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Observation on the growth of *Notothenia coriiceps neglecta* Nybelin and *Notothenia rossi marmorata* Fischer in Admiralty Bay (King George Island, South Shetland Islands)

ABSTRACT: 232 specimens of *Notothenia coriiceps neglecta* and 578 specimens of *Notothenia rossi marmorata* were collected in the region of Admiralty Bay during the period from March to December 1977. The age of the fish was determined from scales. Length — weight relationship was calculated for both species. The parameters of the von Bertalanffy equation were calculated for *Notothenia coriiceps neglecta*, whereas mean lengths for *Notothenia rossi marmorata* were given according to the particular age groups.

K e y   w o r d s : Antarctic, *Notothenia*, growth

1. Introduction

O l s e n (1954) initiated research on the growth of the Antarctic fish by describing the biology and growth of *Notothenia rossi marmorata* in the South Georgia region. A number of papers devoted to the problems of age and growth of this species have appeared in recent years. H u r e a u (1970), among others, calculated parameters of the von Bertalanffy equation for *Notothenia rossi rossi* from the region of the Kerguelen Islands. C r i p s and C a r r i c k (1975) showed the usefulness of the back-calculating method of fish length from scale length for *Notothenia rossi marmorata* from the South Georgia region. Ščerbič (1975) discussed in detail the method of age determination for this species from scales, whereas L i n - k o w s k i and R e m b i s z e w s k i (1978) gave mean lengths for various age groups in the spawning stock off South Georgia.

Fewer papers have been devoted to *Notothenia coriiceps neglecta*. Only H u r e a u (1970) investigated the growth of this species in the region of Terra Adeliae and E v e r s o n (1970) in the region of Signy Island.

In the present paper the problem of the age and growth of the two species mentioned in the region of Admiralty Bay are discussed.

2. Material and methods

Between March and December 1977 232 specimens of *Notothenia coriiceps neglecta* Nybelin and 578 specimens of *Notothenia rossi marmorata* Fischer were collected in the littoral zone of Admiralty Bay, King George Island, South Shetland Islands. The fishes were taken by hooks and lines, using artificial bait. Total length was measured to the nearest 0.5 cm. Scales were used for age determination. The scales of *Notothenia coriiceps neglecta* were prepared according to the method given by Kosswig (1973). *Notothenia rossi marmorata* scales were cleaned mechanically after 20 hours storage in 10% ammonia solution. The method of age investigation was adopted from Hureau (1970) for *Notothenia coriiceps neglecta* and from Ščerbič (1975) for *Notothenia rossi marmorata*. Age was calculated from August 1. Fish from which scales were to be removed, were weighed (wet weight) to the nearest 5.0 g.

3. Results

Notothenia coriiceps neglecta

Scale "checks" of this species were difficult to determine even after preparation.

Sexual dimorphism in growth rate was indicated by calculations of mean length of various age groups of males and females (Table I).

Table I.

Mean length (cm) at age of *Notothenia coriiceps neglecta* of various age groups in Admiralty Bay
Number of fish in parentheses

Age group	Males	Females
IV	19.3 (2)	—
V	20.9 (4)	25.9 (7)
VI	24.5 (17)	28.9 (25)
VII	26.6 (27)	30.3 (30)
VIII	28.9 (32)	32.4 (15)
IX	31.1 (19)	34.0 (12)
X	32.6 (12)	36.6 (7)
XI	33.0 (8)	37.8 (2)
XII	33.2 (2)	38.0 (1)

Although our collection included some samples from March and April the bulk of the material was gathered during the Antractic winter and early spring. The mean lengths listed in Table I refer to these seasons (July to October). These data were fitted to the von Bertalanffy equation:

$$l_t = L\infty(1 - \exp[-k(t - t_0)]);$$

where l_t is the length at age t, $L\infty$ the theoretical maximum length, K the rate at which this length is approached, and t_0 a constant. The resulting equations were:

$$l_t = 38.8 \, (1 - \exp{[-0.16 \, (t + 0.65)]})$$
and $l_t = 43.6 \, (1 - \exp{[-0.16 \, (t + 0.48)]})$,

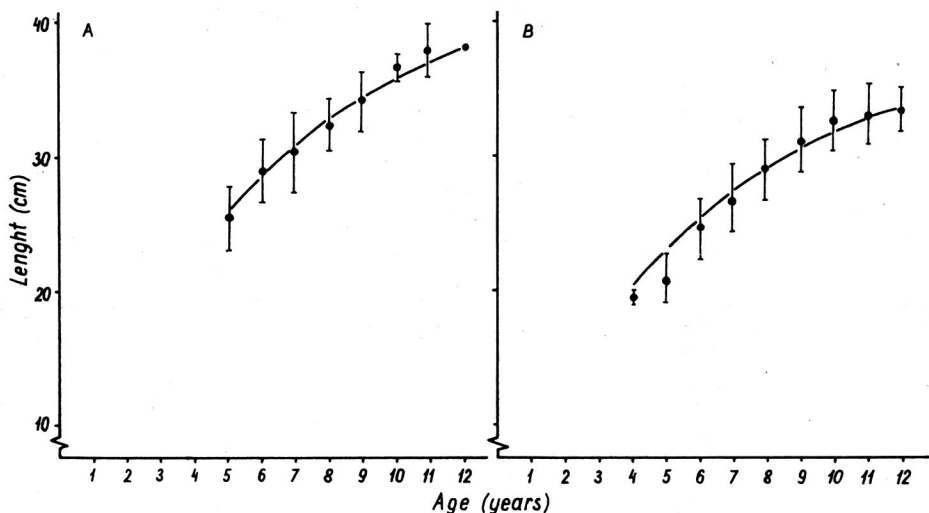for males and females respectively (Fig. 1).

Fig. 1. The von Bertalanffy growth curves of *Notothenia coriiceps neglecta*
A — females, B — males. Marked means and standard deviations of lengths of particular age groups

Power regression of the weight (in grams) on the length (in centimeters) gave:
$W = 0.0085 \, L^{3.1602}$ for males, and $W = 0.006 \, L^{3.2656}$ for females, where W is the weight and L is the length. The calculated r^2 values (coefficient of determination) were 0.96 and 0.95, respectively. The growth curves obtained from scale analyses are transformed into growth in weight in Fig. 2. by these relations.

Notothenia rossi marmorata

The presence of fish of age groups III to VII was observed in the material. The "checks" number on the scales of this species was easy to determine. All the fish were sexually immature, so the data from the both sexes were combined. Stages in ovaries and testes maturation of *Notothenia rossi marmorata* based on the cycle in *Notothenia coriiceps neglecta* described by Everson (1977) were Immature and Maturing Virgin for ovaries, and Immature and Developing for testes. Observations of the mean lengths of fish of age group IV (year classes 1972—1973), the most representative for the whole period of investigations, showed that the growth
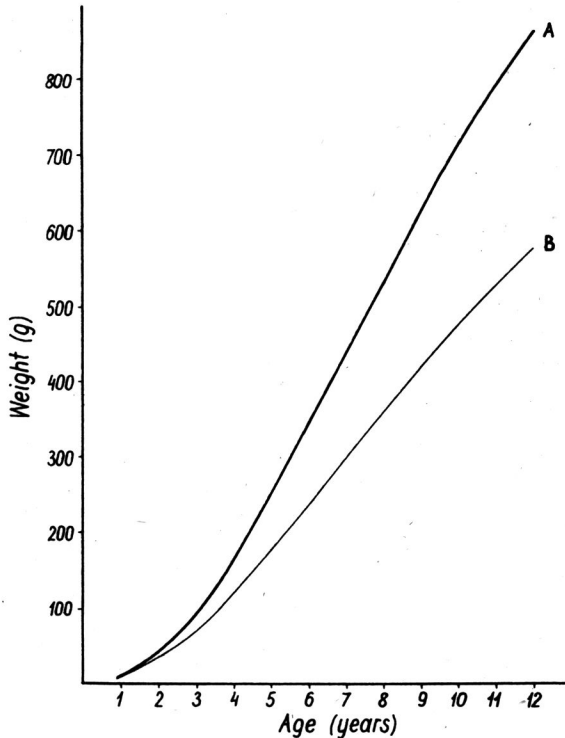
Fig. 2. Growth in weight of *Notothenia coriiceps neglecta*
A — females, B — males

of *Notothenia rossi marmorata* slowed down during the Antarctic winter and spring (Fig. 3). Table II gives the mean lengths of *Notothenia rossi marmorata* in various year classes during investigations conducted in autumn and winter. The length: weight relation calculated for this species is as follows:

$$W = 0.0064 \ L^{3.2216} \ (r^2 = 0.97)$$

4. Discussion

The results of analyses of *Notothenia coriiceps neglecta* growth are comparable with Everson's (1970) data, who investigated the growth of this species in the region of Signy Island (South Orkneys). The author pointed out the difficulties in determing the age from scales and determined it from otoliths. Despite the adopting of a different method of age determination the theoretical lengths calculated for particular age groups and the $L\infty$ values were similar to those obtained by Everson (1970). The "K" coefficients of the Bertalaffy equation, for both sexes of this species from the region of Admiralty Bay, are somewhat higher (0.16), however, than those calculated by Everson (1970) for the region of Signy Island (0.091 for females and 0.129 for males). This can be explained
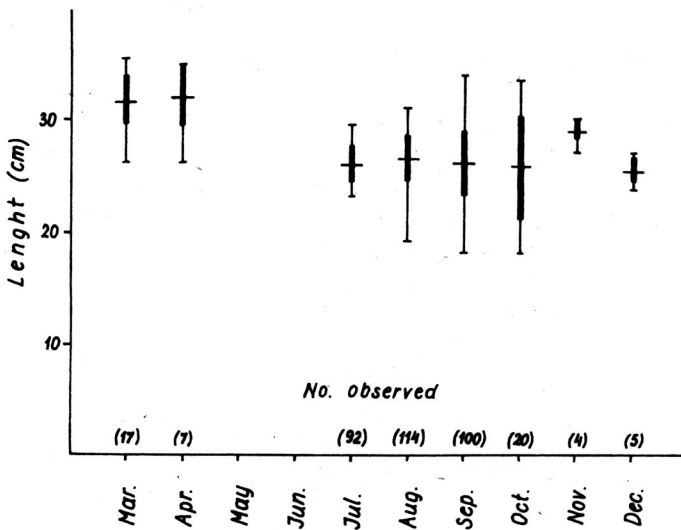
Fig. 3. Mean individual lengths of the IVth age group of *Notothenia rossi marmorata*
during the season investigated
The thin vertical lines indicate the range of variation. The horizontal lines, the mean. The
solid vertical lines, two standard deviations, one on either side of the mean

Table II.

Mean lengths (cm) of year classes of *Notothenia rossi marmorata* in Admiralty Bay
Number of fish in parentheses

Seasons	Year classes					
	1974	1973	1972	1971	1970	1969
March— April	—	26.0 (9)	31.8 (24)	35.5 (84)	37.7 (39)	39.8 (2)
July— October	21.2 (64)	26.2 (326)	33.1 (17)	34.2 (3)	38.0 (1)	—

by the fact that Everson's samples also contained older age groups
(XIII—XV), the presence of which was not observed in the region of
Admiralty Bay. The growth of *Notothenia rossi marmorata* is a difficult
problem to present. The difficulty lies in the fact that juveniles and adults
are separated (Olsen 1954, Ščerbič 1975). Separate investigations of the
growth of these two groups may lead to the same conclusion, as that
reached by Olsen (1954), that the change in the growth pattern is a result
of the offshore migration of the fish. As investigations of *Notothenia rossi
marmorata* in the region of South Georgia showed, the recruitment from
the so-called "fiord fish" to spawning stock is extended in time. The
presence of the same groups (IV—VI) among the "fiord fish" and

"spawning stock" (Olsen 1954) illustrates that fact (Olsen 1954, Crisp and Carrick 1975, Ščerbić 1975, Linkowski and Rembiszewski 1978). Comparison of the mean lengths of fish in the age groups mentioned (IV—VI) in "fiord fish" (Olsen 1954, Crisp and Carrick 1975) and "spawning stock" (Ščerbič 1975, Linkowski and Rembiszewski 1978) shows considerable differences. The largest individuals from these age groups are recruited to the spawning stock. The investigations of growth conducted only on the basis of the material covering the "fiord fish" or spawning stock led to the obtaining of incorrect parameters of the growth equation due to the unrepresentative length composition of the oldest (in "fiord fish") and the youngest (in the spawning stock) age groups. The presence of sexually immature fish was observed in Admiralty Bay only, therefore the growth equation for this species is not given and the information is restricted to mean lengths of age groups. It should be mentioned that fish up to and including the VII age group were found in Admiralty Bay, which may indicate that *Notothenia rossi marmorata* remains in the coastal zone for a longer period as compared with fish from the South Georgia region.

5. Summary

Analysed material was taken by hooks and lines in the off shore waters of Admiralty Bay, in the period of March-December 1977. Age of fish was determined from scales. Nine age groups of *Notothenia coriiceps neglecta* (IV—XII) and five age groups of *Notothenia rossi marmorata* (III—VII) were found.

The comparison of the mean lengths of males and females in particular age groups of *Notothenia coriiceps neglecta* shows the dimorphic differences of the growth rate of this species (Table 1). This phenomenon did not occur for *Notothenia rossi marmorata*. All studied individuals of this species were sexually immature. Growth parameters of von Bertalanffy equation were calculated for *N. coriiceps* and theoretical curves of growth in length and weight were drawn (Fig. 1). The same coefficient "K" (0.16) was obtained for both sexes, but different values of $L\infty$ (43.6 cm for females and 38.8 cm for males).

Slowing down of the growth of *N. rossi marmorata* was found during the autumn--winter period (Fig. 3). The participation of the *N. rossi marmorata* age group VII in studied material indicates that period of the occurrence of this fish in the inshore waters of King George Island is slightly longer than in the fiords of South Georgia.

6. Резюме

Проанализированный материал происходил из удочной ловли в литоральной зоне Залива Адмиральты в месяцах март-декабрь 1977 г. Возраст рыб определялся на основании чешуи. Во время ловли обнаружено 9 возрастных групп *Notothenia coriiceps neglecta* (IV—XII) а также 5 возрастных групп *Notothenia rossi marmorata* (III—VII).

Сравнение средних длин самцов и самок в отдельных возрастных группах *Notothenia coriiceps neglecta* указывает диморфические разницы темпа роста этой породы (таблица I). Похожее явление не выступало у *Notothenia rossi marmorata*. Все исследованные особи этого вида ещё не достигли половой зрелости. Для *N. coriiceps neglecta* были установлены параметры уравнения роста вон Берталанффи и намечено теоретические кривые возраста длины и веса (рис. 1). Для женского и мужского по-

ла получено такой же коэффициент „*K*" (0,16) и разные величины *L*∞ (43,6 см для самок и 38,8 см для самцев).

Обнаружено выразительное замедление роста *N. rossi maimorata* осенью и зимой (рис. 3). Участье в исследованном материале рыб из VII возрастной группы указывает что *N. rossi marmorata* переживает в литоральной зоне острова Кинг Джорж не много дольше чем в фиордах Южной Джоржии.

7. Streszczenie

Analizowany materiał pochodził z połowów haczykowych w strefie przybrzeżnej Zatoki Admiralicji, w okresie marzec-grudzień 1977. Wiek ryb określano na podstawie łusek. W połowach stwierdzono obecność 9 grup wiekowych *Notothenia coriiceps neglecta* (IV—XII) oraz 5 grup wiekowych *Notothenia rossi marmorata* (III—VII).

Porównanie średnich długości samców i samic w poszczególnych grupach wieku *Notothenia coriiceps neglecta* wskazuje na różnice dymorficzne tempa wzrostu tego gatunku (tabela I). Podobnego zjawiska nie stwierdzono u *Notothenia rossi marmorata*. Wszystkie badane osobniki tego gatunku nie osiągnęły jeszcze dojrzałości płciowej. Dla *N. coriiceps neglecta* obliczono parametry równania wzrostu von Bertalanffy i wykreślono teoretyczne krzywe wzrostu długości i ciężaru (rys. 1). Dla obu płci otrzymano taki sam współczynnik "*K*" (0.16), różne natomiast wartości *L*∞ (43,6 cm dla samic i 38,8 cm dla samców).

Stwierdzono wyraźne zahamowanie wzrostu *N. rossi marmorata* w okresie jesienno-zimowym (rys. 3). Udział w badanym materiale ryb z VII grupy wieku wskazuje, że okres przebywania *N. rossi marmorata* w strefie przybrzeżnej Wyspy Króla Jerzego jest nieco dłuższy niż w Fiordach Południowej Georgii.

8. References

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