FOOD AND FEEDING OF THE MACKEREL ICEFISH (*CHAMPSOCEPHALUS GUNNARI*) AROUND SOUTH GEORGIA IN JANUARY/FEBRUARY 1991

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Abstract

The diet composition and feeding intensity of mackerel icefish *(Champsocephalus gunnari)* around South Georgia in January/February 1991 were analysed in 3 877 stomachs collected at 44 stations. Both the proportion of krill *(Euphausia superba)* in the stomachs and the feeding intensity were uncommonly low in a period when energy rich food is needed for the final maturation of the gonads.

Résumé

La composition du régime alimentaire et l'intensité de l'alimentation du poisson des glaces (*Champsocephalus gunnari*) autour de la Géorgie du Sud en janvier/février 1991 ont été analysées pour 3 877 estomacs recueillis à 44 stations. La proportion du krill (*Euphausia superba*) dans les estomacs et l'intensité alimentaire relevées étaient particulièrement faibles en une période où des aliments de haute valeur énergétique sont nécessaires pour la maturation finale des gonades.

Резюме

Состав рациона и интенсивность питания ледяной рыбы *(Champsocephalus gunnari)* вокруг Южной Георгии в январе-феврале 1991 г. были проанализированы в 3 877 желудках. Образцы собирались на 44 станциях. Как пропорция криля *(Euphausia superba)* в желудках, так и интенсивность питания были необычно низкими в период, когда высококалорийная пища необходима для окончательного вызревания гонад.

Resumen

Se examinaron 3 877 estómagos de peces recolectados en 44 estaciones de muestreo con el propósito de analizar la composición cualitativa y cuantitativa de la dieta del draco rayado (*Champsocephalus gunnari*) alrededor de Georgia del Sur durante enero/febrero de 1991. Estos análisis demostraron que la proporción de krill (*Euphausia superba*) en los estómagos y la frecuencia de alimentación fueron extraordinariamente bajos durante el período cuando se necesita alimento de gran contenido energético para la madurez final de las gónadas.

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1. INTRODUCTION

The diet of mackerel icefish (*Champsocephalus gunnari)* around South Georgia and its seasonal and interannual variation has been comparatively well studied qualitatively (see reviews in Kock, 1981; Wilhelms, 1986; Kozlov *et al.*, 1988). Main prey items were krill (*Euphausia superba),* the hyperiid *Themisto gaudichaudii* and mysids (predominantly *Antarctomysis maxima).* Other euphausiids, such as *Thysanoessa* species or lanternfish (Myctophidae) are of minor importance. In years when krill is abundant it represents the staple food. Mackerel icefish then tend to aggregate in areas of krill concentrations. In years of low krill abundance it is replaced in the diet by the ubiquitous, albeit much smaller *T. gaudichaudii* which has a much lower caloric value than krill. In these krill-poor seasons mysids are also taken. *C. gunnari* are often more dispersed in these years of krill scarcity (Kock, 1981).

During the UK Demersal Fish Survey around South Georgia in January/February 1991 mackerel icefish were found to be widely dispersed over the upper part of the shelf (Everson *et al.*, 1991a). An unusually high proportion of sexually mature fish showed no signs of the gonad development necessary leading up to spawning in the coming season from March to May (Everson *et al.*, 1991b). It has been demonstrated in other fish species, such as winter flounder, *Pseudopleuronectes americanus,* that in the face of food shortage an adaptative strategy is to sacrifice egg production and maintain body size (Tyler and Dunn, 1976).

We report here on our findings of the food composition and feeding intensity of mackerel icefish in January/February 1991 which may aid in understanding the irregularities in the maturity process of the species around South Georgia in the 1990/91 season.

2. MATERIAL AND METHODS

The stomach contents of mackerel icefish were qualitatively analysed by one of us (K.-H. Kock) in 3 877 fish which were randomly collected on 44 out of 87 stations sampled during the survey.

Depending on the catch the number of fish investigated per station varied between 16 and 184 but comprised with the exception of four stations at least 40 individuals per haul. Stomach fullness was estimated according to a 5-point scale: 0 - empty, 1 - 1/4 full, 2 - 1/2 full, 3 - 3/4 full, 4 - 4/4 full, stomach wall extended. Prey items were identified to the lowest taxon possible, in general this was to species or genus. The occurrence of each taxon in the stomach was recorded and augmented by information on their prevalence. It was then expressed as a percentage of all stomachs containing food. Despite some shortcomings of this 'frequency of occurrence' method (see Pillay, 1952), its advantages are that it is quick, requires a minimum of apparatus and time and that results from a number of similar studies from previous seasons are available for comparative purposes.

3. RESULTS

3.1 Food Composition

Main prey items were *T. gaudichaudii* (62.5%), *E. superba (22.1%)* and mysids (predominantly *A. maxima)* (21.3%). Although krill was present in 22.1% of the stomachs, it formed the sole prey item in only 9.9% of the stomachs and was the predominant food item in another 9.0% of the stomachs. Other prey species or groups occurring were *Thysanoessa sp. (3.3.%),* myctophids *(Electrona sp., Gymnoscopelus sp.)* (1.8%), early life stages of fish (*C. gunnari* primarily age class 0 and 1) (1.4%) and *Euphausia triacantha* (<0.1%).

The occurrence of the main prey items varied locally. Krill was predominantly found in fish collected on the eastern shelf while mysids were prevailing in parts of the northwestern shelf, in the southeast and on coastal stations in the east. *T. gaudichaudii* was the staple food in most of the western part of the shelf. In fish from the westernmost three stations myctophids formed a significant proportion of the diet (Figure 1).

3.2 Feeding Intensity

More than 50% of the stomachs contained little (1) or no food (0):

Degree of Fullness	**n**	%
0	1 306	33.7
1	839	21.6
2	777	20.0
3	803	20.7
4	152	3.9

The proportion of empty stomachs varied considerably among stations (3.9 to 74.0%). The proportion of stomachs containing little or no food was highest in the west of South Georgia (Figure 2).

4. DISCUSSION

Our study albeit the most extensive analysis carried out so far confirmed, in general, results from earlier investigations on the food composition of mackerel icefish around South Georgia in that the hyperiid *T. gaudichaudii,* krill and mysids form their staple food. A comparison with earlier studies revealed a considerable variation in the importance of each of these prey items from year to year (Figure 3). It cannot be excluded that part of this variation may be due to variations in sample size (60 to 3 877) and an unrepresentative coverage of the shelf from year to year. However, two pairs of observations in December/January 1975/76 (Kock, 1981) and February/March, 1976 (Kozlov *et al.*, 1988) and in January/February 1985 (Wilhelms, 1986; Kozlov *et al.*, 1988) which were each based on several hundred stomachs led to essentially very similar results (Figure 3). It is thus likely that differences between years largely reflect the interannual variations in the availability of the preferred prey *E. superba* around South Georgia. If this hypothesis is correct, then the results we have presented here from a large sample suggest that krill availability in January/February 1991 was one of the lowest within the 16-year period of observation (Figure 3).

A lower krill index in the stomachs was only observed in March 1976 (Linkowski and Rembiszewski, 1978) and January/February 1979 (Kozlov *et al.*, 1988). The observations in March 1976, however, are probably largely biased by their small sample size (**n** = 113) and the poor coverage of the shelf. Plankton surveys in the same season indicated a high abundance of krill around the island (Pommeranz, 1978) which is clearly reflected in the high incidence of krill in icefish stomachs investigated between December 1975 and March 1976 in two other studies (Figure 3; Kock, 1981; Kozlov *et al.*, 1988). Krill occurrence in stomachs of *C. gunnari* in January/February 1991 was even lower than in 1977/78 (Figure 3), a season when krill biomass around the island was found to be very low (Bonner *et al.*, 1978; Wörner, 1979) and reproductive success in krill-eating birds was found to be poor (Croxall *et al.*, 1988).

Despite large variations in stomach fullness within or between seasons locally the proportion of empty stomachs of mackerel icefish in the various studies was commonly of the order of 10 to 20% (Kock, 1981; Wilhelms, 1986; Kozlov *et al.*, 1988). Higher proportions of

empty stomachs were observed only in March 1976 (Linkowski and Rembiszewski, 1978; see discussion above) and in material combined for the period January/February 1965 to 1969 (Kozlov *et al.*, 1988). This indicates that the high proportion of stomachs in January/February 1991 containing little or no food again reflected a situation uncommon in most previous observations.

We do not know at present if our findings are representative for a longer period than the three weeks of the survey. The high dispersal of icefish earlier in this season which made any fishing unprofitable may indicate that this may have been the case. Under these circumstances, both the high incidence of low caloric prey *(T. gaudichaudii)* in the food of mackerel icefish and the low feeding intensity of the fish in the period when energy-rich food is needed for the rapid build-up of the ovaries could have had considerable consequences for the final maturation process in that season.

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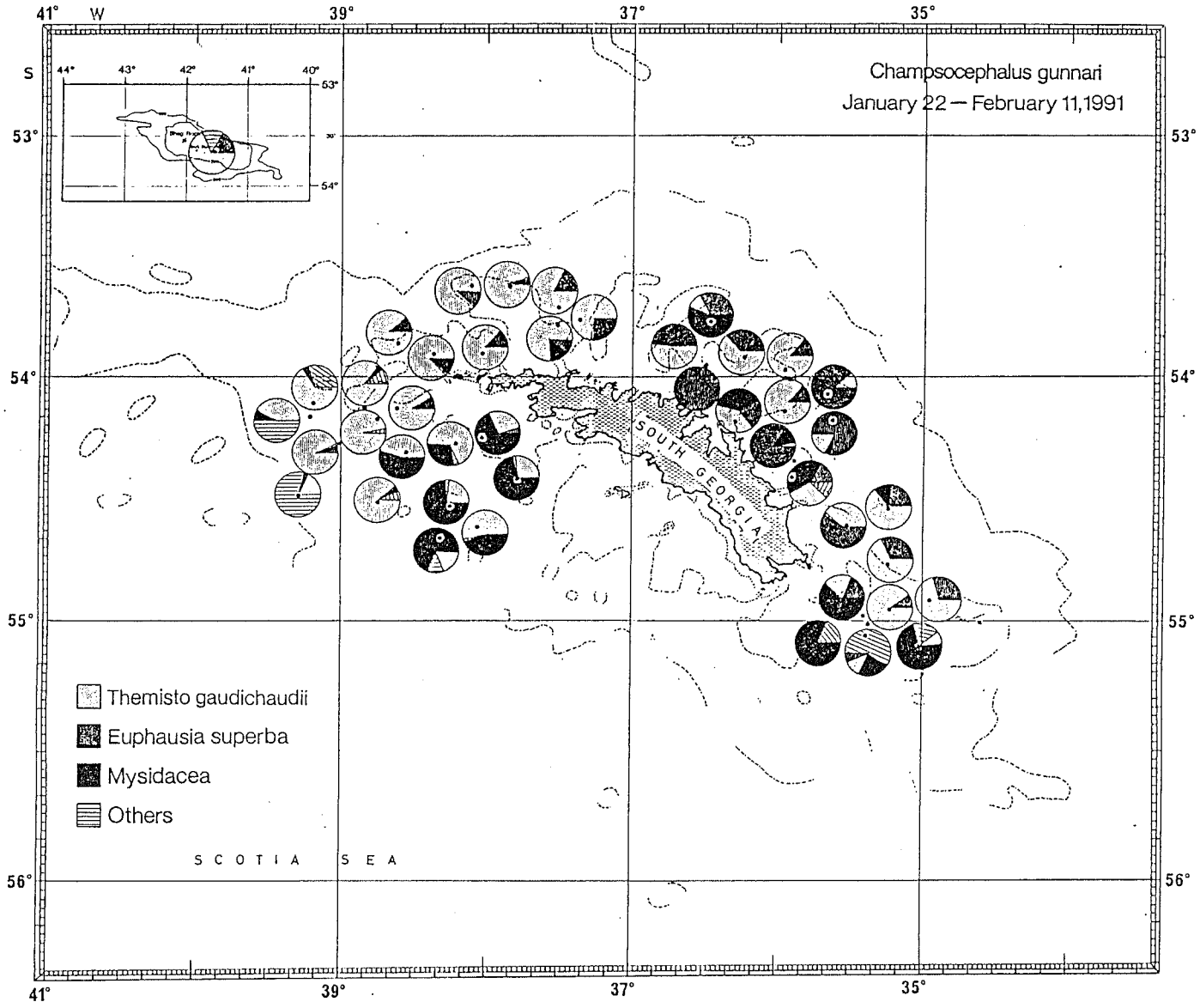
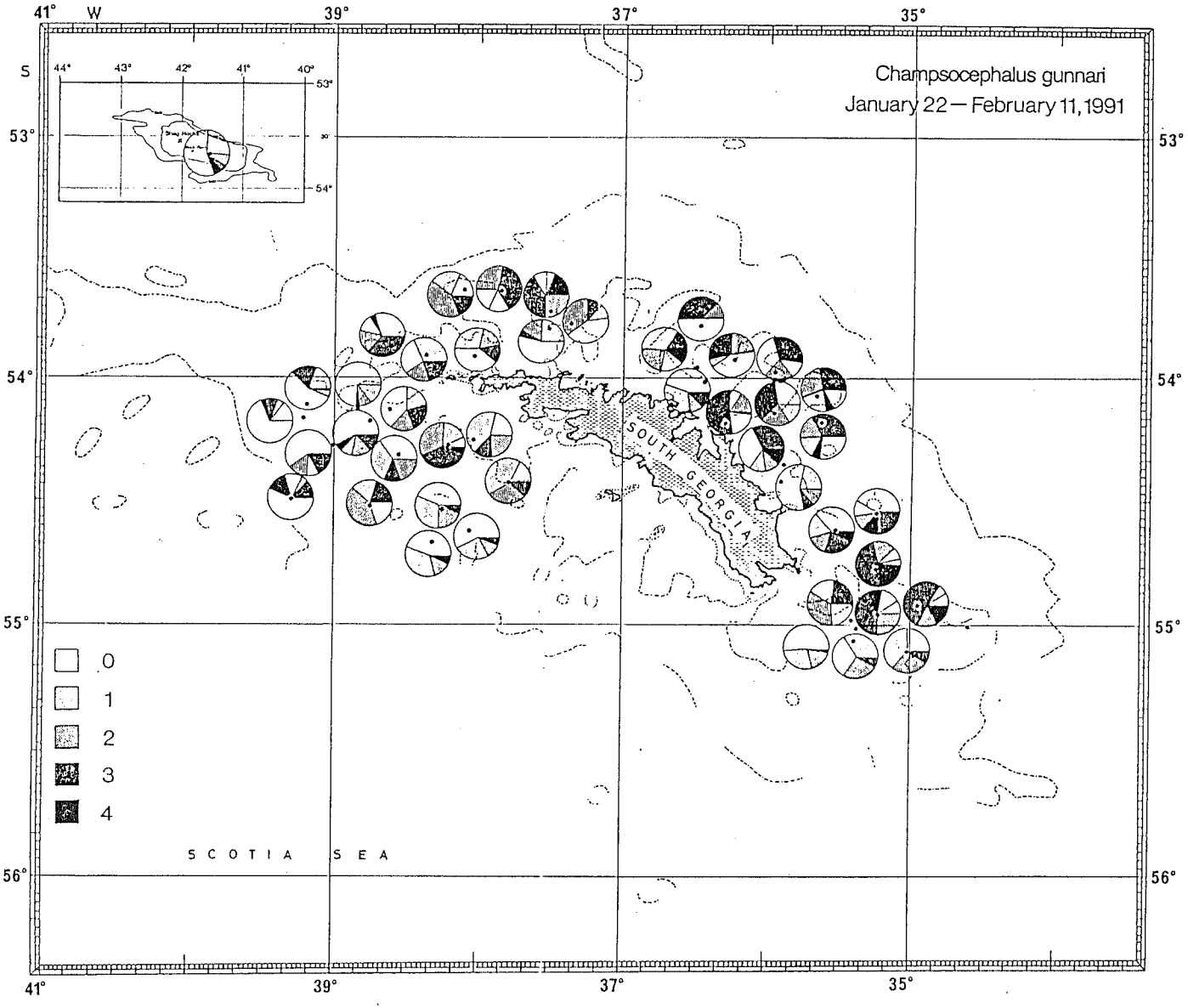


Figure 1: The food composition of mackerel icefish (*C. gunnari)* per station around South Georgia in January/February 1991.



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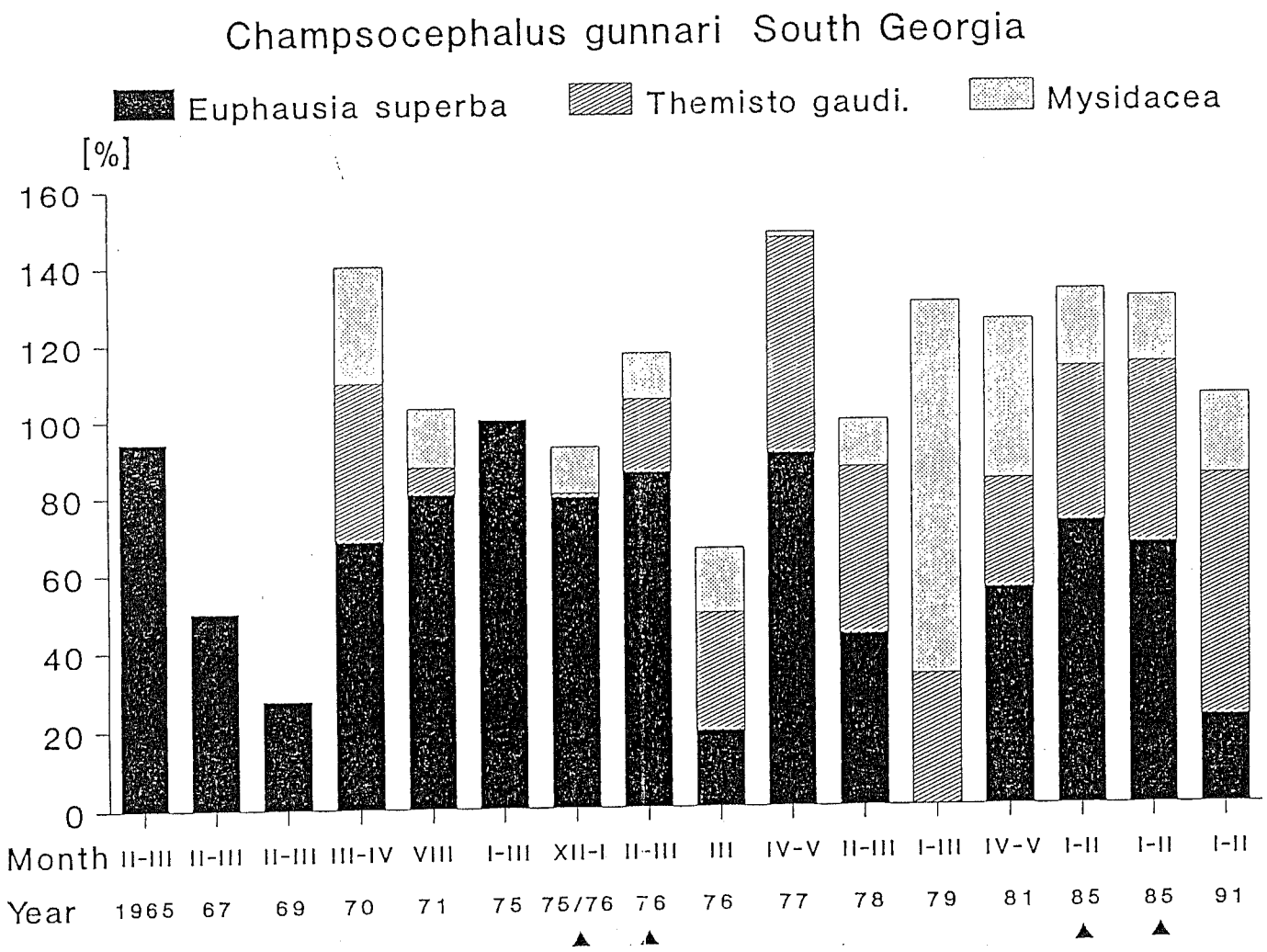

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