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SC-CAMLR-III/BG/11
3 September, 1984

A REVIEW OF POLISH FISHERY AND ASSESSMENT OF FISH STOCK BIOMASS OFF SOUTH GEORGIA

Abstract

The review deals with the analysis of Polish catches off South Georgia in 1976-1982 and changes observed in the structure and biomass of the exploited fish stocks. Fisheries were carried out by 5-10 factory trawlers operating during the whole year with 2-3 month intervals, mostly in the Antarctic winter. In 1976-77, 1980/81 and 1981/82 the target species was Champsocephalus gunnari. In other years it was mixed fishery. The size of Polish catches depended more on the amount of fishing effort applied rather than on fish availability. The bulk of catches consisted of five species : Champsocephalus gunnari, Chaenocephalus aceratus, Pseudochaenichthys georgianus, Notothenia gibberifrons and N. rossii marmorata. The statistical data on catch composition submitted by Poland to the FAO were corrected by proper separation of individual species in commercial catches.

The analyses of catch length and age composition revealed a similar pattern for most of the species. At the beginning of the fishery, the larger and older specimens were dominant in the catches. This situation changed in the late seventies when younger fish began to predominate. The data indicates that the average length and age of C. gunnari and N. rossii marmorata has approached a point at which they reach sexual maturity, and in some cases (e.g. Dissostichus eleginoides) has already gone beyond this point.

The material collected by observers on commercial vessels was used for fish biomass estimates by the "swept area" method. The estimates were obtained under the assumptions of an even fish distribution and 100% catchability of the trawl, and refer to the one-third section of the island shelf. These assumptions and other sources of errors are discussed. The biomass of fishable stocks in the first season of Polish catches was estimated at about 383,000 tons. Differences in the biomass of C. gunnari were the major factor influencing the magnitude of changes of the estimates in subsequent fishing seasons.

EXAMEN DES PECHERIES POLONAISES ET EVALUATION DE LA BIOMASSE DES STOCKS ICHTYOLOGIQUES AU LARGE DE LA GEORGIE DU SUD

Résumé

Le présent document présente l'analyse des prises polonaises au large de la Géorgie du Sud pour les années 1976 à 1982 ainsi que les changements observés se produisant dans la structure et la biomasse des stocks ichtyologiques exploités. Les opérations de pêche ont été effectuées au moyen de 5 à 10 chalutiers-usines se déplaçant durant toute l'année exception faite de quelques intervalles de 2 à 3 mois surtout au cours de l'hiver antarctique. Champsocephalus gunnari fut l'espèce visée en 1976/77, 1980/81 et 1981/82. Quant aux autres années, il s'agit d'opérations de pêche mixte. Le volume des prises polonaises était plutôt fonction de l'importance de l'effort de pêche exercé que de l'abondance des poissons. La plus grande partie des prises était composée de cinq espèces, en l'occurrence: Champsocephalus gunnari, Chaenocephalus aceratus, Pseudochaenichthys georgianus, Notothenia gibberifrons et N. rossii marmorata. Les données statistiques sur la composition des prises présentées par la Pologne à la FAO ont été ajustées en séparant, de façon correcte, les espèces individuelles dans les prises commerciales.

Les analyses de la longueur et de la structure démographique des prises ont démontré des tendances similaires pour la plupart des espèces. Au début des opérations de pêche des spécimens plus gros et plus âgés prédominaient dans les prises mais cette situation s'est modifiée vers la fin des années soixante-dix lorsque des poissons plus jeunes ont commencé à prédominer. Les données indiquent que la longueur et l'âge moyens de C. gunnari et de N. rossii marmorata ont presque atteint le point où ils arrivent à la maturité sexuelle et que dans certains cas (par exemple celui de Dissostichus eleginoides) ce point a déjà été dépassé.

Les données relevées par des observateurs à bord des navires de commerce ont servi à évaluer la biomasse ichtyologique par la méthode de "balayage de zone". Les estimations ont été obtenues en supposant que la distribution des poissons était égale et que la capacité de capture du chalut était de 100%. Elles se rapportent à un tiers de la superficie du plateau insulaire. Ces hypothèses et d'autres sources d'erreurs sont examinées. La biomasse des stocks exploitables au cours de la première saison de captures polonaises était de l'ordre de 383 000 tonnes. Les différences concernant la biomasse de C. gunnari constituent le facteur principal expliquant l'importance des changements se produisant dans les estimations des saisons de pêche ultérieures.

ОБЗОР ПОЛЬСКОГО ПРОМЫСЛА И ОЦЕНКА БИОМАССЫ РЫБНЫХ ЗАПАСОВ ВОКРУГ ЮЖНОЙ ГЕОРГИИ

Резюме

Обзор содержит анализ польских уловов вокруг Южной Георгии в 1976-1982 гг. и описание результатов наблюдений за изменениями в структуре и биомассе эксплуатируемых рыбных запасов. Промысел велся 5-10 плавучими базами, действующими круглый год с интервалами в 2-3 месяца, в основном во время антарктической зимы. В 1976/77, 1980/81 и 1981/82 гг. целевым видом был Champsocephalus gunnari. В другие годы велся ненаправленный промысел. Размер польских уловов зависел больше от величины затраченных промысловых усилий, чем от наличия рыбы. Уловы состояли главным образом из пяти видов: Champsocephalus gunnari, Chaenocephalus aceratus, Pseudochaenichthys georgianus, Notothenia gibberifrons и N. rossii marmorata. Представленные Польшей в ФАО статистические данные по содержанию уловов были разбиты по стандартному разделению по отдельным видам при коммерческих уловах.

Анализ содержания уловов по длине и возрасту дал сходные данные для большинства видов. В начале промысла в уловах преобладали более крупные особи и особи старших возрастных групп. Это положение изменилось в конце семидесятых годов, когда стали преобладать особи младших возрастных групп. Данные показывают, что средние длина и возраст C. gunnari и N. rossii marmorata приблизились к тому уровню, при котором эти виды достигают половозрелости, а в некоторых случаях (напр., Dissostichus eleginoides) уже превысили этот уровень.

Материал, собранный наблюдателями на коммерческих судах, был использован для вырабатывания оценок биомассы рыбы методом "swept area" ("вычищаемых площадей"). При получении оценок предполагалось, что распределение рыбы равномерно и вылавливаемость - 100%; оценки относятся к одной трети площади островного шельфа. Обсуждаются эти предположения и другие источники ошибок. Биомасса вылавливаемых запасов рыбы в течение первого сезона польского промысла была оценена приблизительно в 383000 тонн. Различия в биомассе C. gunnari являлись основным фактором, влияющим на величину изменений в оценках в последующих промысловых сезонах.

UNA REVISION DE LA PESCA DE POLONIA Y EVALUACION DE LA BIOMASA DE LAS EXISTENCIAS DE PECES FRENTE A GEORGIA DEL SUR

Resumen

La revisión trata del análisis de las capturas de Polonia frente a Georgia del Sur durante 1976-1982 y de los cambios observados en la estructura y la biomasa de las existencias de los peces explotados. La pesca fue llevada a cabo por 5-10 arrastreros factoría que operaron durante todo el año, con intérvalos de 2 a 3 meses, generalmente durante el invierno antártico. En 1976-77, 1980/81 y 1981/82 la especie objetivo fue Champsocephalus gunnari. Durante otros años la pesca fue variada. El tamaño de las capturas de Polonia dependieron más de la cantidad de esfuerzo pesquero empleado que de la disponibilidad de los peces. La mayor parte de las capturas estaban formadas por cinco especies: Champsocephalus gunnari, Chaenocephalus aceratus, Pseudochaenichthys georgianus, Notothenia gibberifrons y N. rossii marmorata. Los datos estadísticos sobre la composición de la captura presentados a la FAO por Polonia se corrigieron separando apropiadamente las especies individuales de las capturas comerciales.

Los análisis de la talla de la captura y la composición por edad revelaron un patrón similar con respecto a la mayoría de las especies. Al comienzo de la pesca, predominaban los especímenes más largos y de mayor edad en las capturas. Esta situación cambió en los últimos años de la década del setenta, cuando empezaron a predominar los peces jóvenes. Los datos indican que la talla y edad promedio de C. gunnari y N. rossii marmorata se han aproximado a un punto en que alcanzan la madurez sexual y en algunos casos (por ej. Dissostichus eleginoides) ya se ha pasado dicho punto.

El material recolectado por los observadores en las naves comerciales se utilizó en las estimaciones de biomasa de peces de acuerdo con el método de "barrido de área". Las estimaciones se obtuvieron asumiendo una distribución pareja de peces y un 100% de posibilidad de captura del arrastrero, y se refieren a un tercio de sección de la plataforma de la isla. Se debatió sobre estas suposiciones y otras fuentes de error. Se calculó que la biomasa de las existencias que se pudieron pescar durante la primera temporada de las capturas de Polonia consistió en aproximadamente 383,000 toneladas. Las diferencias en la biomasa de C. gunnari fue el factor más importante que influenció la magnitud de los cambios de las estimaciones en las temporadas pesqueras subsiguientes.

A REVIEW OF POLISH FISHERY AND ASSESSMENT OF FISH STOCK BIOMASS OFF SOUTH GEORGIA

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INTRODUCTION

Fish have been caught in the Southern Ocean since the end of the 1960's. Major fishing grounds in the Atlantic sector of the Southern Ocean are located along the Scotia Arc, in its Indian sector - around a series of sub-Antarctic islands, mid-ocean banks and underwater ridges. So far, no fishing grounds which could be exploited on an industrial scale have been found in other regions of the Antarctic.

Polish fishing operations in the Antarctic were limited to the Atlantic sector of the Southern Ocean except for several fish survey cruises made in the Indian sector. Catches were mainly made on the shelf of South Georgia and also, off the South Orkney Is. and South Shetland Is. This report deals with the analysis of Polish catches off South Georgia in 1976-1982 and changes observed in the structure and biomass of the exploited fish stocks.

MATERIAL AND METHODS

Information about the size and species composition of catches and the size of c.p.u.e. was prepared at the Sea Fisheries Institute on the basis of data submitted by fishery enterprise conducting fishing operations in the Antarctic. Additional information on the catch composition and c.p.u.e. as well as materials for biological studies of the fish taken were collected during the cruises of the Sea Fisheries Institute's research vessel "Profesor Siedlecki" (1976, 1978/79, 1981) or were supplied by observers sent by the Institute to commercial vessels : M.T. "Gemini" (1976/77, 1977/78), M.T. "Rekin" (1976/77), M.T. "Sirius" (1977/78, 1978/79), M.T. "Libra" (1980/81), and M.T. "Neptun" (1981/82) (Fig. 1).

Total length of fish was measured to the nearest cm below. Scales or otoliths were used for age determination. In some cases, the small sample size used for ageing fish is probably not representative for the random sample measured and for the stock, especially with respect to Chaenocephalus aceratus. In the case of this species only length of fish was measured and otoliths collected in the whole period of catches. Prelimiary ageing made in the first three years of catches was not continued further, since the share of this fish in the Polish catches was quite small, ranging between 5 and 8%. In order to quickly supplement the draft of this review fish were aged on the basis of small otolith samples, for the first three years for the second time.

The estimation of fish biomass on the South Georgia shelf was made by the "swept area" method under the assumption of a hundred percent catchability of fishing gear. Material collected by observers on commercial vessels "Gemini, "Libra", and "Neptun" and those caught during the 1978/79 cruise of the "Profesor Siedlecki" were used for biomass estimates (Fig.1, Table I). Fishable stocks in the near-bottom water layer, in three depth zones : 50-150, 150-250, and 250-500 m were estimated. For each zone, mean relative biomass density was calculated with no additional density stratification. The results of the calculations were referred to a part of the island shelf surface area (12,581 km^2) at the boundaries of squares 56-58 and 60-65 (after Everson 1980), which have been the areas of our investigations and fishing operations.

COMMERCIAL CATCHES

The Polish fishing fleet caught from 5,937 to 24,458 tons of fish and krill per annum on the South Georgia fishing grounds (Tables II-VII). The share of Polish catches in the world catches on the South Georgia shelf is difficult to determine on the basis of the available data. In the whole Atlantic sector of the Southern Ocean, it equalled on the average 7.2% of the total catches of fish and krill (20% as regards fish catches alone) (Tables VIII and IX). The size of Polish catches in the Antarctic depended mostly on the amount of fishing effort and, to a lesser degree, on c.p.u.e. attained (Fig. 2).

The bulk of catches consisted of five fish species : Champsocephalus gunnari, Chaenocephalus aceratus, Pseudochaenichthys georgianus, Notothenia gibberifrons and N. rossii marmorata (Fig. 2). Dissostichus eleginoides and other Nototheniids, Raja spp. and krill (except for the 1976/77 season) were taken in small quantities. In the first years of exploitation (until the 1979/80 summer season), P. georgianus, N. gibberifrons, and N. rossii marmorata together constituted between 62.9 and 88.6% of all fish catches; later, one species, C. gunnari, predominated in the catches (over 53%).

High yields of C. gunnari characterized Polish fishing operations off South Georgia at the beginning of 1977 (January-March). In the following months of that year as well as in the whole next season, many species were taken and the yields attained were lower. In the short period of fishing operations of the 1978/79 season, relatively high yields of N. rossi marmorata, N. gibberifrons and Pseudochaenichthys were attained only in August and September. Yields in the catches of C. gunnari were very low in that season as well as in 1979/80. In the latter total c.p.u.e. values were also low. The situation improved in the 1980/81 and 1981/82 seasons, mainly due to the increase in yields of C. gunnari.

Fishing operations were usually conducted by 5 to 10 factory trawlers (2000-3999 GRT category) during the whole year, with 2-3 month intervals, mostly during the Antarctic winter. Trawlers utilized in the main the

P-32/36 and P-36/39 bottom trawls (Table I). In the 1976/77, 1980/81 and 1981/82 seasons, fishing operations were directed at C. gunnari; in the remaining seasons mixed fishery was conducted.

CATCH LENGTH AND AGE COMPOSITION

Champsocephalus gunnari

In the 1975-76 and 1976/77 seasons the stock of C. gunnari was characterized by the presence of large specimens with a length of 35-42 cm, belonging mostly to age groups IV-VIII (Fig. 3). This situation changed completely in the following seasons. Due to intensive fishing in the 1976/77 season, younger specimens began to predominate, especially 3-year olds with a length of 22-33 cm ; the size of stock depended on the abundance of one year class recruited to the stock. Besides this most abundant age group, the catches consisted at that time of small numbers of older fish, mostly belonging to age-groups IV and V, with a length of 33-38 cm. The share of those fish was, as a rule, larger at the beginning of the season (October-November).

Towards the end of the 1977/78 and 1981/82 seasons (February-April), juvenile fish from age-group II, with a length of 13-20 cm, were also observed in the catch.

Chaenocephalus aceratus

In the fishing seasons 1976/77 - 1977/78 fish with a length of 15-75 cm were observed in the catches (Fig. 4). Fish belonged mostly to age groups III-IX with a length of 30-65 cm. During research cruises in the 1978/79 season, the length range of fish caught was similar (12-72 cm).

As in the case of Pseudochaenichthys, younger 1-3 year old fish, with a length below 35 cm predominated, because sampling was made with a trawl of much smaller meshes in the codend. In the 1979/80 season, no investigations were carried out. In the subsequent two seasons juvenile

fish from the abundant year-classes of 1976-1978 continued to predominate : in 1980/81, age-groups II-IV and in the following season, age-groups III-IV.

Pseudochaenichthys georgianus

Changes in length and age observed in fish of this species in the Polish catches are presented in Fig. 5. In the 1976/77 and 1977/78 seasons, Pseudochaenichthys with a length below 45 cm was scarce in the catches. Older fish, belonging to age-groups VIII-XIII, were mostly caught. The materials collected during a research cruise in the 1978/79 season and later, in 1980-1982, show the predominance of younger fish, belonging mostly to age-groups III-VII, with a length of 35-50 cm.

Notothenia gibberifrons

In the first two seasons of intensive fishing, specimens over 10 years old predominated in the catches (Fig. 6). Their number dropped in later years while the number of younger fish was on the increase. In the last season, 7-, 8-, and 9-year olds predominated. Mean length of fish decreased from 37 cm in 1976/77 to 32 cm in the last fishing season.

Notothenia rossii marmorata

The share of young fish in the catches increased between the beginning of our fishing operations and the 1980/1981 season (Fig. 7). At the end of this period, the share of 3-5 year olds recruited at this age to the exploited stock and still to a large degree immature, exceeded 50%. Mean length of fish in Polish catches gradually decreased and equalled, beginning with the 1976/1977 season : 59.1, 53.5, 50.5 and 43.0 cm (there are no data from the 1979/1980 season). A similar decrease, between 6.5 and 5.3 years, in the mean age was observed. In the last fishing season (1981/1982), age structure of the catch improved slightly - the share of age-group III and IV decreased, and mean length of fish increased to 47.8 cm.

Dissoctichus eleginoides

Fish of this species, caught off South Georgia, usually reached larger dimensions than those taken on the remaining Antarctic and sub-Antarctic fishing grounds exploited by our fleet. The length range of the fish caught was 19-206 cm ; in 1977-1979, fish ranging from 46 to 65 cm predominated, in 1980 - fish with lengths of 41-60 cm. Mean length of fish from the South Georgia fishing grounds was 63.3 cm in 1977 and decreased gradually to 50.5 cm in 1980. Smaller specimens were taken on the near-by Shag Rocks fishing grounds ; mean length also decreased there as a result of fishing - it dropped from 49.1 cm in 1979 to 39.3 cm in 1981.

In 1977-1979 D. eleginoides predominating in the catches made off South Georgia belonged to age-groups X-XII (in 1980 - VIII and IX), fish caught on Shag Rocks belonged to age-groups IV-VII (mostly V).

FISH BIOMASS ESTIMATE

The estimation of fish biomass from the South Georgia fishing grounds is referred to the one-third section of the island shelf (12,581 km^2) , at a depth zone of 50-500 m, presented in Fig. 1. The area trawled was different in each of the fishing seasons ; it was also different in each depth zone (Tables I and X). Relative biomass density of each species also exhibited differences, depending on the season and depth (Table X) [redacted]. The greatest differences in biomass density were observed in C. gunnari and it was these differences that influenced most of all the magnitude of changes in the estimated biomass of fish in subsequent fishing seaons (Table XI). On the other hand, the low result of the biomass estimate in the 1978/79 season, so different from the others, is a result of the fishing tactics of the research vessel, differing significantly from the tactics of commercial fishing vessels.

DISCUSSION

Commercial catches

The data contained in tables dealing with Polish catches on the South Georgia fishing grounds (Tables II-VII) differ in some respects from the information in Statlant 08 A and B forms, submitted to the FAO. At the beginning of our exploitation of these fishing grounds, catch reports did not distinguish among various species from the family Nototheniidae.

After the assortment "notothenia", covering two species predominating in the catches - N. gibberifrons and N. rossii marmorata, was distinguished and an additional change concerning the trade name for this group was introduced, catch reports became confusing. In the present paper, on the basis of direct observations conducted by ichthyologists on board fishing vessels, an attempt was made to separate too broad assortments into individual species ; several pieces of false information were also eliminated. Changes in the catch statistics were introduced only in those months of the fishing seasons, in which specialists from the Sea Fisheries Institute were present on the fishing ground. Most corrections were introduced on the basis of observations made from one trawler (two in 1977/78) so the size of catches obtained should be treated as approximate.

Catch length and age composition

The visible decrease in the length and age of fish caught off South Georgia is mentioned by many authors. The rapidly increasing catches of C. gunnari in 1975/76 - 1977/78 were accompanied by a fast decrease in the share of larger fish (35-45 cm) in the stock (Kock et al. 1984). Beginning with the 1978/79 season, the presence of juvenile fish below 20 cm in length was observed in the catches (Sosinski 1981, Bech 1982). What is alarming is the numerous appearance of postlarval and juvenile C. gunnari in the catches of krill, on which they feed (Kompowski 1980, Slosarczyk, 1983). Length distributions for Chaenocephalus from 1975/76 - 1977/78 do not show the impact of the fishery upon the stock structure of this species. (Kock et al. 1984). The same is true about Pseudochaenichthys.

The length distribution from the 1978/79 season comes from research catches made by R.V. "Profesor Siedlecki" and is not a result of intensive fishing in 1977/78 as believed by Kock et al. (1984) after Mucha (1980).

The gradual decrease in the mean length and age of N. rossii marmorata, observed during our catches, was also taking place in the early 1970's, beginning with 68.1 cm and 9.3 years in 1969 to 59.5 cm and 6.8 years in 1973 (Scherbich 1976) and 56.5 cm in 1975/76 (Linkowski and Rembiszewski 1978). A similar process was taking place in the stock of N. gibberifrons. However, considerable differences in age readings between Boronin and Frolkina (1976) and Skora (1980) make it impossible to thoroughly analyse its stock from the beginning of the 1970's.

A detailed analysis of these data indicates that the length and age of many exploited species have approached a point, at which they reach first sexual maturity, and in some cases have already gone beyond this point. Besides juvenile C. gunnari, mentioned above, the share of juvenile fish of the four remaining major species was also large in the catches in the whole period of our exploitation of the South Georgia fishing grounds. However, it did not reach 84% in the case of Chaenocephalus or 56% for Pseudochaenichthys as described by Kock et al. (1984) after Sosinski and Skora (1977) ; accurately speaking, these figures refer to immature fish, in various months of the 1976/77 season, which, especially at the beginning of the season, is not synonymous with juvenile fish. The problem of D. eleginoides from the Shag Rocks fishing grounds seems more serious. The results of our investigations confirm earlier observations of Zacharov and Frolkina (1976) : juvenile fish, age 4 through 8, have been mainly caught at this fishing ground for years.

Fish biomass estimate

Estimations of fish biomass on the South Georgia shelf were made by the "swept area" method by Kock (1980, 1981), Kock et al (1984), Mucha (1982), and Mucha and Skora (unpubl.). Kock's estimation from the 1975/76 season widened the time scope of Mucha's and Skora's investigations while the results of estimations from the 1977/78 and 1980/81 seasons enable a

partial comparison of the results. Besides those mentioned above, there are also estimations of the BIOMASS Working Party on Fish Biology (BIOMASS 1980), based on Polish source data collected during research and commercial cruises in the years 1976-1979.

The biomass of fish estimated by the "swept area" method may be overestimated or underestimated depending on whether the true catchability coefficient of the trawls in larger or smaller than the one assumed in the calculations. The catchability coefficient of the trawl is different for different fish species. In the case of a bottom trawl, it is no doubt larger for fish feeding and living on the bottom (e.g. N. gibberifrons) and smaller for fish undertaking vertical migrations in search of food (C. gunnari).

In the case of C. gunnari, the exclusive use in the calculations of bottom catch results, especially those referring to trawls with a small vertical opening, no doubt leads to underestimation of the species biomass, which is probably the case with polish estimates in the 1977/78 and 1978/79 seasons. This is confirmed by the results of our preliminary estimations based on Polish catches in the 1983/84 season (Table XII, and XIII, Annex I) Many vessels used a pelagic trawl hauled closed to the bottom. C. gunnari was exclusively caught and the results obtained were much better than in the case of a bottom trawl, used at the same fishing ground by other fishing vessels [redacted]. Relative overestimation of the stocks of C. gunnari with respect to other species noted in the first season of our fishing operations and in the 1980/81 season in Polish and German catches (Kock et al. 1984) is a result of fishing directed at this species.

Overestimation may be also caused by the use in the calculations of catch results of fish species which are unevenly distributed on the island shelf. Besides C. gunnari, this may be the case with N. rossii marmorata which, according to the observations of fishermen, often occur in dense concentrations on relatively small fishing grounds. The high relative biomass densities obtained at these fishing grounds cannot be referred to the whole area of the island shelf without the use of density

stratification. The risk of making an error in such a case increases considerably when a small number of hauls is made in a given depth zone. This is the case with fish stocks assessment in March, 1976 in the 150-250 m depth zone, which was based on one haul made by the "Profesor Siedlecki", and consisting in 83.2% of N. rossii Marmorata (BIOMASS 1980, Annex 2). Gulland (1983) uses this estimate and Kock's (1980) estimation from 1975/76 to arrive at a conclusion about the size of fish stocks on the South Georgia shelf before the period of their intensive exploitation at the end of the 1970's. The biomass of fishable stocks in 1975/76 estimated at 1 million tons (Gulland) seems to be overestimated at least 3 times when compared with the estimation of Kock et al. (1984) who give the figure of 338,122 tons or the estimation based on Polish data from the subsequent season (1976/77), equalling 382,707 tons (BIOMASS 1980). In the case of the latter estimate, it should be remembered that its size was greatly influenced by the results from January, 1977, which were no doubt a result of intensive fishing directed at large concentrations of C. gunnari, not observed in this depth zone in the three subsequent months of 1977, nor in March, 1976. The result of calculations from the 1976/77 season is also partly overestimated because of the overestimation of the biomass of N. rossii marmorata in March and April, 1977, caused by reasons mentioned above.

The estimation of fish stocks by the "swept area" method or by means of other methods may be only a more or less accurate evaluation of the fish biomass level or its changes over extended periods of time. Large changes in c.p.u.e. in subsequent months of the season, observed on the South Georgia fishing grounds, directly influence the changes in the calculated biomass density and make it very difficult to interpret them within one season, which is the case with fish biomass estimation in the 1976/77 season (BIOMASS 1980).

If the estimation is based exclusively on the results of catches of a fishing fleet, then the size of the area trawled changing in subsequent exploitation seasons may lead to the inclusion or exclusion of whole shelf depth zones from the calculations. In such cases, the interpretation of the results should be limited to a comparison of relative biomass density between seasons, separately in each depth zone.

All the negative aspects of the method mentioned above do not diminish its value for direct estimation of bottom fish, for which the method of echosounding and echointegration is ineffective. The accuracy of fish stock estimation by the "swept area' method for the species C. gunnari, which, appearing in concentrations, is well recorded over the bottom and in the pelagic zone would be increased by hydroacoustic determination of the distribution of fish. This would make it possible to refer the results of calculations of relative biomass density to the surface area currently occupied by the species under study and would eliminate fish stock estimation outside the boundaries of their occurrence, which must be the case when converting the estimates to cover the whole area of the South Georgia shelf (about 36,000 km^2). In the Polish estimation, the distribution of the fleet and hauls in particular months of fishing seasons was a certain indicator of the distribution of fish concentrations in those sectors of the shelf where trawling could be conducted. Thus, long-term observations of the catches made by Polish trawlers influenced the decision to limit our calculations to about one-third of the island shelf area.

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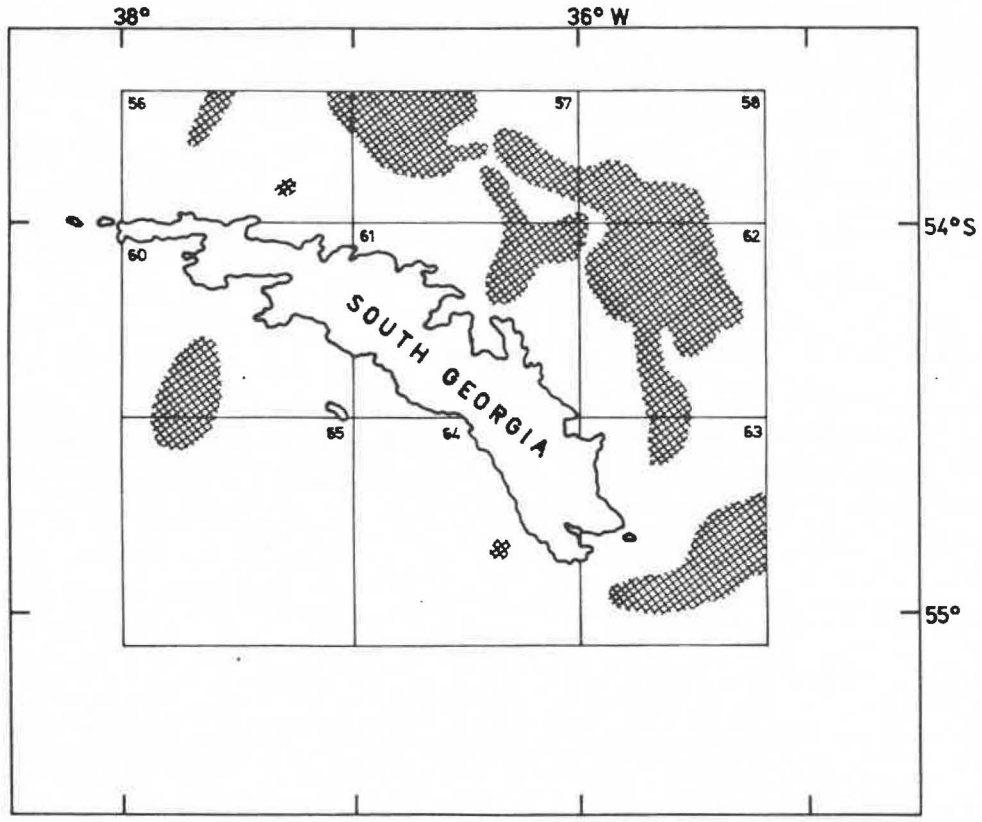

Fig. 1 Area of Polish fishing operations and biological studies off South Georgia in 1976 -1982, at the boundaries of rectangles 56 - 58 and 60 - 65 /after Everson 1980/.

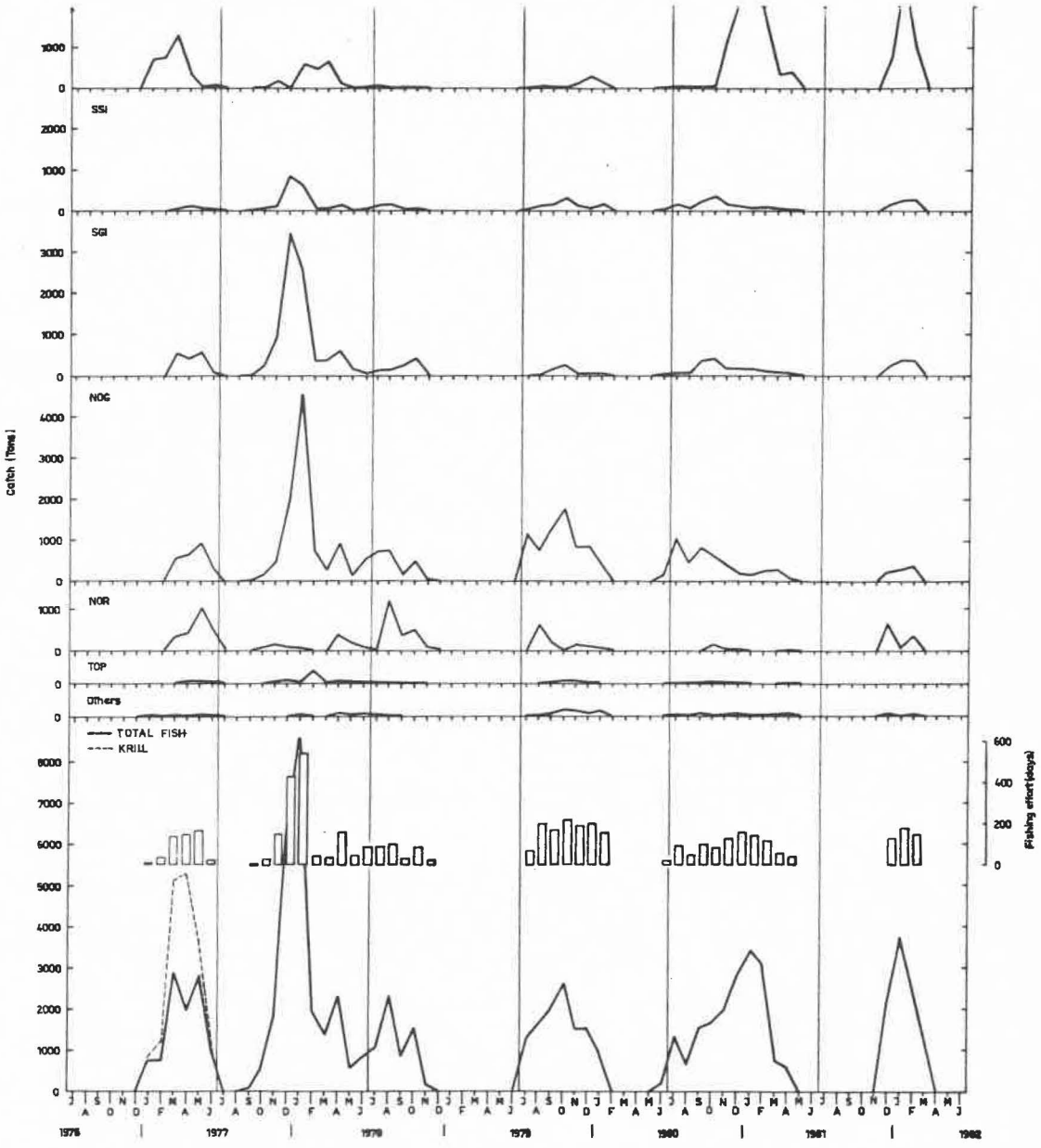

Fig.2 Nominal Polish catches and fishing effort in FAO subarea 48.3 /South Georgia/ in 1976-1982, by species and month

ANI - Champsocephalus gunnari, SSI - Chaenocephalus aceratus, SGI - Pseudochaenichthys georgianus, NOG - Notothenia gibberifrons, NOR - Notothenia rossi marmorata, TOP - Dissostichus eleginoides

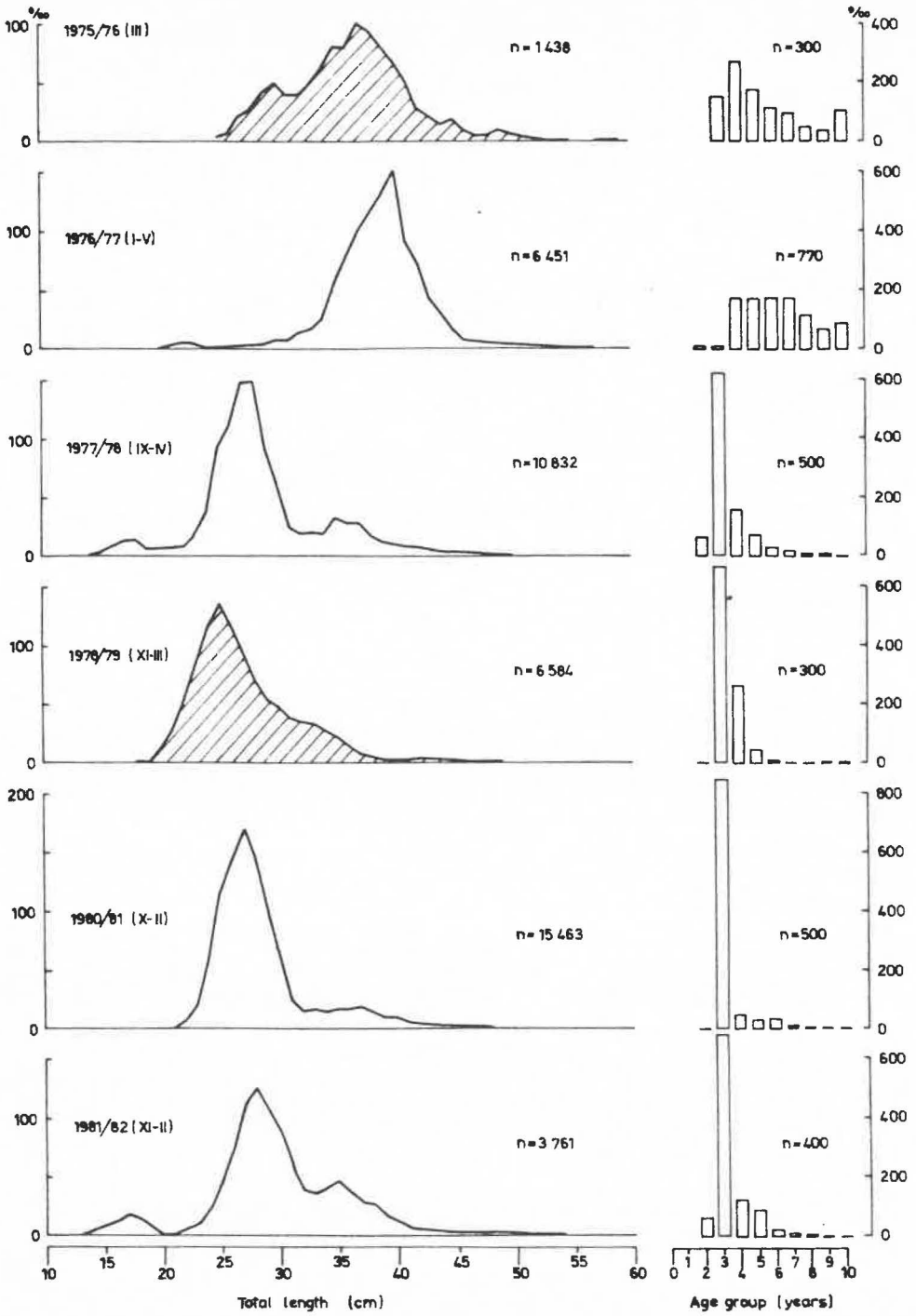

Fig.3 Length and age frequency distributions of Champsocephalus gunnari from South Georgia between 1976 and 1982. Lined figure = scientific sampling.

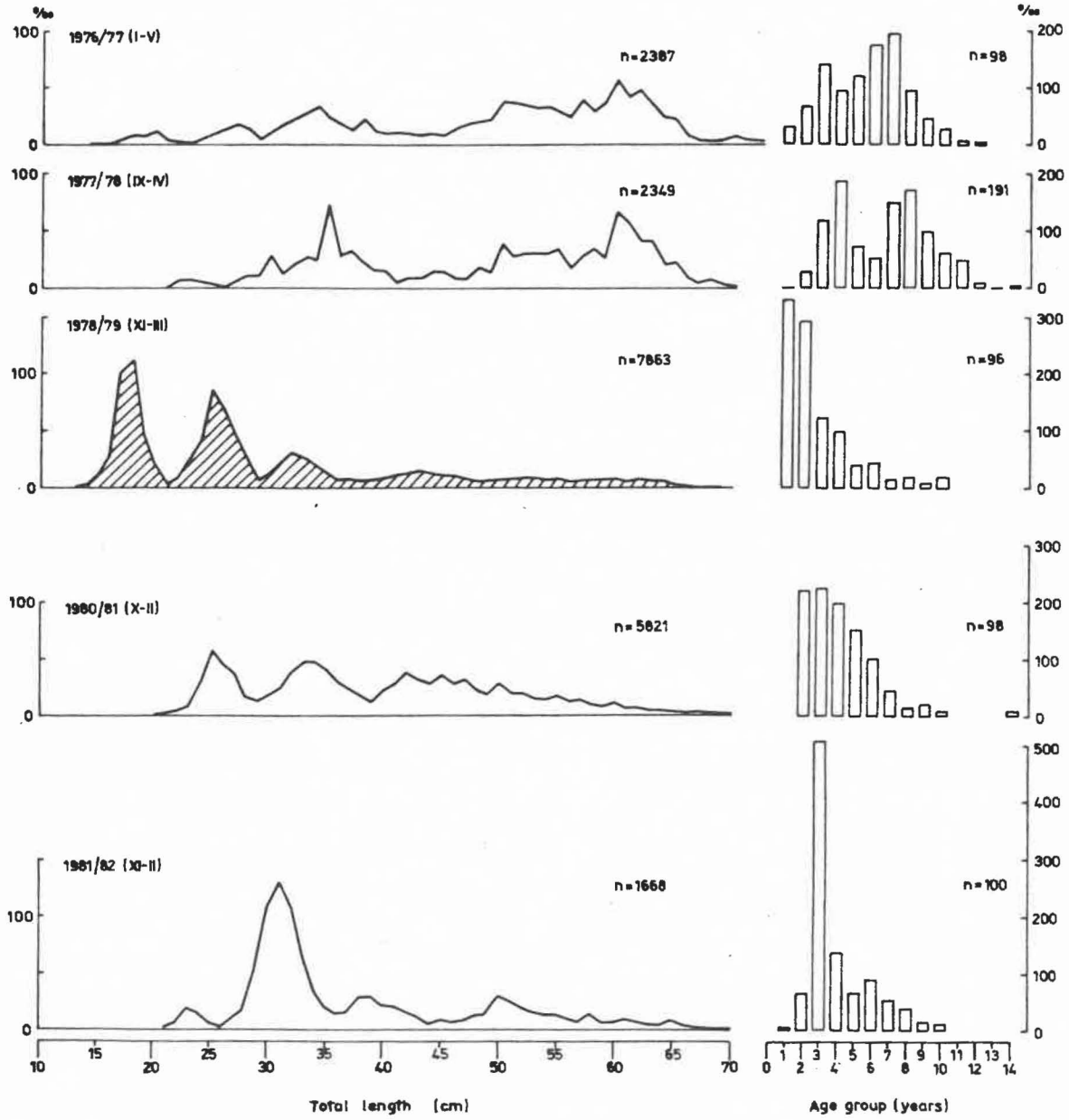

Fig.4 Length and age frequency distributions of Chaenocephalus aceratus from South Georgia between 1977 and 1982. Lined figure = scientific sampling.

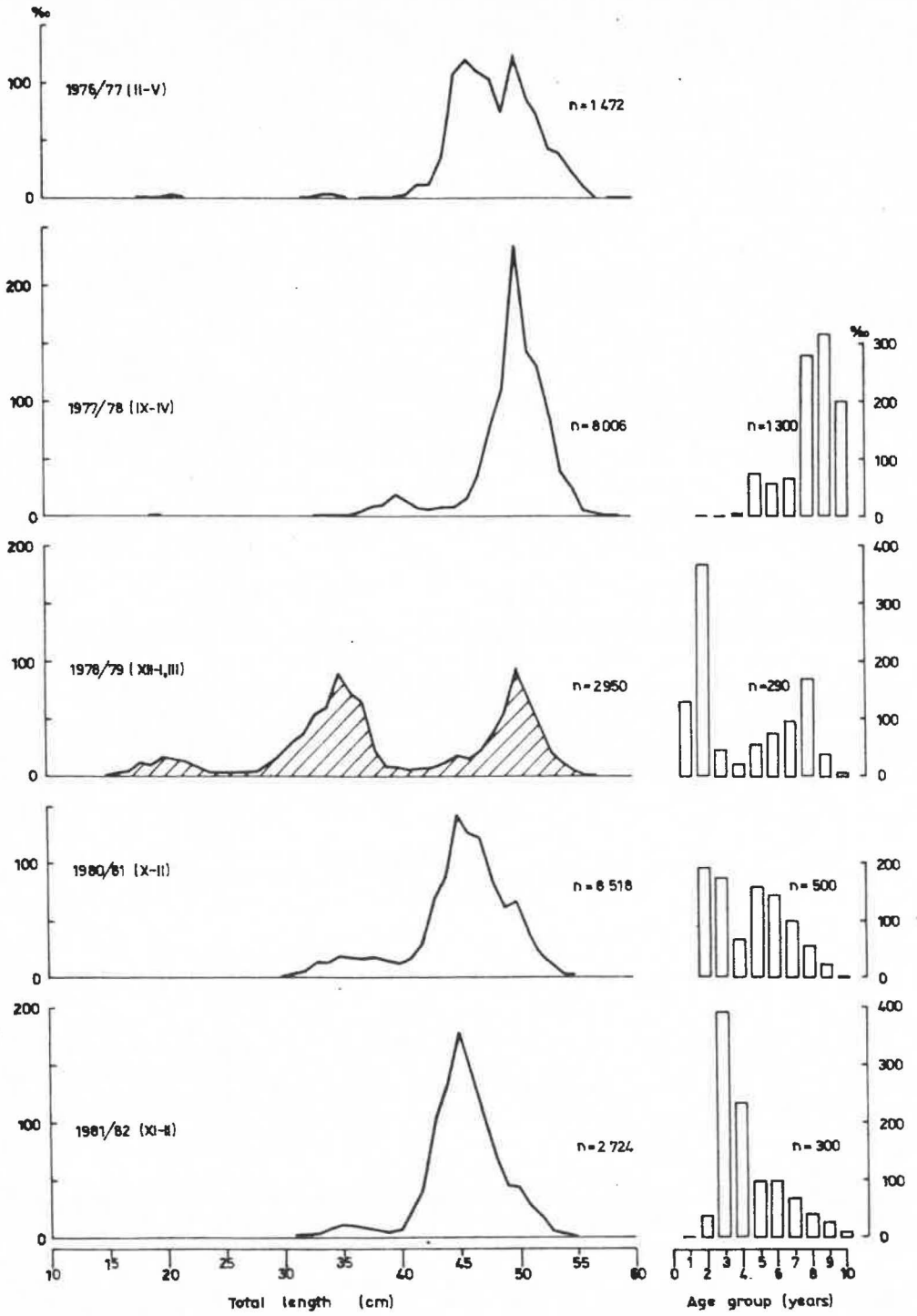

Fig.9 Length and age frequency distributions of Pseudochaenichthys georgianus from South Georgia between 1977 and 1982. Lined figure = scientific sampling.

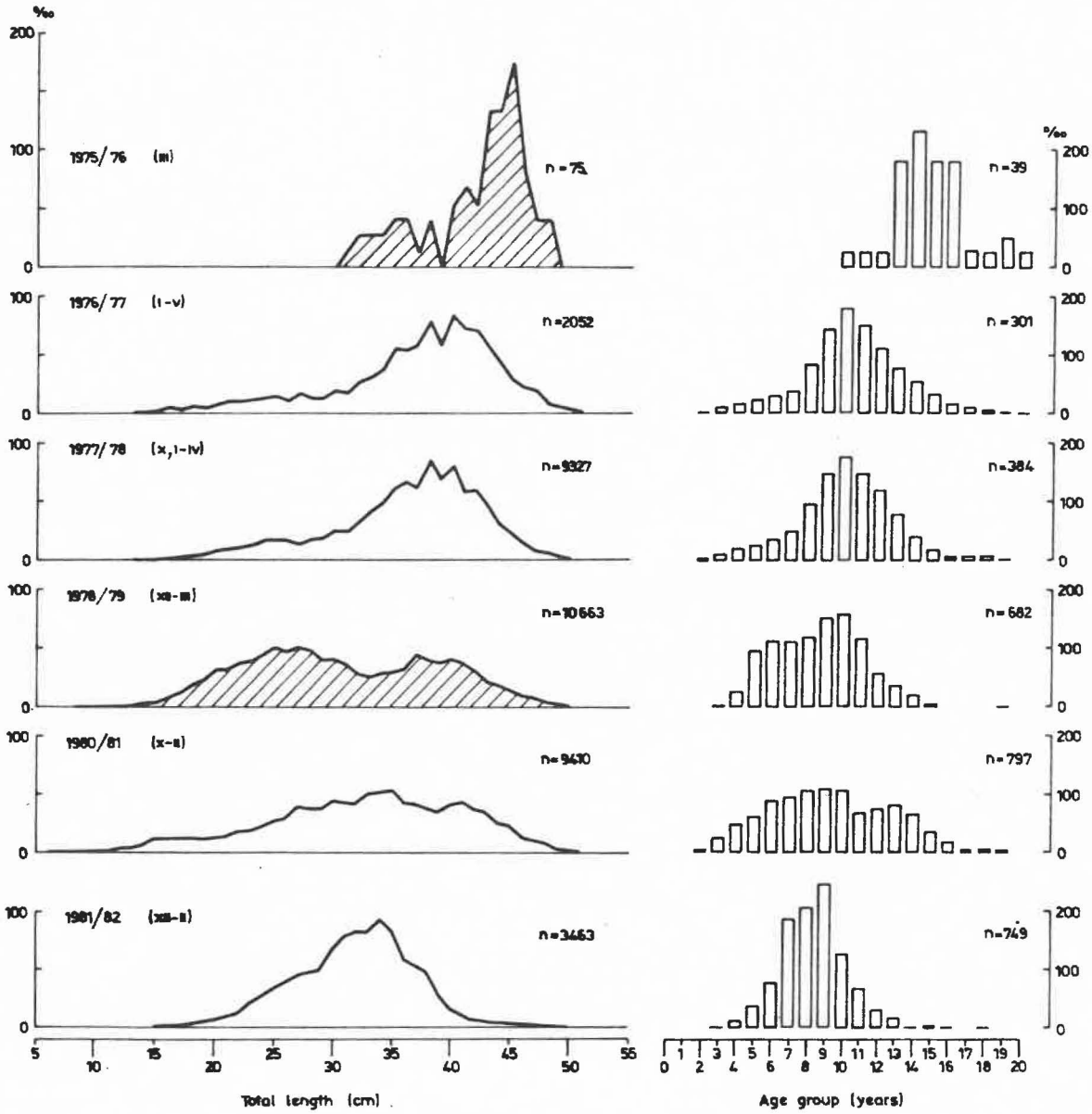

Fig.6 Length and age frequency distributions of Notothenia gibberifrons from South Georgia between 1976 and 1982. Lined figure = scientific sampling.

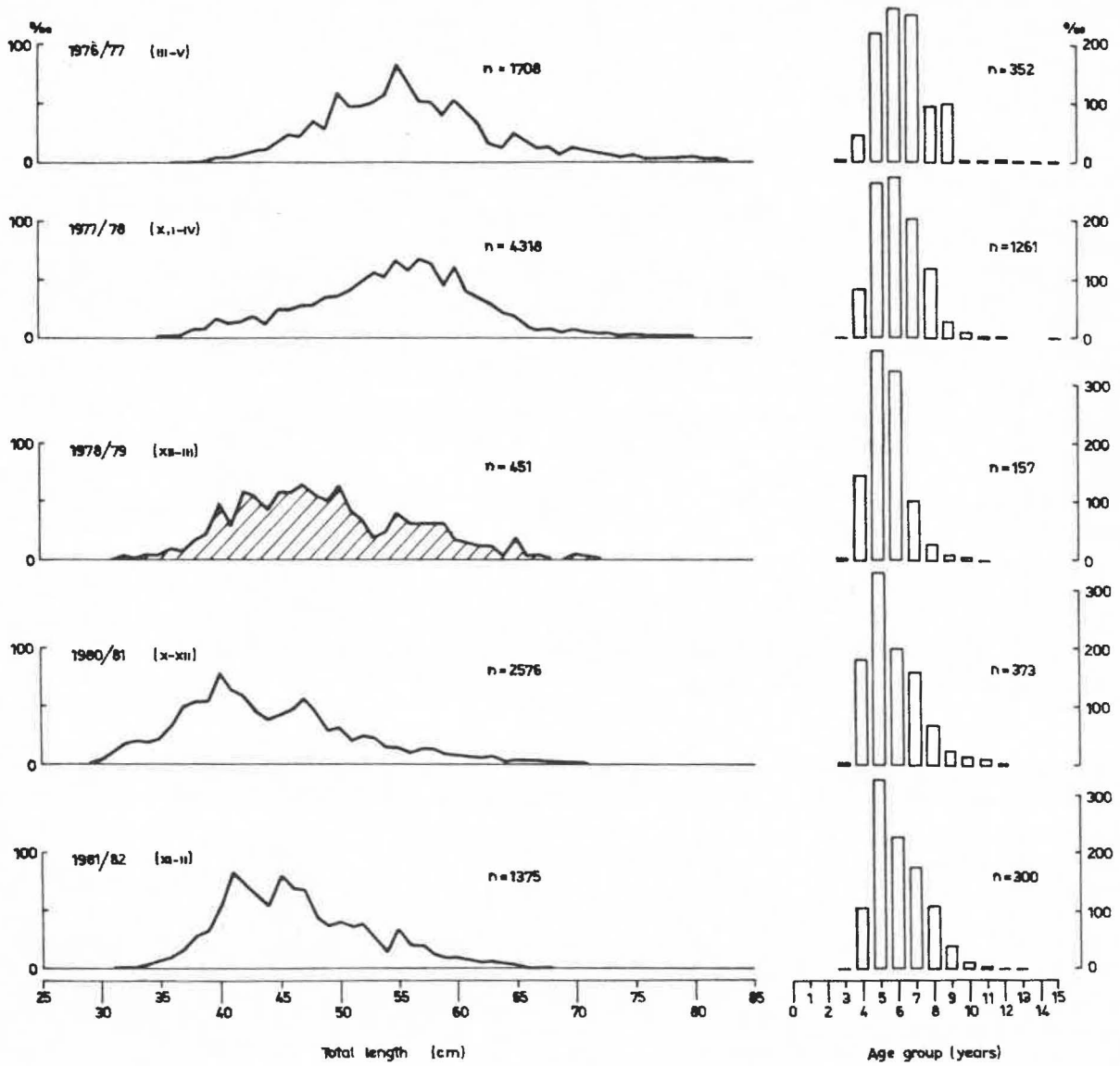

Fig.7 Length and age frequency distributions of Notothenia rossii marmorata from South Georgia between 1977 and 1982. Lined figure = scientific sampling.

Fig. 1. Area of Polish fishing operations and biological studies off South Georgia in 1976-82, at the boundaries of rectangles 56-58 and 60-65 (after Everson 1980).

Fig. 2. Nominal Polish catches and fishing effort in FAO subarea 48.3 (South Georgia) in 1976-1982, by species and month.

ANI - Champsocephalus gunnari, SSI - Chaenocephalus aceratus, SGI - Pseudochaenichthys georgianus, NOG - Notothenia gibberifrons, NOR - Notothenia rossii marmorata, TOP - Dissostichus eleginoides.

Fig. 3. Length and age frequency distributions of Champsocephalus gunnari from South Georgia between 1976 and 1982. Lined figure = scientific sampling.

Fig. 4. Length and age frequency distributions of Chaenocephalus aceratus from South Georgia between 1977 and 1982. Lined figure = scientific sampling.

Fig. 5 Length and age frequency distributions of Pseudochaenichthys georgianus from South Georgia between 1977 and 1982. Lined figure = scientific sampling.

Fig. 6. Length and age frequency distributions of Notothenia gibberifrons from South Georgia between 1976 and 1982. Lined figure = scientific sampling.

Fig.7. Length and age frequency distributions of Notothenia rossii marmorata from South Georgia between 1977 and 1982. Lined figure = scientific sampling.

Fig. 1. Zone des opérations de pêche polonaises et des études biologiques au large de la Géorgie du Sud de 1976 à 1982, aux limites des rectangles 56-58 et 60-65 (d'après Everson 1980).

Fig. 2. Prises nominales polonaises et effort de pêche dans la sous-zone 48.3 de la FAO (Géorgie du Sud) en 1976-1982, par espèce et par mois.

ANI - Champsocephalus gunnari, SSI - Chaenocephalus aceratus, SGI - Pseudochaenichthys georgianus, NOG - Notothenia gibberifrons, NOR - Notothenia rossii marmorata, TOP - Dissostichus eleginoides.

Fig. 3. Répartitions des fréquences de longueurs et d'âges pour l'espèce Champsocephalus gunnari de la Géorgie du Sud entre 1976 et 1982. Figure hachurée = échantillonnage scientifique.

Fig. 4. Répartitions des fréquences de longueurs et d'âges pour l'espèce Chaenocephalus aceratus de la Géorgie du Sud entre 1977 et 1982. Figure hachurée = échantillonnage scientifique.

Fig. 5. Répartitions des fréquences de longueurs et d'âges pour l'espèce Pseudochaenichthys georgianus de la Géorgie du Sud entre 1977 et 1982. Figure hachurée = échantillonnage scientifique.

Fig. 6. Répartitions des fréquences de longueurs et d'âges pour l'espèce Notothenia gibberifrons de la Géorgie du Sud entre 1976 et 1982. Figure hachurée = échantillonnage scientifique.

Fig. 7. Répartitions des fréquences de longueurs et d'âges pour l'espèce Notothenia rossii marmorata de la Géorgie du Sud entre 1977 et 1982. Figure hachurée = échantillonnage scientifique.

Рис. 1. Район польского промысла и биологических исследований вокруг Южной Георгии в 1976-1982 гг. у границ прямоугольников 56-58 и 60-65
(По Эверсону, 1980 г.)

Рис. 2. Номинальные польские уловы и промысловые усилия в подрайоне ФАО 48.3 (Южная Георгия) в 1976-1982 гг. по виду и месяцу.

Рис. 3. Частотное распределение по длине и возрасту Champsocephalus gunnari вокруг Южной Георгии с 1976 г. по 1982 г. Заштрихованная фигура = взятие проб в научных целях.

Рис. 4. Частотное распределение по длине и возрасту Chaenocephalus aceratus вокруг Южной Георгии с 1977 г. по 1982 г. Заштрихованная фигура = взятие проб в научных целях.

Рис. 5. Частотное распределение по длине и возрасту Pseudochaenichthys georgianus вокруг Южной Георгии с 1977 г. по 1982 г. Заштрихованная фигура = взятие проб в научных целях.

Рис. 6. Частотное распределение по длине и возрасту Notothenia gibberifrons вокруг Южной Георгии с 1976 г. по 1982 г. Заштрихованная фигура = взятие проб в научных целях.

Рис. 7. Частотное распределение по длине и возрасту Notothenia rossii marmorata вокруг Южной Георгии с 1977 г. по 1982 г. Заштрихованная фигура = взятие проб в научных целях.

Ilustración 1. Area de las operaciones pesqueras y estudios biológicos efectuados por Polonia frente a Georgia del Sur en 1976 - 1982 en los límites de los rectángulos 56 - 58 y 60 - 65 (según Everson 1980).

Ilustración 2. Capturas y esfuerzo pesquero nominales de Polonia en la súbarea 48.3 de la FAO (Georgia del Sur) en 1976 - 1982 por especie y mes.

ANI - Champsocephalus gunnari, SSI - Chaenocephalus aceratus, SGI - Pseudo-chaenichthys georgianus, NOG - Notothenia gibberifrons, NOR - Notothenia rossii marmorata, TOP - Dissostichus eleginoides.

Ilustración 3. Distribución de frecuencia de talla y edad de Champsocephalus gunnari de Georgia del Sur entre 1976 y 1982.
Figura rayada = muestreo científico.

Ilustración 4. Distribución de frecuencia de talla y edad de Chaenocephalus aceratus de Georgia del Sur entre 1977 y 1982.
Figura rayada = muestreo científico.

Ilustración 5. Distribución de frecuencia de talla y edad de Pseudo-chaenichthys georgianus de Georgia del Sur entre 1977 y 1982. Figura rayada = muestreo científico.

Ilustración 6. Distribución de frecuencia de talla y edad de Notothenia gibberifrons de Georgia del Sur entre 1976 y 1982. Figura rayada = muestreo científico.

Ilustración 7. Distribución de frecuencia de talla y edad de Notothenia rossii marmorata de Georgia del Sur entre 1977 y 1982. Figura rayada = muestreo científico.

Table I

Information on time and location of catches, swept area and fishing gears

Season	Month	Vessel	Place of capture /Division No. after Everson 1980/	Depth range /m/	Swept area /km^2/	No.of hauls	Gear type	Horizontal openning of trawl /m/	Speed of trawling /knots/
1976/77	I-V	M/T"GEMINI"	57,58,61,62,63	150-500	6 194	277	P-36/39	24.0	3.8
1977/78	XII-IV	M/T"GEMINI"	56,57,58,61,62,63,64	150-500	8 164	243	P-32/36 P-36/39	17.5 24.0	3.8 3.8
1978/79	XII-I,III	R/V"PROFESOR SIEDLECKI"	57,58,61,62,63	150-500	5 471	36	26/32	17.0	4.2-4.3
1980/81	X-II	M/T"LIBRA"	57,58,60,61,62,63,65	50-500	11 196	507	P-32/36	17.5	3.2-4.0
1981/82	XI-II	M/T"NEPTUN"	57,58,61,62	50-500	4 722	298	P-32/36	17.5	3.6-3.8

Table II

Nominal Polish catches and fishing effort in FAO subarea 48.3 /South Georgia/

Split Year	1976						1977						Total
	VII	VIII	IX	X	XI	XII	I	II	III	IV	V	VI	
Fishing effort													
No. of hours fished													
No. of days fished							18	38	139	144	165	23	527
Nominal catches													
Total							784	1228	5120	5297	3686	939	17054
Champsocephalus gunnari							703	754	1311	320	25	72	3185
Chaenocephalus aceratus									79	113	74	27	293
Pseudochaenichthys georgianus								2	558	399	572	77	1608
Notothenia gibberifrons *							1	6	580	661	953	326	2527
Notothenia rossii marmorata *									312	440	1074	398	2224
Dissostichus eleginoides									5	55	63	12	135
Miscellaneous marine fishes							32	2	31	3	48		116
Euphausia superba							48	464	2244	3306	877	27	6966

*nominal catches differ from those reported to FAO /see text, page 405 /

Table III

Nominal Polish catches and fishing effort in FAO subarea 48.3 /South Georgia/

Split Year						1977	1978						Total
	VII	VIII	IX	X	XI	XII	I	II	III	IV	V	VI	
Fishing effort													
No. of hours fished			72	416	1874	4591	7358	364	388	2189	450	882	18584
No. of days fished			8	29	154	431	538	43	39	162	45	90	1539
Nominal catches													
Total			78	541	1869	6434	8549	1917	1395	2311	530	834	24458
Champsocephalus gunnari			6	11	178		582	487	668	107	1	29	2069
Chaenocephalus aceratus			21	70	110	846	662	55	65	140	5	59	2033
Pseudochaenichthys georgianus			15	236	916	3427	2542	351	394	601	156	52	8690
Notothenia gibberifrons *			30	141	488	1982	4584	722	268	927	112	521	9775
Notothenia rossii marmorata *			4	83	122	83	59			385	179	77	992
Dissostichus eleginoides			1		55	96	38	302		71	44	28	635
Nototheniidae n.e.i. *			1				53					55	109
Miscellaneous marine fishes							28			80	33	13	154
Euphausia superba							1						1

* nominal catches in 1977 differ from those reported to FAO /see text, page 405 /

Table IV

Nominal Polish catches and fishing effort in FAO subarea 48.3 /South Georgia/

Split year	1978					1979						Total*
	VII	VIII	IX	X	XI*	XII	I	II	III	IV	V	VI	
Fishing effort													
No. of hours fished	1107	1630	745	1215	100								4794
No. of days fished	89	99	34	88	8								318
Nominal catches													
Total	1086	2319	845	1506	181								5937
Champsocephalus gunnari	54	16	35	4	1								110
Chaenocephalus aceratus	134	165	37	89	17								442
Pseudochaenichthys georgianus	116	132	221	404	22								895
Notothenia gibberifrons	728	777	161	497	91								2254
Notothenia rossii marmorata		1204	367	496	47								2114
Dissostichus eleginoides	24	16	11	16	3								70
Nototheniidae n.e.i.	7		13										20
Miscellaneous marine fishes	23	9											32

* nominal catches and fishing effort in November 1978 differ from those reported to FAO /see text, page 405

Table V

Nominal Polish catches and fishing effort in FAO subarea 48.3 /South Georgia/

Split year	1979						1980						Total
	VII	VIII	IX	X	XI	XII	I	II	III	IV	V	VI	
Fishing effort													
No. of hours fished	1112	2023	2396	3022	2997	2689	1889					215	16343
No. of days fished	68	198	169	219	190	200	157					19	1220
Nominal catches													
Total	1248	1604	1997	2657	1497	1506	982*					201	11692*
Champsocephalus gunnari	15	59	29	44	131	297	166					12	753
Chaenocephalus aceratus	57	116	186	328	119	86	170*					22	1084*
Pseudochaenichthys georgianus		21	184	279	65	46	49					21	665
Notothenia gibberifrons	1162	768	1318	1784	832	869	417					124	7274
Notothenia rossii marmorata		606	188		155	104	56						1109
Dissostichus eleginoides	4	19	38	79	79	19	10					7	255
Rajiformes		3	46	91	16	41	7					14	218
Miscellaneous marine fishes	10	12	8	52	100	44	107					1	334

*figures differ from those reported to FAO /see text, page 405 /

Table VI

Nominal Polish catches and fishing effort in FAO subarea 48.3 /South Georgia/

Split Year						1980	1981						Total
	VII	VIII	IX	X	XI	XII	I	II	III	IV	V	VI	
Fishing effort													
No. of hours fished	1528	747	1774	1415	1921	1956	1854	1877	884	666			14622
No. of days fished	93	47	100	83	127	155	139	115	58	41			958
Nominal catches													
Total	1329	645	1552	1677	1988	2828	3407	2095	761	607			16889
Champsocephalus gunnari	44	45	35	51	1244	2258	3056	1636	334	401			9104
Chaenocephalus aceratus	118	57	237	361	113	97	61	90	33	22			1189
Pseudochaenichthys georgianus	77	52	372	430	165	147	145	94	65	37			1584
Notothenia gibberifrons	1059	488	814	642*	403*	236*	142	256	297	70			4407 *
Notothenia rossii marmorata				151*	30*	38*				14			233 *
Dissostichus eleginoides	4	3	22	25	7	1	1			5			68
Rajiformes	1		18	17	26	7	2	1	1	1			74
Miscellaneous marine fishes	26		54			44		18	31	57			230

*figures differ from those reported to FAO /see text, page 405 /

Table VII

Nominal Polish catches and fishing effort in FAO subarea 48.3 /South Georgia/

Split Year	1981					1982						Total
	VII	VIII	IX	X	XI	XII	I	II	III	IV	V	VI	
Fishing effort													
No. of hours fished						1932	2854	2415	23				7224
No. of days fished						128	180	148	4				460
Nominal catches													
Total						2139	3720	2465					8324
Champsocephalus gunnari						748	2704	994					4446
Chaenocephalus aceratus						165	244	267					676
Pseudochaenichthys georgianus						211	381	364					956
Notothenia gibberifrons *						260	310	400					970
Notothenia rossii marmorata *						660	70	370					1100
Nototheniidae n.e.i.						13	11	27					51
Rajiformes						1							1
Miscellaneous marine fishes						81		43					124

*nominal catches differ from those reported to FAO /see text, page 405 /

Table VIII

Nominal catches in the Atlantic sector of the Southern Ocean /FAO area 48/

Split year	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82
Total	40 221	265 178	293 220	388 798	453 176	387 413	460 892
Fish	39 700	158 384	203 297	122 264	96 198	102 296	92 710
Krill	521	106 794	89 923	266 534	356 978	285 117	368 182

Table IX

Nominal catches by countries in FAO area 48

Split year	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82
Total	40 221	265 178	293 220	388 798	453 176	387 413	460 892
Bulgaria			2 088	3 408	1 225		
GDR		790	10 313	4 961	9 970	8 279	
Poland	21	17 054	63 524	37 486	17 928	17 656	8 324
USSR	40 200	247 334	217 295	342 943	424 053	361 478	452 568

Table X

Mean biomass density of fish /tons/km^2/ off South Georgia in 1976-1982, by species and depth zone

Split year	1976/77			1977/78			1978/79			1980/81			1981/82		
Depth zone	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Swept area /km^2/		2897	3297		4675	3489		3130	2341	2348	3748	5100	124	2897	1701
Total /tons/km^2/		34.8	17.7		5.7	5.8		1.5	1.7	19.2	9.4	5.7	14.7	9.1	12.9
Champsocephalus gunnari		25.5	11.4		0.2	0.1		0.1	0.1	17.6	7.2	2.0	11.9	4.9	1.1
Chaenocephalus aceratus		0.4	0.8		0.5	0.3		0.3	0.3	0.4	0.5	0.8	0.6	1.0	0.5
Pseudochaenichthys georgianus		2.1	1.6		3.4	2.8		0.3	0.4	0.5	0.6	0.9	0.7	1.5	1.1
Notothenia gibberifrons		1.3	2.2		1.1	2.2		0.5	0.4	0.7	1.1	1.3	1.5	1.2	3.5
Notothenia rossii marmorata		5.0	1.2		0.5	0.4		0.1	0.1			0.4	+	0.5	6.7
Dissostichus eleginoides		0.5	0.3					+	0.1		+	+			
Other fishes			0.2					0.2	0.3		+	0.3			

/A/ 50-150 m, /B/ 150-250 m, /C/ 250-500 m

+ $<$0.1 tons/km^2

Table XI

Mean biomass of trawlable fish stocks off South Georgia in 1976-1982 estimated by the "swept area" method

Split year	1976/77		1977/78		1978/79		1980/81		1981/82	
Species	$\bar{B}$	$\pm \bar{\Delta}$	$\bar{B}$	$\pm \bar{\Delta}$	$\bar{B}$	$\pm \bar{\Delta}$	$\bar{B}$	$\pm \bar{\Delta}$	$\bar{B}$	$\pm \bar{\Delta}$
Champsocephalus gunnari	226 606	71 763	2 372	740	1 152	653	88 414	15 372	46 192	9 328
Chaenocephalus aceratus	7 595	1 103	5 192	812	4 047	2 546	7 720	843	10 013	1 228
Pseudochaenichthys georgianus	23 210	3 473	39 703	6 082	4 192	1 819	8 717	1 824	16 940	3 315
Notothenia gibberifrons	22 339	3 110	19 989	2 156	5 894	2 109	13 693	1 350	25 801	6 048
Notothenia rossii marmorata	37 928	5 153	5 606	812	1 421	1 078	2 327	930	34 284	11 475
Dissostichus eleginoides	4 676	792	-	-	646	389	233	46	-	-
Others	1 349	201	-	-	3 100	2 028	2 264	348	-	-
Total	323 703	85 595	72 862	10 602	20 452	10 622	123 368	20 713	133 230	31 394

x biomass estimates refer to the total bottom surface/12 581 km^2/of subdivisions 56-58 and 60-65 in the depth range 50-500 m /according to Everson, 1980/

$\bar{B}$ mean biomass /in tons/

$\pm \bar{\Delta}$ 80% confidence limit /in tons/

ANNEX I

Table XII

Biomass /B,tons/[x] and mean biomass density /Dr,tons/km^2/ of trawlable fish stock off South Georgia in November-January 1983/84 estimated by the "swept area" method [xx]
/M/T "TAURUS", commercial bottom trawl P-32/36 /OTB-2/ and commercial midwater trawl P-60/188/OTM-2/

Depth zone		50-150 m			150-250 m			250-500 m			Total		
Species		OTB-2	OTM-2	Total	OTB-2	OTM-2	Total	OTB-2	OTM-2	Total	OTB-2	OTM-2	Total
Champsocephalus gunnari	B	8000	11300	19300	26200	40200	66400	7100	60200	67300	41300	111700	153000
	Dr	3.4	4.8		5.6	8.6		1.4	11.8				
Chaenocephalus aceratus	B	3800	-	3800	14000	-	14000	5600	-	5600	23400	-	23400
	Dr	1.6	-		3.0	-		1.1	-				
Pseudochaenichthys georgianus	B	11000	-	11000	35500	-	35500	24000	-	24000	70500	-	70500
	Dr	4.7	-		7.6	-		4.7	-				
Notothenia gibberifrons	B	1900	-	1900	5100	-	5100	10700	-	10700	17700	-	17700
	Dr	.8	-		1.1	-		2.1	-				
Notothenia rossii marmorata	B	200	-	200	900	-	900	1500	-	1500	2600	-	2600
	Dr	.1	-		.2	-		.3	-				
Others	B	-	-	-	-	-	-	500	-	500	500	-	500
	Dr	-	-		-	-		.1	-				
Total	B	24900	11300	36200	81700	40200	121900	49400	60200	109600	156000	111700	267700
	Dr	10.6	4.8		17.5	8.6		9.7	11.8				

x figures refer to 12 000 km^2/approx./ of the South Georgia shelf area
xx rough estimate

Table XIII

Nominal Polish catches and fishing effort in FAO subarea 48.3 /South Georgia/

Split year	1983						1984						Total
	VII	VIII	IX	X	XI	XII	I	II	III	IV	V	VI	
Fishing effort													
No. of hours fished					1770	3720	48						5538
No. of days fished					135	319	4						458
Nominal catches													
Total					4429	5478	172						10079
Champsocephalus gunnari					4378	3671	49						8098
Chaenocephalus aceratus					3	130	28						161
Pseudochaenichthys georgianus					16	802	70						888
Notothenia gibberifrons					2	506	23						531
Notothenia rossii marmorata					27	323	1						351
Dissostichus eleginoides						3							3
Nototheniidae n.e.i.					3	36	1						40
Rajiformes						7							7

ANNEX 2

Table XIV

Summary of BIOMASS estimates for South Georgia from Polish Research Cruises (BIOMASS 1980)

Year/Month	50 - 150 m		150 - 250 m		250 - 500 m		Σ 50 - 500 m	Ship
	No. of hauls		No. of hauls		No. of hauls			
1976 March	-	-	-1	759 426	16	141 319	900 745	"Siedlecki"
1977 January	-	-	-	-	52	952 220	952 220	"Gemini"
February	-	-	-	-	30	166 751	166 751	"
March	42	225 195	-	-	93	115 457	340 652	"
April	-	-	-	-	77	71 208	71 208	"
1977 December	1	3160	12	67 246	8	37 497	107 303	"Bogucki"
1978 December	-	-	6	26 934	12	14 643	41 577	"Siedlecki"
1979 January	3	16 341	5	29 882	6	9 419	55 372	"Siedlecki"
March	3	39 212	3	31 480	12	26 162	96 854	"

ANNEXE 2

Table XV

Vessel : R/V "PROFESOR SIEDLECKI"
Year : 1976
FAO Statistical Area : 48
Gear type : OTB-2 /P-28/33/
Towing speed : 4.2 kn.

Month : March
Subarea : 48.3
Gear size : headline 28 m
Estimated swept area : 143 900 m^2/hr

Depth Zone	0 - 50		50 - 150		150 - 250		250 - 500		>500 m	
Number of hauls					1		16			
Species	Catch	C/hr	Catch	C/hr	Catch	C/hr	Catch	C/hr	Catch	C/hr
Champsocephalus gunnari					115	139	4 970	163		
Chaenocephalus aceratus					290	349	6 484	213		
Pseudochaenichthys georg.					290	349	12 522	412		
Notothenia gibberifrons					85	103	13 556	446		
N. rossii marmorata					4 165	5 018	21 363	702		
N. larseni					-	-	10	<1		
Trematomus hansoni					-	-	525	17		
Dissostichus eleginoides					-	-	1 077	36		
Raja spp.					55	66	945	31		
Other fishes					-	-	904	30		
Total					5 000	6 024	62 356	2 050		

Survey strategy /tick one box/

1. **Predetermined sampling design** ☐
2. **Opportunistic sampling** ☐
3. **Experienced skipper searching for fish** ☒