SC-CAMLR-VII/BG/23

RESULTS OF FISH STOCK ASSESSMENT SURVEY, SOUTH GEORGIA, DECEMBER 1987 - JANUARY 1988

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Abstract

Commercial fish stocks around South Georgia have been declining since the early 1970's. A survey to monitor these stocks was carried out from December 1987 to January 1988. It complements earlier surveys in the same area and showed that most of the stocks are continuing to decline. *Notothenia rossii* is showing no signs of recovery and *Champsocephalus gunnari* is likely to continue declining in abundance.

Résumé

Les stocks de poissons commerciaux autour de la Géorgie du Sud ont été en déclin depuis le début des années 70. Une campagne d'étude pour contrôler ces stocks a été effectuée de décembre 1987 à janvier 1988. Elle complète les études antérieures effectuées dans la même région, et a démontré que la plupart des stocks continuent à décliner. *Notothenia rossii* ne manifeste en aucune façon s'être rétabli, et l'abondance de *Champsocephalus gunnari* risque de continuer à décliner.

Резюме

Коммерческие запасы рыбы в районе Южной Георгии уменьшались с начала 70-х годов. Съемка по мониторингу этих запасов проводилась с декабря 1989 г. по январь 1988 г. Это дополнило результаты предыдущих съемок, проводившихся в этом районе, и показало, что большинство запасов продолжают уменьшаться. *Notothenia rossii* не имеет никаких признаков восстановления и численность *Champsocephalus gunnari*, возможно, будет продолжать уменьшаться.

Resumen

Las poblaciones de peces, comerciales alrededor de Georgia del Sur han estado declinando desde principios de los años 70. Se llevó a cabo una prospección para controlar estas poblaciones, desde diciembre de 1987 a enero de 1988. Esta complementa prospecciones anteriores en la misma área e indica que la mayoría de poblaciones continúan declinanado. *Notothenia rossii* no muestra cambios de recuperación, y es probable que *Champsocephalus gunnari* continúe declinando abundantemente.

1. INTRODUCTION

The fish stocks of the South Georgia region represent an important commercial resource to a number of nations. However, these stocks have been declining since the late 1970's (Kock 1985,1986; Gabriel 1987). In the early 1970's the fishery was supported mostly by the catch of *Notothenia rossii*, which yielded hundreds of thousands of tonnes in a season (Kock 1986). The decline in abundance of this species since that time has been striking. By 1985 the stock was estimated to be less than 10% of its pristine size (Kock 1985). The fishery is presently supported by catches of *Champsocephalus gunnari*, but its decline is also evident (Kock 1986). Other species have also shown rapid declines in the South Georgia region. Between 1975/76 and 1980/81 abundance estimates decreased by as much as two orders of magnitude (Kock et al. 1985).

The Commission for the Conservation of Antarctic Marine Living Resources has adopted a set of measures aimed at rebuilding the stocks of *N. rossii* and maintaining the other fish resources in the Antarctic. Commercial fishing has been prohibited within 12 miles of the island of South Georgia. A minimum mesh size of 120 mm is required of fisheries directed toward *N. rossii* and *Dissostichus eleginoides* and 80 mm of fisheries directed toward *N. gibberifrons*, *N. kempi*, *N. squamifrons*, and *C. gunnari*. The Commission has also recommended minimization of by-catch of *N. rossii* in other fisheries.

In an effort to monitor the status and response of these stocks, a number of surveys have been conducted around South Georgia by research vessels. This paper will examine the status of these fish stocks as of the 1987/88 survey cruise and discuss their changes over recent years. The analysis is based mostly on the comparison of estimates of stock biomass and size structure from the research vessel cruise surveys in 1984/85 (Kock 1985a), 1986/87 (Gabriel 1987), and 1987/88.

2. METHODS

The 1987/88 survey took place between 19 December 1987 and 10 January 1988. The sampling was based on a stratified random survey design. Stations were allocated to 100 m depth strata roughly in proportion to the area within each stratum and randomly assigned to specific locations within stratum (stratum 1: 50-150 m, stratum 2: 151-250 m, stratum 3: 251-500 m; Everson 1984) (Figure 1). This procedure follows that of Kock (1985) and Gabriel (1987). Most of the comparisons made here will be in reference to these two surveys.

Thirty minute tows (at 3.5 Knots) were made by the R.V. *Professor Siedlecki* using a P32/36 otter trawl equipped with 80 mm mesh and 43 - 52 mm mesh liner (Crawford 1988). The mouth opening was 17.5 m and the headrope height was 4 m (Christensen pers. comm.).

A total of 113 tows were conducted during the survey. One hundred and four occurred along the South Georgia coast and were considered standard (e.g. little or no gear damage) (Figure 1). Only four successful tows were conducted in the Shag Rocks area (division 89, Everson 1984). This maintains continuity of sampling for Shag Rocks, but can only give qualitative results. Sampling density was 1 standard tow/350 Km^2 around South Georgia and 1 standard tow/1326 Km^2 at Shag Rocks. Total biomass was estimated based on swept-area calculations (Mini-SURVAN program, Appendix A; McKenna 1988). All analyses in this report are in reference to data which has been corrected for any subsampling on deck or in the laboratory, and was standardized to 30 minute tows.

3. RESULTS

Four species (*C. gunnari, Pseudochaenichthys georgianus, N. gibberifrons,* and *Chaenochephalus aceratus*) accounted for over 86% of the catch (by weight) in the 1987/88 survey. The status of each of these species will be described in turn, as well as four other species that are of interest in the region. The biomass estimates for each species are summarized in Table 1 and are compared with earlier estimates in Table 2. A brief summary of the length information for the 1987/88 survey is given in Table 3. Too few tows were made at Shag Rocks to explicitly describe the population structure in that area. The length data from Shag Rocks was combined with those from South Georgia for the discussion here.

3.1 *Champsocephalus gunnari*

Since the decline of *N. rossii* the fishery in the South Georgia region has been supported mostly by *C. gunnari.* During the 1987/88 survey *C. gunnari* occurred in 98% of the tows around South Georgia and 100% of the Shag Rocks tows. It accounted for 33.5% of the catch by weight. The largest concentrations were located west and southwest of the island (Figure 2a). The largest tow was at station 86, yielding 428 kg. This represents 13% of the catch of this species. Most of the catch was from stratum 2 (15/31/1*)(Table 1).

The stratified mean catch per tow was 27.7 kg and the population was estimated to be 15086 mT at South Georgia. At Shag rocks the mean catch per tow was 18.2 kg and the population was estimated to be 1445 mT. This estimate is about 31% of the 1986/87 population (52672 mT, Gabriel 1987) and is very close to Kock's (1985) estimate for the 1984/85 stock (Table 2).

The average length was 26.7 cm with obvious modes at approximately 16, 23, and 32 cm (Figure 3a). The first and second modes were present in both 1986/87 and 1987/88, but no discernable mode was seen at 32 cm in 1986/87. The large mode found at 22 cm in 1986/87 (Gabriel 1987) progressed to form a smaller mode at about 32 cm in 1987/88. Fifty percent of the fish in the 22 - 25 cm size range are mature (L_{50}) (Kock et al. 1985). based on survey catches 44% of the population was at or below L_{50}.

3.2 *Pseudochaenichthys georgianus*

This species of ice fish was relatively more predominant than in earlier surveys and was the only major species which showed an increase in estimated biomass since the 1986/87 survey. During the 1987/88 survey *Ps. georgianus* occurred in 80% of the tows around South Georgia and did not occur in the Shag Rocks area. It accounted for 23.6% of the catch by weight. The largest concentrations were located northeast of the island (Figure 2b). The largest tow was at station 27, yielding 456 kg. This represents 20% of the catch of this species. Most of the catch was from stratum 2 (4/17/1*) (Table 1).

The stratified mean catch per tow was 20.9 kg and the population was estimated to be 11412 mT. This estimate is roughly double the estimate for 1986/87, but only 29% greater than the 1984/85 estimate (Table 2).

The average length was 42.9 cm with obvious modes at approximately 21, 35, and 44 cm (Figure 3b). This size structure is similar to the 1986/87 season, but the magnitudes of the two largest length modes (35 cm and 44 cm) were reversed in 1987/88.

3.3 *Notothenia gibberifrons*

This species was the most common Notothenid in the South Georgia region during the 1987/88 survey. It occurred in 93% of the tows around South Georgia and 75% of the Shag Rocks tows, and accounted for 15.6% of the catch by weight. The largest concentrations were located southeast of the island (Figure 2c). The largest tow was at station 45, yielding 122 kg. This represents 8% of the catch of this species. Most of the catch was from stratum 2 (6/9/1*) (Table 2).

The stratified mean catch per tow was 13.2 kg and the population was estimated to be 7189 mT at South Georgia. At Shag rocks the mean catch per tow was 7.7 kg and the population was estimated to be 609 mT. This value for the stock size is more than 40% lower than that estimated for the 1986/87 season (Table 2).

The average length was 42.9 cm with obvious modes at approximately 5, 17, and 37 cm (Figure 3c). This is nearly identical to that found in 1986/87. It is unclear whether a mode existed at about 22 cm.

3.4 *Chaenocephalus aceratus*

C. aceratus was the rarest of the three species of ice fish during the 1987/88 survey. However, it still accounted for 13.5% of the catch by weight. It occurred in 89% of the tows around South Georgia, but was not found in the Shag Rocks area. The largest concentrations were located east and northeast of the island (Figure 4a). The largest tow was at station 39, yielding 78 kg. This represents 6% of the catch of this species. Most of the catch was from stratum 2 (3/14/1*) (Table 1).

The stratified mean catch per tow was 12.2 kg and the population was estimated to be 6642 mT. This estimate is 58% of the 1984/85 stock (Kock 1985) and has decreased by about 40% since the last season (1986/87) (Table 2).

The average length was 38.6 cm, which is nearly 5 cm greater than the 1986/87 mean (33.9 cm, Gabriel 1987). The obvious modes occurred at approximately 15, 24, 32, and 46cm (Figure 5a). The size structure in 1986/87 was similar, but had a stronger mode at about 25 cm and a weak one at about 33 cm. There is also an indication of decreasing size with increasing depth for this species, whereas all other species showed either an increase in mean size with depth or no apparent change (Table 3).

There are four additional species of fish which are, or have been, of commercial interest. They are *N. rossii*, *N. squamifrons*, *Dissostichus eleginoides*, and *Patagonotothen brevicauda guntheri*.

3.5 *Notothenia rossii*

Although this species is rare now, it is the species that supported the commercial fishery in the South Georgia region in the early 1970's. Everson (1977) estimated the pristine stock at 500 000 tonnes. It declined rapidly from that time. By 1985 its population had dropped to less than 10% of this value (Kock 1985). It has continued to drop even at this low population level. The biomass was estimated to be between 2 000 and 4 000 mT in 1986/87 (Gabriel 1987). The estimated value from the 1987/88 survey was 1049 mT.

During the 1987/88 survey *N. rossii* occurred in only 32% of the tows around South Georgia and was not found in the Shag Rocks area. Eighty three percent of these contained

less than five individuals and 43% contained a single individual. It accounted for 2.1% of the catch by weight. The largest concentrations were located north and southwest of the island (Figure 4b). The largest tow was at station 21, yielding 35 kg and consisting of 24 fish. This represents 16% of the catch of this species. Most of the catch was from stratum 2 (3/6/1*) (Table 1).

The stratified mean catch per tow was 1.9 kg and the population was estimated to be 1049 mT. This population estimate is 26% of the 1986/87 estimate (based on a normal distribution, Gabriel 1987) and 8.2% of the stock present in 1984/85 (Kock 1985) (Table 2).

The average length was 49.9 cm, which is the same as for the 1984/85 population (Kock 1985). It is close to the length of 50% maturity (Scherbich 1976, cited in Kock et al. 1985). The size structure was not clear enough to accurately identify any modes (Figure 5b). Only one individual less than 35 cm was caught.

3.6 *Notothenia squamifrons*

This Notothenid was more common in past surveys (Table 1). During the 1987/88 survey *N. squamifrons* occurred in 23% of the tows around South Georgia and 25% of the Shag Rocks tows. It accounted for 0.5% of the catch by weight. The largest concentrations were located northeast of the island (Figure 4c). The largest tow was at station 31, yielding 7 kg. This represents 15% of the catch of this species. It was unique in that most of the catch was from stratum 3 and it was completely absent from stratum 1 (shallowest) (0/1/13*) (Table 1).

The stratified mean catch per tow was 0.7 kg and the population was estimated to be 384 mT at South Georgia. At Shag rocks the mean catch per tow was 13.2 kg and the population was estimated to be 42 mT. At best this estimate shows a decline in biomass of an order of magnitude (based on the delta distribution, Gabriel 1987) and possibly two orders of magnitude (based on the normal distribution, Gabriel 1987) since the 1986/87 season (Table 2).

The average length was 18.7 cm. This is about half of the 1986/87 value. The size structure of this species was very different from that of the 1986/87 season. Although the modes at 17 and 28 cm correspond to the first two in the 1986/87 season, the third and largest peak (at 40-42 cm) was absent from the 1987/88 survey. The strongest peak in 1987/88 was at the smallest size (~ 18 cm)(Figure 5c). Only 20 individuals greater than 30 cm were collected.

3.7 *Dissostichus eleginoides*

This predatory species was generally uncommon in the 1987/88 survey, but accounted for the single largest catch (12 mT) at a non-random site (this observation could not be included as a representative station). It occurred in 32% of the tows around South Georgia and 75% of the Shag Rocks tows, and accounted for 1.3% of the catch by weight. The largest concentrations were located northwest of the island and at Shag Rocks (Figure 6a). The largest tow was at station 104, yielding 20 kg. This represents 15% of the catch of this species, which was evenly distributed between the three strata (1/1/1*) (Table 1).

The stratified mean catch per tow was 1.3 kg and the population was estimated to be 697 mT at South Georgia. At Shag rocks the mean catch per tow was 5.1 kg and the population was estimated to be 408 mT. This population is approximately half of the 1986/87 stock and 14% of the 1984/85 population (Kock 1985) (Table 2).

The individual lengths had the widest range of any species (6 - 125 cm). The average length was 33.3 cm; a decrease of over ten centimeters from 1986/87. Sampling was not extensive enough to clearly describe the size structure, but there appear to be modes at roughly 16, 27, and 46 cm (Figure 7a). Nine individuals over 55 cm were collected.

3.8 *Patagonotothen brevicauda guentheri*

Patagonotothen brevicauda guentheri is unique in that it is endemic to Shag Rocks. During the 1987/88 survey it occurred in 100% of the Shag Rocks tows, but was not found in the South Georgia area. It accounted for 0.5% of the catch by weight. The largest tow was at station 129, yielding 30 kg (Figure 6b). This represents 63% of the catch of this species. Most of the catch was from stratum 1 (7/4/1*) (Table 1).

The stratified mean catch per tow was 11.28 kg and the population was estimated to be 895 mT. This stock estimate is greater than that for 1986/87 (331 kg, Gabriel 1987), but is 14% of the 1984/85 estimate (Kock 1985) (Table 2).

The average length was 15.2 cm and the only obvious mode was at about 15 cm (Figure 7b), which is similar to that described for the 1986/87 population.

4. DISCUSSION

The stock of *C. gunnari* experienced a severe decrease since the 1986/87 survey (Table 2). The catch for that season was supported by the single, strong 84/85 year class (Gabriel 1987). The decreased biomass in 1987/88 would suggest that this cohort has been greatly reduced. Length frequency distributions suggest that this cohort (32 cm) is the strongest, but its magnitude relative to the 85/86 cohort (~23 cm) is much smaller than in the previous season (Figure 3a). The abundance of pre-recruit fish appears to be low (Figure 3a). Future catches of *C. gunnari* will depend on what remains of the 84/85 year class and the weak 85/86 cohort. Future declines in biomass are likely.

Fish in the 44-48 cm size class were responsible for the increased stock of *Ps. georgianus* in 1987/88 (Figure 3b, Table 3)). However, this increase may be temporary, because the following two year classes are small (Figure 3b). As members of this strong year class are removed by fishing the population will probably decline again.

The decrease in the *N. gibberifrons* population was substantially greater between 1986/87 and 1987/88 (5331 mT) than from 1984/85 to 1986/87 (2633 mT) (Table 2). However, the stock might be improved by the relatively large number of fish less than 25 cm that are about to recruit (Figure 3c).

The biomass of *Ch. aceratus* has declined steadily from 1984/85 to the present (Table 2), while the average size has increased. This can be explained by the progression of the large mode found at 25 cm, in 1986/87, to about 32 cm in 1987/88. The cohorts following the 32 cm class are small and will probably not substantially increase this stock (Figure 5a). Without strong recruitment the decrease in biomass can be expected to continue.

Despite the very low stock size of *N. rossii* it has continued to decline. Declining biomass and a relatively large mean length (49.9 cm), indicate the continued removal of sexually mature individuals without new recruitment to rebuild the population.

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* The proportion of catch, by weight, in each stratum : stratum1/stratum2/stratum3

The biomass of *N. squamifrons* showed the most drastic decline of the species examined. The population dropped by one to two orders of magnitude and the mean length was halved since 1986/87. It appears that the fishery was almost completely supported by fish that were in the 40-42 cm size class during 1986/87. This size class was absent from the 1987/88 population and no fish over 40 cm were caught. The length frequency distribution shows that the strongest mode was at 18 cm (1987/88) (Figure 5c). This group of recruits might contribute to a recovery in the 1988/89 season, but the magnitude of that recovery is uncertain.

The estimated population of *D. eleginoides* is about half the size of the 1986/87 population and the mean length has dropped by over 10 cm. The decreasing mean size shows the removal of large, sexually mature individuals and the decreasing biomass indicates no substantial recruitment. It is not clear from the length frequency distribution (Figure 7a) if substantial recruitment can be expected in the near future.

The population estimate of *P.b. guentheri* increased relative to the 1986/87 season, but this is probably due to the difference in sampling gear used (80 mm mesh in 1986/87 at Shag Rocks). The population as of 1987/88 is about 14% of that estimated for the 1984/85 season (Table 2). The significance of this decrease is unknown, but appears to be substantial. Not enough information is available to accurately describe the biomass trends of this species.

In summary, it is clear that all of the stocks examined here, with the exception of *Ps. georgianus*, have declined since the 1986/87 survey, and most for much longer than that. It seems likely that this trend will continue. The increase of *Ps. georgianus* appears to be due to a strong year class, but this will probably be short-lived. Based on research catches, without a substantial increase in recruitment, *C. gunnari* is likely to decline rapidly in the future.

LITERATURE CITED

CHRISTENSEN, W.C. 1988. Personal communication. University of Rhode Island, Wickford, Rhode Island, U.S.A., January 1988.

CRAWFORD, R. 1988. U.S. Antarctic marine living resources (AMLR) program ecosystem monitoring survey, 1987-88 Part 1. Cruise report (1987-1988). AMLR Reference Document 3: 2-10.

EVERSON, I. 1984. Areas of seabed within selected depth ranges in the South-West Atlantic and Antarctic Peninsula regions of the Southern Ocean. British Antarctic Survey, Cambridge, England.

GABRIEL, W. 1987. Results of fish stock assessment survey, South Georgia Region, November - December 1986. SC-CAMLR-VI/BG/12.

KOCK, K.-H. 1985. Preliminary results of investigations of the Federal Republic of Germany on *Notothenia rossii marmorata* (Fischer, 1885) in January/February 1985. SC-CAMLR-IV/BG/11, 1985.

KOCK, K.-H. 1986. The state of exploited Antarctic fish stocks in the Scotia Arc Region during SIBEX (1983-1985). Archiv Fur Fischereiwissenschaft 37: 129-186.

KOCK, K.-H, G. DUHAMEL, J.-C. HUREAU. 1985. Biology and status of exploited Antarctic fish stocks: a review. Biological Investigations of Marine Antarctic Systems and Stocks (BIOMASS) Vol. 6. SCAR/SCOR. 143 pp.

SCHERBICH, L.V. 1976. Length weight composition and growth rate of the marbled notothenia. [in Russian]. Trudy, Atlant. Nauchno-issled. Ryb. Khoz. Okeanogr. 86: 82-93.

SOURCE CODE OF THE SURVEY ANALYSIS PROGRAM;
WRITTEN IN QUICK basic (MICROSOFT), VERSION 4.0.

```
PRINT "Mini-SURVAN,  filename:SMSURVAN.BAS"
PRINT
PRINT "  BY Jim McKenna"
PRINT "  7 June 1988"
PRINT
'
'    STATISTICAL FORMULAS USED TO ESTIMATE THE POPULATIONS OF FISH IN THE
'    SOUTH GEORGIA AND SHAG ROCKS AREAS DURING THE 1987-1988 AMLR CRUISE.
'
'
'    KEYWORD DEFINITION
'
'          µk - Sample mean for stratum k
'          µST - Stratified mean
'           xi - Observation (catch of tow i)
'           Nk - Number of stations in stratum k
'           N - Total number of stations (=tows)
'           S2k - Sample variance for stratum k
'           SEk - Standard error for stratum k
'           ßk - Expansion factor for stratum k
'           ßST - Expansion factor for the whole survey area
'            a.s.t - Area of standard tow (0.019452838 n.mi.2, Gabriel 1988
'                                                  pers comm)
'           CONF - 95% confidence limits of the stratified mean population
'                 estimate.
'           Vk - Variance of mean for stratum k
'           VST - Variance of stratified mean
'           SEST - Standard error of stratified mean
'            CVk - Coefficient of variation for stratum k
'            CVST - Coefficient of variation for stratified mean
'             Pk - Minimum population for total area, stratum k
'            S2Pk - Variance of the Minimum population for the total area,
'                                                  stratum k
'           PST - Minimum population for total area based on stratified mean
'           S2PST - Variance of Minimum population for the total area, based
'                 on the stratified mean.
'
'                                  Nk
'                                  Σ xi
'                                 i=1
'      Sample Mean        µk=------------                  Manual
'                                  Nk
'
'
'
'                                    Nk
'                                    Σ(xi-µk)
'                                   i=1
'      Sample  Variance        S2k=----------------        Cochran
'                                    (Nk-1)
```

Coefficient of variation $CVk = \frac{Sk}{\mu k} \times 100$ Manual

Variance of the Mean $Vk = \frac{S2k}{Nk}$ Snedecor

Standard Error of the Mean $SEk = \beta Vk$ Manual

Minimum population for total area $Pk = \mu k \beta k$

Variance of the Minimum Population for Area $S2Pk = Vk\ \beta k$

STRATIFIED STATISTICS

Stratified Mean $\mu ST = \frac{\sum_{k=1}^{L} \beta k\ \mu k}{\beta ST}$ Cochran

Population Variance $S2ST = \frac{\sum_{i=1}^{N} (xi - \mu ST)}{(N - 1)}$

Variance of Stratified Mean $VST = \Sigma(Vk\ (\beta k / \beta ST))$ Cochran

Standard Error of Stratified Mean $SEST = \beta VST$ Manual

Coefficient of Variation $\frac{SEST}{\mu ST} \times 100$ Manual

Minimum Population for Total Area, $PST = \mu ST\ \beta ST$

```
'     Stratified
'
'
'     Variance of Minimum
'    Population for Area,     S2PST= VST ßST
'     Stratified
'
'                                ΣAk
'                          ,βST=-----
'                                a.s.t.
'
'     95% Confidence Limits:      µST æ (1.96 SEST)
'
'
' 1986: STRATUM  AREA(S.G.)  EXPANSION FACTOR  # OF TOWS
'                  -------    -----------    -----------------    ----------
'               1      2249              115333.328          34
'               2      5271              270307.688          56
'               3      3089              158410.250          19
'
'
'
DEFDBL A
PRINT
PRINT "This program will accept either weight or number data"
PRINT "The purpose is to produce the same statistical breakdown and "
PRINT "population estimates as SURVAN"
PRINT "  Data are expected in the following form:"
PRINT "       station,stratum,species(full name in quotes),weight or count"
PRINT "  The data must be sorted by species!!"
PRINT "  All observations with an abundance value of 0. should be removed!"
PRINT "  This program expects the data to have been corrected to a standard"
PRINT "  tow of 30 min. at 3.5 knots, and for any subsampling that occurred."
PRINT "  A representative tow is defined as one in which the quality code"
PRINT "   values are as follows:"
PRINT "    STATION_TYPE_CODE = 1"
PRINT "     HAUL_COND        = 1 or 2"
PRINT "    GEAR_COND       <= 6"
PRINT
PRINT "during program operation the data are stored in arrays according"
PRINT "to stratum."
PRINT
'
INPUT "Please, enter a title for this run :"; TITL$
PRINT "INITIALIZATION AND DIMENSIONING ..."
AST = .019452838#: 'area of standard tow (n.mi. )
DIM BETA(3), AREA(3)
DIM AR(3, 300), NK(3): ' abundance arrays and # of obs. in each stratum
DIM MEAN(3), S2(3), S(3), CV(3), V(3), SE(3), P(3), S2P(3): ' SAMPLE statistics
'
GOSUB INIT:
FIRSTPASS = 1
COUNT = 1
TOTAREA = 0
FOR I = 1 TO 3
   PRINT "Please, enter the area expansion factor for stratum"; I; " (n.mi. ):"
```

```
   INPUT BETA(I)
    PRINT "Please, enter the area of stratum"; I; " (n.mi. ):"
   INPUT AREA(I)
    PRINT "Please, enter the # of REPRESENTATIVE stations (=tows) in stratum"; I; ":"
    INPUT NK(I)
  TOTAREA = TOTAREA + AREA(I)
NEXT I
BETAST = TOTAREA / AST
'
PRINT "Are the data for this run WEIGHT (W) or NUMBERS (N)?"
INPUT TYPFLAG$:  ' flag for weight or counts
IF TYPFLAG$ = "W" OR TYPFLAG$ = "w" OR TYPFLAG$ = "WEIGHT" OR TYPFLAG$ = "weight"
OR TYPFLAG$ = "wt" OR TYPFLAG$ = "WT" THEN TYPFLAG$ = "WEIGHT (Kg)" ELSE
TYPFLAG$ = "NUMBERS"
'
INPUT " Enter the name for the output file"; FIL2$
OPEN "O", 2, FIL2$
'
RETRY: INPUT "Are the data in a file"; ans1$
IF ans1$ <> "Y" AND ans1$ <> "y" AND ans1$ <> "n" AND ans1$ <> "N" THEN GOTO RETRY:
IF ans1$ = "N" OR ans1$ = "n" THEN GOTO LOOP1:
'
INPUT "ENTER THE NAME OF THE DATA FILE", FILN$
OPEN "I", 1, FILN$
'
LOOPX: IF ans1$ = "y" OR ans1$ = "Y" THEN GOSUB READDATA:
IF ans1$ = "y" OR ans1$ = "Y" THEN GOTO RRUN:
'
' ENTER DATA DIRECTLY
LOOP1:   PRINT "ENTER station,stratum,species,abundance FOR POINT"; PT; ":"
       PT = PT + 1
      INPUT ST, STRT, SPP$, ABUND
      IF FIRSTPASS = 1 THEN LASTSP$ = SPP$: FIRSTPASS = 0
       IF SPP$ <> LASTSP$ THEN PRINT "Please hold that datum. The program will now run
the stats on "; LASTSP$; " and return to this point for the next species": GOTO RDEND:
       LASTSP$ = SPP$
      ON STRT GOTO ARRAY1, ARRAY2, ARRAY3
ARRAY1: AR(1, ARCOUNT1) = ABUND
       ARCOUNT1 = ARCOUNT1 + 1
      GOTO LOOP1:
ARRAY2: AR(2, ARCOUNT2) = ABUND
       ARCOUNT2 = ARCOUNT2 + 1
      GOTO LOOP1:
ARRAY3: AR(3, ARCOUNT3) = ABUND
       ARCOUNT3 = ARCOUNT3 + 1
      GOTO LOOP1:
'
RDEND: LASTSP$ = SPP$
'
RRUN: PRINT "Calculating statistics..."
FOR K = 1 TO 3
   PRINT "STRATUM"; K; " ..."
   PRINT "MEAN"
   SUM1 = 0
   IF AR(K, 1) = 0 THEN
      MEAN(K) = 0!
```

```
      S2(K) = 0!
      CV(K) = 0!
      V(K) = 0!
      SE(K) = 0!
      P(K) = 0!
      S2P(K) = 0!
'
    GOTO 50
  END IF
  FOR I = 1 TO NK(K)
     SUM1 = SUM1 + AR(K, I)
  NEXT I
  MEAN(K) = SUM1 / NK(K): 'MEAN BY STRATUM
  PRINT "VARIANCE"
  SUMV = 0
  FOR I = 1 TO NK(K)
     SUMV = SUMV + (AR(K, I) - MEAN(K)) ^ 2
  NEXT I
  IF NK(K) = 1 THEN
       S2(K) = 0
   ELSE
       S2(K) = SUMV / (NK(K) - 1):  ' VARIANCE BY STRATUM
  END IF
  PRINT "COEFFICIENT OF VARIATION"
   CV(K) = SQR(S2(K)) / MEAN(K) * 100:  ' COFF. OF VAR.
  PRINT "VARIANCE OF THE MEAN"
   V(K) = S2(K) / NK(K): ' VAR. OF THE MEAN
  PRINT "STANDARD ERROR OF THE MEAN"
    SE(K) = SQR(V(K))
  PRINT "MINIMUM POPULATION ESTIMATE FOR TOTAL AREA"
    P(K) = MEAN(K) * BETA(K)
  PRINT "VARIANCE OF THE MINIMUM POPULATION ESTIMATE"
     S2P(K) = (V(K) * BETA(K) ^ 2):  ' VAR. OF MIN. POP. EST.
50 NEXT K
PRINT " ---- STRATIFIED STATISTICS ---- "
  N = NK(1) + NK(2) + NK(3): ' TOTAL NUMBER OF SAMPLES TAKEN
  PRINT "STRATIFIED MEAN"
  SUM1 = 0
  FOR K = 1 TO 3
      SUM1 = SUM1 + (MEAN(K) * BETA(K))
  NEXT
  STMEAN = SUM1 / BETAST: 'STRATIFIED MEAN
  PRINT "POPULATION VARIANCE"
  PSUM = 0
  FOR K = 1 TO 3
     FOR I = 1 TO NK(K)
        PSUM = PSUM + (AR(K, I) - STMEAN) ^ 2
     NEXT I
  NEXT K
  IF N = 1 THEN
     S2ST = 0
   ELSE
     S2ST = PSUM / (N - 1): ' POPULATION VARIANCE
  END IF
  PRINT "VARIANCE OF STRATIFIED MEAN"
  VST = 0
```

```
 FOR K = 1 TO 3
    VST = VST + (V(K) * (BETA(K) / BETAST) ^ 2): ' VAR. OF STRAT. MEAN
 NEXT K
 PRINT "STANDARD ERROR OF THE STRATIFIED MEAN"
 SEST = SQR(VST)
 PRINT "COEFFICIENT OF VARIATION"
 IF STMEAN = 0! THEN
    CVST = 0
   ELSE
    CVST = SEST / STMEAN * 100
 END IF
 PRINT "MINIMUM POPULATION ESTIMATE, BASED ON STRATIFIED MEAN"
 PST = STMEAN * BETAST
 PRINT "VARIANCE OF MIN. POPULATION ESTIMATE, BASED ON STRATIFIED MEAN"
 S2PST = VST * BETAST ^ 2: ' VAR. OF MIN. POP., STRAT. MEAN
   PRINT "95% confidence limits"
  CONFU = STMEAN + (1.96 * SEST)
  CONFL = STMEAN - (1.96 * SEST)
'go to output sub.
  GOSUB POUT:
  IF EOF(1) AND COUNT = 1 THEN COUNT = 2: GOSUB POUT ELSE IF EOF(1) AND COUNT = 2
THEN STOP
'
GOSUB INIT: ' REINITIALIZE VARIABLES
GOTO LOOPX: ' CONTINUE WITH THIS DATA SET
'
'
READDATA: PRINT "SUB. TO READ DATA FROM A FILE..."
IF FIRSTPASS = 1 THEN INPUT #1, ST, STRT, SPP$, ABUND
IF FIRSTPASS = 0 THEN ST = NEXTST: STRT = NEXTSTRT: SPP$ = NEXTSP$:
ABUND = NEXTAB
LASTSP$ = SPP$
WHILE SPP$ = LASTSP$ AND NOT EOF(1)
      ON STRT GOTO ARR1, ARR2, ARR3
ARR1: AR(1, ARCOUNT1) = ABUND
       PRINT "1"; ARCOUNT1; AR(1, ARCOUNT1)
      ARCOUNT1 = ARCOUNT1 + 1
     GOTO LOOP2:
ARR2: AR(2, ARCOUNT2) = ABUND
       PRINT "2"; ARCOUNT2; AR(2, ARCOUNT2)
      ARCOUNT2 = ARCOUNT2 + 1
     GOTO LOOP2:
ARR3: AR(3, ARCOUNT3) = ABUND
       PRINT "3"; ARCOUNT3; AR(3, ARCOUNT3)
      ARCOUNT3 = ARCOUNT3 + 1
     GOTO LOOP2:
LOOP2: IF EOF(1) THEN GOTO EX1:
INPUT #1, ST, STRT, SPP$, ABUND: PRINT ST, STRT, SPP$, ABUND
EX1: WEND
'
FIRSTPASS = 0
'Hold these as the first record of the next species input set.
NEXTST = ST
NEXTSTRT = STRT
NEXTSP$ = SPP$
NEXTAB = ABUND
```

```
'
RETURN
'
INIT: ARCOUNT1 = 1:  ' next empty element of array AR1
ARCOUNT2 = 1: ' next empty element of array AR2
ARCOUNT3 = 1: ' next empty element of array AR3
PT = 1:  ' count of points entered for this species-location
'
' Re-initialize abundance array.
FOR K = 1 TO 3
  FOR I = 1 TO 300
      AR(K, I) = 0!
  NEXT I
NEXT K
RETURN
'
POUT: 'SUB. TO SEND RESULTS TO OUTPUT FILE.
PRINT #2, "Mini-SURVAN", "CATCH/TOW"
PRINT #2, " "
PRINT #2, TAB(25); DATE$, TIME$
PRINT #2, " "
PRINT #2, TAB(12); LASTSP$, TYPFLAG$
PRINT #2, TITL$
PRINT #2, " "
PRINT #2, TAB(115); "VARIANCE"
PRINT #2, "STRATUM"; TAB(15); "SAMPLE"; TAB(30); "SAMPLE"; TAB(45);
"COEFFICIENT"; TAB(60); "VARIANCE"; TAB(72); "STANDARD ERROR"; TAB(90);
"MINIMUM POPULATION"; TAB(110); "MINIMUM POPULATION"
PRINT #2, TAB(11); "N"; TAB(15); "MEAN"; TAB(30); "VARIANCE"; TAB(45); "OF
VARIATION"; TAB(60); "THE MEAN"; TAB(72); " OF THE MEAN"; TAB(90); "FOR TOTAL
AREA"; TAB(110); "FOR TOTAL AREA"
PRINT #2, " "
FOR K = 1 TO 3
   PRINT #2, K; TAB(11); N; TAB(15); MEAN(K); TAB(30); S2(K); TAB(45); CV(K);
TAB(60); V(K); TAB(72); SE(K); TAB(90); P(K); TAB(110); S2P(K)
NEXT K
PRINT #2, " ": PRINT #2, " "
PRINT #2, TAB(115); "VARIANCE OF"
PRINT #2, TAB(10); "STRATIFIED"; TAB(25); "POPULATION"; TAB(38); "VARIANCE OF ";
TAB(53); "STANDARD ERROR OF"; TAB(71); " COEFFICIENT"; TAB(85); "MINIMUM
POPULATION"; TAB(110); "MINIMUM POPULATION"
PRINT #2, TAB(10); "  MEAN     "; TAB(25); "VARIANCE"; TAB(38); "STRATIFIED MEAN";
TAB(55); "STRATIFIED MEAN"; TAB(71); " OF VARIATION"; TAB(85); " FOR TOTAL AREA";
TAB(110); "FOR TOTAL AREA"
PRINT #2, " "
PRINT #2, TAB(10); STMEAN; TAB(25); S2ST; TAB(38); VST; TAB(55); SEST; TAB(71);
CVST; TAB(85); PST; TAB(110); S2PST
PRINT #2, " "
PRINT #2, "95% CONFIDENCE LIMITS"
PRINT #2, "ABOUT STRATIFIED MEAN", "LOW:", CONFL, "HIGH:", CONFU
PRINT #2, " ": PRINT #2, " "
'
RETURN
```

Table 1: Estimates of mean trawlable biomass and coefficients of variation by depth strata, December 1987 - January 1988.

	Stratum							
	50-150 m		151-250 m		251-500 m		Combined	
	Minimum biomass (mt)	Coef. var. (%)	Minimum biomass (mt)	Coef. var. (%)	Minimum biomass (mt)	Coef. var. (%)	Minimum biomass (mt)	Coef. var. (%)
C. gunnari								
South Georgia	3557	46.8	10878	24.0	651	36.9	15086	20.7
Shag Rocks	225	-	1188	94.8	34	-	1447	77.8
Ps. georgianus								
South Georgia	1426	22.7	9017	28.1	970	88.4	11412	23.6
N. gibberifrons								
South Georgia	1834	28.0	4404	17.5	950	29.9	7189	13.5
Shag Rocks	538	-	60	100.	10	-	609	9.9
Ch. aceratus								
South Georgia	703	16.1	5252	14.5	686	31.7	6642	12.0
N. rossii								
South Georgia	234	30.2	634	35.7	181	73.1	1049	25.9
N. squamifrons								
South Georgia	-	-	17	38.8	367	26.6	384	25.5
Shag Rocks								
D. eleginoides								
South Georgia	65	53.9	221	45.6	410	25.2	697	21.3
Shag Rocks	326	-	83	81.8	-	-	408	16.5
P.b. guntheri								
Shag Rocks	564	-	331	69.1	103	-	999	-
Number of hauls								
South Georgia	33		54		17		104	
Shag Rocks	1		2		1		4	

Table 2: Comparison of estimates of mean trawlable biomass, standard deviation and coefficient of variation based on the normal distribution, 1984/85 and 1986/87, relative to estimates for 1987/88.

	Shag Rocks			South Georgia			Combined		
	Minimum biomass (mt)	Std. dev.	Coef. var. (%)	Minimum biomass (mt)	Std. dev.	Coef. var.	Minimum biomass (mt)	Std. dev.	Coef. var. (%)
C. gunnari									
Kock (1985)	-	-	-	-	-	-	15821	16042	101.4
Gabriel(1987)	10023	5523	55.1	42649	8047	18.9	52672	9760	18.5
1987/88	1447		77.8	15086		20.6	16533	3301	20.0
Ps. georgianus									
Kock (1985)	-	-	-	-	-	-	8134	2684	33.0
Gabriel(1987)	-	-	-	4579	671	14.6	4579	671	14.6
1987/88	-	-	-	11412	2691	23.6	11412	2691	23.6
N. Gibberifrons									
Kock (1985)	-	-	-	-	-	-	15762	4476	28.4
Gabriel(1987)	363	164	45.2	12766	1975	15.5	13129	1982	15.1
1987/88	609	60	9.9	7189	969	13.5	7798	971	12.5
Ch. aceratus									
Gabriel(1987)	-	-	-	10816	1441	13.3	10816	1441	13.3
1987/88	-	-	-	6642	800	12.0	6642	800	12.0
N. rossii									
Kock (1985)	-	-	-	-	-	-	12781	12768	99.9
Gabriel(1987)	-	-	-	3966	2707	68.3	3966	2707	68.3
1987/88	-	-	-	1049	277	25.9	1049	277	25.9
N. squamifrons									
Gabriel(1987)	30	17	56.7	37166	29164	78.5	37196	29165	78.4
1987/88	42	-	-	384	98	25.5	284	98	25.5
D. eleginoides									
Kock (1985)	-	-	-	-	-	-	8159	6242	76.5
Gabriel(1987)	763	305	39.9	1541	519	33.7	2304	602	26.1
1987/88	408	67	16.5	697	149	21.3	1105	163	14.8
P.b. guntheri									
Kock (1985)	-	-	-	-	-	-	7256	3417	47.1
Gabriel(1987)	331	141	45.4	-	-	-	331	141	45.4
1987/88	999	229	25.6	-	-	-	999	229	22.9

Table 3 : Summary of length information for 1987/88 AMLR survey of South Georgia

Species	Size Range (cm)	Mean Overall Length (cm)	Mean Length by Stratum (cm) 1	2	3	L_{50}* (cm)	Obvious Modes (cm)
C. gunnari	2 - 57	26.7	21.4	29.2	34.9	22 - 25	16,23,32
Ps. georgianus	8 - 57	42.9	44.9	42.4	44.6	41 - 46	21,35,44
N. gibberifrons	3 - 51	21.4	17.7	24.0	27.5	32 - 34	5,17,37
N. rossii	7 - 69	49.9	52.3	48.4	53.4	41 - 51	- - -
Ch. aceratus	11 - 71	38.6	43.7	38.1	36.1	46 - 58	15,24,32,46
N. squamifrons	7 - 40	18.7	-	22.6	18.6	~ 30 [1]	18,28
D. eleginoides	6 - 125	33.3	24.2	40.3	47.7	~ 95 [2]	16,27,46
P.b. guntheri	9 - 22	15.2	14.9	16.2	14.6	-	15

* Length of 50% maturation, taken from Table 2, Kock et al. 1985

[1] for Kerguelen

[2] for Crozet

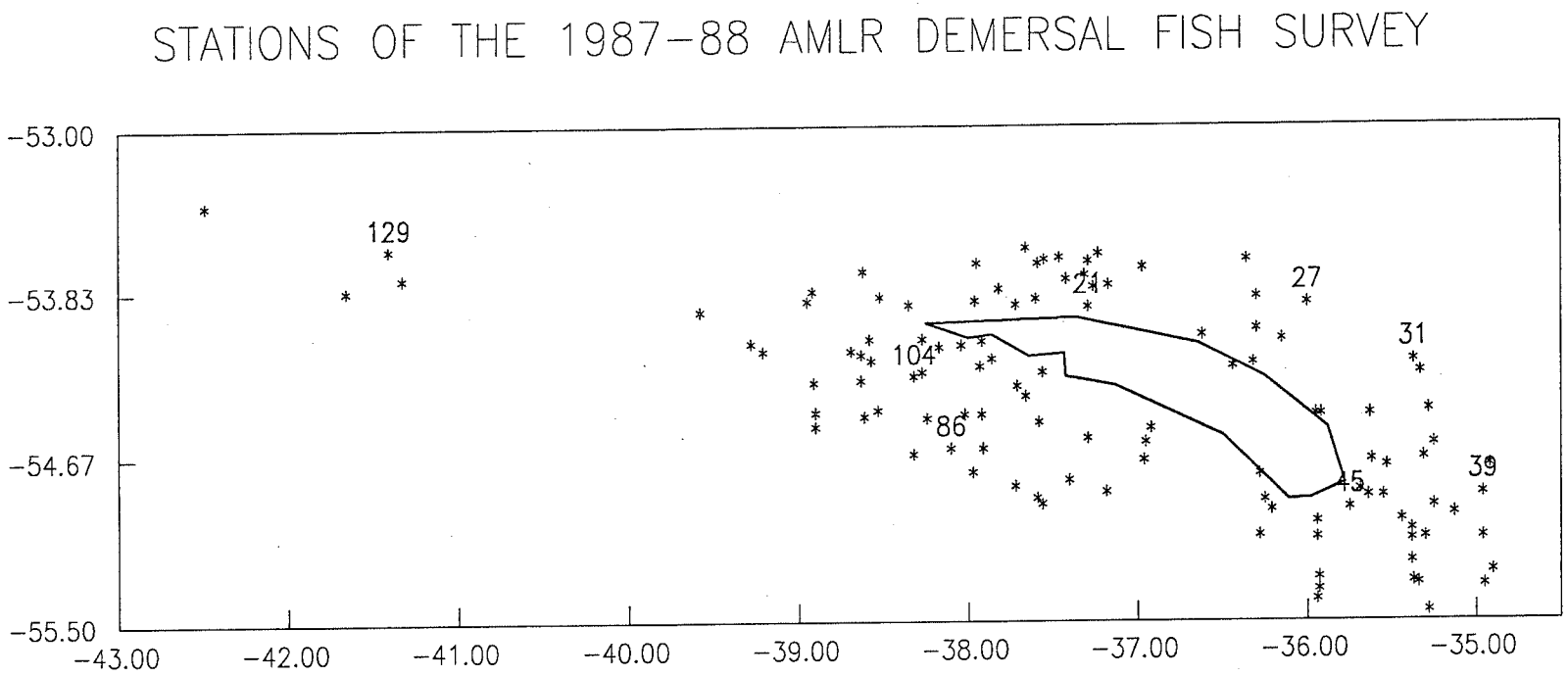


Figure 1: Map of station locations for the 1987-1988 AMLR survey cruise - South Georgia and Shag Rocks. The axes are in degrees west longitude and degrees south latitude, respectively. Only those stations which are explicitly referenced in the text have been labelled with a number.

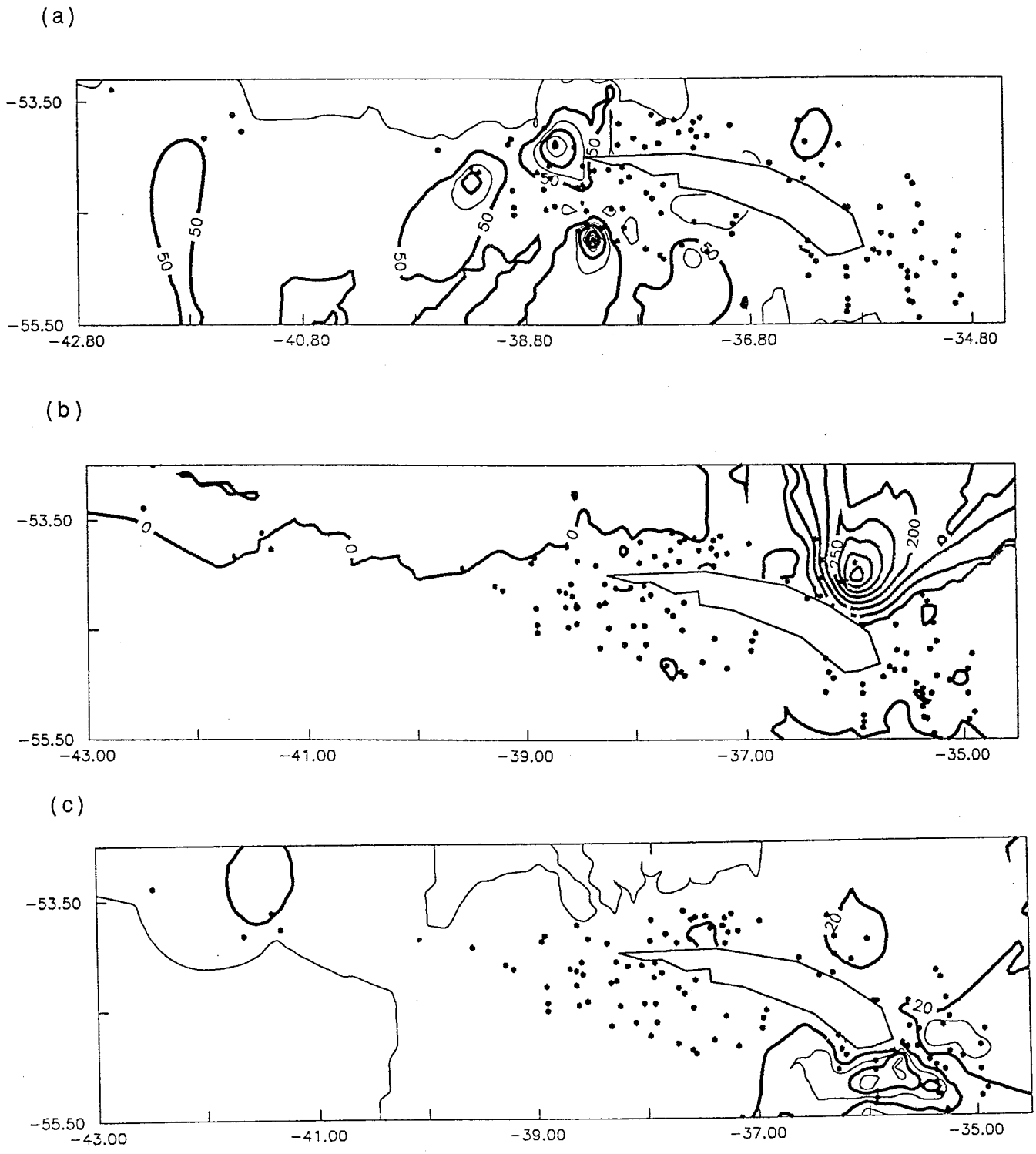
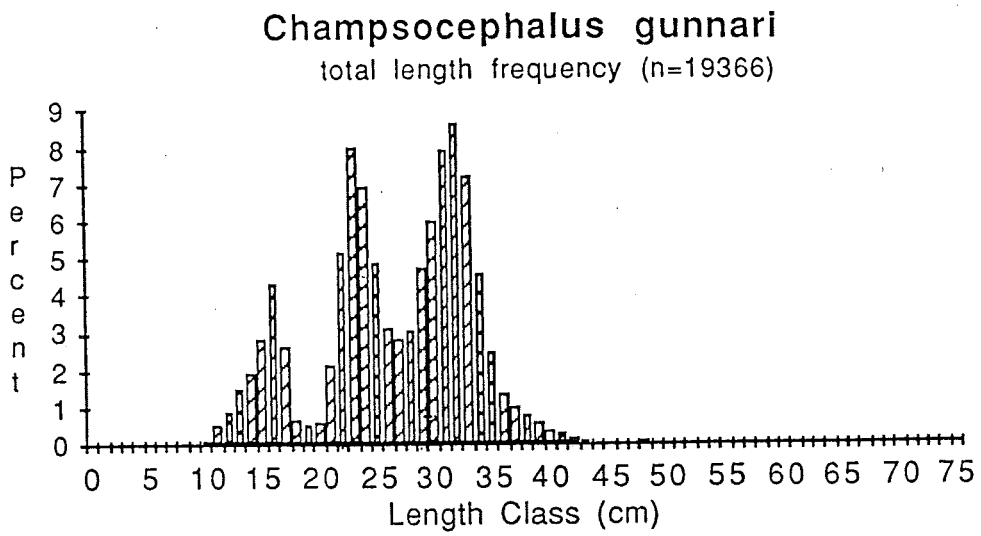


Figure 2: (a) Distribution of catch per tow, *Champsocephalus gunnari*. Contour interval is 50 kg (range 0-350).

(b) Distribution of catch per tow, *Pseudochaenichthys georgianus*. Contour interval is 50 kg (range 0-400).

(c) Distribution of catch per tow, *Notothenia gibberifrons*. Contour interval is 20 kg (range 0-80).

(a)



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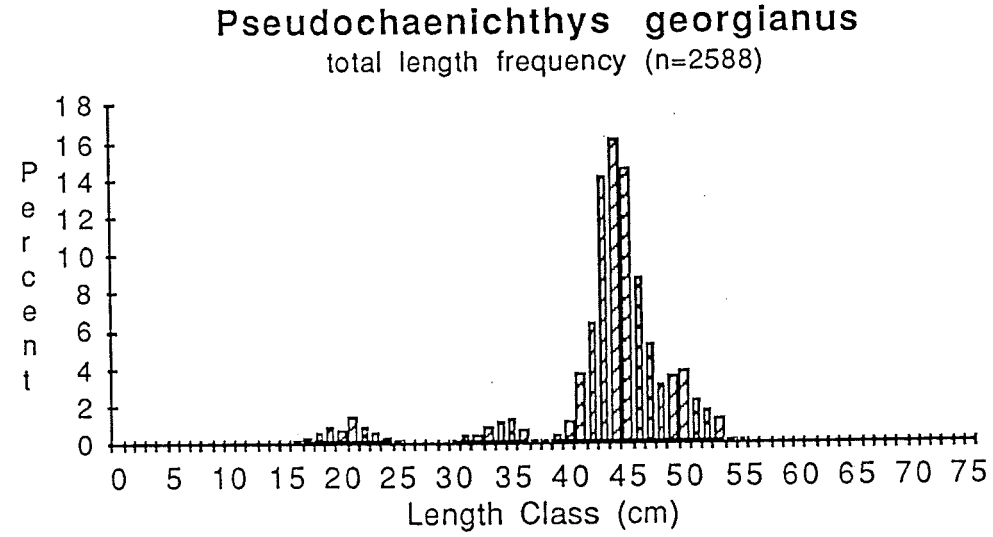

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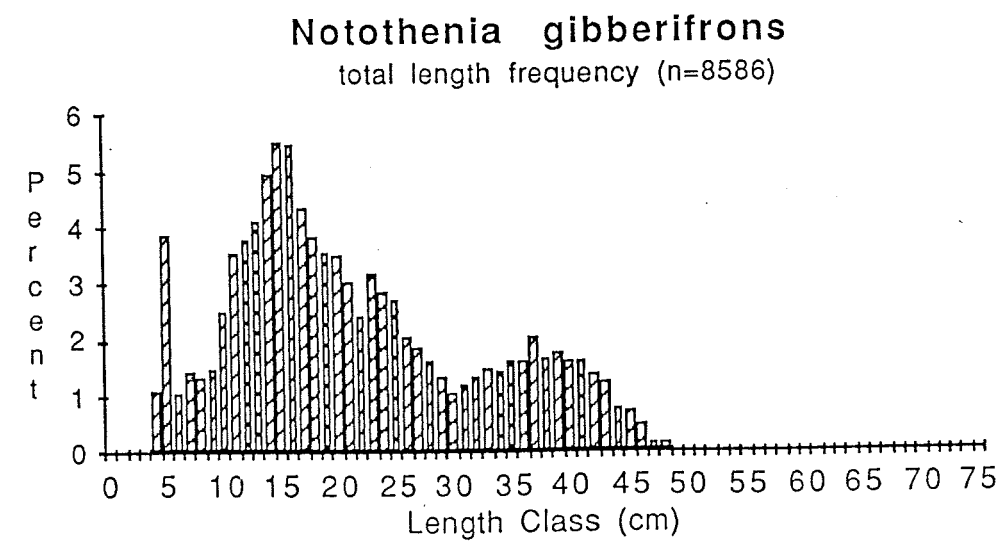


Figure 3: (a) Length frequency distribution, *Champsocephalus gunnari.*

(b) Length frequency distribution, *Pseudochaenichthys georgianus.*

(c) Length frequency distribution, *Notothenia gibberifrons.*

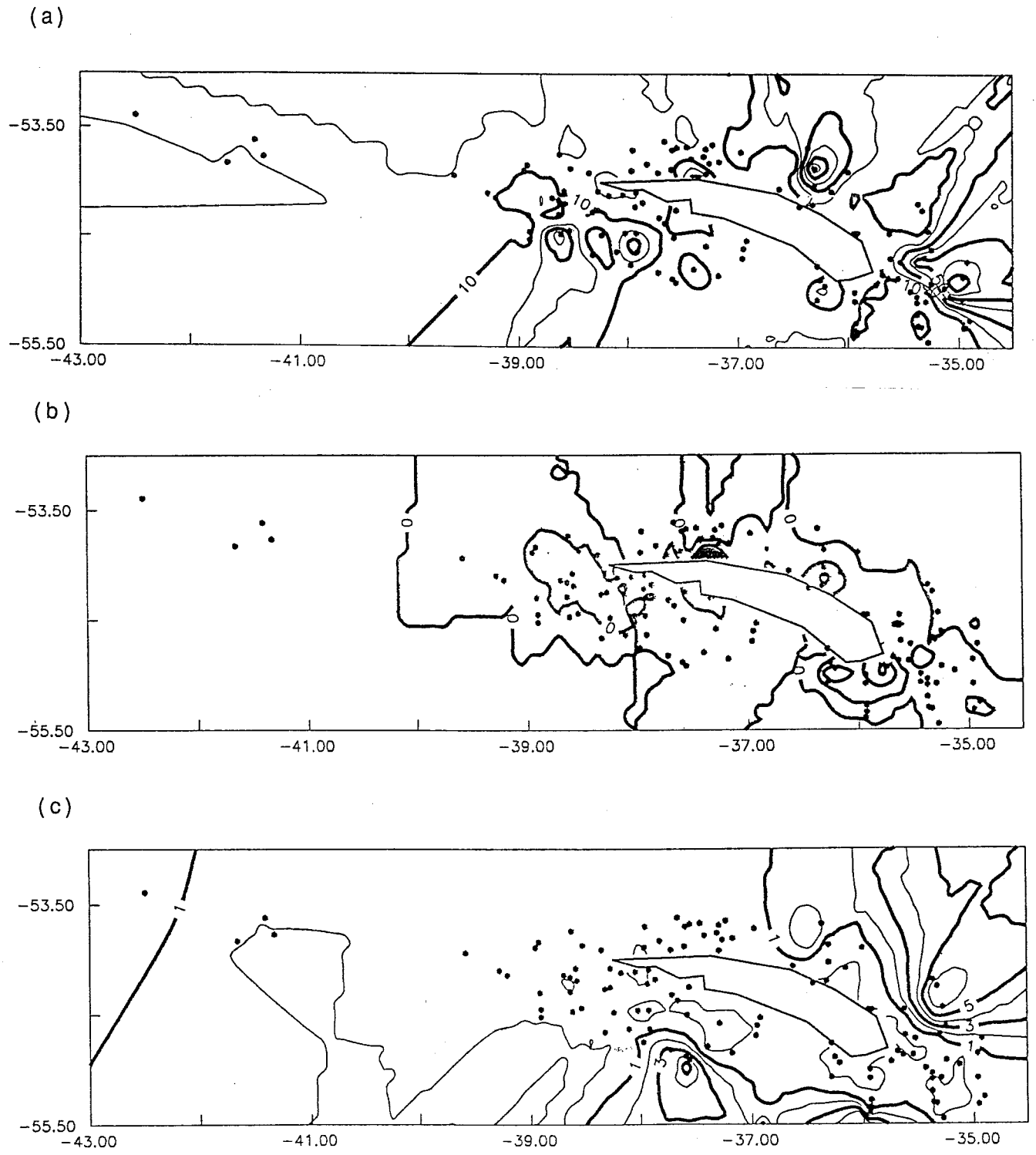
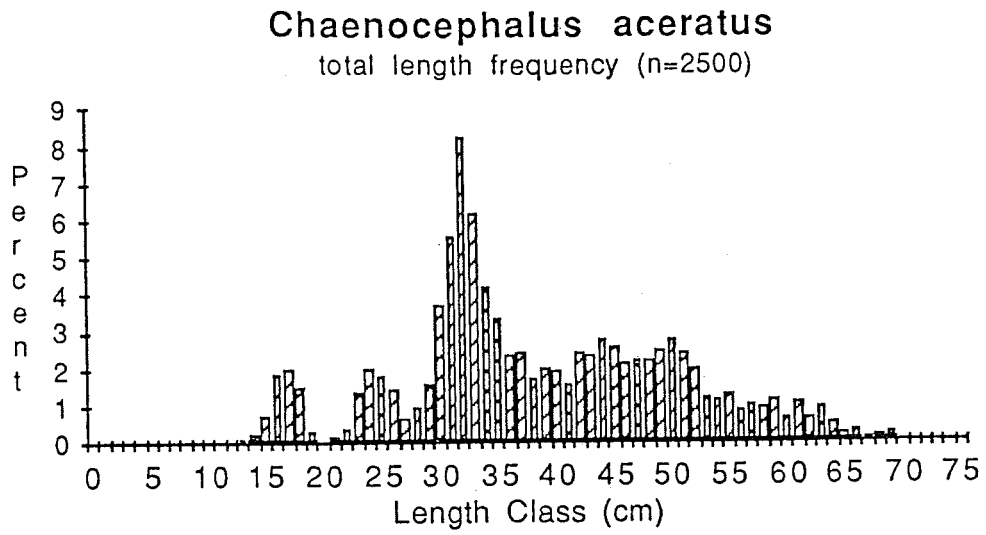


Figure 4: (a) Distribution of catch per tow, *Chaenocephalus aceratus*. Contour interval is 10 kg (range 0-70).

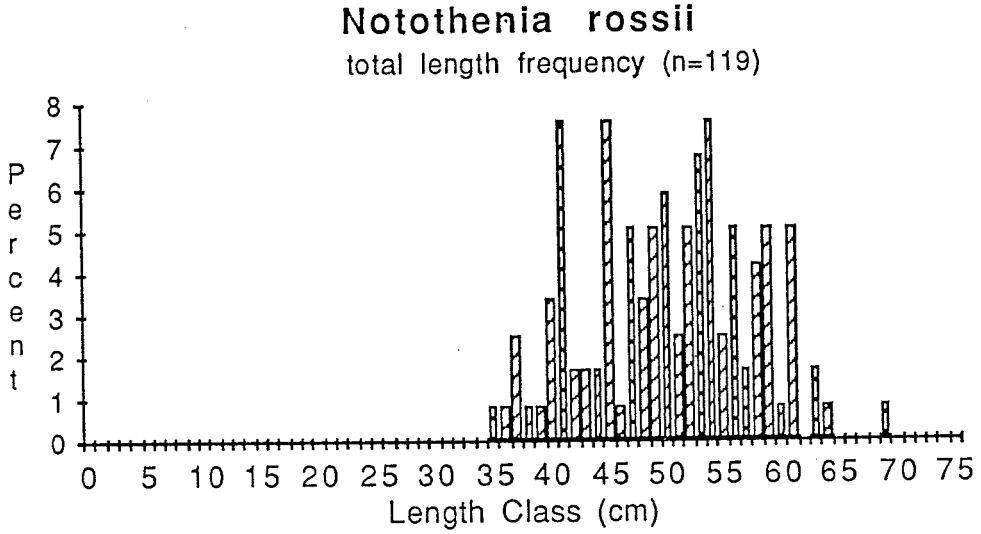
(b) Distribution of catch per tow, *Notothenia rossii*. Contour interval is 5 kg (range 0-25).

(c) Distribution of catch per tow, *Notothenia squamifrons*. Contour interval is 1 kg (range 0-6).

(a)



(b)



(c)

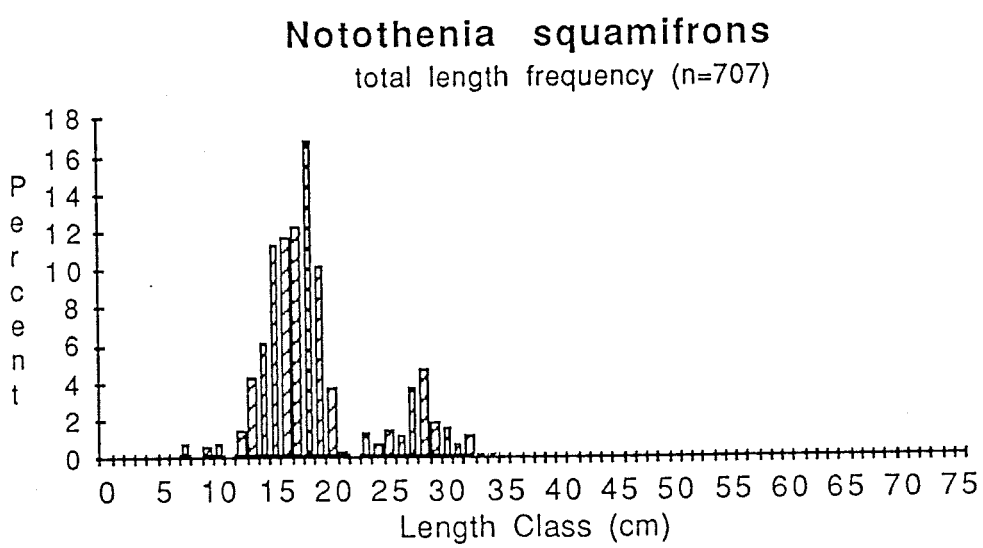
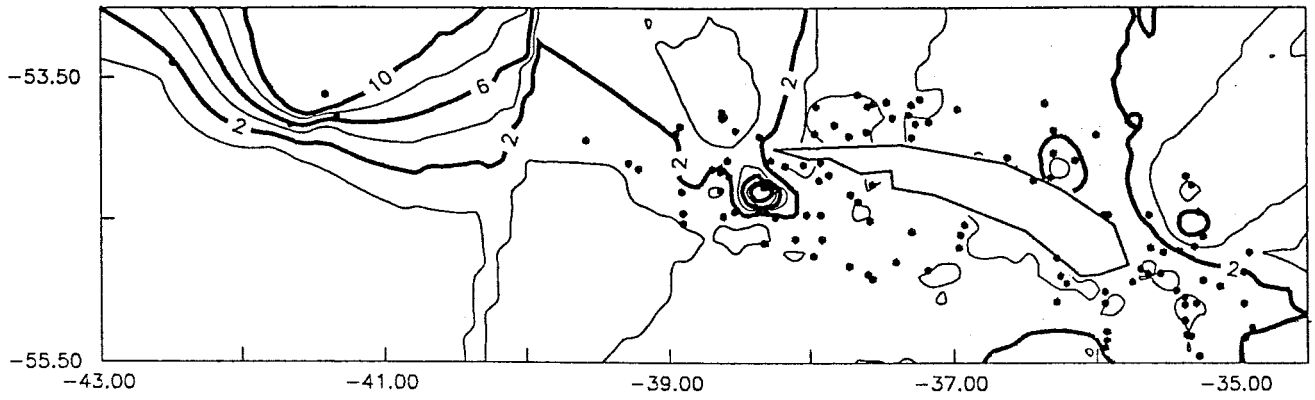


Figure 5: (a) Length frequency distribution, *Chaenocephalus aceratus.*

(b) Length frequency distribution, *Notothenia rossii.*

(c) Length frequency distribution, *Notothenia squamifrons.*

(a)



(b)

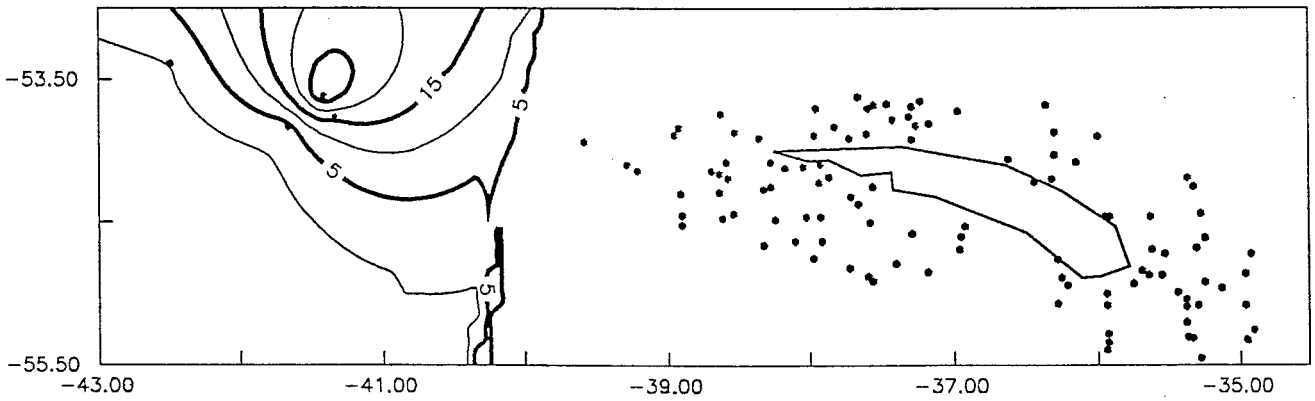
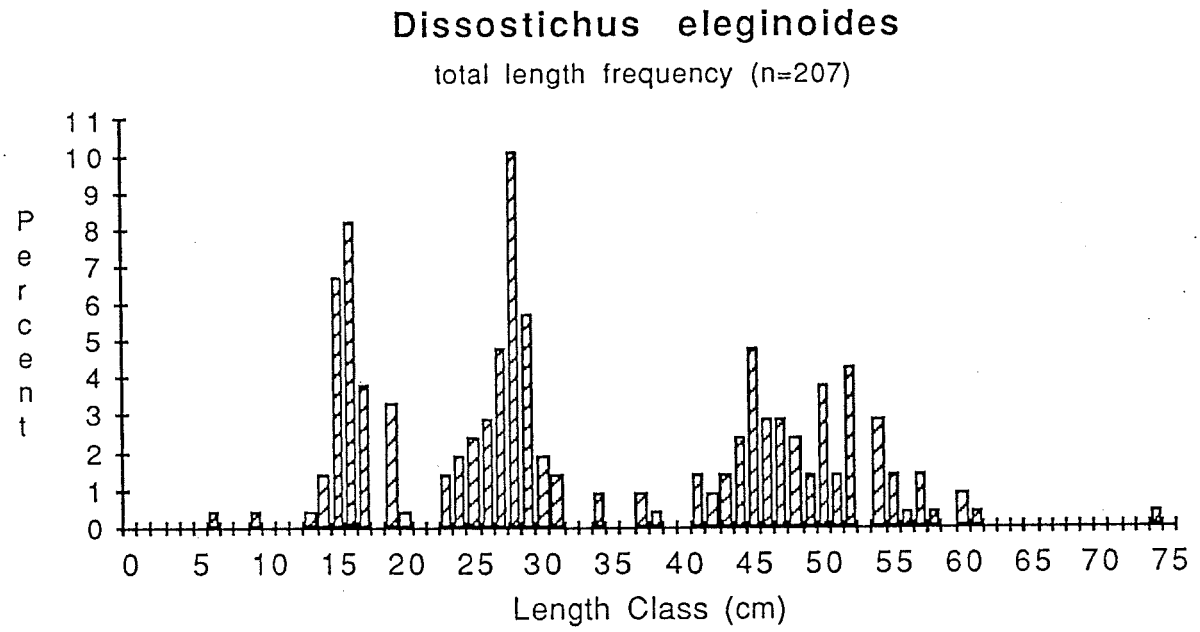


Figure 6: (a) Distribution of catch per tow, *Dissostichus eleginoides.* Contour interval is 2 kg (range 0-10).

(b) Distribution of catch per tow, *Patagonothen brevicauda guntheri.* Contour interval is 5 kg (range 0-25).

(a)



(b)

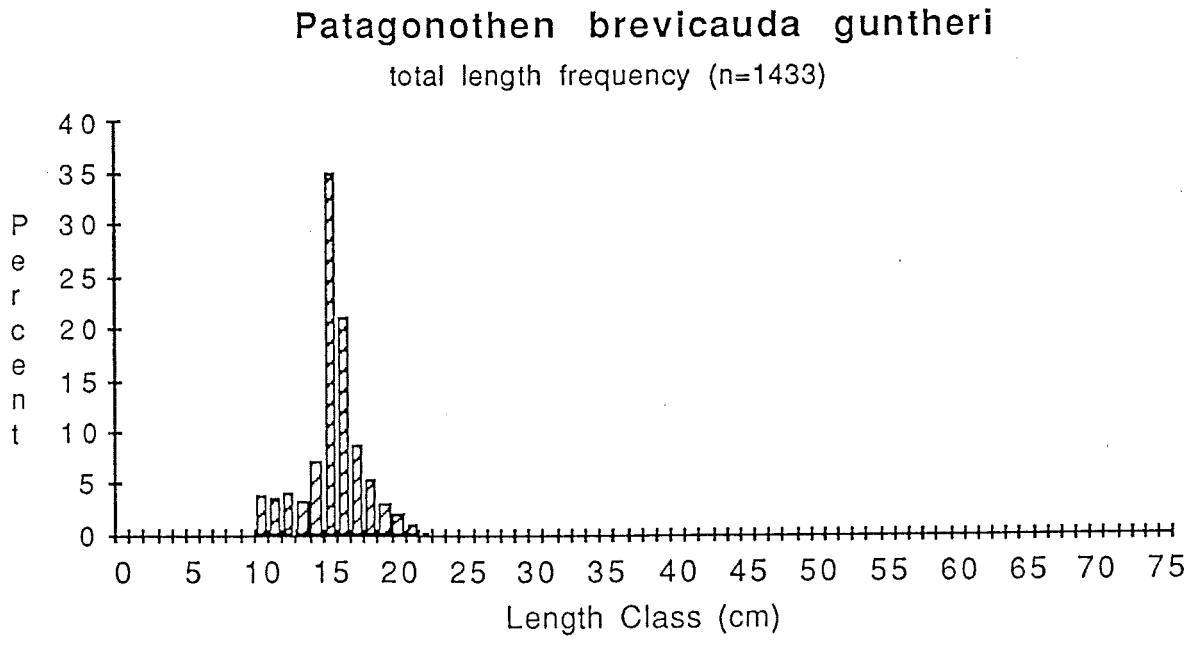


Figure 7: (a) Length frequency distribution, *Dissostichus eleginoides*

(b) Length frequency distribution, *Patagonothen brevicauda guntheri.*

Légendes des tableaux

Tableau 1 Estimations de la biomasse chalutable moyenne et des coefficients de variation par couches de profondeur, décembre 1987 - janvier 1988.

Tableau 2 Comparaison des estimations de la biomasse chalutable moyenne, de l'écart-type et du coefficient de variation basés sur la distribution normale, 1984/85 et 1986/87, par rapport aux estimations pour 1987/88.

Tableau 3 Résumé des informations sur les longueurs pour la campagne d'étude des AMLR au large de la Géorgie du Sud.

Légendes des figures

Figure 1 Carte des emplacements des stations pour la campagne d'étude des AMLR de 1987-88 - en Géorgie du Sud et dans les Shag Rocks. Les axes sont en degrés de longitude ouest et degrés de latitude sud, respectivement. Seules les stations dont il est fait mention explicite dans le texte ont été indiquées par un chiffre.

Figure 2
(a) Distribution de prise par trait de chalut, *Champsocephalus gunnari.* L'équidistance des courbes est de 50 kg (fourchette 0-350).

(b) Distribution de prise par trait de chalut, *Pseudochaenichthys georgianus.* L'équidistance des courbes est de 50 kg (fourchette 0-400)

(c) Distribution de prise par trait de chalut, *Notothenia gibberifrons.* L'équidistance des courbes est de 50 kg (fourchette 0-80)

Figure 3
(a) Distribution de fréquences de longueurs, *Champsocephalus gunnari.*

(b) Distribution de fréquences de longueurs, *Pseudochaenichthys georgianus.*

(c) Distribution de fréquences de longueurs, *Notothenia gibberifrons.*

Figure 4
(a) Distribution de prise par trait de chalut, *Chaenocephalus aceratus.* L'équidistance des courbes est de 10 kg (fourchette 0-70).

(b) Distribution de prise par trait de chalut, *Notothenia rossii.* L'équidistance des courbes est de 5 kg (fourchette 0-25).

(c) Distribution de prise par trait de chalut, *Notothenia squamifrons.* L'équidistance des courbes est de 1 kg (fourchette 0-6).

Figure 5
(a) Distribution de fréquences de longueurs, *Chaenocephalus aceratus.*

(b) Distribution de fréquences de longueurs, *Notothenia rossii.*

(c) Distribution de fréquences de longueurs, *Notothenia squamifrons.*

Figure 6
(a) Distribution de prise par trait de chalut, *Dissostichus eleginoides.* L'équidistance des courbes est de 2 kg (fourchette 0-10).

(b) Distribution de prise par trait de chalut, *Patagonothen brevicauda guntheri.* L'équidistance des courbes est de 5 kg (fourchette 0-25).

Figure 7 (a) Distribution de fréquences de longueurs, *Dissostichus eleginoides.*

(b) Distribution de fréquences de longueurs, *Patagonothen brevicauda guntheri.*

Заголовки к таблицам

Таблица 1 Оценки средней величины биомассы промысловой части запаса и коэффициенты вариативности по горизонтам, декабрь 1987 г. - январь 1988 г.

Таблица 2 Сравнение оценок средней величины биомассы промысловой части запаса, среднего квадратического отклонения и коэффициента вариативности, основанных на нормальном распределении, 1984-85 гг. и 1986-87 гг.

Таблица 3 Сводка данных по длине для съемки AMLR в районе Южной Георгии, 1987-88 гг.

Подписи к рисункам

Рисунок 1 Карта расположений станций для рейса 1987-88 гг. с целью съемки AMLR в районе Южной Георгии и скал Шаг. Оси координат соответственно выражены в градусах западной долготы и градусах южной широты. Цифрами обозначены только те станции, о которых подробно говорится в тексте.

Рисунок 2 (a) Распределение величин улова за одно траление, *Champsocephalus gunnari.* Расстояние между контурами равно 50 кг (диапазон 0-350).

(b) Распределение величин улова за одно траление, *Pseudochaenichthys georgianus.* Расстояние между контурами равно 50 кг (диапазон 0-400).

(c) Распределение величин улова за одно траление, *Notothenia gibberifrons.* Расстояние между контурами равно 20 кг (диапазон 0-80).

Рисунок 3 (a) Частотное распределение длин, *Champsocephalus gunnari.*

(b) Частотное распределение длин, *Pseudochaenichthys georgianus.*

(c) Частотное распределение длин, *Notothenia gibberifrons.*

Рисунок 4 (a) Распределение величин улова за одно траление, *Chaenocephalus aceratus.* Расстояние между контурами равно 10 кг (диапазон 0-70).

(b) Распределение величин улова за одно траление, *Notothenia rossii*. Расстояние между контурами равно 5 кг (диапазон 0-25).

(c) Распределение величин улова за одно траление, *Notothenia squamifrons*. Расстояние меду контурами равно 1 кг (диапазон 0-6).

Рисунок 5 (a) Частотное распределение длин, *Chaenocephalus aceratus*.

(b) Частотное распределение длин, *Notothenia rossii*.

(c) Частотное распределение длин, *Notothenia squamifrons*.

Рисунок 6 (a) Распределение величин улова за одно траление, *Dissostichus eleginoides*. Расстояние между контурами равно 2 кг (диапазон 0-10).

(b) Распределение величин улова за одно траление, *Patagonothen brevicauda guntheri*. Расстояние между контурами равно 5 кг (диапазон 0-25).

Рисунок 7 (a) Частотное распределение длин, *Dissostichus eleginoides*.

(b) Частотное распределение длин, *Patagonothen brevicauda guntheri*.

Encabezamientos de las Tablas

Tabla 1 Estimaciones de la biomasa media explotable y coeficientes de variación por estratos de profundidad, diciembre de 1987 - enero de 1988.

Tabla 2 Comparación de las estimaciones de la biomasa media explotable, desviación estándar y coeficiente de variación basado en la distribución normal, 1984/85 y 1986/87, relativo a las estimaciones para 1987/88.

Tabla 3 Resumen de la información de tallas para la prospección AMLR de 1987/88 en Georgia del Sur.

Leyendas de las Figuras

Figura 1 Mapa con la localización de las estaciones para el crucero de prospección AMLR de 1987/88 - Georgia del Sur y rocas Cormoran. Los ejes están indicados en grados longitud Oeste y grados latitud Sur respectivamente. Solamente aquellas estaciones mencionadas explícitamente en el texto están designados con un número.

Figura 2 (a) Distribución de captura por arrastre, *Champsocephalus gunnari*. El intervalo del contorno es 50 kg (rango 0-350).

(b) Distribución de captura por arrastre, *Pseudochaenichthys georgianus*. El intervalo del contorno es 50 kg (rango 0-400).

(c) Distribución de captura por arrastre, *Notothenia gibberifrons*. El intervalo del contorno es 20 kg (rango 0-80).

Figura 3 (a) Distribución de frecuencia por tallas, *Champsocephalus gunnari*.

(b) Distribución de frecuencia por tallas, *Pseudochaenichthys georgianus*.

(c) Distribución de frecuencia por tallas, *Notothenia gibberifrons*.

Figura 4 (a) Distribución de captura por arrastre, *Chaenocephalus aceratus*. El intervalo de contorno es 10 kg (rango 0-70).

(b) Distribución de captura por arrastre, *Notothenia rossii*. El intervalo de contorno es 5 kg (rango 0-25).

(c) Distribución de captura por arrastre, *Notothenia squamifrons*. El intervalo de contorno es 1 kg (rango 0-6).

Figura 5 (a) Distribución de la frecuencia por tallas, *Chaenocephalus aceratus*.

(b) Distribución de la frecuencia por tallas, *Notothenia rossii*.

(c) Distribución de la frecuencia por tallas, *Notothenia squamifrons*.

Figura 6 (a) Distribución de la captura por arrastre, *Disssostichus eleginoides*. El intervalo del contorno es 2 kg (rango 0-10).

(b) Distribución de la captura por arrastre, *Patagonothen brevicauda guntheri*. El intervalo del contorno es 5 kg (rango 0-25).

Figura 7 (a) Distribución de la frecuencia por tallas, *Disssostichus eleginoides*.

(b) Distribución de la frecuencia por tallas, *Patagonothen brevicauda guntheri*.