Andrzej KOMPOWSKI

Stock monitoring

**CHANGES IN THE BLACKFIN ICEFISH STOCK STRUCTURE
(*CHAENOCEPHALUS ACERATUS* (LÖNNBERG, 1906), *PISCES*,
NOTOTHENIOIDEI, *CHANNICHTHYIDAE*)
OFF SOUTH GEORGIA WITHIN 1975 - 1992***

**ZMIANY W STRUKTURZE STADA BORELA (*CHAENOCEPHALUS*
ACERATUS (LÖNNBERG, 1906), *PISCES*, *NOTOTHENIOIDEI*,
CHANNICHTHYIDAE) W REJONIE POŁUDNIOWEJ GEORGII
W LATACH 1975 - 1992**

Department of Biological Marine Resources, Agricultural University of Szczecin, Poland

The paper demonstrates results of the stock monitoring of blackfin icefish in the region of South Georgia in the period of 1988/89 - 1991/92 as well as summarises seventeen-year period of observation (1976/77 - 1991/92).

The influence of fishing on stock structure and supposed reasons of fluctuation of year-classes number are discussed.

INTRODUCTION

Since the the fishing season 1976/77 (Kock 1985) blackfin icefish has become mentioned as a separate position in the catches in the South Georgia area. The author referred to (Kock 1991, 1992) states, that the exploitation of the species has begun much earlier and the lack of information resulted from disregarding fishes of this species in the fishing reports in former Soviet Union - although undoubtedly they contributed a constant by-catch in the catches of *Notothenia rossi* performed by bottom trawl. Thus the real amount of blackfin icefish catches was likely much higher when comparing to the official statistics.

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Stock monitoring of blackfin icefish in the region off South Georgia was carried out by Polish researchers since 1976. Detailed results of monitoring within 1976/77 - 1984/85 as well as 1985/86 - 1987/88 are presented in Kompowski's works, 1990a and 1990b, respectively.

The objective of present paper is to show and discuss the results of blackfin icefish stock monitoring in the period of 1988/89 - 1991 as well as to recapitulate and analyze the Polish observation performed throughout seventeen years of investigations (1976/77 - 1991/92) with an attempt of estimation factors influencing the stock structure.

MATERIALS AND METHOD

Fish to be studied in the period of 1988/89 - 1991/92 were collected during realization of the international Polish-British Programm concerning fish resources estimation in the area off South Georgia. They were sampled at random from the catches performed by bottom trawl, during the antarctic summer, by following vessels: R/V „Profesor Siedlecki” M/T „Hill Cove” and M/T „Falkland Protector” (1990/91 and 1991/92).

The total length of 9 305 fishes were measured and age of 1 478 blackfin icefish were determined, being read from the otoliths, employing the method described by Kompowski (1990a). The summary of studies made is demonstrated in Tab. 1.

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Table 1
Number of blackfin icefish studied in the South Georgia area by „split years”

„Split years”	Length measurements	Age determination
1988/89	1114	288
1989/90	1618	319
1990/91	2596	401
1991/92	3977	470
Total	9305	1478

RESULTS AND DISCUSSION

Results of monitoring of the blackfin icefish off South Georgia within 1988/89 - 1991/92

Fig. 1 shows the age and length distribution of blackfin icefish catches throughout 1975/76 - 1991/92. Seeing that data concerning last 4 fishing seasons have not been so far published anywhere, they will be discussed in details here.

Fig. 1. Length and age structure of the blackfin icefish stock in the South Georgia area in the period of 1975/76 - 1991/92

1975/76 - after Kock 1981; 1976/77 - 1984/85 - after Kompowski 1990a;
1985/86 - 1986/87 after Kompowski 1990b; 1988/89 - 1991/92 - original.

In the fishing season 1988/89 in the catches of R/V „Profesor Siedlecki” juveniles of blackfin icefish predominated, with some groups of similar length being clearly distinguished. Among others, fish can be found in 15 - 20 cm (mode - 17 cm), 24 - 28 cm (mode - 26 cm) and extremely abundant 36 - 45 cm (mode 39 - 40 cm) length classes. Examinations of otoliths showed that there were fishes belonging to I, II and IV age group, respectively. The latter one represented as much as 39.6% of all fish under investigation. Moreover, in the catches older mature blackfin icefish were found as well, belonging to V - XII groups of age (Fig. 1).

In the next fishing season 1989/90 in the catches of M/T „Hill Cove” juveniles of blackfin icefish were prevailing, too, constituting 39.4% of the whole sample caught. Two groups of fish of similar length were distinguished clearly, with the modes: 18 and 27 cm, corresponding to I and II age group. Additionally, fishes 42 - 52 cm long were very numerous (mode: 45 - 48 cm), with the most fish belonging to V age group - so to the abundant year-class born in 1984. Individuals of this year-class, in the previous season being immature, at present (in January) possessed gonads at II or III stage of maturity according to 5-stage Everson's scale - so they were already mature (Fig. 1).

In the successive fishing season 1990/91, in the experimental catches of M/T „Falkland Protector” about a half (50.7%) of fish examined consisted of juvenile, immature blackfin icefish, among which 3 groups of specimens of similar size were predominated (modal length: 17, 26 and 32 cm) belonging to I, II and III age group, respectively. The abundant year-class of 1984, at present being a member of VI age group, contributed 18.4% to the all individuals investigated. This age group was represented by mature fish 45 - 57 cm long (mode - 49 cm). Older age groups (VII - XI+) 50 - 72 cm long, consisted almost of females, contributed jointly 11.7% to the whole sample under study (Fig. 1).

In the last of fishing seasons described (1991/92) in the catches of M/T „Falkland Protector”, juvenile, immature blackfin icefish 14 - 36 cm long were predominating in higher even extent than in previous years, constituting jointly ca 70% of all individuals captured. Three groups of fish of modal length 17, 25 and 34 cm - belonging to I, II and III age groups - can be observed among those juveniles. Fishes from the II age group born in 1989 were extremely abundant, contributing as much as 41.1% to all fish captured. Moreover, fishes were found in IV - XII+ groups of age, as well. The number of strong in count year-class 1984 - at present belonging to VII age group - markedly decreased, contributing only 5.6% to all fishes under study. Specimens from this group of age - large mature fishes 48 - 57 cm long (mode - 52 cm) were characterized by weight ranging from 750 - 2000 g.

As can be seen from the data given above, in the whole four-year period 1988/89 - 1991/92 the abundant supply of recruitment was able to record.

Changes in the stock structure of blackfin icefish within 1975/76 - 1991/92 and their supposed reasons

The vital (demographic) structure of blackfin icefish stock in the South Georgia region has been observed pretty regularly since the fishing season 1975/76 (among others: Gubsch 1980; Gubsch and Hoffmann 1987; Kock 1981, 1986, 1991; Kompowski 1990a, 1990b; Ślósarczyk et al. 1985; Sosiński and Szlakowski 1992).

In Fig. 1, demonstrating length and age of blackfin icefish in catches by the bottom trawl, during the Antarctic summer in 1975/76 - 1991/92 fishing seasons, some intervals are distinguishable.

In seasons of 1975/76 - 1977/78 the range of fish length was fairly wide: from 15 to 80 cm, whereas large, mature individuals over 40 cm long were predominated. The largest specimens over 60 cm long being almost exclusively females, contributing in number over 20.0% to the catches (Kompowski 1990b). It was a stock structure typical for the stock under the weak pression of fishing (Fig. 1). The stock biomass, estimated by means of „swept area” method as well as by virtual population analysis (Kock and Agnew, by Kock 1991, 1992) was high, amounting ca to 19 thousands t.

The increase of blackfin icefish catches in the fishing season 1977/78 and succeeding ones (Kock 1991, 1992) resulted in considerable decrease of large fish count in the stock within 1978/79 - 1981/82. Contribution of large fish over 60 cm long decreased to 3.0 - 4.0% (Kompowski 1990b). At the same time in this period the stock was provided with the strong in number year-classes born in 1976, 1977 and 1978 (Fig. 1).

In the succeeding period - including fishing seasons 1980/81 - 1985/86, the supply of recruitment was very feeble and gradually growing old of stock was observed (Fig. 1). As can be seen from Agnew and Kock's examinations (by Kock 1991, 1992), the biomass of this stock decreased to the level lower by over a half when comparing to the values estimated for the initial period of study.

In the season 1986/87 an extremely strong year-class born in 1984 occurred in the catches - next being observed till the end of investigation - i.e. to 1991/1992 (Fig. 1).

In the five successive seasons: 1987/88 - 1991/92 the recruitment although lower than in 1986/87 - remaining on pretty high level (Fig. 1). Simultaneously the stock biomass, has become gradually, though slowly, to increase (Agnew and Kock, by Kock 1991, 1992). Nevertheless the recovering of the stock is slowly and large fishes (over 60 cm of total length) still constitute inconsiderable proportion of the population studied (2.5 - 4.2%).

The decisive influence on the blackfin icefish stock structure in the region of South Georgia in the period discussed undoubtedly exerts the pression of fishing - strong in the second half of seventies as well as in the first one of eighties, next practically being decreased to null thanks to the restrictions provided by CCAMLR. In Everson et al. (1992) opinion the pression being exerted indirectly on blackfin icefish stock through the elimina-

tion of juveniles of this species, being captured along with krill, is not high. After investigation of by-catch of fishes in the krill catches they concluded, that: "... large scale krill harvesting is probably having little effects on the stock of *Chaenoccephalus* ...".

The interesting phenomenon recorded is marked fluctuations of the year-classes number of blackfin icefish, thereby variations of the recruitment level. So far no attempts were made in order to explain reasons of this phenomenon.

The number of year-class is determined - first, by the spawning stock abundance, affecting the amount of eggs laid; secondly by environmental factors - being favourable or unfavourable for the development of eggs, larvae and juveniles.

Figure utilised by Kock (1991, 1992) from the earlier work (Agnew and Kock 1990) displayed the nearly linear relationship between the biomass of spawning stock of blackfin icefish and the number of recruits belonging to the I age group. This relationship can explain the occurrence of strong year class born in 1976, 1977 and 1978 - when the biomass of stock was high and large mature individuals were prevailing as well as feeble supply of recruitment throughout 1980/81 - 1985/86 - when the biomass of stock was low. However, strong in number year-class 1984 came into existence when the stock biomass was the lowest. So the environmental factors must have affected the number of this year class. As is well known the strongest effects of them are observed in larval, postlarval and juvenile period (see for instance in: Cushing 1974; Sissenwine 1984). The spawning of blackfin icefish takes place in the South Georgia region since the end of February to beginning of May (Permitin 1973; Kock 1981; Burchett et al. 1983). The length of larvae in August and September ranged within 12.0 - 30.0 mm (S.L.), in November 30.0 - 36.3 mm, in January and February 46.0 - 73.5 mm, while in March and April (as postlarvae) they are as much as 63.0 - 99.0 mm long (Efremenko 1979, 1983; Kompowski 1980; Ślósarczyk 1983, 1987; North 1988; North and Murray 1992). Among the biotic environmental factors the most important role affecting the abundance of year-class plays availability of food - and Kompowski (1980) found out that in March and April, 1977 in the South Georgia region postlarval blackfin icefish of total length covering the range 78.0 - 112.0 mm (L.S. = 72.0 - 98.0 mm) was existing in the krill swarms, intensively feeding on this crustacean. The abundance of krill in the South Georgia region during the Antarctic summer and autumn maybe one of the factors affecting the strength of blackfin icefish year-classes. Variations of the krill biomass from year to year, connected mainly with the changes of its distribution, are commonly known and probably being caused by changes of hydrobiological conditions, especially referring to the translocation (dislocation) of whirling system connected with the interaction of East and West Wind Drifts (see, among others, in: Heywood et al. 1985; Godlewska and Rakusa-Suszczewski 1988; Everson 1988; Priddle et al. 1988). Heywood et al. (1985) observed during the antarctic winter in 1983 and summer in 1983/84 an extremely low krill

biomass in the South Georgia area - resulting in the decrease of survival of young of species feeding on krill: a black-browed albatross (*Diomedea melanophrys*), penguins (*Pygoscelis papua* and *Eudyptes chrysolophus*) as well as fur seals (*Arctocephalus gazella*) (Priddle et al. 1988). Still the Antarctic summer and autumn in 1985, when postlarvae of the strong year-class of blackfin icefish born in 1984 attained sizes adequate for feeding on krill, were characterized already by the krill biomass close to the average one in the region of South Georgia - what is confirmed by close to the normal a reproductive success (counted per capita) of the birds and fur seals species mentioned (Priddle et al. 1988). Therefore any other factors must exist, except for described above, which can affect the number of blackfin icefish year-classes in the South Georgia region. Maybe it is a food availability in the early larval period - when the blackfin icefish feeding on the smaller preys than krill does.

REFERENCES

- Burchett M.S., P.J. Sayers, A.W. North, M.G. White, 1983: Some biological aspects of the near-shore fish populations at South Georgia. *Brit. Antarct. Surv. Bull.*, **59** : 63-74.
- Cushing D.H., 1974: The natural regulation of fish populations. In: *Sea Fisheries Research* [Harden Jones F.R., ed.], London : 399-412.
- Efremenko V.N., 1983: Atlas of fish larvae of the Southern Ocean. *Cybium*, **7** (2) : 3-74.
- Everson I., 1988: Can we satisfactorily estimate variation in krill abundance? In: *Antarctic Ocean and Resources Variability* [Sahrhage D., ed.], Springer Verlag : 199-208.
- Everson I., A. Neyelov, Y.E. Permitin, 1992: Bycatch of fish in the South Atlantic krill fishery. *Antarctic Science*, **4** (4) : 389-392.
- Godlewska M., S. Rakusa-Suszczewski, 1988: Variability of krill, *Euphasia superba* Dana, 1852 (Crustacea, Euphasiacea), distribution and biomass in the Western Antarctic (Bransfield Strait, Drake Passage, Elephant Island) during 1976-1987. *Inv. Pesq.*, **52**, 4 : 575-586.
- Gubsch G., 1980: Untersuchungen zur Alterbestimmung und zum Wachstum beim Eisfisch *Chaenocephalus aceratus* Lönnberg. *Fischerei-Forschung*, **18**, 1 : 7-10.
- Gubsch G., U. Hoffman, 1987: Fischerei-biologische Untersuchungen an Eisfisch- und Nototheniaarten des atlantischen Sektors der Antarktis. *Fischerei-Forschung*, **25**, 3 : 79-83.
- Heywood R.B., I. Everson, J. Priddle, 1985: The absence of krill from the South Georgia Zone, winter 1983. *Deep-Sea Res.*, **32**, 3 : 369-378.
- Kock K.-H., 1981: Fischerei-biologische Untersuchungen an drei antarktischen Fischarten: *Champsocephalus gunnari* Lönnberg, 1905; *Chaenocephalus aceratus* (Lönnberg, 1906) und *Pseudochaenichthys georgianus* Norman, 1937 (Notothenioidei, Channichthyidae). *Mitteil. Inst. Seefisch. Bundesforschungsanstalt für Fischerei*, **32** : 1-226.
- Kock K.-H., 1985: The state of exploited Antarctic fish stocks around South Georgia (Antarctic). *Arch. FischWiss.*, **36**, 1/2 : 155-183.
- Kock K.-H., 1986: The state of exploited Antarctic fish stocks in the Scotia Arc region during SIBEX (1983-1985). *Arch. FischWiss.*, **37**, 1 : 129-186.
- Kock K.-H., 1991: The state of exploited fish stocks in the Southern Ocean - a review. *Arch. FischWiss.*, **41**, 1 : 1-66.
- Kock K.-H., 1992: *Antarctic fish and fisheries*. Cambridge University Press, pp. 375.
- Kompowski A., 1980: Studies on juvenile *Chaenocephalus aceratus* (Lönnberg, 1906) (Pisces, Channichthyidae) from off South Georgia. *Acta Ichth. Pisc.*, **10**, 1 : 45-53.
- Kompowski A., 1990a: Biological characteristics of Scotia Sea icefish, *Chaenocephalus aceratus* (Lönnberg, 1906) from the South Georgia area. *Rep. Sea Fish. Inst., Gdynia*, **22** : 50-68.
- Kompowski A., 1990b: Studies on the composition of the stock of *Chaenocephalus aceratus* (Lönnberg, 1906), Pisces, Channichthyidae, in the region of South Georgia and South Shetlands. *Acta Ichth. Pisc.*, **20**, 1 : 29-44.

- North A.W., 1988: Distribution of fish larvae at South Georgia: horizontal, vertical, and temporal distribution and early life history relevant to monitoring year-class strength and recruitment. SC-CAMLR Sel. Sci. Pap./4, 1987 : 105-141.
- North A.W., A.W.A. Murray, 1992: Abundance and diurnal vertical distribution of fish larvae in early spring and summer in a fjord at South Georgia. Antarctic Science, 4, 4 : 405-412.
- Permitin Y.E., 1973: Fecundity and reproduction biology of whiteblooded fish (fam. Channichthyidae) and fishes of families Muraenolepidae and Bathydraconidae of the Scotia Sea (Antarctic). Vopr. Ichth., 13, 2 : 245-258. (In Russian).
- Priddle J., J.P. Croxal, I. Everson, R.B. Heywood, E.J. Murphy, P.A. Prince, C.B. Sear, 1988: Large - scale fluctuations in distribution and abundance of krill - a discussion of possible causes. In: Antarctic Ocean and Resource Variability [Sahrhage D., ed.], Springer Verlag : 169-182.
- Sissenwine M.P., 1984: Why do fish population vary? In: Exploitation of Marine Communities. Dahlen Konferenzen [May R.M., ed.], Springer Verlag : 54-94.
- Ślósarczyk W., Preliminary estimation of abundance of juvenile Nototheniidae and Channichthyidae within krill swarms east of South Georgia. Acta Ichth. Pisc., 13, 1 : 3-11.
- Ślósarczyk W., Contribution to the early life history of Channichthyidae from the Bransfield Strait and South Georgia (Antarctica). Proc. 5th Congr. Eur. Ichth., Stockholm, 1985 : 427-433.
- Ślósarczyk W., J. Sosiński, M. Mucha, K. Skóra, A. Kompowski, 1985: A review of Polish fishery and assessment of fish stock biomass off South Georgia. Sel. Pap. Presented to the Sci. Comm. Of CCAMLR 1982-1984, Part I : 385-422 + 15 tabl.
- Sosiński J., J. Szlakowski, 1992: Biological characteristics and biomass estimates of the fish stocks on the South Georgia shelf in the 1986/87 - 1988/89 seasons. Acta Ichth. Pisc., 22, 2 : 77-105.

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STRESZCZENIE

Monitoring stada borela (*Chaenocephalus aceratus* (Lönnberg, 1906)), prowadzony był przez polskich badaczy w rejonie Pd. Georgii od 1976 r. Wyniki obserwacji nad strukturą długościową i wiekową stada w ostatnich czterech sezonach lata antarktycznego: 1988/89 - 1991/92 wykazały bardzo obfite uzupełnienie tego stada przez osobniki młodociane (rys. 1)

Analiza całego okresu polskich badań (1976 - 1992) uwidacznia zmiany w strukturze stada spowodowane silną presją rybołówstwa w drugiej połowie lat siedemdziesiątych i w pierwszej połowie lat osiemdziesiątych. Zmiany te polegały m.in. na znacznym zmniejszeniu odsetka dużych ryb - ponad 60 cm (głównie samic) z około 20% do około 3 - 4%.

Mimo istnienia prawie prostoliniowej zależności między biomasą tarlaków a liczebnością uzupełnienia, silne pokolenie 1984 r. urodziło się w okresie - gdy ta biomasa była najniższa.

Fluktuacja liczebności pokoleń borela jest, być może, związana z wahaniami biomasy kryła, gdyż skorupiak ten jest głównym pokarmem osobników juwenalnych borela latem i jesienią antarktyczną. Na liczebność pokoleń może również wywierać wpływ dostępność pokarmu we wczesnym okresie larwalnym, gdyż borel odżywia się drobniejszymi organizmami niż krył.

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Author's address:

Prof. Tit. D.Sc. Andrzej Kompowski
Department of Biological Marine Resources
Agricultural University of Szczecin
Kazimierza Królewicza 4, 71-550 Szczecin Poland