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Changes in composition of *Notothenia gibberifrons* Lönnerberg population of the shelf of South Georgia in the years 1977—1979

ABSTRACT: Observations indicate a constantly decreasing mean age of shoal. In consecutive years of investigations a loss of older individuals was recorded. At present the catches consist of 3—14 years old fishes; 9—10 years old dominate. During the austral summer the fish most probably do not migrate. The shoal of the shelf maintains approximately constant frequency and dominance in classes of length.

Key words: Antarctic fish, age, migration, reproduction, feeding

1. Introduction

The South Georgia shelf has been until quite lately a very attractive fishing ground for fishing fleet in this region of Antarctic. This was the place of numerous seasonal concentrations of *Notothenia rossi marmorata* Fischer, *Champscephalus gunnari* Lönnerberg, *Pseudochaenichthys georgianus* Norm. and *Chaenocephalus aceratus* Lönnerberg. These technologically attractive fishes were the base for economic exploitation of ichthyofauna resources in the area. Considering these mass catches *N. gibberifrons* was considered as an additional catch, nevertheless its economical significance is increasing as the yields of species exploited up to now are decreasing. *N. gibberifrons* occurring in each bottom catch is the most common fish of the South Georgia shelf.

Its first taxonomic description has been given by Lönnerberg (1905), whereas Regan (1913) and Norman (1938) added to this description. Permitin and Siljanova (1971) have conducted preliminary observations on the biology of reproduction and among others determined the minimal and quantitative composition have been published by Permitin and Tarverdeva (1972). Complementary works on the subjects are those by Lin-

kowski and Rembiszewski (1978) and of Rembiszewski, Krzeptowski and Linkowski (1978) based on material from the I Polish Marine Antarctic Expedition in 1976. At the moment Wörner and James (unpublished data) from the University of Kiel (West Germany) are elaborating data from observations on juvenile forms of this species.

2. Methods

The material has been obtained from bottom catches made by Polish boats in the South Georgia region, in the years 1977—1979, at the depth 100—500 m. The number of individuals examined is vt in Table I.

Table I
Number of individuals examined

Elements compared	1977		1978		1978/79	
	Jan. — May	Jan. — Apr.	Dec. — Mar.			
Measurements of length	5088	8168	10663			
Detailed analyses	1225	1606	982			
Age readings	600	600	318			

Fish selected from catches at random were analysed ichthyologically in detail. *Longitudo totalis* was measured to the nearest cm below weight with an accuracy to 5 g, the sex, maturity stage of gonads (acc. to 8-degree Maier's scale) were determined and also the stomach content determined by a 5-point scale from 0 to 4: 0 — empty stomach, 1 — filled in 25%, 2 — filled in 50%, 3 — filled in 75%, 4 — full stomach. The scales were used to read the age. The relation between the length and weight of fish was calculated using the equation:

$$W = aL^b$$

where: W — body weight in grammes, L — body length in cm, a, b — bellow initiate the research on the length and age of *Notothenia gibberifrons* in its regions of occurrence.

3. Results and discussion

The length of caught fish was 9—53 cm. Frequency (in per cents) in particular classes of length was not identical for three consecutive seasons (Fig. 1). In the years 1977—1978 fish 34—43 cm in length dominated, whereas in 1979 individuals measuring 23—28 cm prevailed. Thus comparing the frequency of fish in classes of size over three seasons examined it could be said that big individuals were decreasing in number in the region of South Georgia. Also the mean length of caught fish decreased: in 1977 — 37 cm, in 1978 — 34 cm, in 1979 — 30 cm.

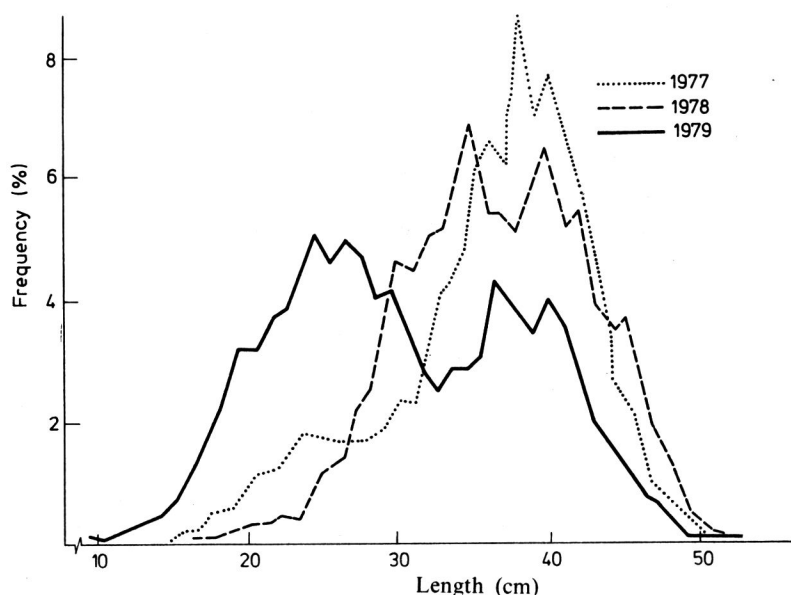


Fig. 1. Frequency of *Notothenia gibberifrons* individuals in classes of body length in the region of South Georgia in the years 1977—1979

On the basis of many measurements (10 663 ind.) of fish length during the austral summer (November 1978 — March 1979) the frequency in classes of length (Fig. 2) was determined for 3 months (December, January, March). But in March catches were made twice — in the second and third decade.

The shoal under observations showed high stability of length distribution. In each period of investigations fish from two classes dominated over others and were similar to one another. Their boundary values were 21—31 cm and 36—41 cm. Thus the population composition as regards length did not change during the austral summer. Thus, it can be assumed that at this time of the year the fish of this species living on the area examined do not migrate.

A sample of 200 individuals with empty stomachs or with only traces of food was used to calculate the relation between the body length of fish and its weight (Fig. 3). The correlation coefficient between the parameters examined was 0.95.

Observations on the age composition of the shoal of *Notothenia gibberifrons* from the shelf of South Georgia in the years 1977—1979 show a stable decrease in the mean age of the shoal: in 1977 — 12.7 years, in 1978 — 10.7 years, in 1979 — 8.5 years. In successive years of investigations older individuals decrease in number (Fig. 4). Table II presents the frequency in age groups for both sexes observed in our investigations and in those of Russian scientists in 1969, 1971 and 1972 (Boronin and Frolkina 1976). These data leave no doubt that the loss of older individuals is observed for both sexes. At present (1979) in the shoal 9—10 years old fish dominate (Fig. 4). Spawning of *N. gibberifrons* takes place during the austral winter (Permitin and Siljanova 1971). During the summer the gonads are in low maturity stages. They do not attain the fifth stage. The recorded

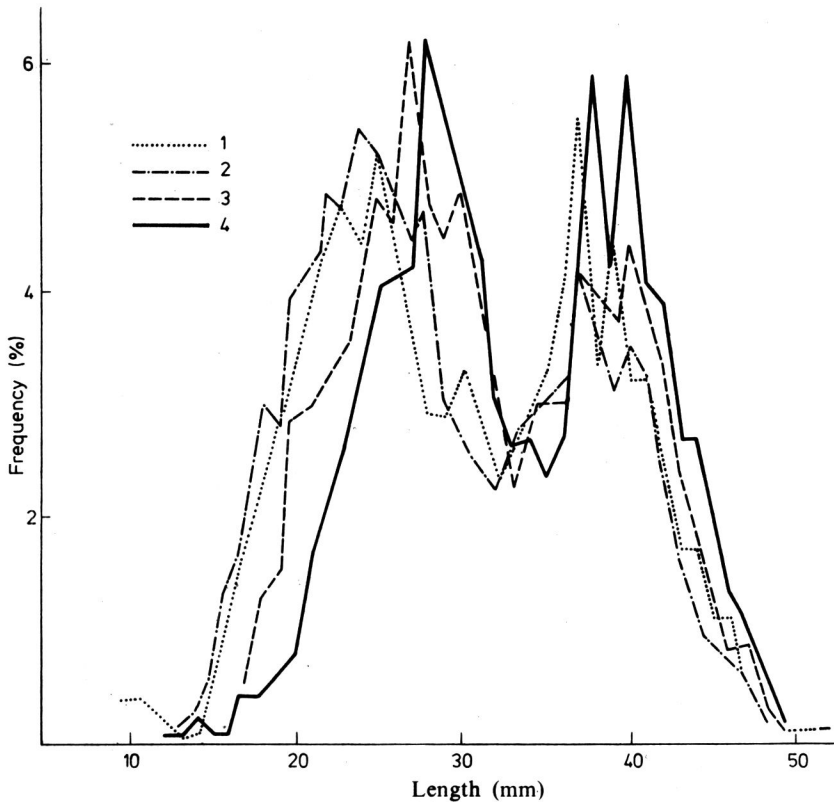


Fig. 2. Frequency of *Notothenia gibberifrons* individuals in classes of body length in the season of catches 1978/1979 in the region of South Georgia
 1 — December 1978, $n = 1480$, 2 — January 1979, $n = 3469$, 3 — second decade of March 1979, $n = 4129$, 4 — third decade of March 1979, $n = 1585$

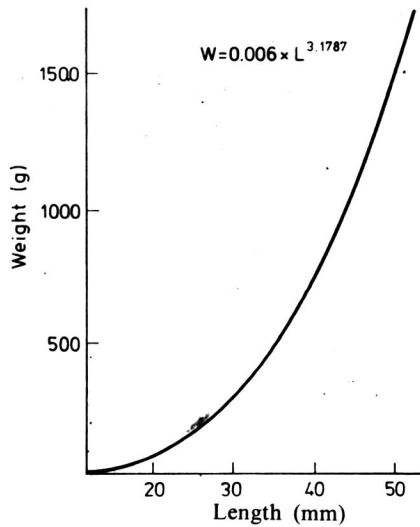


Fig. 3. Relation between weight (W) and body length (L) of *Notothenia gibberifrons* individuals in the region of South Georgia

Table II

Notothenia gibberifrons individuals (%) in particular age groups

Year	Sex	Age group																								
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV	
1969/1972*)	male			0.2	1.8	2.0	3.0	5.9	6.6	10.0	10.1	13.5	12.6	13.4	11.2	5.1	3.1	1.3	0.2							
	female			0.5	2.5	2.6	3.2	6.0	8.2	7.4	14.2	13.0	11.2	13.5	10.5	4.0	2.1	1.0	1.0							
1977	male			0.4		1.3	0.8	5.5	6.4	6.0	6.8	11.5	18.5	12.0	13.2	9.0	4.7	1.3	1.3	1.3						
	female			0.6	0.6		1.2	2.4	3.6	2.4	4.2	13.3	11.5	11.0	16.4	6.1	10.3	7.9	1.8	4.2	1.2	0.6			0.6	
1978	male			1.6	2.6	2.1	3.6	5.2	8.8	11.9	18.8	19.8	13.0	7.8	5.7	1.0			0.5							
	female			0.5	1.5	3.1	3.6	4.6	10.2	17.3	16.8	9.7	10.7	7.7	5.6	2.6	1.5	1.5	1.0	0.5						
1979	male				0.7	8.8	8.1	11.0	12.5	20.6	16.9	11.8	5.1	4.4												
	female				3.3	15.9	9.3	9.3	8.8	19.2	19.2	9.9	1.6	2.7	0.5											

*) on the basis of results of Boronin and Frolkina (1976)

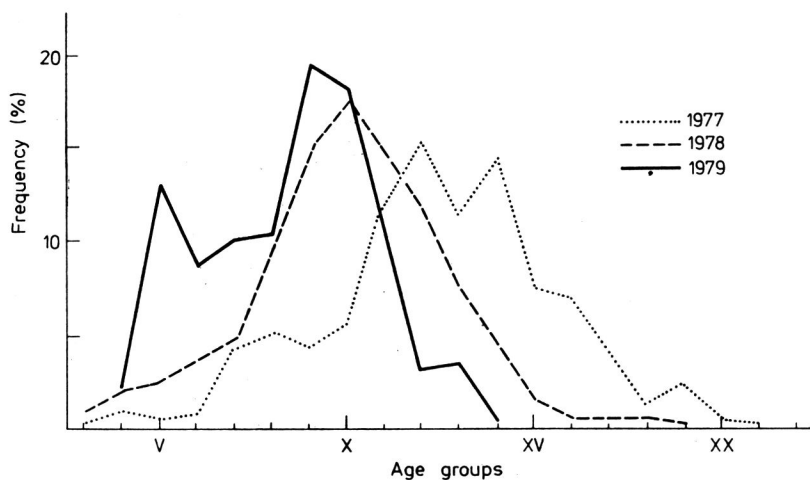


Fig. 4. Frequency of age groups of *Notothenia gibberifrons* in the South Georgia region in the years 1977—1979

percentage of fish in a specific stage over the period of time examined is given in Table III. When examining the per cent of stages recorded among fish of the spawning shoal (Fig. 5), the slow but progressing maturation of gonads can be observed. The ratio of males to females is almost constant and remains usually 1:1. Observations were also carried out on the feeding intensity of this species. The per cent (Table IV) of individuals with empty stomachs was small, on the average less than 10%. In February the fulfillment of stomachs was the highest. In May the fish ate much less than in other months.

According to these observations the conclusion is obvious: industrial catches are responsible for the present state of population *N. gibberifrons* on the shelf of South Georgia. Bigger (and older) individuals are decreasing in number. This is confirmed by data obtained in 1976 by Linkowski and Rembiszewski (1978) when fish of body length 43—48 cm (23—28 cm at present) dominated in the population colonizing this shelf. This is also reflected by the age composition of the shoal. Boronin and Frolkina (1976) have stated that the basic group of fish attains maturity at following lengths: males 28—35 cm, females 32—40 cm. If the tendency described above spawning shoal. *Notothenia gibberifrons* which spawns in winter has a low but gradual tendency for gonad maturation over the months of austral summer. Alimentary tracks in 90% of fish shown symptoms of feeding.

4. Conclusions

1. Average length and age of caught individuals is decreasing.
2. Most likely the fish do not migrate in summer. The shoal of the shelf shows rather constant frequency and dominance in classes of length.
3. At present the catches consist of 3—14 years old fish, years old individuals 9—10 dominate.

Table III

Percentage*) of fish with different stages of gonad maturity

Stage of gonad maturity	Year	Months					
		Dec.	Jan.	Feb.	Mar.	Apr.	May
1	1977	—**)	—	4	7	26	17
	1978	24	12	—	18	16	—
	1979	—	31	—	17	—	—
2	1977	—	—	51	28	4	9
	1978	69	47	—	44	46	—
	1979	—	54	—	42	—	—
3	1977	—	—	28	42	51	31
	1978	7	38	—	26	26	—
	1979	—	15	—	32	—	—
4	1977	—	—	17	23	19	43
	1978	0	3	—	12	12	—
	1979	—	0	—	9	—	—
5—8	1977	—	—	0	0	0	0
	1978	0	0	—	0	0	—
	1979	—	0	—	0	—	—

*) 100% is the every month sample for succeeding years

**) lack of data

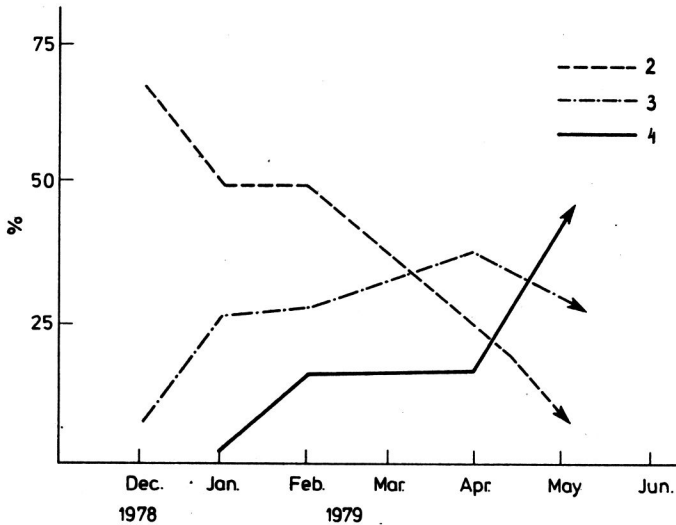


Fig. 5. Percentage of *Notothenia gibberifrons* individuals with different stages of gonad maturity acc. to 8-degree Maier's scale
2, 3, 4 — maturity stages

- Up to May the maturity of gonads of *Notothenia gibberifrons* reaches only the fourth stage.
- Analysis of the extent of filling the stomachs by the caught fish indicates near-bottom feeding of the shoal.

Table IV

Percentage*) of fish varying as to stomach fullness

Degree of stomach fullness	Year	Months					
		Dec.	Jan.	Feb.	Mar.	Apr.	May
0	1977	—**)	1	0	3	7	12
	1978	3	5	—	12	5	—
	1979	—	9	—	29	—	—
1	1977	—	16	0	29	50	57
	1978	19	47	—	27	22	—
	1979	—	41	—	53	—	—
2	1977	—	31	3	29	26	22
	1978	41	32	—	30	33	—
	1979	—	37	—	14	—	—
3	1977	—	27	13	14	5	5
	1978	31	13	—	24	26	—
	1979	—	11	—	3	—	—
4	1977	—	25	84	25	12	4
	1978	6	3	—	7	14	—
	1979	—	2	—	1	—	—

*) 100% is the every month sample for succeeding years

**) lack of data

5. Summary

The material was obtained from seine net catches on the shelf of South Georgia in 1977, 1978 and 1979. Table I gives the number of *Notothenia gibberifrons* analysed. Every year the number of big individuals in the shoal decreased (Fig. 1). This was also reflected by the age composition of the shoal (Fig. 3, Table II). In 1977 the mean length of fish was 37 cm and its age 12.7 years, in 1978 — 34 cm and 10.7 years, respectively, and in 1979 — 30 cm and 8.5 years. In summer (December-March) the fish most probably do not migrate, because the population length remains almost unchanged as regards frequency and dominance in classes (Fig. 2). Sex ratio was 1:1. Stages of gonad maturity tended to mature (Fig. 5) but did not exceed degree 4 in May (Table III). Ninety per cent of fish was grazing (Table IV).

These results are an opening for the research on the length and age of *N. gibberifrons* in regions of its occurrence.

6. Резюме

Материал происходил из проведённых заводов донной волокушей на шельфе Южной Джорджии в очередных годах 1977, 1978 и 1979. Количество анализированных рыб *Notothenia gibberifrons* указано в таблице I. Констатировано ежегодное уменьшение в стае количества больших особей (рис. 1). Это нашло также отражение в возрастном составе стаи (рис. 3, таблица II). В 1977 году средняя длина рыбы достигала 37 см, а её возраст 12,7 года. На год позже эти величины уменьшились до 34 см и 10,7 лет. Зато в 1979 году они достигли 30 см и 8,5 года. В летний период (декабрь-март) рыбы вероятно не предпринимают миграций так как распределение популяции по длине уверживается приблизительно на неизменном уровне посещаемости и преобладания в классах (рис. 2). Взаимоотношение самцов и самок удерживалось

на уровне пропорции 1:1. Процентная участь отдельных стадий гонад указывано тенденцию к зрелости (рис. 5) не переходя в мае 4 степени (таблица II). Рыбы в 90% кормятся (таблица IV).

Результат приведен в статье является началом работ над длиной и возрастом *Notothenia gibberifrons* в районах их выступления.

7. Streszczenie

Materiał pochodził z zaciągów przeprowadzonych włókem dennym na szelfie Południowej Georgii w latach 1977, 1978 i 1979. Liczbę analizowanych ryb *Notothenia gibberifrons* podaje tabela I. Stwierdzono coroczne zmniejszanie się w stadzie ilości osobników dużych (rys. 1). Znalazło to również odbicie w składzie wiekowym stada (rys. 3, tabela II). W 1977 r. średnia długość ryby wynosiła 37 cm, a jej wiek 12,7 lat. Rok później wartości te uległy obniżeniu do 34 cm i 10,7 lat. Natomiast w 1979 osiągnęły wielkość 30 cm i 8,5 lat. W okresie letnim (grudzień — marzec) ryby prawdopodobnie nie podejmują wędrówek, gdyż rozkład długościowy populacji utrzymuje się w przybliżeniu na niezmiennym poziomie frekwencji i dominacji w klasach (rys. 2). Stosunek płci utrzymywał się na poziomie proporcji 1:1. Stadia dojrzałości gonad wykazywały tendencje dojrzewania (rys. 5), nie przekraczając w maju stopnia 4 (tabela III). Ryby w 90% żerują (tabela IV).

Przytoczone w artykule rezultaty stanowią rozpoczęcie prac nad długością i wiekiem *Notothenia gibberifrons* w rejonach jej występowania.

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