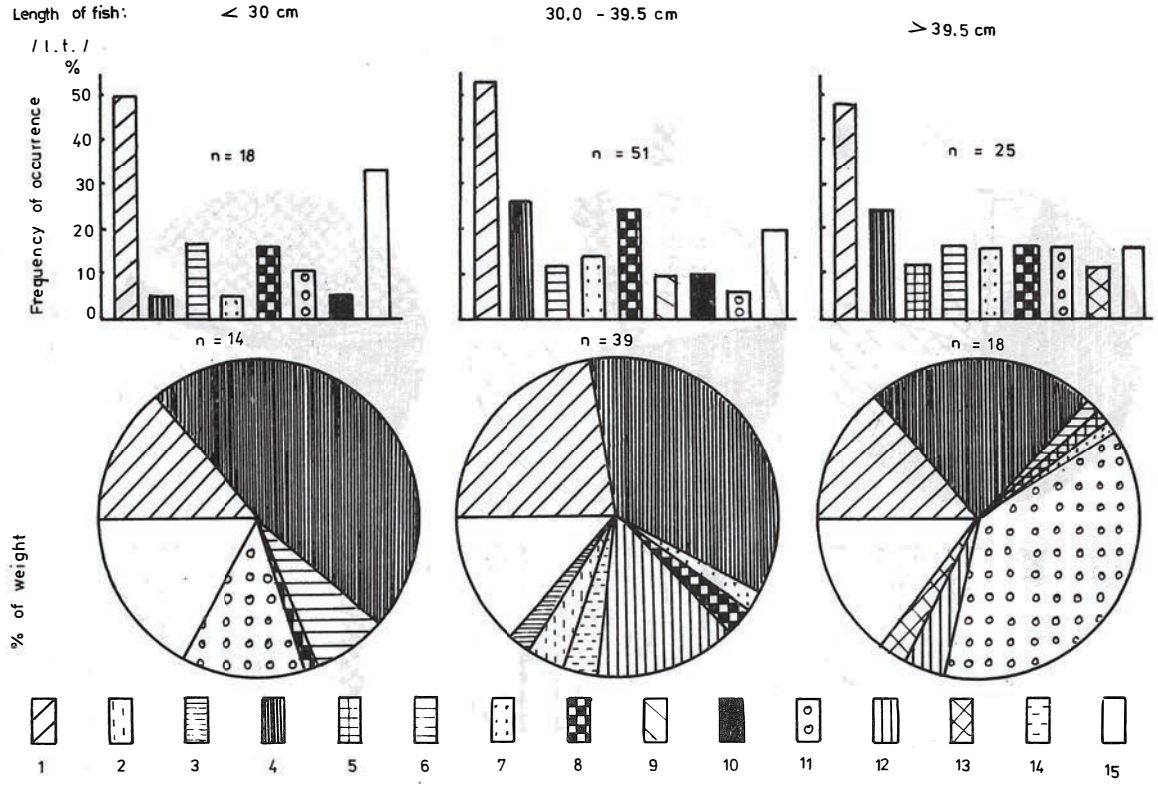

Fig. 2. Food composition of *N. gibberifrons* on the fishing ground "NE of Cumberland Bay". 1. *Polychaeta*, 2. *Priapulida*, 3. *Echiurida*, 4. *Euphausia superba* 5. *Amphipoda*, 6. *Isopoda*, 7. *Macrura natantia*, 8. Non-identified *Crustacea*, 9. *Bivalvia*, 10. *Cephalopoda*, 11. *Echinodermata*, 12. *Ascidiae*, 13. *Pisces*, 14. Fish eggs, 15. Other, and non-identified remains

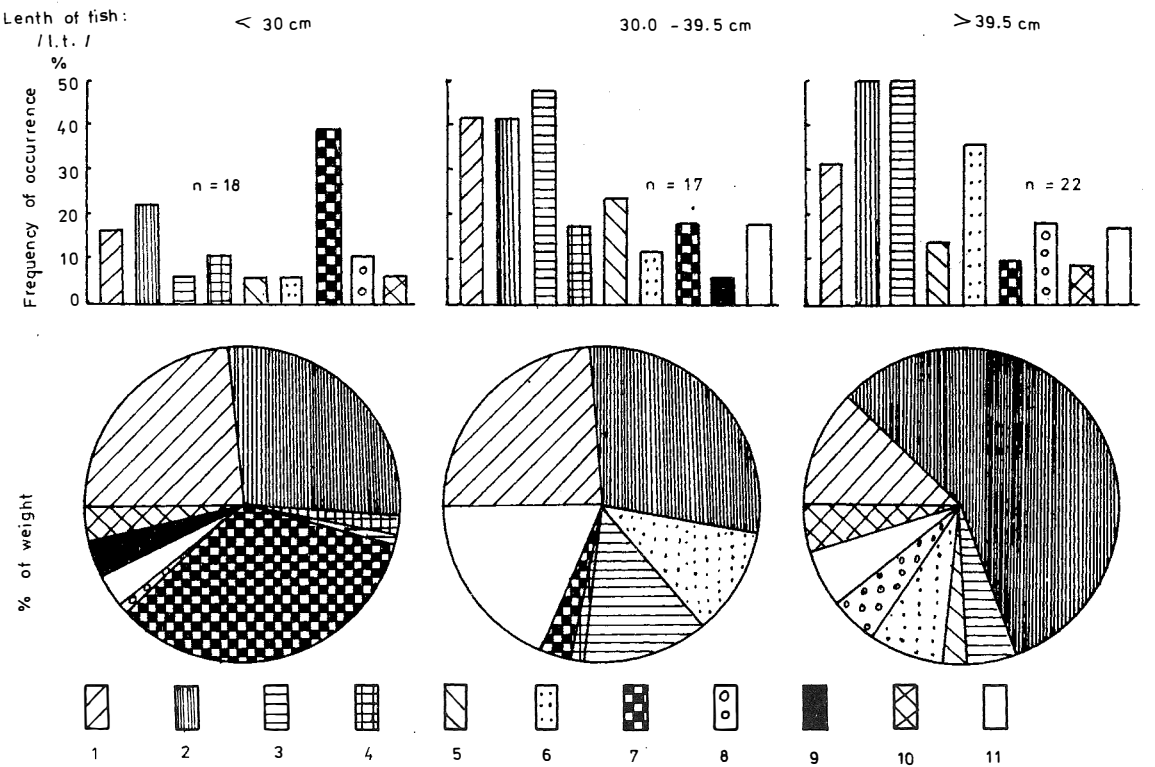

Fig. 3. Food composition of *N. gibberifrons* on the fishing ground "NE of Cape Charlotte". 1. *Polychaeta*, 2. *Euphausia superba*, 3. *Isopoda*, 4. *Amphipoda*, 5. *Mysidacea*, 6. *Macrura natantia*, 7. Non-identified *Crustacea*, 8. *Ophiuroidea*, 9. *Salpae*, 10. *Pisces*, 11. Other, and non-identified remains

GONAD MATURITY AND FECUNDITY

Gonad maturity stages

The catches contained individuals of widely varying lengths (13.5–50.0 cm). A considerable part of the catches was made up by sexually immature individuals which could not be sexed visually. Almost all such individuals were ascribed to gonad stage 1. However, 8 individuals of irrecognizable sex were assigned to stage 2 because of a more advanced gonad development. The author has previously (Kompowski, 1985) assessed the length at the first maturity of *N. gibberifrons* off South Georgia at 37.5 cm (l.t.), which amounts to 65% of L_∞. Among the individuals of this length, the mature: immature individuals ratio was 1:1.

As seen from Table 5, gonads of the individuals caught were at Maier's scale stages 1 to 6. Table 5 shows also that in the third decade of March those individuals at stage 2–4 prevailed, with only two females being assigned to stage 5. In the first decade of May, the contribution of stages 4 and 5 increased considerably. In the second and third decades of May, most mature fish had their gonads at stages 5 and 6. Only a small proportion of individuals had their gonads at stage 2, and stage 3 and 4 gonads were absent altogether. Ovaries were usually more advanced in their development than testes.

Thus, over the period of study, the *N. gibberifrons* fishery was based on a pre-spawning concentration containing a considerable proportion (35.8–67.1%) of immature individuals.

Diameter of eggs in gonads

The stage 6 ovaries examined were found to contain two kinds of eggs. Most of the ovary content consisted of large opaque eggs, yellow or bright orange in colour. Their diameter (when preserved) ranged within 0.8–1.45 mm, the range 1.0–1.2 mm prevailing (Fig. 4). Presumably, those large eggs were to be laid in the nearest spawning season. The other kind were small, transparent eggs with well-visible nuclei. The diameter of those eggs, when preserved, ranged within 0.05–0.55 mm (Fig. 4). This second generation of eggs was to be laid in the next spawning, a year later.

Fecundity

The absolute fecundity of the fish examined ranged from 26.349 eggs in a 40.5 cm long female to 113,436 eggs in a 50.0 cm long one (Fig. 5). Fig. 6 presents the fecundity – fish weight relationship; the relationship covers the range of 39.697 eggs in a female weighing 635 g (total weight) to 113.436 eggs in a female weighing 1,518 g. The relative fecundity (Fig. 7) ranged within 33.9–101.66 eggs/g; the mean relative fecundity was 73.8±18.667 eggs/g.

Table 5

Gonad maturity of N. gibberifrons and percentages of males, females, and immature individuals in March and May 1977 off South Georgia

Period of study	Gonad maturity stage																Total		Including					
	I		II		III		IV		V		VI		VII		VIII				immature		♂♂		♀♀	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
March 3rd decade	18	39.2	9	19.6	10	21.7	7	15.2	2	4.3	–	–	–	–	–	–	46	100.0	18	39.2	15	32.6	13	28.2
May, 1st decade	48	35.8	16	11.9	2	1.5	28	20.9	40	29.9	–	–	–	–	–	–	134	100.0	48	35.8	52	38.8	34	25.4
May, 2nd decade	131	67.1	20	10.3	2	1.0	–	–	20	10.3	22	11.3	–	–	–	–	195	100.0	134	68.7	31	15.9	30	15.4
May, 3rd decade	55	48.6	7	6.2	–	–	–	–	26	23.1	25	22.1	–	–	–	–	113	100.0	59	52.2	31	27.4	23	20.4

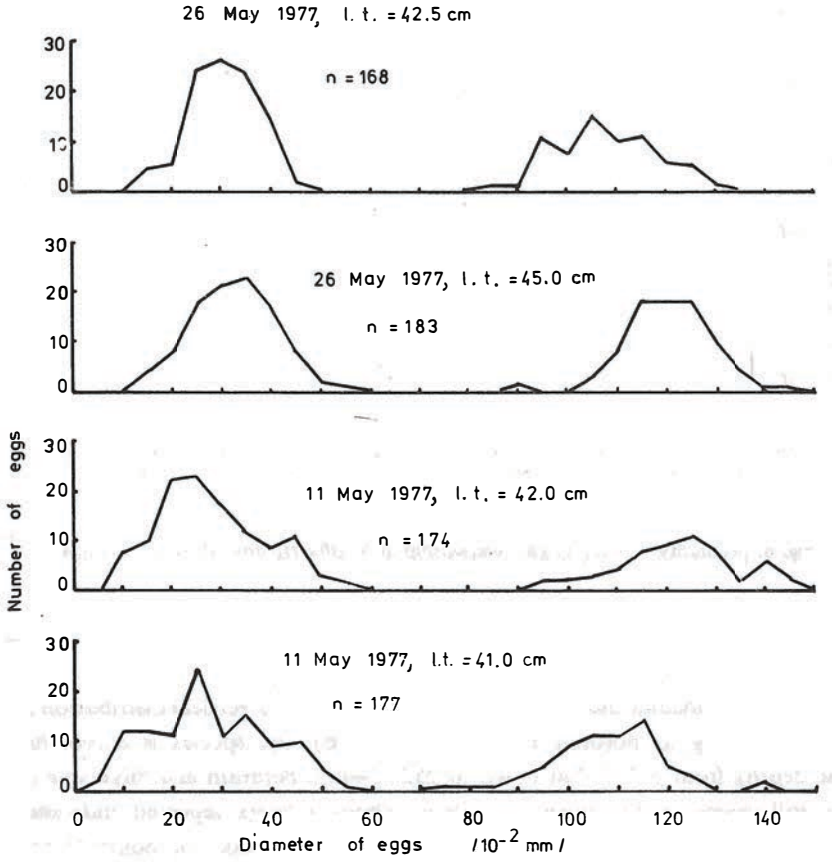

Fig. 4. Egg diameter of *N. gibberifrons* off South Georgia

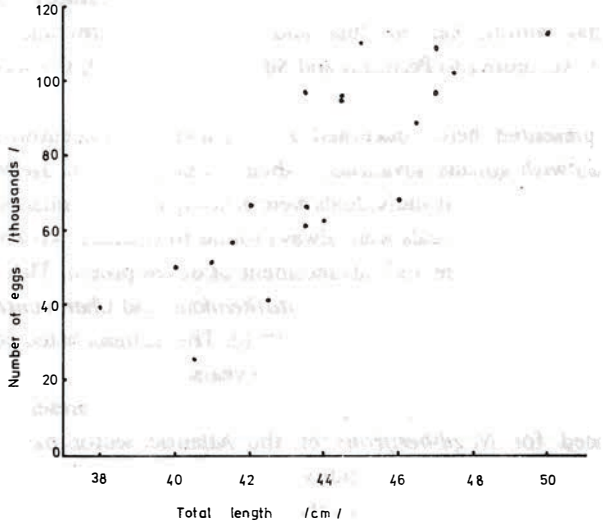

Fig. 5. Fecundity – total length relationship in *N. gibberifrons* off South Georgia

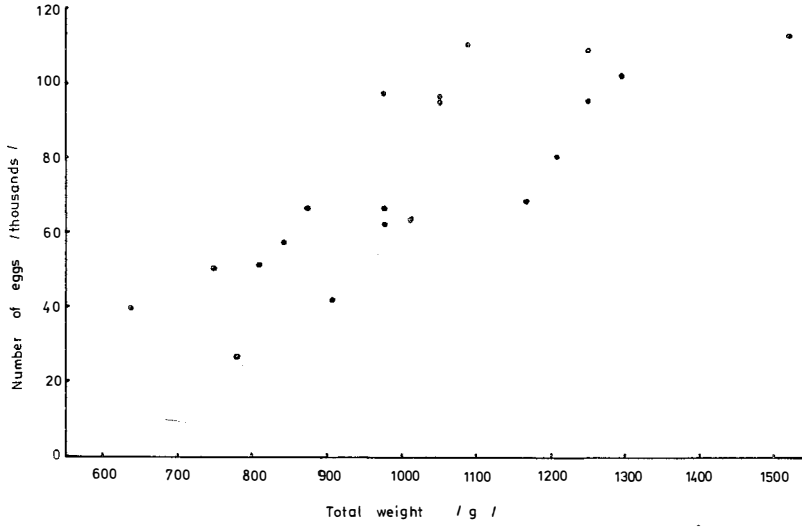

Fig. 6. Fecundity – total weight relationship in *N. gibberifrons* off South Georgia

DISCUSSION

N. gibberifrons inhabits the western Antarctica waters. Its vertical distribution is very extensive. According to Boronin and Frolkina (1976), the species is eurybathic and occurs at depths from 5.7–7.3 m down to 252–344 m. Permitin and Silyanova (1971) report a still wider range, down to 750 m. Those authors reported individuals of *N. gibberifrons* with maturing gonads from off South Shetlands and South Orkneys at depths of 155–750 m, at water temperatures of –0.1°C to –0.4°C, and from off South Georgia at 115–600 m depth range (0.7 to 1.7°C water temperature). The species spawns during the austral winter, i.e., in July and August (Permitin and Silyanova, 1971; Silyanova, 1981). According to Permitin and Silyanova (op. cit.), the species has demersal eggs.

The studies presented here concerned a pre-spawning concentration consisting of mature individuals with gonads advanced in their development; in late May they attained stage 6 Maier's scale. The adult individuals were accompanied by smaller, immature ones.

The ovaries of adult individuals were always found to contain two generations of eggs, the generations differing in size and advancement of development. This is a phenomenon found in most (if not in all) species of the *Nototheniidae* and *Channichthyidae* studied so far (Everson, 1970; Kock, 1979; Silyanova, 1981). The authors listed conclude that eggs of the species complete their development in two years.

The absolute fecundity of *N. gibberifrons*, as assessed in the present work, falls within the range recorded for *N. gibberifrons* of the Atlantic sector of the Antarctica by Lisovenko and Silyanova (1979). Fecundity of most fishes, including the *Nototheniidae* (Lisovenko and Silyanova, 1979) and the *Channichthyidae* (Kock, 1979, 1981), is

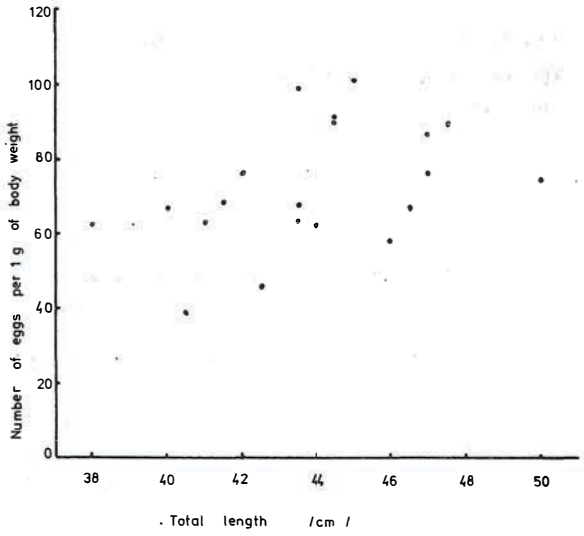

Fig. 7. Relative fecundity – total length in *N. gibberifrons* off South Georgia

approximately proportional to the fish weight and to the cube of its length. Owing to a small amount of data in the present work, the empirical findings are reported only.

According to Boronin and Frolkina (1976), *N. gibberifrons* feeds with the highest intensity in January – March, the feeding intensity being reduced from May through September, that is during spawning and just before it. According to Hureau (1970), the *Nototheniidae* undergo a period of fasting, more or less directly related to spawning. In spite of their gonads being highly advanced in their development, adult individuals of the population studied still fed with a considerable intensity.

N. gibberifrons, treated by Naumov and Permitin (1973) as a demersal species in terms of its morphology, feeds – as shown by the present study and also by reports of, i.a., Permitin and Tarvedeva (1972), Krzeptowski et. al. (1976), and Linkowski and Rembiszewski (1978) – mainly on benthos; however, *Euphasia superba* is an important food item. This is typical of the Antarctica, at least of its western part. The species belonging to various trophic groups, viz. plankton and benthos feeders, omnivores, and predators, feed on the krill either permanently or under favourable conditions. The latter, for demersal species, ensue when the krill descends to near bottom water layers (Permitin and Tarverdeva, 1972; Naumov and Permitin, 1973; Tarverdeva, 1972; Kock, 1981). According to Kanaeva et al. (1969), large krill concentrations make high feeding efficiences possible. Feeding on krill requires neither a long time nor energy expenditures.

It is interesting to find fish eggs in the *N. gibberifrons* food. So far, nobody has reported on that. Thus it is difficult to ascertain whether the eggs are ingested accidentally or whether *N. gibberifrons* exerts a pressure on demersal eggs-producing species.

In view of the considerably diversified food of *N. gibberifrons*, the food including both typically benthic organisms and the krill as well as fish and their eggs, the species should be classified as an omnivore.

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BADANIA NAD POKARMEM I PŁODNOŚCIĄ ŻÓŁTEJ NOTOTENII, *NOTOTHENIA GIBBERIFRONS* LÖNNBERG, 1905 (*PISCES, NOTOTHENIOIDEI*) Z REJONU POŁUDNIOWEJ GEORGII

STRESZCZENIE

Materiał zebrano w rejonie położonym na północny-wschód od Południowej Georgii w marcu i maju 1977 r. (rys. 1, tabl. 1).

Średni stopień napełnienia żołądków zawierał się w granicach 0,40–3,91. Nie zaobserwowano, aby wysokość tego wskaźnika była zależna od pory doby lub od długości ryb (tab. 2). Również wielkość indeksów napełnienia żołądków wydaje się być niezależna od pory doby (tab. 3), jest ona jednak nieco niższa u ryb małych, jak również może zależeć od miejsca połowu.

Pokarm żółtej nototenii jest bardzo zróżnicowany (tab. 4, rys. 2 i 3). Największe znaczenie mają *Polychaeta, Euphausia superba, Isopoda* oraz *Echinodermata.* W skład pokarmu wchodzi poza tym bardzo dużo różnych innych bezkręgowców oraz ryby i ich ikra. Żółtą nototenię należy uznać za euryfaga.

Na łowiskach występowały razem ryby niedojrzałe (13,5–37 cm l.t.) i dojrzałe (ponad 37 cm). Stan gonad tych ostatnich rozwinął się od II–IV stadium w skali Maiera w końcu marca do stadiów V i VI w końcu maja (tab. 5). Jajniki były na ogół nieco bardziej rozwinięte niż jądra. W jajnikach były dwie generacje jaj, różniące się wielkością i stopniem rozwoju (rys. 4). Większe jaja były przypuszczalnie przeznaczone do złożenia w bieżącym sezonie tarłowym, mniejsze stanowiły zapas przyszłoroczny. Płodność absolutna, uwzględniająca tylko duże jaja starszej generacji, wahała się od 26349 jaj u samicy o długości 40,5 cm do 113436 jaj u samicy o długości 50,0 cm. Płodność względna zmieniała się w granicach 33,91–101,66 jaj/g; średnio 73,8±δ = 18,667 (rys. 5–7).

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ИССЛЕДОВАНИЯ ПИТАНИЯ И ПЛОДОВИТОСТИ ЖЁЛТОЙ НОТОТЕНИИ, NOTOTHENIA GIBBERIFRONS LÖNNBERG, 1905 (PISCES, NOTOTHENIOIDEI)РАЙОНА ЮЖНОЙ ГЕОРГИИ

Р е з ю м е

Материал собран в районе северо-восточнее от Южной Георгии в марте и мае 1977 г. (Рис.1, Табл.1). Средний уровень наполнения желудков содержался в границах 0,40 - 3,91. Незамечено, чтобы величина этого показателя зависела от времени суток или от длины рыб (Табл.2). Также величина показателей наполнения желудков по-видимому не зависит от времени суток (Табл.3), но она чуть ниже у мелкоразмерных рыб, а также, может зависеть от места вылова.

Пища жёлтой нототении очень разнообразна (Табл. 4, Рис.2 и 3). В пище в наибольшем количестве обнаружены: Polychaeta, Euphausia superba,Isopoda, Echinodermata. В состав пищи входит также очень большое количество различных других беспозвоночных, а также рыбы и их икра. Жёлтую нототению можно считать всеядной.

На местах промысла находились одновременно особи неполовозрелые (13,5 - 37 см l.t.) и половозрелые (больше 37 см). Гонады последних развивались от II-VI стадий, по шкале Майера, в конце марта, до V и VI в конце мая (Табл.5). Яичники

вообщие были более развитие чем семенники. В яичниках были два поколения яиц, отличающихся величиной и степенью развития (Рис.4). Большие яйца были повидимому предназначены для вымета в текущем нерестовым сезоне, а меньшие являлись запасом на следующий год. Плодовитость абсолютная, учитывающая только большие яички старшего поколения, колебалась от 26349 яичек у самки длиной 40,5 см до 113436 яичек у самки длиной 50,0 см. Плодовитость относительная изменялась в границах 33,91-101,66 яичек/г; в среднем 73,8 ±б = 18,667 (Рис.5-7).

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