FEEDING AND FOOD INTAKE OF *ELECTRONA CARLSBERGI* (TÅNING, 1932) MYCTOPHIDAE

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Abstract

In summer and autumn *Electrona carlsbergi* feeds mainly on copepods. Daily food intake estimated by various methods was from 3.7 to 5.6% of fish body weight. The amount of food consumed by *E. carlsbergi* during the year in the waters to the south of the Antarctic Convergence is about 15 times fish body weight.

Résumé

En été et automne, *Electrona carlsbergi* se nourrit principalement de copépodes. La consommation journalière de nourriture est estimée par diverses méthodes varier entre 3,7 et 5,6% du poids du corps du poisson. La quantité de nourriture consommée par *E. carlsbergi* en une année dans les eaux au sud de la Convergence antarctique est égale à environ 15 fois le poids du corps du poisson.

Резюме

В летне-осенний сезон вид *Electrona carlsbergi* в основном кормится веслоногими. Оценки объема потребляемой ежедневно пищи, полученные различными методами, колеблются в пределах 3,7-5,6% веса тела. Годовой объем пищи, потребляемой видом *E. carlsbergi* в водах к югу от антарктической конвергенции, превышает вес тела особей этого вида приблизительно в 15 раз.

Resumen

Entre verano y otoño, *Electrona carlsbergi* se alimenta principalmente de copépodos. El consumo de alimento diario, estimado por diversos métodos, osciló entre un 3.7% y un 5.6% del peso del pez. La cantidad de alimento consumido por *E. carlsbergi* durante el año en las aguas meridionales de la Convergencia Antártica es, aproximadamente, 15 veces el peso del pez.

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1. INTRODUCTION

Electrona carlsbergi (Tåning) is one of the most abundant species of the Myctophidae family living in the Southern Ocean. It is a typical plankton eater feeding predominantly on phytophagous copepods. *Electrona carlsbergi* itself is a food of squid and some species of fish and birds (Zaselsky *et al.*, 1985).

Published data give a fairly complete picture of species composition of food consumed by *E. carlsbergi*, frequency of occurrence and size of individual prey species (Naumov *et al.*, 1981; Rembiczewski *et al.*, 1978; Zaselsky *et al.*, 1985). A number of papers provide a comparative analysis of *E. carlsbergi* feeding spectra in different parts of the Southern Ocean. (Kozlov, Tarverdieva, 1989; Oven *et al.*, 1990; Tarverdieva, 1986).

For an understanding of the role of *E. carlsbergi* in the ecosystems of the Southern Ocean, quantitative data on its food intake is most important. So far little is known about this matter. In particular, Naumov *et al.* (1981) assumed that in summer the daily food intake of *E. carlsbergi* in the Scotia Sea is close to the total index of consumption which is 3.37% of fish body weight.

The basic objective of the present paper is to estimate the daily and annual food intake of *E. carlsbergi* using various methods.

2. MATERIALS AND METHODS

Materials for studying feeding of *E. carlsbergi* were collected in February-March 1989 in the area to the south of the Antarctic Convergence between 1° and 38° W during the cruise of RV *Artemida*.

A sample of at least 25 fish were taken from every catch for analysis. Fish length was measured to the nearest 1 mm, and the weights to the nearest 10 mg. Sex and maturity stage were identified visually. Stomach contents were examined under a binocular microscope, food items were counted and identified as accurately as possible. Large intact crustaceans (euphausiids, hyperiids) were measured. Since the food bolus of one fish was normally very small, from 15 to 25 samples from the same catch were combined for weighing. For calculation of the mean total index of stomach fullness the derived value was divided by the sum of weights of the examined fish. Altogether 914 fish from 21 hauls were examined.

3. RESULTS AND DISCUSSION

In summer copepods were the major prey items in the diet of *E. carlsbergi* in the Antarctic Convergence area. Frequency of occurrence of prey items slightly differed depending on fish length: copepods from the genus Calanus (*C. simillimus, C. tonsus*) prevailed in the diet of fish below 70 mm, *Rhincalanus gigas* were consistently predominant in larger fish. On the whole, the frequency of copepod and *R. gigas* occurrence was up to about 50% and 28% respectively of the total number of food items.

In addition to copepods, *Parathemisto gaudichaudi* (normally less than 6 mm in length), *Thysamoessa macrura, Limacina helicina var. australis*, and chaetognaths occurred in the diet of *E. carlsbergi*. Hyperiids were predominantly preyed on by individuals below 70 mm in length. The frequency of occurrence of euphausiids, chaetognaths and pteropods in fish of all size groups was practically constant.

The daily feeding rhythm of *E. carlsbergi* was determined using the averaged data from all hauls made in February/March. Two peaks of feeding activity were noted: one in the morning and another in the evening (Table 1). Other authors mention a similar daily feeding

pattern (Konstantinova, 1988; Oven *et al.*, 1990; Zalesky *et al.*, 1985). The results obtained made possible a rough estimation of the daily food intake of *E. carlsbergi* by means of the Romanova method (1958).

The mean rate of food digestion estimated by means of evaluating changes in stomach fullness index during two falls in feeding was $16.4^o/_{ooo}$ per hour. In this case the daily food intake of *E. carlsbergi* is about 3.7% of body weight. The food digestion rate estimated for the sharpest drop in feeding was $23.1^o/_{ooo}$ per hour with a daily food intake of about 5.6% of body weight.

Another estimate of food consumption by *E. carlsbergi* was obtained using the Winberg equation (1956) based on data on mean annual weight increment and energy metabolism rate. The energy metabolism level in Myctophidae may be assessed from the results obtained for *Myctophum nitidulum* by Abolmasova and Belokopytin (1988). The parameters of the energy metabolism equation estimated by these authors were used in the present paper. Recalculation of parameter A (see Table 2) for temperature of *E. carlsbergi* habitat was made by introducing the temperature correction factor (Winberg, 1983). Table 2 contains the basic data for estimation of the annual and mean daily food intake of fish at age 2 and 3.

The annual food intake of *E. carlsbergi* males amounted to about 76.7 kcal. Assuming the calorific value of food consumed by *E. carlsbergi* to be 0.7 kcal/g, Shushkina and Musaeva (1982) give an annual food intake of 109.6 g or 1 480% of body weight. The annual food intake of females is estimated at 86.9 kcal. This corresponds to 124.1 g of food (1 500% of body weight).

The mean daily food intake estimated on the basis of the above values was about 4% of body weight both in males and females.

Thus, according to these very rough estimates, the amount of food consumed by *E. carlsbergi* during the year in the Antarctic Convergence area is about 15 times fish body weight. Further studies including daily stations in different periods of the year are needed to refine the values derived.

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Table 1: Daily food intake of *E. carlsbergi* estimated by taking into account the range of the index of stomach fullness variation during the day.

Local Time	Time Span (hours)	Variation in Total Index of Fullness ($^o/_{ooo}$)	Amount of Consumed Food ($^o/_{ooo}$)	
0.30 - 07.30	7	7.9 - 21.00	132.1[x]	(174.1)[xx]
7.30 - 09.30	2	21.0 - 47.0	60	(72)
9.30 - 10.30	1	47.0 - 50.4	20.4	(26.4)
10.30 - 12.30	2	50.4 - 4.2	-	-
12.30 - 14.30	2	4.2 - 46.0	75.8	(87.8)
14.30 - 16.30	2	46.0 - 56.5	44.5	(56.5)
16.30 - 17.30	1	56.5 - 75.5	36	(42)
17.30 - 18.30	1	75.5 - 66.0	-	(13.5)
18.30 - 20.30	2	66.0 - 17.1	-	-
20.30 - 0.30	4	17.1 - 7.9	-	(82.8)

[x]   at a digestion rate of $16.4^o/_{ooo}$ per hour
[xx] at a digestion rate of $23^o/_{ooo}$ per hour

Table 2: Basic parameters for estimating food consumption by *E. carlsbergi* using the Winberg equation (1956).

Parameter	Males		Females
Mean length at age 2	72.82 mm		74.40 mm
Mean length at age 3	83.20 mm		85.60 mm
Mean weight at age 2	6.075 g		6.734 g
Mean weight at age 3	8.764 g		9.834 g
Weight increment	2.689 g		3.100 g
Gonad weight	-		0.994 g
Time span		1 year	
Calorific value		1.72 kcal/g	
Temperature of habitat		0.8 - 2.5°C	
Parameters of energy metabolism equation: $R = AW^K$		A = 0.184 K = 0.79	

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