CCAMLR SCIENTIFIC ABSTRACTS
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Commission for the Conservation of
Antarctic Marine Living Resources

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PREFACE

CCAMLR Scientific Abstracts provides a comprehensive record of all scientific papers presented for the consideration of the annual meetings of the CCAMLR Commission and Scientific Committee and of their subsidiary bodies.

This volume is the first in the series and contains abstracts of scientific papers presented in 1992. It corresponds to the Eleventh Meetings of the CCAMLR Commission and the Scientific Committee and is published only in English.

Papers fall into three categories:

(i) Scientific papers submitted for consideration of the meetings, but published elsewhere, for which the full reference and published abstract are given;

(ii) Scientific papers not yet published or not intended for publication, which are listed as "unpublished"; and

(iii) Supplementary scientific papers not intended for publication, for which the title alone is listed.

All abstracts are listed in groups by respective CCAMLR bodies at meetings of which these papers were submitted. Each abstract is preceded with a unique CCAMLR document number, e.g. SC-CAMLR-XI/BG/11 (background document number 11 submitted at the Eleventh Meeting of the Scientific Committee); or WG-Krill-92/8 (document number 8 submitted at the 1992 meeting of the Working Group on Krill).

Unpublished papers must not be cited without written permission of the author(s). Addresses of principal authors are given for this purpose.

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Scientific Committee

SC-CAMLR-XI/8
Status and trends of Antarctic and sub-Antarctic seabirds. SCAR Bird Biology Sub-Committee. CCAMLR, *Report of the Eleventh Meeting of the Scientific Committee (SC-CAMLR-XI)*, Annex 9, 1991, pp. 441-462, (English).

SC-CAMLR-XI/9
Abundance and trends of Antarctic pinniped populations. SCAR Group of Specialists on Seals. CCAMLR, *Report of the Eleventh Meeting of the Scientific Committee (SC-CAMLR-XI)*, Annex 8, 1991, pp. 463-476, (English).

SC-CAMLR-XI/BG/9
Entanglement of Antarctic fur seals in man-made debris at Bird Island, South Georgia. J. Arnould (British Antarctic Survey, High Cross, Madingley Road, Cambridge, CB3 0ET, United Kingdom), 10 pp., (English, unpublished).

The incidence of entanglement of Antarctic fur seals (*Arctocephalus gazella*) in man-made debris at Bird Island, South Georgia, was monitored throughout the austral winter and summer of 1991 as part of an on-going study by the British Antarctic Survey. Only seven seals were observed entangled during the winter months (April to October) while 48 were sighted during the pup-rearing period (November to March). Entanglement during the winter months was comparable to that observed in 1991 (seven). While the incidence of entanglement during the pup-rearing period was slightly higher than in the previous year (48 compared to 30), it was substantially lower than during the 1988/89 and 1989/90 seasons (190 and 156, respectively). Polypropylene straps (44%), of the type used in packaging bands, and fishing net fragments (27%) were the most common items found on seals. These proportions are similar to those reported in previous years.

SC-CAMLR-XI/BG/11
Trophic relations of the cephalopod *Martialia hyadesi* (Teuthoidea: Ommastrephidae) at the Antarctic Polar Front, Scotia Sea. P.G. Rodhouse, M.G. White and M.R.R. Jones (British Antarctic Survey, High Cross, Madingley Road, Cambridge, CB3 0ET, United Kingdom). *Marine Biology, 114*, pp. 415-421, 1992, (English).

Samples of squid, *Martialia hyadesi*, were collected aboard two Japanese squid jigging vessels carrying out commercial fishing trials at the Antarctic Polar Frontal Zone, north Scotia Sea in February 1989. The dissected stomachs of 61 specimens were classified according to fullness and the contents examined visually. Identifiable food items included fish sagittal otoliths, crustacean eyes, the lappets on euphausiid first antennule segments and cephalopod sucker rings. The most frequent items in the squid's diet were the myctophid fishes *Krefftichthys anderssoni* and *Electronacarlsbergi*, the euphausiid *Euphausia superba* and a hyperiid amphipod, probably *Themisto gaudichaudii*. A small proportion of the sample had been feeding cannibalistically. Total lengths of the fish prey were estimated from sagittal otolith size using published relationships. All fish were relatively small; 7 to 35% of squid mantle-length. However, it is possible that some heads of larger fish are discarded by the squid and so are not represented by otoliths in the stomach contents. Over the size range of squid in the sample there was no relationship between size of fish prey and size of squid. Similarly, when the squid sample was divided into groups according to prey categories: crustaceans, crustaceans + fish, fish, cephalopod, there was no evidence that dietary preference was related to squid size. The prevalence of copepod-feeding myctophids in the diet of this squid, which is itself a major prey item of some higher predators in the Scotia Sea, suggests that a previously unrecognised food chain: copepod - myctophid - *Martialia hyadesi* - higher predator, may be an important component of the Antarctic oceanic ecosystem.

SC-CAMLR-XI/BG/14
CPUEs and body length of Antarctic krill during the 1990/91 season in the fishing grounds north of Livingston Island and north of Elephant Island. T. Ichii (National Institute of Far Seas Fisheries 5-7-1, Orido, Shimizu, 424 Japan), 18 pp., (English, unpublished).

This paper summarises Japanese krill catch data for the 1990/91 season in Subarea 48.1. Two kinds of CPUEs, catch/tow and catch/towing time, and body length frequency of krill were examined for each 10-day period. Levels of both CPUEs rose in mid-summer and fell at the end of summer. Krill with a modal length of 46 to 50 mm were dominant throughout summer. The total catch of krill (i.e., 54 720 tonnes) corresponds to only 3.4% of the estimated krill biomass in the fishing grounds.

Working Group on Krill

WG-KRILL-92/4
Further computations of the consequences of setting the annual krill catch limit to a fixed fraction of the estimate of krill biomass from a survey. D.S. Butterworth, G.R. Gluckman, S. Chalis (Department of Applied Mathematics, University of Cape Town, Rondebosch 7700, South Africa), 24 pp., (English, unpublished).

The results of Butterworth *et al*. (1991) relating potential krill yield to a pre-exploitation survey estimate of krill biomass are extended as specified by WG-Krill in 1991. The most important of these extensions is integration over the ranges of uncertainty for a number of the model parameters. Results are provided for the probability of spawning biomass falling below various fractions of its median pre-exploitation level, as a function of the fraction of the biomass estimate which is set as the catch for a 20-year period. Three alternative fishing seasons are considered. Fishing in summer (near-coincident with the period of krill growth), or throughout the year, allows a greater catch (for the same risk of depletion) than in the case of fishing in winter.

WG-KRILL-92/5
State of the Antarctic krill (*Euphausia superba* Dana) resources in the Sodruzhestva Sea area (Divisions 58.4.2 and 58.4.3) from 1988 to 1990. V.A. Bibik and V.N. Yakovlev (YugNIRO, 2 Sverdlova Street, Kerch, 334500, Russia), 12 pp., (English, unpublished).

Interannual variations in dynamics of krill stock in the Sodruzhestva Sea area for the period from 1988 to 1990 are discussed in this paper. It has been established that a considerable increase in the stock size in 1990 was due to a good recruitment from 1986 and 1987 year-classes and a low level of krill flux out of the area in 1989/1990.

WG-KRILL-92/6
Report of biological observations carried out on board the krill fishing vessel *More Sodruzhestva* from April to August 1991. V.I. Latogursky (AtlantNIRO, 5 Dimitry Donskoy Street, Kaliningrad 236000, Russia), 21 pp., (Russian, unpublished).

An observation program was carried out by a biologist-observer on board the krill fishing vessel *More Sodruzhestva* from April to August 1991 in Subareas 48.2 and 48.3. The program included observation of krill fishing operations, collection and processing of catch samples for analysing physiological status and size composition of krill and also for determining the level of by-catch of juvenile channichthyids. In general, krill density in Subarea 48.2 was twice as high as that in Subarea 48.3. Catch-per-haul was 9.51 and 4.74 tonnes respectively. Krill of two modal sizes, 45 to 48 mm and 49 to 52 mm, were dominant in catches taken in April/May in the northwest of Subarea 48.2. Krill of modal sizes 31 to 32 mm and 35 to 36 mm made up the bulk of catches in the southeast of the subarea. No by-catch of juvenile fish was observed in Subarea 48.2. Krill of the following three modal groups was dominant in Subarea 48.3: 35 to 38 mm, 39 to 42 mm and 45 to 46 mm. By-catch of juvenile *Champsocephalus gunnari* was observed in these subareas during the period 17 to 23 May 1991. Sightings of marine mammals and birds in the vicinity of the vessel were also recorded.

WG-KRILL-92/7

Acoustic estimation of krill (*Euphausia superba*) biomass and behaviour in the Ross Sea. M. Azzali (National Research Council, Institute for Marine Fishery, Molo Mandracchio, 60100 Ancona, Italy), 25 pp., (English, unpublished).

In this paper the results of the Italian acoustic survey in the Ross Sea (November 1989 to January 1990) are presented and some implications of the results in comparison with previous krill estimates are discussed. The mean biomass density of krill assessed for the whole survey area (286 000 km^2) is very close to that assessed in the Indian Ocean sector by the BIOMASS program. Thus, contrary to prevailing opinion, the Pacific Ocean sector of the Antarctic is not krill-deficient. The Italian acoustic survey was conducted in two stages characterised by different environmental conditions: (i) with pack-ice covering much of the area; and (ii) one week after ice had receded. Dense aggregations of krill were observed in the area previously covered by ice, indicating that krill also aggregates below ice. Thus for biomass estimation, areas temporarily covered by ice need also to be considered. During the Italian expedition, at latitudes between 70° and 75°S where daytime prevailed, only krill swarms and a few irregular patches were observed in the depth range from 10 to 70 m. Diurnal, vertical migrations were not observed. It confirms that krill behaviour is greatly influenced by light. Data recorded digitally on tape were processed in the laboratory to compare the TS obtained for 38 and 120 kHz. Measurements on 132 krill swarms indicate that TS for 38 kHz is 10.15 dB (standard deviation = 1.6 dB) less than for 120 kHz and also 15 dB less than the value recommended by BIOMASS for 50 kHz. Preliminary results also indicate that TS at 120 kHz used in the BIOMASS program is strongly overestimated. Our results, which need to be confirmed by data from other surveys, appear to indicate that the biomass of krill during FIBEX was underestimated in part due to the area selected, TS used and the disregard of krill behaviour.

WG-KRILL-92/8

Possible approaches to the evaluation of the Antarctic krill mortality. L.G. Maklygin and V.I. Latogursky (AtlantNIRO, 5 Dimitry Donskoy Street, Kaliningrad 236000, Russia), 13 pp., (Russian, unpublished).

Parameters of the von Bertalanffy growth equation for 1928 and 1970 to 1976 were calculated on the basis of summary data on krill age groups defined by means of the Harding method. Parameters obtained were used to calculate total krill mortality using different methods earlier used only in fish stock assessments. As a result of uncertainty in age groups, estimates had a wide range of values which varied from 0.75 to 1.17. No fishery impact on the size structure of krill population was found.

WG-KRILL-92/9

Diurnal changes of some biological characteristics of *Euphausia superba* Dana in swarms (westward of the South Orkney Islands, 24 March to 18 June 1990 - based on data reported by biologist-observer). A.V. Vagin, R.R. Makarov and L.L. Menshenina (VNIRO, 17a Verkhnaya Krasnoselskaya Street, Moscow 107140, Russia), 22 pp., (English, unpublished).

Investigations of diurnal variations in size composition of *Euphausia superba* were carried out aboard the commercial trawler *Grigory Kovtun* in the fishing area near the South Orkney Islands from March to June 1990. Observations were carried out on six trawl stations. Every station consisted of a series of catches by a standard commercial trawl (9 to 12 tows per station). An increase in the average size of animals during daytime was observed at several stations. These changes were found to be related to the increased proportion of males as well as to the difference in average length of males and females. During diurnal vertical migrations males began to move inside swarms first. When diurnal migration was not observed (particularly during the last season) the diurnal changes in *Euphausia superba* size composition were less pronounced or not found at all. The significance of these observations on

the size composition of *E. superba* for the future design of krill surveys is considered in this paper. A gradual decrease in the average size of *E. superba* from the end of March to June was observed in the area surveyed. We suggest that these changes are related to the drift of swarms, not to changes in krill behaviour thought to occur during the winter post-spawning non-feeding season. It is hard to explain these changes by the impact of the fishery on larger krill specimens.

WG-KRILL-92/10
A guideline for collection, analysing and preparation of report on material collected by a biologist-observer on board a commercial trawler (draft). V.I. Latogursky and R.R. Makarov AtlantNIRO, 5 Dimitry Donskoy Street, Kaliningrad 236000, Russia), 11 pp., (English, unpublished).

The main stages of *E. superba* sampling from commercial catches are reviewed and described. The sampling includes mass-measuring of body length, analysis of maturity stages, feeding activity and body weight. Periodicity of sampling and sample sizes are suggested. Formats for recording data and reporting results of observations are also included.

WG-KRILL-92/11
Status of krill target strength. K.G. Foote, D. Chu and T.K. Stanton (Institute of Marine Research, PO Box 1870, N 5024 Bergen, Norway), 37 pp., (English, unpublished).

Empirical estimates for the target strength of krill are extracted from publications. These are confined to measurements on aggregations of live euphausiids and should not be affected by a frequent cause of bias in single-animal measurements, namely thresholding. Theoretical estimates for the target strength are derived from the deformed-cylinder scattering model assuming specific sets of physical and orientational parameters, for which there is an empirical basis. The theoretical estimates show a non-monotonic dependence of target strength on both animal size and transmit frequency, notwithstanding admitted shortcomings. Some recent single-animal measurements of target strength for live euphausiids and euphausiid-related specimens, made under high signal-to-noise-ratio conditions, are consistent with the general pattern. Several specific recommendations are made for future, improved determinations of krill target strength. Based on the comparisons, general prediction curves for the target strength are presented that are applicable to a wide range of lengths, acoustic frequencies and orientation parameters.

WG-KRILL-92/12
Variability of krill stock composition and distribution in the vicinity of Elephant Island during AMLR investigations 1988-1992. V. Loeb and V. Siegel (Moss Landing Marine Laboratories, PO Box 450, Moss Landing, Ca. 95039, USA), 40 pp., (English, unpublished).

Krill stock composition and distributional patterns in the vicinity of Elephant Island during austral summer 1988 to 1992 are described. Changes in both size and maturity composition over the five-year period indicate strong recruitment from the 1987/88 and 1990/91 year-classes and poor recruitment from the 1988/89 and 1989/90 year-classes. Year-class success may be related to the abundance of large mature stages and/or the development state of mature females during early summer. The overall distributional patterns during each year indicate that the older year classes were associated with oceanic/Drake Passage waters while younger classes were associated with water masses to the south. Between-year differences in distribution patterns reflected changes in year-class success and maturity stage composition.

WG-KRILL-92/13
Fine-scale catches of krill in Area 48 reported to CCAMLR 1990 to 1991. CCAMLR Secretariat, 19 pp., (English, unpublished).

WG-KRILL-92/14 Rev. 1
Managing Southern Ocean krill and fish stocks in a changing environment. I. Everson (British Antarctic Survey, High Cross, Madingley Road, Cambridge CB3 0ET, United Kingdom), 22 pp., (English, unpublished).

Management of Antarctic krill, *Euphausia superba*, and the mackerel

icefish, *Champsocephalus gunnari*, under CCAMLR is discussed in relation to changes in their distribution and abundance arising from variation in circulation of the circumpolar current. It is concluded that on a Southern Ocean scale it is currently not possible to detect change but on a local scale, such as at South Georgia, major changes are detectable. These changes affect the krill fishery directly in terms of local catch and the way the fleets are deployed. Major local reductions in krill are thought to have a significant effect on natural mortality of the icefish.

WG-KRILL-92/15

Review of length-weight relationships for Antarctic krill. V. Siegel (Institut für Seefischerei, Palmaille 9, 2000 Hamburg 50, Germany), 9 pp., (English, unpublished).

Length-weight relationships for krill, *Euphausia superba*, are listed for ash-free dry weight, dry weight, and wet weight as well as relationships for other Antarctic euphausiid species. Information on sex and dominant maturity stages underlying the data are supported. The influence of seasonal changes in length-weight relationship parameters is discussed. Recommendations are given for the use of the listed length-weight relationships.

WG-KRILL-92/16

Alternative methods for determining subarea or local area catch limits for krill in Statistical Area 48. G. Watters and R.P. Hewitt (Southwest Fisheries Science Center, La Jolla, Ca. 92038, USA), 17 pp., (English, unpublished).

CCAMLR Conservation Measure 32/X sets a 1.5 million tonne precautionary catch limit on krill (*Euphausia superba*) in Statistical Area 48. The measure also implies an application in future of precautionary limits to subareas or local areas of this area. Nine alternative methods of determining subarea or local area krill catch limits are evaluated relative to six criteria: (i) the degree to which information on biological relationships is considered; (ii) the cost of data collection; (iii) the reliability of required information; (iv) the ease of enforcement; (v) the effects on current fishing patterns; and (vi) the potential for delay in implementing the alternative. The probability of adverse impact on dependent species is minimised when a high amount of biological information is considered and the potential for delay is low. Therefore, we consider the following tradeoff to be important: choosing a biologically explicit alternative and delaying implementation, or choosing a biologically unrealistic alternative and implementing a management scheme immediately. We recognise that other tradeoffs may be equally important. Alternatives that allocate the 1.5 million tonne limit by evenly dividing the catch among subareas or by using historical catches to set limits can be categorised as having a low potential for delaying implementation, but they ignore information on biological relationships. Alternatives based on protective zones, critical periods, predator censuses, and predator-prey models include large amounts of biological information, but may not be practical in the near future. Alternatives based on continental shelf area, simple pulse fishing, and krill surveys are not biologically explicit and result in delayed implementation. None of the alternatives are categorised as being both biologically explicit and immediately available for implementation. However, two of the alternatives (i.e., protective zones and critical periods) are unsatisfactory only because they would alter current fishing patterns. These two alternatives could be implemented immediately if the CCAMLR Member nations are willing to tolerate changes in current fishing patterns.

WG-KRILL-92/17

Calibration of an acoustic echo-integration system in a deep tank, with system gain comparisons over standard sphere material, water temperature and time. D.A. Demer and R.P. Hewitt (Scripps Institution of Oceanography, La Jolla, Ca. 92039, USA), 20 pp., (English, unpublished).

This paper outlines the theory and procedures for calibrating an echo integration acoustic system with a standard sphere. It presents the results of an extensive calibration of a Simrad EK500 scientific echosounder with a 120 kHz split-beam transducer in a refrigerated 10 m

deep tank. Calibration parameters are studied in relation to sphere material (tungsten carbide and copper), water temperature (0.5 to 5.5°C), transmitted pulse length (0.1, 0.3 and 1.0 ms), target depth (0.8 to 7.5 m), and over time (149 days). A discussion follows concerning the ramifications of calibration errors and variability on the accuracy of acoustic biomass estimation.

WG-KRILL-92/18
Krill catch distribution in relation to predator colonies, 1987-1991. D.J. Agnew (CCAMLR Data Manager, 25 Old Wharf, Hobart, Tasmania 7000, Australia), 8 pp., (English, unpublished).

The distribution of krill catches in relation to predator colonies in Subareas 48.1 and 48.2 is shown. 74 to 90% of catches in Subarea 48.1 are taken within 100 km of predator colonies between December and March, and these are between 10 and 18% of the estimated total penguin consumption in this period. The pattern of fishing is very consistent in all years 1988 to 1991 in Subarea 48.1, but is more variable in Subarea 48.2 where 1989 and 1990 show highly mobile fishing patterns. 53 to 78% of total catches in Subarea 48.2 are taken within the 'critical period' defined above, and these are between 2 and 45% of the estimated total penguin consumption. The largest catch taken in this critical period was 94 860 tonnes in Subarea 48.1, in 1989, and 88 139 tonnes in Subarea 48.2 (1991).

WG-KRILL-92/19
Distribution of krill (*Euphausia superba* Dana) catches in the South Shetlands and South Orkneys. D.J. Agnew (CCAMLR Data Manager, 25 Old Wharf, Hobart, Tasmania 7000, Australia), 8 pp., (English, unpublished).

Zones of 20 km width are defined around selected colonies of penguins distributed around the coasts of the South Shetland and South Orkney Islands. Krill catches in these zones are shown to have a consistent pattern in Subarea 48.1 but an unpredictable distribution in Subarea 48.2, probably as a result of more variable hydrographic conditions. About 50% of the catch in Subarea 48.1 from December to March was taken within 40 km of the coast, and 90% within 80 km in all years 1988 to 1990. In 1987 and 1988, 75% of the catch in Subarea 48.2 between December and March was taken within 80 km of colonies in the South Orkneys. Estimates of consumption rates, foraging ranges and population sizes from the literature are used to show that for some years, at distances of between 20 and 60 km from predator colonies, catches in January and February may be up to 48% of the land-based predator consumption. Whilst the overall ratio of catch to consumption is relatively low (27%), any competition between the fishery and predators as a result of large increases in catch is likely to emerge in these areas earlier than would be expected considering the fishery as a whole.

WG-KRILL-92/20
Krill biomass in Area 48 and Area 58: Recalculations of FIBEX data. P.N. Trathan, D.J. Agnew, D.G.M. Miller, J.L. Watkins, I. Everson, M.R. Thorley, E. Murphy and C. Goss (British Antarctic Survey, High Cross, Madingley Road, Cambridge, CB3 0ET, United Kingdom), 30 pp., (English, unpublished).

FIBEX acoustic and length frequency data held in the BIOMASS database were used to provide estimates of mean density and biomass for the Indian Ocean sector and the West Atlantic sector as well as for FAO Statistical Area 41.0, Subareas 48.1, 48.2, 48.3, 48.6 and Division 58.4.2. Density estimates were calculated using the target strength relationships used at the original FIBEX acoustic workshop report in Anon. (1986). Estimates for the different areas were also calculated using the target strength relationships of Green *et al.* (1990). The new estimates were on average 4.76 times larger than the old estimates for those cruises (seven out of the nine considered) that used a survey frequency of 120 kHz.

WG-KRILL-92/21
Chilean krill fishing operations 1992: Answering SC-CAMLR-X, paragraph 6.36. V. Marín, D. Rivas and A. Palma (Depto. Cs. Ecológicas, Fac. de Ciencias, Universidad de Chile), 11 pp., (English, unpublished).

WG-KRILL-92/22
Management subdivisions within the CCAMLR Convention Area with special reference to Area 58. S. Nicol (Australian Antarctic Division, Channel Highway, Kingston, Tasmania 7050, Australia), 14 pp., (English, unpublished).

The current subdivision of the CCAMLR Convention Area is examined and some of the problems inherent in the system are outlined. A rationale for the further subdivision of Area 58 is developed and a scheme is suggested based on: available data on krill distribution patterns, oceanographic features and on fishery data.

WG-KRILL-92/23
Estimation of the biomass of krill in Prydz Bay during January/February 1991 and February/March 1992 using echo integration. I. Higginbottom and T. Pauly (Australian Antarctic Division, Channel Highway, Kingston, Tasmania 7050, Australia), 22 pp., (English, unpublished).

Hyrdoacoustic surveys of the abundance of krill (*Euphausia superba*) in the Prydz Bay region were undertaken in January/February 1991 and February/March 1992. The surveys indicated some association of krill with the shelf break in the western part of the survey area but also found that the shelf break was in general not a region of relatively high krill abundance. The mean surface density of krill was 15.4 g/m^2 and 7.4 g/m^2 in 1991 and 1992, respectively. These densities are large compared to estimates of 1.95, 3.45 and 1.78 g/m^2 for Subareas 48.1, 48.2 and 48.3 (SC-CAMLR-X) but small compared to 20.2 g/m^2 estimated for January 1985 from the Australian SIBEX-II data. The Australian SIBEX-II estimate falls in the middle of the range of densities estimated from seven reported surveys between 1981 and 1985 (Higginbottom *et al.*, 1988). The biomass of krill in 3.5 million km^2 of the Prydz Bay region was estimated to be between 4.8 to 5.4 million tonnes in 1991 and between 2.2 and 2.6 million tonnes in 1992. The extent of bias in these results due to the presence of substantial biomasses of species other than *Euphausiasuperba* in the survey areas (Williams *et al.*, 1983; Ikeda *et al.*, 1984, 1986; Hosie *et al.*, 1988) could not be determined.

WG-KRILL-92/24
Characteristics of oceanic structure in the waters around the South Shetland Islands of the Antarctic Ocean between December 1990 and February 1991: Outstanding coastal upwelling? M. Naganobu, T. Katayama, T. Ichii, H. Ishii and K. Nasu (National Research Institute of Far Seas Fisheries, Orido 5-7-1, Shimizu, Shizuoka, 424 Japan), 19 pp., (English, unpublished).

The sixth Antarctic survey cruise of RV *Kaiyo Maru* was carried out in waters around the South Shetland Islands, which are known as a fishing area for krill, during the 1990/91 austral summer. In order to investigate seasonal changes in oceanic structure, two sets of observations were carried out in the same area with an interval of 40 days. The following characteristic change was clearly recognised in the waters of the insular shelf. During the first set of observations the Antarctic Surface Water over the insular shelf, as a whole, had a temperature below 0°C. However, 40 days later, during the second set of observations, the temperature in the same waters rose above 0°C. The reason for this temperature rise is considered to be an intrusion of the Warm Deep Water over the insular shelf. The following two processes are considered responsible for such an intrusion: the first is the steady topographic upwelling of the Warm Deep Water; and the second is the wind-driven coastal upwelling. The distribution patterns of temperature, salinity, density, dissolved oxygen and nutrient salts support this explanation.

WG-KRILL-92/25
Hydrographic flux in Statistical Area 48 in the Antarctic Ocean. M. Naganobu (National Research Institute of Far Seas Fisheries, Orido 5-7-1, Shimizu, Shizuoka, 424 Japan), 14 pp., (English, unpublished).

This report was presented in order to provide information on oceanographic flux in Statistical Area 48. Surface geostrophic

flow in Statistical Area 48 was calculated using oceanographic data which have been accumulated since 1925. In addition, geostrophic velocity and volume transport through each observation transect were calculated using oceanographic data which were collected during cruises undertaken by RV *Kaiyo Maru* of the Fisheries Agency of Japan, in the last nine years. The results provide background information not only for understanding krill flux in Statistical Area 48, but the oceanographic flux in the Antarctic Atlantic Ocean in general.

WG-KRILL-92/26

Abundance, size and maturity of krill (*Euphausia superba*) in the krill fishing ground of Subarea 48.1 during the 1990/91 austral summer. T. Ichii, H. Ishii and M. Naganobu (National Research Institute of Far Seas Fisheries, Orido 5-7-1, Shimizu, Shizuoka, 424 Japan), 19 pp., (English, unpublished).

Acoustic and net sampling surveys for krill were conducted in the krill fishing ground north of the South Shetland Islands from 18 January to 3 February 1991. Distinct offshore-inshore heterogeneities in abundance and maturity of krill were observed. The survey area was divided into four zones; oceanic, slope frontal, neritic and nearshore zones. The mean density of krill was low in the oceanic zone (8.5 g/m^2), intermediate in the frontal (37.3 g/m^2) and neritic (28.1 g/m^2) zones, and extremely high in the nearshore zone (134.7 g/m^2). The last zone corresponds to the shelf break or the shelf area where topographic eddies were generated suggesting that hydrodynamic convergence might be responsible for accumulation of krill in this zone. The total biomass over the survey area was estimated to be 1.59 ± 0.45 million tonnes (95% confidence limit), of which 1.22 ± 0.42 million tonnes was concentrated in the fishing ground (frontal + neritic + nearshore zones). Information from other studies indicated that krill biomass in this region had been lower than expected until early February 1991. As for maturity stages of krill, spawning krill (modal body length 49 mm) were dominant in the oceanic and frontal zones, whereas less mature krill (modal length 45 mm) dominated in the neritic and nearshore zones. Juveniles, which were scarce in the survey described, were found restricted mainly to the nearshore zone. Gravid females were exceedingly abundant in the slope frontal zone with a mean density of 23.9 g/m^2 (411 000 tonnes), as contrasted with a low 3.7 g/m^2 (163 000 tonnes) in the oceanic zone. Gravid females were nearly absent in the neritic and nearshore zones. This indicates that slope frontal features may be important for the formation of favourable conditions for krill spawning.

WG-KRILL-92/27

Differences in distribution and population structure of krill (*Euphausia superba*) between penguin and fur seal foraging areas near Seal Island. T. Ichii, H. Ishii, J.L. Bengtson, P.L. Boveng, J.K. Jansen and M. Naganobu (National Research Institute of Far Seas Fisheries, Orido 5-7-1, Shimizu, Shizuoka, 424 Japan), 19 pp., (English, unpublished).

Shipboard tracking study for krill-eating predators (penguins and female fur seals) at Seal Island were conducted to identify and evaluate their foraging areas during early January 1990/91. Penguin foraging areas were found in inshore regions where krill frequently occurred but higher density areas of krill (≥250 g/m^2) were rather limited. In contrast, fur seal foraging areas were found in offshore regions where krill occurred only occasionally but in large aggregations (surface length ca. 2 to 3 km) of higher densities (≥250 g/m^2). In the inshore foraging areas krill undertake diurnal vertical migrations, tending to be at a deeper range from 50 to 100 m in the day while at a shallower range from 20 to 50 m at night. In the offshore foraging areas krill do not undertake any diurnal vertical migrations, staying close to the surface throughout the day. With regard to body size and maturity of krill in the inshore foraging areas, middle-sized krill (modal length 43 mm), which consisted mainly of non-gravid krill, were dominant with occasional occurrences of juveniles (modal length 21 mm). In contrast, in the offshore foraging areas, large-sized krill (modal length 47 mm) were dominant, of which gravid females were a

majority. Thus horizontal and vertical distributions and population structure of krill were totally different between the foraging areas of penguins and fur seals. The reasons why fur seals chose offshore foraging areas instead of inshore foraging areas are discussed.

WG-KRILL-92/28
Comment on "further computations of the consequences of setting the annual krill catch limit to a fixed fraction of the estimate of krill biomass from a survey" (WG-Krill-92/4). H. Hiramatsu (National Research Institute of Far Seas Fisheries, Orido 5-7-1, Shimizu, Shizuoka, 424 Japan), 8 pp., (English, unpublished).

This paper re-examines the estimates of potential yield calculated by WG-Krill-92/4, using a simplified version of the model. The results indicate that these estimates are too low.

WG-KRILL-92/29
An argument against big incidental krill mortality stated in WG-KRILL-91/6. E. Sakitani (Japan Deep Sea Trawlers Association, 3-6 Kanda-Ogawacho, Ogawacho-Yasuda Building, Chiyodaku, Tokyo 101, Japan), 1 pp., (English, unpublished).

No krill escapement from trawl nets and subsequent krill mortality were observed during fishing for krill by Japanese krill fishing vessels.

WG-KRILL-92/30
Procedure to correct for acoustic beam width effects when assessing the biomass of krill aggregations. M. Barange, D.G.M. Miller and I. Hampton (Sea Fisheries Research Institute, Private Bag X2, Roggebaai 8012, South Africa), 3 pp., (English, unpublished).

Abstract not available.

WG-KRILL-92/31
Summary of some recent studies comparing echolevels at 38 and 120 kHz. I. Everson (British Antarctic Survey, High Cross, Madingley Road, Cambridge, CB3 0ET, United Kingdom), 12 pp., (English, unpublished).

Abstract not available.

WG-KRILL-92/32
Fish captured as by-catch during the 1991 Chilean Antarctic krill fishery. E. Acuña, A. Mujica and H. Apablaza (Facultad de Ciencias del Mar. U. Catølica del Norte - Sede Coquimbo, Casilla 117, Coquimbo, Chile). 9 pp., (English, unpublished).

The main objective of this research is to analyse the information on fish by-catch in the krill fishery collected in 1991 during krill fishing around the South Shetland Islands, on board the Chilean factory vessel *Kirishima*. The fishing ground was divided into two areas: Area A, north of the southern South Shetland Islands and Area B, north of Elephant Island. The samples were taken from hauls of a commercial midwater trawl (mouth area approximately 40 x 40 m and mesh size from 1.5 to 3 cm). A total of 42 out of 50 samples contained fish. Fish by-catch was found in 62.5% of the samples from Area A and in 22.2% from Area B. A total of 131 adult fishes were sampled. They belong to six different families and 16 species (six channichthyids, four nototheniids, three myctophids, one bathydraconid, one paralepidid and one anotopterid). The most common species were *Pleuragramma antarcticum*, *Chaenocephalus aceratus*, *Champsocephalusgunnari* and juveniles of *Chaenodraco* spp. Thirteen of the 16 species were captured in Area A and only eight of them in Area B. *Krefftichthys anderssoni*, *Notolepis coatsi* and *Anotopterus pharao* were captured only in Area B, while all the channichthids except *Cryondraco antarcticum*, *Notothenia coriiceps*, *Pleuragramma antarcticum*, *Parachaenichthyscharcoti*, were captured only in Area A. It is concluded that by-catch of fish during krill fishing is higher in the area to the south of the South Shetlands (mainly off Snow, Livingston and Greenwick Is) where its impact upon fish juveniles is also higher, probably due to the fact that this area may contain spawning and nursery grounds of fish over the shelf near the islands. Research was financed by INACH (Chilean Antarctic Institute).

WG-KRILL-92/33

Krill population biology during the 1991 Chilean Antarctic krill fishery. A. Mujica, E. Acuña and A. Rivera (Facultad de Ciencias del Mar. U. Católica del Norte - Sede Coquimbo, Casilla 117, Coquimbo, Chile), 8 pp., (English, unpublished).

The population biology of the Antarctic krill, *Euphausia superba* was studied from samples taken in 1991 during krill fishing operations around the South Shetland Islands on board the Chilean factory vessel *Kirishima*. The hauls were done with a commercial midwater trawl (mouth area approximately 40 x 40 m and mesh size from 1.5 to 3 cm). Two subsamples of 100 specimens each were taken from 50 samples and analysed. The fishing ground was divided into two areas: Area A, north of the southern Shetland Islands; and Area B, north of Elephant Island. The samples were grouped by the time of capture: daytime, twilight and night-time. The specimens were measured (total length, TL) to the nearest millimetre and weighed (wet weight) to the nearest 0.01 g. Also mean catch-per-hour and mean catch-per-towing time were determined for the total of 419 hauls. In Area A, a unimodal size frequency distribution was found with a size range between 30 and 55 mm TL, and a mean TL of 45 mm for females and 48 for males. A very weak mode with juvenile specimens between 26 and 36 mm TL was also found. The sex composition was 65.1% females, 34.4% males and 1.4% juveniles. Of the females sampled, 25.2% bore spermatophores. Although the smallest specimen found with a spermatophore had 36.5 mm TL, 80% of the females with spermatophores had a TL larger than 45 mm. In Area B, a biomodal size frequency distribution and a larger size range were found, with one mode between 32 and 55 mm TL (mean 43 mm for females and 47 mm for males), and one with juvenile specimens between 20 and 39 mm TL with a 32 mm mode. Females comprised 47.1%, males 40% and juveniles 12.9%. Of the females sampled, 27.1% bore spermatophores, with a size range between 35.4 and 56 mm TL, although 88% of them had a TL larger than 45 mm. The size frequency distribution showed no significant differences between the three time periods. However, when the sex composition is considered, males are more abundant in night-time catches while females are more abundant during daytime catches, thus showing an opposite trend. Considering all catches, the yield in terms of tonnes-per-mile and tonnes-per-hour was higher during the daytime than during twilight and night in both fishing areas. These daytime catches were also made at consistently greater depths. Research was financed by INACH (Chilean Antarctic Institute).

WG-KRILL/CEMP-92/4

CCAMLR Ecosystem Monitoring and a feedback management procedure for krill. A. Constable (Faculty of Environmental Sciences, Griffith University, Nathan, Qld 4111, Australia), 12 pp., (English, unpublished).

The CCAMLR Ecosystem Monitoring Program has been developing a technique which might detect short-term declines in land-based predator performance (e.g., reproductive performance) that may be attributable to loss of prey through fishing activities. The principal fishery in the CCAMLR Convention Area is the krill fishery and this paper examines ways in which the information being obtained from the Ecosystem Monitoring Program might be incorporated into a feedback management strategy for this fishery.

Working Group for the CCAMLR Ecosystem Monitoring Program

WG-CEMP-92/4

CCAMLR Ecosystem Monitoring Program Draft Management Plan for Cape Shirreff CEMP land-based site. Chile, 18 pp., (English, unpublished).

WG-CEMP-92/5

CCAMLR Ecosystem Monitoring Program Draft Management Plan for Magnetic Island CEMP land-based site. Australia, 7 pp., (English, unpublished).

WG-CEMP-92/6
Elephant seal and penguin population studies: Tools to understand ecological changes and/or fisheries effect. D.F. Vergani, Z.B. Stanganelli, A.R. Carlini and G.E. Soave (Instituto Antártico Argentino, CERLAP, Calle 8 Nro. 1467, 1900 La Plata, Argentina), 15 pp., (English, unpublished).

Data on annual fluctuations of the populations of elephant seals between 1980 and 1990, and Adélie penguins between 1987 and 1990, at Stranger Point (King George Island) are presented in this paper. To complete a ten-year data series of Adélie penguins for comparative purposes, we have included data from Trivelpiece *et al*. (1990) on Adélie penguins from Admiralty Bay, located a few kilometres from Stranger Point. During the period of the study there were two principle events: firstly, the population decline observed in 1982/83; and secondly, the decline that began in 1987 and continued to 1990. Both elephant seal and penguin populations were affected. Possible causes of these declines, both environmental and fishery-related, are analysed.

WG-CEMP-92/7
CEMP indices: Their calculation and comparison by the Secretariat. D.J. Agnew (CCAMLR Data Manager, 25 Old Wharf, Hobart, Tasmania 7000, Australia), 38 pp., (English, unpublished).

The CCAMLR Ecosystem Monitoring Program acquires data indicators of breeding success and population 'health' from a number of birds and seals in the Antarctic. In order to examine these indicators for trends the data have to be summarised as indices of the 13 predator parameters concerned. Indices, and the methods used by the Secretariat for their calculation, are defined so that they accurately summarise the data and its variance, and so that changes in the parameters are detectable at levels of statistical significance appropriate to the Program.

WG-CEMP-92/8 Rev. 1
CEMP indices and trends 1992 Part 1: Penguin parameters. D.J. Agnew (CCAMLR Data Manager, 25 Old Wharf, Hobart, Tasmania 7000, Australia), 22 pp., (English, unpublished).

Indices of penguin breeding parameters, derived from data held at the CCAMLR Data Centre according to the methods given in WG-CEMP-92/7, are given in here in matrix form sorted by subarea, species, site, country and year.

WG-CEMP-92/9
Monitoring sea-ice distribution: Report of the Secretariat project on acquisition of satellite imagery. CCAMLR Secretariat, 23 pp., (English, unpublished).

WG-CEMP-92/10
Suggestion for change in format of CEMP Standard Methods publication. CCAMLR Secretariat, 2 pp., (English, unpublished).

WG-CEMP-92/11
Can we use discriminant function analysis to sex penguins prior to calculating an index of morphometric parameter? D.J. Agnew (CCAMLR Data Manager, 25 Old Wharf, Hobart, Tasmania 7000, Australia), 22 pp., (English, unpublished).

In sexually dimorphic species, morphometric parameters have separate distributions for males and females, and these often overlap. Whilst discriminant analysis can be used to determine the sex of individuals, it is only able to correctly sex a certain proportion of birds. Two overlapping normal distributions are used to show that there is a difference between the real mean parameter for a sex, and the apparent mean derived by sexing the birds using discriminant analysis. When discriminant functions are able to correctly determine the sex of birds with greater than 80% success, the difference between the true and apparent mean is likely to be undetectable when fewer than 600 birds are sampled. Combining all data for both sexes is considered as a procedure for avoiding the necessity of sex determination, but uncertainty in sex ratios can lead to considerable Type I and Type II errors. Lack of knowledge about the sex ratio between years makes combining the data a very doubtful procedure and use of a discriminant function to determine sex is recommended as being most practically robust.

WG-CEMP-92/12
CEMP indices and trends 1992 Part 2: Flying birds and fur seals parameters. CCAMLR Secretariat, 19 pp. (English), 3 pp., (English, unpublished).

WG-CEMP-92/13
CEMP data availability. CCAMLR Secretariat, 7 pp., (English, unpublished).

WG-CEMP-92/15
Distribution and abundance of krill in the vicinity of Elephant Island in the 1992 austral summer. R.P. Hewitt and D.A. Demer (Southwest Fisheries Science Center, La Jolla, Ca. 92038, USA), 19 pp., (English, unpublished).

Krill distribution and abundance were estimated from four acoustic surveys, conducted in the vicinity of Elephant Island, Antarctica, from mid-January to mid-March 1992. The first and last surveys covered a 105 by 105 n mile study area immediately north of Elephant Island. During the first survey, krill were distributed in a wide band extending along the north side of Elephant Island and wrapping around the western end; biomass was estimated to be 2.2 million tonnes. During the second survey, the highest densities of krill were over the shelf extending to the northwest from Elephant Island and including the Seal Island archipelago; high densities of krill also extended off the shelf from the northeast end of Elephant Island into deeper water. Biomass in the smaller survey area was estimated to be 0.7 million tonnes. Three weeks later, high krill densities were still apparent in the vicinity of Seal Island, but the area of high density previously mapped off the northeast end of Elephant Island had retracted considerably; biomass was estimated to be 0.4 million tonnes. During the final survey, conducted six weeks after the first survey, krill were mapped in reduced densities primarily to the west of Elephant Island; biomass over the larger survey area had declined to 1.1 million tonnes.

WG-CEMP-92/16
AMLR 1991/92 field season report: Objectives, accomplishments and tentative conclusions. *Administrative Report LJ-92-17*, Southwest Fisheries Science Center, La Jolla, California, USA, 1992, 116 pp., (English).

WG-CEMP-92/17
Antarctic Peninsula Integrated Study Region bioenergetics model input parameters. D.A. Croll and J.K. Jansen (National Marine Mammal Laboratory, Alaska Fisheries Science Center, National Marine Fisheries Service, 7600 Sand Point Way NE, Bin C15700, Seattle, Wa. 98115-0070 USA), 18 pp., (English, unpublished).

Abstract not available.

WG-CEMP-92/18
Metabolic rates, foraging ranges, and assimilation efficiencies of penguins: A review. D.A. Croll (National Marine Mammal Laboratory, Alaska Fisheries Science Center, National Marine Fisheries Service, 7600 Sand Point Way NE, Bin C15700, Seattle, Wa. 98115-0070 USA), 18 pp., (English, unpublished).

Abstract not available.

WG-CEMP-92/19
Synthesis and evaluation of data for estimating prey requirements of Antarctic fur seals in the Antarctic Peninsula Integrated Study Region. P.L. Boveng and J.L. Bengtson (National Marine Mammal Laboratory, National Marine Fisheries Service, 7600 Sand Point Way, NE, Seattle, Wa. 98115, USA), 5 pp., (English, unpublished).

Abstract not available.

WG-CEMP-92/20
An automatic weighing and recording system as an aid for the study of the foraging ecology of Adélie penguins (*Pygoscelis adeliae*). K.R. Kerry, J.R. Clarke and G.D. Else (Australian Antarctic Division, Channel Highway, Kingston, Tasmania 7050, Australia), 18 pp., (English, unpublished).

A system that automatically weighs, identifies and determines the direction of penguins moving between their breeding colony and the sea is described. Data obtained from it for a complete colony (589 nests from which 412 chicks were

fledged) and related to the foraging ecology of the Adélie penguin, *Pygoscelis adeliae,* are presented for the period hatching to fledging. These were obtained at Béchervaise Island (total Adélie penguin population 1 816 nests) near Mawson Station, Antarctica, during the 1991/92 breeding season. The system logged more than 800 000 penguin crossings over a period of three months. Results show that from hatching (20 December to 10 January) onwards males and females deliver a similar mass of food to the chick per visit despite males being approximately 480 g (11.5%) heavier when empty. A mass of 45 kg was delivered to the colony for each chick raised to fledging. The average fledging weight was 3.1 kg. The value of the system for large-scale data collection in longterm monitoring and ecological studies is discussed.

WG-CEMP-92/21

An interpretation of the growth of the Adélie penguin rookery at Cape Royds, 1955-1990. N. Blackburn, R.H. Taylor and P.R. Wilson (Datalogisk Institut, Århus Universitet, 8000 Århus C, Denmark). *New Zealand Journal of Ecology 15*(2): 117-121, 1991, (English).

The population dynamics of the Cape Royds rookery were modelled by computer, in order to determine the probable causes of the dramatic increase since 1980 in the numbers of Adélie penguins, *Pygoscelis adeliae,* breeding in the Ross Sea region, Antarctica. Variations in the extent of sea-ice around the rookery during incubation and chick rearing cannot feasibly explain the population increase and another factor or event must be introduced, which increases chick production per breeding pair and decreases adult mortality. The timing of the event is critical and rules out the cessation of human impacts or the depletion of competing baleen whales as causal factors. The event is seen as most probably the result of a recent warming of the Ross Sea climate.

WG-CEMP-92/22

Recent increase and southern expansion of Adélie penguin populations in the Ross Sea, Antarctica, related to climatic warming. R.H. Taylor and P.R. Wilson (Department of Scientific and Industrial Research, Land Resources, Private Bag, Nelson, New Zealand). *New Zealand Journal of Ecology 14*: 25-29, (English).

The numbers of Adélie penguins *Pygoscelis adeliae* (Hombron and Jacquinot) in the Ross Sea, Antarctica, have increased markedly over the past 10 years. Proportionally, this increase is most pronounced in McMurdo Sound, where the species' breeding range has recently been extended 3 km south to Cape Barne (77°35'S) with the re-occupation of a former rookery that was abandoned sometime before the present century. These biological trends show remarkable synchronisation with physical evidence of climatic variation in the McMurdo Sound region. We suggest that the dynamics of Adélie penguin populations may be very sensitive indicators of changes in the Antarctic climate.

WG-CEMP-92/23

Status and trends of Adélie penguin populations in the Ross Sea region. R.H. Taylor, P.R. Wilson and B.W. Thomas (Department of Scientific and Industrial Research, Land Resources, Private Bag, Nelson, New Zealand). *Polar Record 26*(159): 293-304, 1991, (English).

Aerial reconnaissance and photography were used in the Ross Sea sector of Antarctica to determine the breeding locations of Adélie penguins, *Pygoscelis adeliae,* and to count the numbers of nests occupied during the early incubation period. All islands and sea coasts between 158°E and 175°E were searched from 1981 to 1987 and 11 previously unreported breeding rookeries were discovered. Thirty-eight Adélie rookeries are now known from the region, with a total of about 1 082 000 breeding pairs - almost half the world population. Some rookeries were photographed in all, or most, of the seven seasons to study the pattern of natural fluctuations in Adélie populations, and comparisons have been made with earlier counts. Populations at nearly all rookeries have increased in size over the last 10 to 20 years. Possible reasons for this, and for annual fluctuations in numbers breeding, include seasonal variations in sea-ice and weather conditions, and longer-term climatic change.

WG-CEMP-92/24
New Zealand Antarctic Research Programme. Scientific proposal for the aerial survey of Adélie penguin rookeries, 1992/93. P.R. Wilson (Department of Scientific and Industrial Research, Land Resources, Private Bag, Nelson, New Zealand), 14 pp., (English, unpublished).

Since parameters of penguin populations may provide indices of the abundance of the key prey species (krill) and thus the state of the Antarctic marine ecosystem, aerial reconnaissance and photography are used in the Ross Sea sector of Antarctica to determine where Adélie penguins (*Pygoscelis adeliae*) breed, and to count the numbers of nests occupied during the early incubation period and the number of surviving chicks in mid-January (when weight and measurements of samples of chicks at Capes Royds and Crozier give a condition index). All islands and sea coasts between 158°E and 175°E were searched from 1981 to the present and 12 previously unreported breeding rookeries were discovered. 39 Adélie rookeries are now known from the region, with a total of about 1 082 000 breeding pairs - almost half the world population. Some rookeries were photographed in all, or most, of the seasons to study the pattern of natural population fluctuations. Populations at nearly all rookeries have increased markedly in size over the last 10 years. Possible reasons for this, and for annual fluctuations in numbers breeding, include seasonal variations in sea-ice and weather conditions and longer-term climatic change. This work identifies the need for complementary Ross Sea baseline studies, including studies of primary productivity and effects of ice thickness and UV radiation; climate change; krill distribution and abundance; seasonal distribution of sea-ice; air temperature at sites remote from continental influence; and satellite tracking of radio-tagged penguins to study foraging range and winter dispersion. In 1992/93 we propose repeating the photographic surveys of rookeries on Ross Island using helicopters in December and January to count incubating adults and surviving chicks, respectively. Rookeries north of Ross Island will be photographed from an RNZAF C-130 in December. Details of methods and logistics are discussed. Developing, printing, collating, filing and counting all photographs of study rookeries is completed in New Zealand each season.

WG-CEMP-92/25
Preliminary assessment of the data available for estimating the krill requirements of crabeater seals. J.L. Bengtson, T.J. Härkönen and P.L. Boveng (National Marine Mammal Laboratory, National Marine Fisheries Service, 7600 Sand Point Way, NE, Seattle, Wa. 98115, USA), 13 pp., (English, unpublished).

Abstract not available.

WG-CEMP-92/26
Homogeneity of Adélie penguins as krill samplers. E. Marschoff and B. González (Instituto Antártico Argentino, Cerrito 1248, 1010 Buenos Aires, Argentina), 5 pp., (English, unpublished).

A nested ANOVA design was used to measure the variance component due to differences between individual Adélie penguins in the length of krill eaten, using data from Esperanza Bay. The variance component -0.26 was not significantly different from zero ($F = 0.093$; $P = 0.54$). This finding supports the argument for using individual penguins to estimate parameters of the prey population without discriminating by sex, weight or other factors pertaining to the predator.

WG-CEMP-92/27
Advice from the IWC Scientific Committee concerning estimation of the prey requirements of baleen whales in the CEMP Integrated Study Regions. Convener of WG-CEMP, 5 pp., (English, unpublished).

WG-CEMP-92/28
Progress in preparing for a workshop on methods to study the at-sea behaviour of marine mammals and birds. Convener of WG-CEMP, 4 pp., (English, unpublished).

WG-CEMP-92/29
Potential relevance of the global environment facility and system of

marine protected areas to the CCAMLR Ecosystem Monitoring Program. Convener of WG-CEMP, 6 pp., (English, unpublished).

WG-CEMP-92/30

On the problem of Soviet krill fishery allocation and intensity in the area of Elephant Island in the season of 1988-89. V.A. Sushin and A.S. Myskov (AtlantNIRO, 5 Dimitry Donskoy Street, Kaliningrad 236000, Russia), 33 pp., (English, unpublished).

Microscale data from the Soviet krill fishery off Elephant Island (Subarea 48.1) between 59° to 62°S and 53° to 57°W during the period from 21 November 1988 to 25 March 1989, are analysed. Though the total catch of the USSR in the above-mentioned season reached a maximum, for the last nine seasons the total fishing intensity by the USSR around Elephant Island has been low. In 1988/89, only one standard vessel operated in the area during 40% of the period. The highest catch-per-unit-effort was observed in January (7.7 tonnes per hour of trawling on average), and the lowest in November (3.5 tonnes per hour of trawling on average). Fisheries tactics follow the following scheme: vessels enter the Elephant Island area and search for krill concentrations; these concentrations are fished as they drift from the island; and vessels return to the first search area when the concentrations have been lost. The velocity of the northeastward drift of krill concentrations, calculated by fleet displacement, amounted to 9.7 to 11.1 km/day (11 to 13 cm/sec). An analysis of fishing ground allocation by five-day periods showed that the areas in which the fleet operated overlap a minor part of the foraging zones for animals which feed on krill. Based on this, and taking into account the low fishing intensity, it was concluded that the current krill fishery does not significantly affect the seals and birds which feed on krill.

WG-CEMP-92/31

Geographic Aspects of *Euphausia superba* resources exploitation. R.R. Makarov (VNIRO, 17a Verkhnaya Krasnoselskaya Street, Moscow 107140, Russia), 22 pp., (Russian, unpublished).

Data on the distribution and biomass of *Euphausia superba* aggregations in the Atlantic sector and near adjacent waters (in particular areas outside the Scotia Sea) are given. Concentrations of *E. superba* of the same order of biomass as in the Scotia Sea were observed at several subregions along the periphery of the Weddell Gyre and also nearshore to Antarctica. Offshore concentrations of *E. superba* show increased spatial irregularity. Development of fisheries activity in these currently unfished areas should include acquisition of preliminary information on changeability of *E. superba* aggregation distribution prior to the initiation of fishing. Complex investigations directed at determining drift patterns of *E. superba* as well as the related changeability of aggregation location in the open-ocean environment are also required. Exploitation of offshore aggregations of *E. superba* will be associated with regular search activity prior to and during the course of every fishing season.

WG-CEMP-92/32

Investigations of intensity of krill drift near South Georgia Island. V.V. Popov (Laboratory of Marine Mammal Research, VNIRO, 17a Verkhnaya Krasnoselskaya Street, Moscow 107140, Russia), 16 pp., (Russian, unpublished).

Calculations of drift speeds of Antarctic krill along the northeastern shore of South Georgia Island (between 53 to 55°S and 34 to 39°W) were carried out. The length of the island's continental shelf was assumed to be about 300 km, and the average width of shelf (from the shore to the 500 m isobath) was assumed to be about 60 km. Speed of drift in these spatial limits was assumed to be about 10 cm sec^{-1}. The average density of krill before the beginning of transport along the island's shore was assumed about 0.1 g m^{-3}. The total amount of krill transported along the island's shelf (over the limits indicated above) was examined for three types of water circulation (Maslennikov, 1979). Duration of krill drift (from the beginning of immigration onto the shelf and to the end of emigration off the shelf) along the northeastern shore of South Georgia fluctuated from 35-37 days to 75-100 days.

For separate cases this duration was evaluated to be as much as 140 to 150 days (when crustaceans are transported back again on shelf zone under the conditions of the first type of water circulation). The minimum period of krill presence near the island is expected under the third type of water circulation, but maximal duration of krill presence here is suggested for the first type of water circulation. Total renewal of krill, in shelf waters off the island is assumed to take place not less than two to three times per year. Peculiarities of accumulation and drift of krill related to the consequence of types of water circulation change are examined.

WG-CEMP-92/33
Preliminary results of RV *Dmitriy Stefanov* research in the Antarctic area of the Atlantic Ocean in April 1992. L.G. Maklygin, V.N. Shnar, A.V. Remeslo, A.P. Malyshko, I.A. Trunov, A.V. Barabanov, V.P. Shopov and A.G. Shepelev (AtlantNIRO, 5 Dimitry Donskoy Street, Kaliningrad 236000, Russia), 14 pp., (Russian, unpublished).

Oceanographic, hydroacoustic and trawl surveys were carried out within a 30 x 30 mile polygon in the fishing area northwestward of Coronation Island from 18 to 22 April 1992. Krill biomass was estimated at the beginning and the end of the survey to be 56 100 and 61 200 tonnes respectively. During the rest of the survey hydroacoustic assessment of krill aggregation density and sampling at oceanographic stations was carried out along the polygon perimeter. There were four duplicates of perimeter stations and midwater trawl hauls were made periodically for ground truthing. Average estimates of krill aggregation density by 15-mile perimeter sections, average water flow and scheme of geostrophic currents were obtained, and from this the balance of krill transport from and into the polygon was calculated. The first two duplicates revealed an accumulation within the contour, the second two showed a loss, accumulation being 52 000 tonnes higher than the loss. We show that fishing aggregation stability is mainly determined by the water dynamics, in particular the availability and duration of heterogeneity in the current fields. From 25 to 27 April three bottom trawled hauls were made to collect data on size and age composition of icefish, *Champsocephalus gunnari*, green notothenia and yellowfin notothenia over the shelf of South Georgia and Shag Rocks. The research was carried out by RV *Dmitriy Stefanov* owned by PPO Yugrybpoisk (Ukraine).

WG-CEMP-92/34
Preliminary results of experiments on krill transport study in the South Orkney area (April 1992). L.G. Maklygin, V.N. Shnar, A.P. Malyshko and A.G. Shepelev (AtlantNIRO, 5 Dimitry Donskoy Street, Kaliningrad 236000, Russia), 22 pp., (Russian, unpublished).

Oceanographic, hydroacoustic and trawl surveys were carried out within a 30 x 30 mile polygon in the fishing area northwestward of Coronation Island from 18 to 22 April 1992. Krill biomass was estimated at the beginning and the end of the survey to be 56 100 and 61 200 tonnes respectively. During the rest of the survey hydroacoustic assessment of krill aggregation density and sampling at oceanographic stations was carried out along the polygon perimeter. There were four duplicates of perimeter stations and midwater trawl hauls were made periodically for ground truthing. Average estimates of krill aggregation density by 15-mile perimeter sections, average water flow and scheme of geostrophic currents were obtained, and from this the balance of krill transport from and into the polygon was calculated. The first two duplicates revealed an accumulation within the contour, the second two showed a loss, accumulation being 52 000 tonnes higher than the loss. We show that fishing aggregation stability is mainly determined by the water dynamics, in particular the availability and duration of heterogeneity in the current fields. The research was carried out by RV *Dmitriy Stefanov* owned by PPO Yugrybpoisk (Ukraine).

WG-CEMP-92/35
Krill biomass and distribution variability in Subarea 48.3 in June 1991. S.M. Kasatkina, E.I. Timokhin, P.P. Fedulov and K.E. Shulgovsky

(AtlantNIRO, 5 Dimitry Donskoy Street, Kaliningrad 236000, Russia), 74 pp., (Russian, unpublished).

Temporal and spatial variability of krill distribution characteristics was investigated in an 8 x 6 mile micropolygon, where eight consecutive hydroacoustic surveys were carried out. Krill aggregations occurred as fields of small swarms whose spatial distribution characteristics (size and density of swarms, swarm field density, number of swarms per mile) varied considerably from tack to tack within each survey. The maximum horizontal extension of swarms was 120 m, although about 70% of swarms were of 30 m in length, with density up to 200 g/m^3. About 75% of all swarms revealed biomass to be less than 1 tonne. Average statistical parameters of swarms in the polygon varied insignificantly from survey to survey, while the swarm number varied within the broad range from 1 918 to 7 000 and further to 1 554 units. Krill biomass in the polygon varied spasmodically within the range from 1 091 to 6 085 tonnes. Krill distribution variability revealed in the polygon suggests an irregular import and export of krill from the polygon due to transport by the current. Additionally, in the upper layer of 0 to 50 m swarm number was almost constant, and krill redistribution due to transport and diurnal migrations occurred in the layer of 50 to 150 m. Estimated velocity of krill swarm displacement corresponded to the estimated water transport velocity in the polygon, suggesting that passive krill transport occurred.

WG-CEMP-92/36

The foraging range of Adélie penguins at Béchervaise Island, Mac. Robertson Land, Antarctica, and its overlap with the krill fishery. K.R. Kerry, J.R. Clarke and G.D. Else (Australian Antarctic Division, Channel Highway, Kingston, Tasmania 7050, Australia), 8 pp., (English, unpublished).

The foraging ranges of six female and four male Adélie penguins breeding at Béchervaise Island near Mawson Station (Mac. Robertson Land) were determined by satellite tracking using the ARGOS system. Birds were tracked over four foraging trips (by two females and four males) during the incubation period (November to December 1991) and 17 trips (by four females and two males) throughout January 1992 when birds were feeding chicks. Most birds made foraging trips to the continental shelf break (1 000 m isobath) approximately 110 km distant at its closest point. Birds feeding chicks also made journeys of one to two days ranging up to 12 km after 17 January when the sea became ice free to the coast. Concentrations of krill, *Euphausiasuperba*, which have in the past been the subject of a fishery, occur along the shelf break zone where the birds were foraging. There is potential for overlap between the foraging range of Adélie penguins breeding along the Mac. Robertson Land Coast (approximately 150 000 pairs) and any future harvest of krill in the region. The foraging range of the birds at Béchervaise Island considerably exceeds the 15 to 50 km determined for birds in the South Shetland and South Orkney Islands and reflects the distance offshore of krill, one of their major food sources.

WG-CEMP-92/37

Diving pattern and performance in non-breeding gentoo penguins (*Pygoscelis papua*) during winter. T.D. Williams, A. Kato, J.P. Croxall, Y. Naito, D.R. Briggs, S. Rodwell and T.R. Barton (British Antarctic Survey, High Cross, Madingley Road, Cambridge, CB3 0ET, United Kingdom). *The Auk 109*(2):223-234, 1991, (English).

We studied diving patterns and performance (dive depth, duration, frequency and organisation during the foraging trip) in relation to diet in non-breeding gentoo penguins (*Pygoscelis papua*) over 59 days (involving 5 469 dives) in winter. We estimated foraging ranges and prey capture rates, and compared foraging behaviour with that of breeding (chick-rearing) birds. Foraging was highly diurnal with 98% of foraging trips completed during the same day. Foraging trip frequency was 0.8/day, trip duration was 6 to 8 hours, and birds spent 51 to 62% of the foraging trip diving. Dive depth and duration were bimodal. Shallow dives (<21 m; 42% of total number and 16% of total dive time) averaged 5 to 7 m and 0.5 to 1.3 min. Deep dives (>30 m;

55% of total number and 81% of dive time) averaged 74 to 105 m and 2.7 to 3.5 min, respectively. Deep-dive duration exceeded the subsequent surface interval, but shallow dives were followed by surface intervals two to three times dive duration. Deep dives showed clear diel patterns, averaging 10 to 20 m at dawn and dusk and 70 to 90 m at midday. These results are consistent with the patchy vertical and horizontal distribution and diel movements of Antarctic krill, the main winter prey of gentoo penguins (including study birds). We suggest that shallow dives are mainly searching dives, and deep dives mainly for feeding. Foraging activity of non-breeding gentoo penguins in winter is similar to that of chick-rearing birds. The only major differences are that foraging-trip frequency is 20% less and stomach-content mass on return ashore 30% less in winter. We conclude that foraging activity in gentoo penguins is changed by varying the frequency and duration of foraging trips, rather than by changing the pattern and rate of diving.

WG-CEMP-92/38
Diving pattern and performance in the macaroni penguin *Eudyptes chrysolophus*. J.P. Croxall, D.R. Briggs, A. Kato, Y. Naito and Y. Watanuki (British Antarctic Survey, High Cross, Madingley Road, Cambridge, CB3 0ET, United Kingdom), 28 pp., (English, unpublished).

The pattern and characteristics of diving in two female macaroni penguins (*Eudyptes chrysolophus*) was studied, during the brooding period, using continuous-recording time-depth recorders, for a total of 18 days (15 consecutive days) during which the depth, duration and timing of 4 876 dives were recorded. Diving in the first 11 days was exclusively diurnal, averaging 244 dives on trips lasting 12 hours. Near the end of the brooding period trips were longer and included diving at night. About half of all trips (except those involving continuous night-time diving) was spent in diving and dive rate averaged 14 to 25 dives per hour (42 per hour at night). The duration of daytime dives varied between trips, and averaged 1.4 to 1.7 min, with a subsequent surface interval of 0.5 to 0.9 min. Dive duration was significantly directly related to depth, the latter accounting for 53% of the variation. The average depths of daytime dives were 20 to 35 m (maximum depth 115 m). Dives at night were shorter (average duration 0.9 min) and much shallower (maximum 11 m); depth accounted for only 6% of the variation in duration. Estimates of potential prey capture rates (three to five krill per dive; one krill every 17 to 20 s) are made. Daily weight changes in chicks were directly related to number of dives, but not to foraging trip duration nor time spent diving. Of the other species at the same site which live by diving to catch krill, gentoo penguins forage exclusively diurnally, making longer, deeper dives; Antarctic fur seals, which dive to similar depths as macaroni penguins, do so mainly at night.

WG-CEMP-92/39
Pup production and distribution of breeding Antarctic fur seals (*Arctocephalus gazella*) at South Georgia. I.L. Boyd (British Antarctic Survey, High Cross, Madingley Road, Cambridge, CB3 0ET, United Kingdom), 37 pp., (English, unpublished).

A census of the breeding population of Antarctic fur seals (*Arctocephalus gazella*) at South Georgia was carried out during the 1990/91 breeding season. Using counts of adult females ashore at the breeding grounds during the pupping period, together with corrections for the likelihood of a female being ashore at a census and for pregnancy rate (71% in 1990/91), pup production was estimated as 269 000 (95% confidence intervals 188 000 to 350 000). The breeding population in 1990/91 was reduced at longterm study sites probably because of a short-term reduction in food availability. Data from these sites were used to estimate the pup production of the population had 1990/91 been a typical year. Based on values from 1983/84 to 1990/91, pup production in 1990/91 would have been 378 000 (S.E. = 19 100) if it had been an average year). The annual increase from 1976/77 to 1990/91 was 9.8% which shows that the rate of increase in pup production has declined since the initial period of population expansion in the 1950s

and 1960s. Increased population size has led to an expansion of the breeding range at South Georgia.

WG-CEMP-92/40
Effects of maternal age and condition on parturition and the perinatal period of Antarctic fur seals. N.J. Nunn and I.L. Boyd (British Antarctic Survey, High Cross, Madingley Road, Cambridge, CB3 0ET, United Kingdom), 27 pp., (English, unpublished).

The effect of maternal age and condition on the date of parturition and the duration of the perinatal period of Antarctic fur seals at Bird Island, South Georgia, were investigated over three consecutive breeding seasons. Females rear young during a four month lactation period in a highly seasonal but predictable environment. Although females may first pup at 3 years of age they did not attain full adult size until 6 years of age; older females (≥6 years) tended to be heavier, longer, and in better condition than younger females (3 to 5 years). Older females returned to breeding beaches earlier and could occupy the most suitable pupping sites, and gave birth when densities of animals on the beaches were low (i.e., more favourable for pup survival). Females that arrived earlier were able to remain ashore longer with their pups prior to departing on their first foraging trips but this was unrelated to either maternal age or condition. Younger females returned later in the pupping season, possibly as a result of late implantation due to smaller energy reserves than older and larger females. In 1990 all females arrived late, were in poorer condition, gave birth to lighter pups, and had shorter perinatal periods. This suggests that not only was implantation late but that females returned to an area of low food availability prior to parturition.

WG-CEMP-92/41
Influence of maternal characteristics and environmental variation on reproduction in Antarctic fur seals. N.J. Nunn and I.L. Boyd (British Antarctic Survey, High Cross, Madingley Road, Cambridge, CB3 0ET, United Kingdom), 24 pp., (English, unpublished).

Antarctic fur seals breed synchronously in a highly seasonal environment. There is considerable interannual variation in food supply which affects breeding performance. However, food supply may also influence future performance through effects on female ovulation, implantation, and/or pregnancy. We used foraging trip duration, pup growth rate, and weaning mass as indicators of the food available to females during the pup-rearing period (December to April) and examined relationships between these and pup production and timing of breeding in the following year. Productivity (pup production) was positively correlated with growth rate and weaning mass of both male and female pups in the previous season ($\underline{P} < 0.05$) and negatively correlated with the variation around the mean birth mass of males ($\underline{P} < 0.05$) suggesting that poor feeding conditions one season led to lower production the next. The timing of birth was positively correlated with foraging trip duration ($\underline{P} < 0.05$) and negatively correlated with the birth and weaning masses of male and female pups, the duration of the perinatal period, growth of male pups and the variation in the late season growth (last two months) of male and female pups ($\underline{P} < 0.05$ in all cases). This indicates that females give birth later the season following a year where food resources are scarce. These results are consistent with poor feeding conditions, indicated by slow pup growth and long foraging trips leading to lower production and delayed pupping the following year. We suggest that this results from females being in poorer condition in years of food shortage and therefore (i) fewer females implant (or more abort) and (ii) implantation is delayed.

WG-CEMP-92/42
Southern Ocean environmental changes: Effects on seabird, seal and whale populations. J.P. Croxall (British Antarctic Survey, High Cross, Madingley Road, Cambridge, CB3 0ET, United Kingdom), 29 pp., (English, unpublished).

The main changes in the distribution and abundance of marine top predators in the Antarctic in the last two centuries were caused by human over-exploitation. Hypotheses that increases in populations of krill-eating penguins and seals represent recovery from exploitation, accelerated by

removal of krill-eating whales, are being re-evaluated in the light of correlations between population size and reproductive success of seabirds and seals and various features of the biological and physical environment. These correlations involve phocid and otariid seals, penguins and flying birds and sites ranging from the Antarctic continent to sub-Antarctic islands. Although the nature of, and balance between, physical and biological influences differ between sites, regions and different types of predator, processes (including potentially important links with the Southern Oscillation) involving sea-ice extent and distribution play a key role. Major uncertainties over the nature and the links between physical and biological processes and the responses of marine populations preclude any confident prediction of the potential effects of future environmental change. However, certain taxa, especially those of specialist ecology, extreme demography and restricted distribution (especially in high latitudes) are especially vulnerable to at least some of the likely environmental changes.

WG-CEMP-92/43
Penguins and Man. J.C. Ricca, M.A. Porretti and D.F. Vergani (CERLAP - IAA, Calle 8 Nro. 1467, (1900) La Plata, Argentina), 7 pp., (Spanish, Video presentation).

WG-CEMP-92/44
CEMP Standard Methods in video. J.C. Ricca, M.A. Porretti and D.F. Vergani (Instituto Antártico Argentino - CERLAP, Calle 8 Nro. 1467, (1900) La Plata, Argentina), 6 pp., (Spanish, Video presentation).

WG-CEMP-92/45
Changes in Adélie penguin population between 1963-1992 breeding seasons at Hope Bay. A.R. Carlini, D.F. Vergani and M.A. Gasco (Instituto Antártico Argentino - CERLAP, Calle 8 Nro. 1467, (1900) La Plata, Argentina), 3 pp., (English, unpublished).

During the 1991/92 breeding season penguins occupying nests with eggs were counted from one week following the peak of egg laying (9 November) to 28 November in the Hope Bay rookery similar to those counts carried out by Lefeuvre (1963) (Croxall, pers. comm.). Census areas were determined to enable comparison with this author and according to zones of human disturbance and environmental sensitivity defined by Acero and Agraz (1991): high impact (HI), medium impact (MI) and no impact (NI). The breeding success of 100 pairs of Adélie penguins in HI and 100 pairs in NI was determined. Comparison with Lefeuvre's counts indicated that the number of penguins occupying nests with eggs have increased in all sectors considered. Considering Lefeuvre's counts as a baseline, the increase in different impact zones from 1963 varied from 10.9% to 50.4% in HI and NI respectively. The breeding success was 1.03 and 1.09 chick fledges per pair in HI and NI respectively. According to these preliminary results, differences in increases between zones of high and no impact could not be explained completely by differences in breeding success. Human impact could produce changes in distribution patterns caused by different recruitment rate into the colony.

WG-CEMP-92/46
What is the key factor in breeding success of Adélie penguins at the Antarctic Peninsula area? Z.B. Stanganelli and D.F. Vergani (Instituto Antártico Argentino - CERLAP, Calle 8 Nro. 1467, (1900) La Plata, Argentina), 10 pp., (English, unpublished).

During the last decades human activities have been increasing in Antarctica in two ways: fisheries and land activities. Human activities have affected predator populations. Firstly, fisheries activities compete with seals and birds for food resources. Secondly, there is often conflict between an Antarctic Base and a breeding colony in its vicinity. Despite the general picture of increasing penguin populations in Antarctica, there is evidence that human activities, particularly associated with permanent research stations, may have adverse effects (Wilson *et al.*, 1991; Ainley, 1983; Young, 1991). A further important factor is the effect of the natural environment on predator populations. For management purposes, when a change in a predator population parameter is seen, it will be very important to discover which of

the three factors has caused that change. In this study we present information on breeding success of Adélie penguins in three points of the Antarctic Peninsula area: Stranger Point (King George - 25 de Mayo Is) South Shetland, Hope Bay, Antarctic Peninsula and Mosman Peninsula (Laurie Is) South Orkney. According to the results obtained, natural environmental impact appears to be the most important regulating factor at present. Human impact should be considered in the light of the carrying capacity of the ecosystem.

WG-CEMP-92/47

The hazard assessment of cetaceans by the use of a non-destructive biomarker in skin biopsy. M.C. Fossii, L. Marsili, C. Leonzio and S. Focardi (Dipartimento di Biologia Ambientale, Universita' di Siena, Via delle Cerchia 3, 53100, Siena, Italy), 7 pp., (English, unpublished).

Cetaceans have been subjected to heavy anthropogenic pressure in the last century. In addition to hunting there now exists the subtle threat of pollution which may be responsible for metabolic impairment, stranding episodes and population decline. The need to study pollutants and their effect on cetacean populations often conflicts with the need to protect these animals. In this paper we describe a new method of collecting skin and hypodermic biopsies in the fin whale (*Balaenopteraphysalus*) and striped dolphin (*Stenellacoeruleoalba*) in order to analyse Mixed Function Oxidase (MFO) activity and organochlorine levels. The results show marked differences between the two species. MFO activity in skin and organochlorines in blubber were higher in the striped dolphin than the fin whale. Although MFO activity was several times lower than BPMO activity detected in liver samples of the same species by Watanabe *et al*. (1989), it was easily detectable by conventional enzyme methods in whole tissue rather than the microsomal fraction. BPMO activity in striped dolphins was four-times higher than in fin whales ($p < 0.020$). PCB and DDT levels were 12-times ($p < 0.0005$) and nine-times ($p < 0.0005$) higher respectively in the striped dolphin than in the fin whale. According to the well known capacity of organochlorines to induce MFO activity in fish, bird and mammal liver, the main explanation of this interspecific difference in enzyme responses may lie in the chlorinated hydrocarbon induction process. The new method enables the main effects of exposure to lipophilic contaminants to be assessed in a non-destructive way in biomarker studies.

WG-CEMP-92/48

Specificity of the habitat of Antarctic fur seals (*Arctocephalus gazella*) and penguins (*Pygoscelis*) at Cape Shirreff. L. Lavanderos, H. Torres and J. Capella (Unidad de Investigaciones Antárticas, Area de Macropercepción y Medioambiente, Centro de Estudios Espacalies, Universidad de Chile, Casilla 411-3, Santiago, Chile), 20 pp., (Spanish, unpublished).

The spatio-temporal distribution of *Arctocephalus gazella, Pygoscelis papua* and *Pygoscelis antarctica* reflects the choice of animals of favourable distribution of available food resources. This should imply an effective energy budget of animals associated with territorial occupation. Analysis of spatial distribution of food resources and their topological relationships with distribution of population by means of a Geographical Information System (GIS), allows us to study the System Architecture of the area and determine potential patches in territorial occupation for conservation and management.

WG-CEMP-92/49

Notes on the status of krill predators in Prydz Bay Integrated Study Region, Division 58.4.2. J.R. Clarke (Australian Antarctic Division, Channel Highway, Kingston, Tas. 7050, Australia), 8 pp., (English, unpublished).

Abstract not available.

WG-CEMP-92/50

Estimation of prey requirements for krill predators. J.P. Croxall (British Antarctic Survey, High Cross, Madingley Road, Cambridge, CB3 0ET, United Kingdom), 3 pp., (English, unpublished).

WG-CEMP-92/51

Assessment of and proposal for studies on Antarctic bioenergetics. C.G. Guerra-Correa (Instituto de

Investigaciones Oceanologicas, Facultad de Recursos del Mar, Universidad de Antofagasta, Casilla 170, Antofagasta, Chile), 9 pp., (Spanish, unpublished).

The economy of Antarctic ecosystems is based mainly on ocean productivity. It is important therefore that these studies follow a scientific integrated ecosystemic approach in order to understand their function and the necessary basis for rational management. In this regard, knowledge of energy transfer processes in the main community components allows us to understand and use the different potential and available data. Defining an area of study in the southwest of the Shetland Islands, where Chile has logistic facilities and long experience, proves necessary in order to give current and future projects a multi-disciplinary, integrated and ecosistemic approach. The main topics are (i) studies on primary production, (ii) secondary production and (iii) energy requirements of higher predators.

WG-CEMP-92/52

Summary of environmental impact research carried out at Cape Shirreff, Livingston Island, Antarctica. D. Torres (Jefe Departamento Planes, Instituto Antártico Chileno, Luis Thayer Ojeda 814, Correo 9, Santiago, Chile), 8 pp., (Spanish, unpublished).

Abstract not available.

WG-CEMP-92/53

Distribution of *Arctocephalus gazella* at Cape Shirreff, Livingston Island, Antarctica in December 1991 and January 1992. A.A. Lobo and D. Torres (Departamento de Planes, Instituto Antártico Chileno, Casilla 165221 - Correo 9, Santiago, Chile), 4 pp., (Spanish, unpublished).

The study of the ecology of *Arctocephalus gazella* at Cape Shirreff started in 1981 with the financial support of the Instituto Antártico Chileno. The study was discontinued in 1985 and 1986 due to logistic problems and was resumed in 1987. The main results indicate an increase in the population abundance (Aguayo *et al.*, 1992). The two censuses carried out during the 1991/92 season in Cape Shirreff yielded a total of 5 444 and 6 881 fur seals in December 1991 and January 1992 respectively. In 10 beaches of a total of 30 surveyed during the first census, and in 13 beaches surveyed during the second census, the number of pups exceeded the number of females. Accordingly, the number of females was corrected to 5 861 for the first census and 7 826 for the second one. An increase of 965 individuals was observed, which is a 33.5% increase in the second census. On the other hand the difference in the number of pups between the two censuses (2 033 and 2967) showed an increase of 934 pups, which is a 45% increase in the second census. These values show that for the period when the first census (13 December 1991) was carried out, more than 50% of the pups counted had already been born.

WG-CEMP-92/54

Report on bird studies on Ardley Island, South Shetland Archipelago. M. Sallaberry and J. Valencia (Department of Ecology, Faculty of Sciences University of Chile, PO Box 653, Santiago, Chile), 10 pp., (English, unpublished).

This report covers the period 1983 to 1992 on bird research at Ardley Island (62°13'S, 58°55'W). We describe briefly the environment and a list of the nesting seabirds, marine mammals and our yearly field activities during spring and summer. Biological research was directed towards population, feeding and reproductive ecology. A banding program for penguins (1984) and Wilson's storm petrel (1986) using stainless steel has been established, a database is maintained at the Ornithology Laboratory and copies are sent to the SCAR Bird Biology Sub-Committee. Results include nesting penguin censuses from 1973 to 1991. The largest nesting population is *Pygoscelis papua* (3 221 nests) followed by *Pygoscelis adeliae* (1 187 nests) and *Pygoscelis antarctica* (89 nests). Total nesting population fluctuation ranges from 2 821 nests (1982/83) to 6 216 (1991/92). Some of the factors that may contribute to these fluctuations are discussed. Tables containing the figures of banded birds per season are presented. The total for penguins is 2 913 and for Wilson's storm petrels, 334 birds banded. The list of references contains several publications derived from these research activities. The

financial support of INACH, the logistic support of the Chilean Air Force and field collaboration of our students is acknowledged.

WG-CEMP-92/55
The population ecology of seabirds at Svarthamaren, Droning Maud Land: Causes and consequences of variation in reproductive success of two long-lived seabirds species (Antarctic petrel and south polar skua) at Svarthamaren. An experimental approach. Norway, 11 pp., (English, unpublished).

Working Group on Fish Stock Assessment

WG-FSA-92/4
***Champsocephalus gunnari* Lönnberg distribution on South Georgia shelf from inventory survey data collected by AtlantNIRO**. I.A. Trunov (AtlantNIRO, 5 Dimitry Donskoy Street, Kaliningrad 236000, Russia), 9 pp., (Russian, unpublished).

A total of eight trawling surveys of bottom fish were made on the South Georgia shelf. The *Champsocephalus gunnari* distribution pattern varied markedly by year which can be attributed to differing survey dates. The most dense *C. gunnari* aggregations observed were mainly in the northern, northwestern and northeastern parts of the island shelf. Near Shag Rocks they could be seen in separate years. Year-to-year fluctuations of catch-per-unit-effort, predominance of certain groups and mean weight of the fish were obviously governed by the intensity of fishing.

WG-FSA-92/5
Collected data and stock assessment results for *Notothenia squamifrons* from Ob and Lena Banks, Division 58.4.4. A.K. Zaitsev and S.M. Pronenko (YugNIRO, Sverdlova 2, Kerch, Republic of Crimea, 334500 Ukraine), 21 pp., (Russian, unpublished).

Catch and age/length composition data for *Notothenia squamifrons* from Ob and Lena Banks (Division 58.4.4) are presented for the period from 1978 to 1990 split-years. These data were used in VPA analyses made for each bank separately. The CCAMLR VPA program, version 4.1 was used. The resulting biomass estimates for 1990 are 10 200 tonnes for Ob Bank and 20 700 tonnes for Lena Bank. These estimates may be used in calculation of a TAC which, in accordance with our calculations, should be 2 000 tonnes for Ob Bank and 4 000 tonnes for Lena Bank.

WG-FSA-92/6
By-catch of juvenile *Champsocephalus gunnari* in krill fishery on the shelf of South Georgia Island. G.A. Frolkina, V.I. Latogursky and V.A. Sushin (AtlantNIRO, 5 Dimitry Donskoy Street, Kaliningrad 236000, Russia), 20 pp., (Russian, unpublished).

From 1982 to 1990, AtlantNIRO conducted a series of juvenile fish trawl surveys of abundant species around South Georgia. Results of these surveys were summarised and compared with published data. Juveniles of *Champsocephalus gunnari* were found to be distributed from the surface to 500 m depth with a maximum density observed at depth between 100 and 200 m. High catches of *C. gunnari* juveniles were regularly taken in the south, southwest and southeast parts of the shelf. Juveniles of *C. gunnari* were usually found along the periphery of krill concentrations but not inside these concentrations. Estimated mortality of *C. gunnari* juveniles is relatively small and it was estimated that 0.3 to 0.5% of fish survived up to an age of one year.

WG-FSA-92/7
A fish stock assessment survey design for Subarea 48.1. G. Watters (Southwest Fisheries Science Center, La Jolla, Ca. 92038, USA), 16 pp., (English, unpublished).

There is a lack of information regarding the abundance of exploitable finfish in Subarea 48.1. A comprehensive, bottom trawl survey of fish stocks in Subarea 48.1 would make it easier for the Working Group on Fish Stock Assessment to assess the stocks in this region and assist the Scientific Committee in giving management advice to the Commission. A stratified

random survey is proposed; the strata correspond to depth ranges (stratum 1: 50 to 150 m; stratum 2: 151 to 250 m; stratum 3: 251 to 500 m). A rule is derived from catch rate data obtained during previous stock assessment surveys around Elephant Island to allocate sampling effort among the three depth strata. 176 trawl stations are randomly selected by gridding the survey area. The survey is designed to cover all of Subarea 48.1.

WG-FSA-92/8
Length-age composition of the Patagonian toothfish, *Dissostichus eleginoides*, from the Kerguelen Island area. V.G. Prutko and V.N. Chikov (YugNIRO, Sverdlova 2, Kerch, Republic of Crimea, 334500 Ukraine), 16 pp., (Russian, unpublished).

Results of age/length composition studies of the Patagonian toothfish, *Dissostichus eleginoides*, from various fishing grounds of the shelf and continental slope areas of the Kerguelen Islands are presented. Detailed results of these studies are compiled in tables such as age/length keys, mean fish length by age, length and age frequency distributions in catches. Soviet vessels first carried out a fishery for these species in the 1984/85 season. Fishing grounds during this period were located in the west shelf area (48°30' to 49°30'S and 66°50' to 67°20'E) and total catch was about 6 700 tonnes. Length composition of catches taken within 300 to 500 m depth range did not fluctuate considerably, mean fish length being 76.0 to 86.6 cm. Fish aged 2 to 14 were most abundant in catches, mean age being 8.2 to 9.8 years. In the 1991/92 season fishing for the species was concentrated in the north shelf area (47°10' to 47°30'S and 66°50' to 67°20'E) and the total catch was about 5 200 tonnes. In other seasons between 1984 and 1992 catches of the species was taken only occasionally and annual catches were from 500 to 3 100 tonnes. Mean length of fish taken at 300 to 500 m depth was 58.1 cm, mean age was 5.8 years. Mean length of fish taken at 540 to 600 m depth was 85.8, mean age was 9.7 years. Results presented in the paper are in agreement with results of other studies conducted in the past by French and Russian scientists.

WG-FSA-92/9
Stock size and TAC estimation for the Patagonian toothfish, *Dissostichus eleginoides*, from the Kerguelen Island area. S.M. Pronenko, P.B. Tankevich, V.V. Gerasimchuk and V.N. Chikov (YugNIRO, Sverdlova 2, Kerch, Republic of Crimea, 334500 Ukraine), 12 pp., (Russian, unpublished).

Biological data and fishery statistics collected from 1984 to 1992 were used for stock size and TAC estimation of the Patagonian toothfish, *Dissostichus eleginoides*, from the Kerguelen shelf area. The method of R. Jones (1964) was used for estimating population size and TAC. Calculations were done for the 1984/85 and 1991/92 seasons where directed fishery for the species took place. Population size of *D. eleginoides* for these seasons was estimated at 43 000 to 50 000 tonnes. The TAC was estimated at 7 300 to 7 500 tonnes.

WG-FSA-92/10
On the problem of by-catch of juvenile fish in the krill fishery. S.A. Pankratov and E.A. Pakhomov (YugNIRO, Sverdlova 2, Kerch, Republic of Crimea, 334500 Ukraine), 34 pp., (Russian, unpublished).

Studies of by-catch of juvenile fish in krill catches by research vessels were conducted during 1985 to 1988 in the Kosmonavtov and Sodruzhestva Seas (Antarctic Indian Ocean sector). An Isaacs-Kidd trawl with an opening area of 6.0 m^2 was used to take trawls in the 0 to 200 m surface layer over the bottom depth range from 100 to 5 000 m. In 1988, studies included catches taken by a commercial krill trawl with an opening area in a small meshed section of the trawl bag of 100 m^2. Catches were mainly taken over depth ranges from 300 to 500 m and 2 500 to 4 200 m. Most frequently observed species of fish in krill catches were *Pleuragramma antarcticum*, *Electrona antarctica* and *Trematomus eulepidotus*. Other species were observed in catches only occasionally and in small numbers. By-catch of juvenile fish was highest in Prydz Bay and Fram Bank areas. By-catch of juvenile fish in Isaacs-Kidd trawls was

usually less than 50 fish per 30 minutes of trawling. By-catch in commercial trawls was from 114 - 1 x 10^6 fish per tonne of krill caught. Small by-catches of fish were usually observed when krill catches were higher than 2 tonnes (2 to 12 tonnes) and over the bottom depth less than 1 000 m. Maximum by-catches (up to 1 x 10^6 fish per tonne of krill) were observed when krill catches were less than 2 tonnes and over the bottom depth from 1 500 to 4 500 m. It was found that areas of maximum concentrations of juvenile fish and krill did not overlap. Therefore, high fish by-catch corresponds to low krill catch and *vice versa.* It was concluded that the krill fishery should be best conducted over the bottom depth more than 1 200 m and on high-density krill concentrations. It was also suggested that in order to avoid large by-catch of juvenile fish, krill fishing should not be conducted in shallow waters over the continental slope.

WG-FSA-92/11

A brief outline of the biology of the Antarctic silverfish, *Pleuragramma antarcticum* Boulenger, 1902 (Nototheniidae) from the Antarctic Indian Ocean. V.V. Gerasimchuk (YugNIRO, Sverdlova 2, Kerch, Republic of Crimea, 334500 Ukraine), 47 pp., (Russian, unpublished).

The Antarctic silverfish (*Pleuragramma antarcticum*) is one of the most numerous species in the offshore waters of Antarctica. In the Indian Ocean sector of the Southern Ocean there are at least three relatively isolated groups. Fish aged from 0+ to 3+ years live in the epi- mesopelagic zone where there are macro aggregations of plankton, while fish aged from 3+ to 12+ years form near-bottom, pelagic schools. Fish belonging to various spatial groups have different growth characteristics. Females mature when they reach 13 to 16 cm in length and 4 to 6 years of age. Males reach maturity at 12 to 18 cm in length and 4 to 7 years of age. The potential absolute and relative fertility of this species is one of the highest for high-latitude Antarctic fish. Spawning occurs in the winter-spring period. *P. antarcticum* is a plankton-eater and is itself an important part of the diet of species higher up the food chain. *P. antarcticum* has a fairly high level of instantaneous natural mortality, mainly due to its position on the food chain. It would probably be unwise to commence exploratory commercial fishing of this species in areas of international monitoring.

WG-FSA-92/12

Species composition of scientific/ commercial catches of *Electrona carlsbergi*. Anon., VNIRO (17a Verkhnaya Krasnoselskaya Street, Moscow 107140, Russia), 3 pp., (English, unpublished).

A general feature of myctophid distribution in this area is an increase in the proportion of myctophid species other than *Electronacarlsbergi* in catches in the autumn and winter when *E. carlsbergi* swarms are dispersed over the Polar Frontal Zone. In the summer large concentrations of *E. carlsbergi* form the proportion of other species of myctophids decreases dramatically. Research was carried out on board the vessel *Vozrozhdenie* in 1987-89 over an area of the Polar Frontal Zone (between 48°-52°S and 40-25°W) to the north of South Georgia Island. In October-November 1987, catch rates were 100 to 300 kg per 1 to 1.5 hours of trawling (140 to 260 m depth). Myctophidae (up to 9-11 species) as well as individual fish of other mesopelagic families (Paralepididae, Gempylidae, Bathylagidae and others) were encountered. The proportion of the target species, *E. carlsbergi*, varied from 40 to 80% in catches with *Gymnoscopelus nicholsi* (20 to 40%), *G. piabilis* (5 to 30%) and *G. braueri* (5 to 10%). Individuals of *Krefftichthys andersoni, Electrona subaspera, E. antarctica* and *Protomyctophum bolini* were recorded. In December 1987, catches varied between 0.1 to 10 tonnes per 0.5 to 1.5 hours trawling (30 to 340 m depth). Small catches (≤0.5 tonnes) contained *E. carlsbergi* (65 to 99%), *G. piabilis* (5 to 25%) and *G. nicholsi* (5%). *E. carlsbergi* was the dominant species in catches over 1 tonne. In April 1988, catches (200 to 350 m depth) were low over the research area (150 to 200 tonnes of mixed species, 200 to 350 m depth). *G. nicholsi, G. piabilis* and

G. braueri occurred fairly regularly with *E. carlsbergi* and in some smaller catches they comprised 60 to 80%. In the north (around 48°S) up to 25% of catches contained *Symbolophorus boops* and catches contained individuals of *Thunnus thynnus*, *Cubiceps gracilis* and *Brama* spp. and the squid *Martialia* spp. In November-December 1988, catches (1 to 2 tonnes per 1.5 to 2 hours, 50 to 200 m depth) were almost exclusively made up of *E. carlsbergi* (99 to 100%). In March 1989, catches (0.15 to 12 tonnes, 200 to 250 m depth) of *E. carlsbergi* accounted for 80 to 100% although in catches up to 0.5 tonnes the proportion of *G. nicholsoni* and *G. piabilis* was 5 to 20%. In April/May 1989, catches (0.08 to 1.5 tonnes, 100 to 350 m depth) of *E. carlsbergi* accounted for 90 to 100%, *G. braueri* - 10% and *G. nicholsi* - 3 to 5%.

WG-FSA-92/13

Pre-spawning and spawning biology of the Patagonian toothfish, *Dissostichus eleginoides*, around South Georgia (Subarea 48.3). I.N. Konforkin and A.N. Kozlov (VNIRO, 17a Verkhnaya Krasnoselskaya Street, Moscow 107140, Russia), 14 pp., (English, unpublished).

Samples gathered from research expeditions of the longliners *Medvezhy* (April to June 1986) and *Maksheevo* and *Mirgorod* (June to July 1992) have produced new data on the biology of the reproductive part of the *Dissostichus eleginoides* population in Subarea 48.3. Analysis and synthesis of these data have established the bathymetric distribution patterns for different size groups of toothfish around Shag Rocks and South Georgia. A differentiation analysis of the sex structure of the *D. eleginoides* population was carried out. The dynamics of the maturity structure of the adult part of the *D. eleginoides* population are shown for the pre-spawning and spawning periods. A preliminary assessment of the reproductive ability (fecundity) of females of the species is presented. Data are also presented on the feeding patterns of *D. eleginoides* sampled from longline catches. Some differences in food composition in relation to fishing depth were noted.

WG-FSA-92/14

Brief report of activities carried out by the vessel *Mirgorod* in the Shag Rocks and South Georgia areas during the months May to June 1992. Anon., VNIRO (17a Verkhnaya Krasnoselskaya Street, Moscow 107140, Russia), 13 pp., (English, unpublished).

During the periods 20 to 24 May, 14 to 25 June and 1 to 3 July, the vessel carried out research activities in the Shag Rocks area on a site bounded by 53°27' to 53°36' S and 40°48' to 41°35 W. 45 longline settings were made at depths from 380 to 1 560 m. During the periods 27 to 29 June and 4 to 9 July the vessel operated at the following positions: 53°28' to 53°59' S, 36°30' to 35°29' W and 54°08' to 54°26' S, 39°27' to 39°56' W. 20 longline settings were made at depths from 1 000 to 1 400 m. *Dissostichus eleginoides* was taken over a wide depth range from 600 to 1 500 m. Concentrations were most often observed at depths of 1 100 to 1 400 m with a near-bottom water temperature of 1.7-1.9° C. Swarms in the Shag Rocks area were dominated by large pre-spawning fish - specimens were 96 to 110 cm in length and 10 to 13 years old. In the South Georgia area 10 to 15 year-old specimens with a length of 96 to 119 cm were predominant in catches. Biological characteristics varied depending on the location and depth of fishing. The majority of fish were at the pre-spawning stage. The first specimens with running ripe sex organs were noted at the end of June, although most were not yet ready to spawn. Absolute fecundity of females at the fourth stage of maturity varied from 87.7 to 200 thousand eggs, giving an average of 133.8 thousand. According to research data from 1 986 fecundity ranged from 54.1 to 236 thousand eggs. Over the research period feeding intensity of *D. eleginoides* was low (average 0.06 to 0.46) and was not dependent on the time of day.

WG-FSA-92/15

Brief report of the activities carried out by the vessel *Maksheevo* in the Shag Rocks and South Georgia areas from June to July 1992. Anon., VNIRO (17a Verkhnaya Krasnoselskaya Street, Moscow 107140,

Russia), 5 pp., (English, unpublished).

From 14 to 28 June the vessel worked the area 53°31' to 53°55'S, 40°01' to 40°59'W. 41 longline settings were made at depths between 590 and 1 330 m. Catch size of *Dissostichus eleginoides* ranged from 370 to 490 kg per 1 000 hooks. The largest catches were recorded at the depth range 1 100 to 1 300 m. The largest prespawning specimens, having a mean length of 104.7 to 109.5 cm and weight of 12.3 to 13.8 kg, were distributed at depths between 810 and 1300 m. Variously sized fish from 72 to 130 cm long were distributed in shallower water between 600 and 800 m. For *D. eleginoides* mean length varied between 100.7 to 102.1 cm and mean mass was between 11.5 and 12.0 kg. The bulk of the catch was comprised of specimens in prespawning condition (maturity stages 3 and 4); immature specimens accounted for 20%. The shelf zone of the South Georgia area at 53°27' to 53°51'S, 39°43' to 35°57'W was studied from 21 to 27 July. 20 longline settings were completed in the presumed spawning area for *D. eleginoides* at 53°26' to 53°28'S, 36°30' to 35°57'W at depths between 1 200 and 1 700 m. No commercial concentrations were discovered in this area. Catch size varied from 100 to 200 kg per 1 000 hooks. The length of *D. eleginoides* ranged from 87 to 130 cm: there were two modal groups of 105 to 107 cm and 108 to 110 cm and mean length was 106 cm. Spawning and post-spawning females accounted for 70% of the catch. Out of the total number of females 28.5% were actively spawning and 33% were spent. Males comprised 30% of the catch and were represented by specimens with running ripe sexual organs (90% at stages 5 to 6), 10% of males were post-spawners. The stomachs of the majority (94%) of examined fish were empty; the food of 6% was composed of digested fish (50%) and squid bait (33.3%). Crab was discovered in the stomachs of some specimens of *D. eleginoides* caught in deep waters (1 500 to 1 700 m).

WG-FSA-92/16

CCAMLR Workshop on Design of Bottom Trawl Surveys, Hamburg, Germany, 16 to 19 September 1992). CCAMLR, *Report of the Eleventh Meeting of the Scientific Committee (SC-CAMLR-XI)*, Annex 5, Appendix H, 1991, pp. 289-329, (English).

WG-FSA-92/17

Fish stock assessment survey in Subarea 48.3. I. Everson, G. Parkes, S. Campbell, K.-H. Kock, J. Szlakowski, Z. Cielniaszek, C. Goss and S. Wilhelms (British Antarctic Survey, High Cross, Madingley Road, Cambridge, CB3 0ET, United Kingdom), 40 pp., (English, unpublished).

Abstract not available.

WG-FSA-92/18

Condition factor study of *Champsocephalus gunnari*. I. Everson, G. Parkes, S. Campbell, K.-H.Kock, J. Szlakowski, Z. Cielniaszek, C. Goss and S. Wilhelms (British Antarctic Survey, High Cross, Madingley Road, Cambridge, CB3 0ET, United Kingdom), 40 pp., (English, unpublished).

Abstract not available.

WG-FSA-92/19

Secretariat stock assessment software. CCAMLR Secretariat, 3 pp., (English, unpublished).

WG-FSA-92/20

Reports of juvenile fish as by-catch in the krill fishery. CCAMLR Secretariat, 5 pp., (English, unpublished).

WG-FSA-92/21 Rev. 1

Remarks on natural mortality of *Dissostichus eleginoides* in Subarea 48.3. C.A. Moreno and P.S. Rubilar (Instituto de Ecología y Evolución, Universidad Austral de Chile, Casilla 567, Valdivia, Chile), 13 pp., (Spanish, unpublished).

Natural mortality (**M**) from the Chilean longline fishery in *Dissostichus eleginoides* of Subarea 48.3 (N = 7 848) was calculated after Sparre (1990). The von Bertalanffy parameters obtained independently by three authors were used. Three cases were considered: fishing site, fishing depth and hook type. It was determined that there were no significant differences in **M** by fishing depth and hook type with different

growth parameters although there was with fishing sites. On the other hand, when comparing the different mean values of **M** for the different cases, it was found that there were significant differences between fishing sites and curve hooks No. 14 and straight hooks No. 22. The general mean value of **M** calculated for the 44 analysed situations was 0.14 ± 0.03, being the range between 0.0623 and 0.2727.

WG-FSA-92/22

Catch-at-age analysis applied to new fisheries: The case of *Dissostichus eleginoides*. A.V. Zuleta and C.A. Moreno (Instituto de Fomento Pesquero, Casilla 8-V, Valparaíso, Chile), 9 pp., (English, unpublished).

Traditionally, the approach used in the assessment of new fisheries has been based on research surveys, making it possible to estimate the standing stock and potential yield of a resource by coarse methods. The main aim of such surveys is the monitoring of fishing operations in order to develop an intense spatial sampling design, which is sustained by assessment procedures that are quite similar to those commonly used in the statistical sampling theory. These procedures are, to a certain extent, limited by the complex fishing strategies of the operators and by the movements of fish stocks, which seriously affect model assumptions. We suggest an alternative method of optimising fishing research procedures using methods based on an analysis of catch composition. We also examine, as an example, the application of catch-at-age analysis to the stock of *Dissostichus eleginoides* in the southernmost part of Chile, where a new fishery has commenced with aims similar to the CCAMLR objectives of estimating abundance levels and potential yields, and thus ensuring that the initial levels of exploitation will be potentially sustainable.

WG-FSA-92/23 Rev. 1

An iterative model to construct an age/length key to assess the age composition of a new fishery for *Dissostichus eleginoides* in Chilean waters. H. Robotham and Z. Young (Instituto de Fomento Pesquero, Casilla 8-V, Valparaíso, Chile), 13 pp., (Spanish, unpublished).

Traditional estimation of age composition of catch requires that age/length data and random length frequency have been sampled from the same population. If this assumption is not filled the estimates of the age distribution could be biased. By using an iteration algorithm it is possible to overcome this limitation. The age composition of catch for *Dissostichus eleginoides* was obtained with the application of a single age/length key to the monthly length distribution using the non-linear model (Hoenig and Heisey, 1987). We found an age distribution of catch pattern which is not significantly different from the one obtained by using traditional methods.

WG-FSA-92/24

Fishing of the Patagonian toothfish (*Dissostichus eleginoides)* by the Chilean fleet (1991/92) in Subarea 48.3 (South Georgia Island) and proposed TAC for the 1992/93 season. P. Arana, M. Arredondo and V. Venturini (Escuela de Ciencias del Mar, Universidad Católica de Valparaíso, Casilla 1020, Valparaíso, Chile), 39 pp., (Spanish, unpublished).

This study analyses fisheries activities carried out by the Chilean longline fishery targeting the Patagonian toothfish (*Dissostichus eleginoides*) in Subarea 48.3 (South Georgia Island). From the end of December 1991 until the close of the fishery on 10 March 1992, the fleet caught around 80% of the TAC set for this subarea. Two separate fishing grounds could be clearly distinguished to the north of South Georgia Island (including Black and Shag Rocks), and to the south of the island, hauls being made at depths between 1 100 and 1 450 m. Total effort was 2.71 million hooks. 2 883 tonnes were caught (CPUE = 1.06 kg/hook), a yield higher than those of previous seasons. Length frequency by sex of 8 360 specimens was determined (total length corrected from standard length measured in 5 mm intervals). Length distributions ranged between 40 and 145 cm for males (mean = 96.7 cm) and 40 and 200 cm for females (mean = 108.8 cm). The total catch was estimated

at 255 139 specimens, with a ratio of 59% males and 41% females. Stock assessment was made by using two methodological approaches: pseudo-cohort analysis and De Lury's method. The total catch recorded for the subarea was used, while the total effort was estimated by projecting the results of the Chilean fleet to all vessels that operated during the season. Using different combinations of $\mathbf{F_{0.1}}$, total length at first catch and natural mortality (assumed to be most likely for this species) TACs ranged between 1 085 and 5 768 tonnes (De Lury) and 7 832 and 8 210 tonnes (cohort analysis). On the basis of these results, the proposed TAC for the 1992/93 season in Subarea 48.3 is 6 000 tonnes.

WG-FSA-92/25
Database information of Antarctic fishes: Call for cooperation. A. Jarre-Teichmann (Alfred Wegener Institute for Polar and Marine Research, PO Box 12 01 61, Columbusstr., 2850 Bremerhaven, Germany), 2 pp., (English, unpublished).

WG-FSA-92/26
Variations in food composition and feeding intensity of mackerel icefish (*Champsocephalus gunnari*) at South Georgia. K.-H. Kock, I. Everson, S. Wilhelms, S. Campbell, J. Szlakowski, G. Parkes, Z. Cielniaszek and C. Goss (Institut für Seefischerei, Bundesforschungsanstalt für Fischerei, Palmaille 9, D-2000 Hamburg 50, Germany), 23 pp., (English, unpublished).

The diet composition and feeding intensity of mackerel icefish (*Champsocephalus gunnari*) around Shag Rocks and the mainland of South Georgia was investigated in January/February 1985, January/February 1991 and January 1992 by analysing approximately 9 000 stomachs. Main prey items were krill (*Euphausia superba*), the hyperiid *Themisto gaudichaudii*, mysids and in 1985 also *Thysanoessa* species. The proportion of krill and *Themisto* in the diet items varied considerably between the three seasons, whereas the proportion of mysids in the diet remained fairly constant. Krill is obviously the preferred diet. In years of krill shortage such as in 1991, krill is replaced by *Themisto gaudichaudii* and sometimes *Thysanoessa*. Variation in food composition between sampling sites was high. This high variation can be primarily attributed to differences in prey availability, but appears to be much less influenced by differences in length composition of the fish between sampling stations. Feeding intensity also varied considerably between seasons. It was highest in 1992.

WG-FSA-92/27
Notes on the use of virtual population analysis for stock assessment of the mackerel icefish, *Champsocephalus gunnari* (Lönnberg, 1906) in Subarea 48.3 for the 1990/91 and 1991/92 seasons. G. Parkes (Renewable Resources Assessment Group, Imperial College, 8, Prince's Gardens, London SW7 1NA, United Kingdom), 34 pp., (English, unpublished).

Following on from the apparent failure to satisfactorily assess the status of the *Champsocephalus gunnari* population in Subarea 48.3 at WG-FSA-91 using VPA, attempts were made to re-work the analysis using Laurec-Shepherd and ADAPT tuning techniques, from 1991 back to 1977. The predicted age structure, dominated in recent years by the 1987 year-class (1 year olds in 1988), was quite robust, despite the use of various combinations of survey and CPUE indices for tuning. According to the VPA the population in 1991/92 was composed of a large proportion of 5 year olds, which was not observed during the survey on *Falklands Protector* in January 1992. Breakdown in the credibility of the VPA results in most recent years is attributed to the invalid assumption of constant **M** and contradictions in the input data. A conservative approach to management for 1992/93 is recommended, based on the results of surveys by *Falklands Protector* in 1990/91 and 1991/92.

WG-FSA-92/28
The 1992 *Dissostichus* fishery in Subarea 48.3. D.J. Agnew and C.A. Moreno (CCAMLR, 25 Old Wharf, Hobart, Tasmania 7000, Australia), 16 pp., (English, unpublished).

The 1992 longline fishery for *Dissostichus eleginoides* in Subarea 48.3 was open from 4 November 1991 to

10 March 1992. A total of 3 382 tonnes was taken by one Bulgarian, five Russian and eight Chilean vessels, with a maximum catch of 375 tonnes in a five-day period. Catch rate was not influenced by fishing depth, time of day or soak time, but was dependent on type of hook and geographical position. Larger fish were caught around Shag Rocks than to the north and southeast of South Georgia. CPUE varied markedly between fleets, being about 1 kg/hook in the Chilean fleet, 0.2 to 0.4 in the Russian and 0.2 in the Bulgarian, and these differences were probably a result of the different hook types used by the fleets.

WG-FSA-92/29

A preliminary report on research conducted during experimental crab fishing in the Antarctic during 1992 (CCAMLR Area 48). R.S. Otto and A. MacIntosh (National Marine Fisheries Service, Kodiak Laboratory, PO Box 1638, Kodiak, Ak. 99615, USA), 26 pp., (English, unpublished).

Fishing operations for Antarctic crab began in July 1992 with an initial trip by the FV *Pro Surveyor* to South Georgia Island. Fishing operations were conducted in accordance with the Plan for Research and Data Collection During Exploratory Crab Fishing in the Antarctic that was submitted by the US Delegation during CCAMLR-X. Fishing operations are continuing at this time and only limited data are currently available. This report describes fishing operations and biological data taken during the initial trip. All fishing was done with pots (traps). *Paralomis spinosissima* and *P. formosa* were the only species of crabs captured. A minimum size limit of 102 mm carapace width, which allows one or more breeding opportunities for adult male crab, was established for *P. spinosissima*. Based on limited data a size limit of 90 mm carapace width is recommended for *P. formosa*. Female and undersized male crabs were immediately returned to the sea. The type of pot employed seldom retains fish and negligible amounts were taken. Experience in Bering Sea and Aleutian Island crab fisheries suggests that the catch rates observed in Statistical Area 48 are indicative of crab populations that can support viable fisheries. Sustainable yields of crabs in Area 48 can not be directly estimated from the limited data at hand. Comparison with crab fisheries in the Aleutian Islands suggests that Area 48 might have an annual potential of about 6 000 tonnes. With regard to Article II of the CCAMLR Convention and assuming continued fishing is restricted to taking only males above a specified size limit: (i) the potential for reducing populations to levels below those which ensure their stable recruitment is minimal; (ii) the potential for disrupting ecological relationships appears to be negligible; and (iii) no changes in the marine ecosystem are anticipated. Data on fishery operations were recorded using the NMFS Antarctic Ecosystem Research Group (AERG) Log Book System. Biological data and specimens will be archived at the NMFS Kodiak Laboratory until final research reports are completed. Specimens for taxonomic studies will be forwarded to the US National Museum. All data will be made available as specified by the CCAMLR Scientific Committee after fishing operations are completed.

WG-FSA-92/30

Preliminary analysis of the growth of *Dissostichus eleginoides* from the austral zone of Chile and South Georgia. M. Aguayo (Instituto de Fomento Pesquero, Avda Colon 3620, Talcahuano, Chile), 15 pp., (Spanish, unpublished).

Counts of scale rings were used to determine the age of *D. eleginoides* taken by commercial vessels in 1991. For the area of the southeastern Pacific, between 47° and 57°S, the von Bertalanffy growth parameters were:

	L_∞	K	t_0
Males	199.2	0.074	-0.809
Females	214.0	0.062	-1.265
Both	216.1	0.062	-0.877

This information was used to construct an age/length key for the area. A preliminary analysis of a sample of 370 fish taken in a research survey in April 1991 around South Georgia generated a further age/length key using similar methods. This survey took place in the same area as the commercial fishery in that year and used longline methods similar to those employed in the fishery.

WG-FSA-92/31

Exploratory longline fishing around the Kerguelen Islands (Division 58.5.1). Description of the fishing effort, catchability and target size of *Dissostichus eleginoides*. G. Duhamel (Muséum national d'histoire naturelle, Laboratoire d'Ichtyologie générale et appliquée, 43 rue Cuvier, 75231 Paris Cedex 05, France), 11 pp., (French, unpublished).

Longline exploratory fishing cruises have occurred around the Kerguelen Islands (Division 58.5.1) during the 1990/91 and 1992/92 fishing seasons. Two longliners have exploited the western slope of the Kerguelen shelf. Monitoring of the fishing cruises on board one of the longliners has allowed description of the fishing method. Bottom longlines have been used at depth 400 to 600 m and the main line, 1 to 2 miles long, supports 2 400 to 3 600 hooks. Right hooks (61 to 75 mm long) are baited with imported fish (horse mackerel) or squid and local fish (*Champsocephalus gunnari*) caught by trawlers. The efficacity of the automatic longline baiter is about 75%. The catchability coefficient is about 10.9% but loss of fish alongside the ship reduces the value to about 10.2%. Catches concern mainly *Dissostichus eleginoides* and by-catch are low (0.28%). The length frequency distributions (LFD) of fish randomly sampled confirm that the mean size caught by longline is similar to the value from the previous trawler's catches in the same fishing sector. The mean size (total length) for two successive fishing seasons is comparable (93.40 cm during 1990/91 and 92.95 cm during 1991/92). Catches concern mainly adults and difference in mean size occurs between males (88.09 cm during 1990/91 and 88.13 cm during 1991/92) and females (98.70 cm during 1990/91 and 98.61 cm during 1991/92) as previously recorded. The sex-ratio is equal.

WG-FSA-92/32

CCAMLR Glossary of Terms. CCAMLR, *Report of the Eleventh Meeting of the Scientific Committee (SC-CAMLR-XI)*, Annex 12, 1991, pp. 481-487, (English).