ISSN 0704-3716

CANADIAN TRANSLATION OF FISHERIES AND AQUATIC SCIENCES

No. 4673

Feeding of deep-water fishes of the genus Cyclothone (Gonostomatidae, Pisces)

by T.A. Gorelova

Original Title: O pitanii glubokovodnykh ryb roda Cyclothone (Gonostomatidae, Pisces)

From: Okeanologiya XX: 321-328, 1980

Translated by the Translation Bureau (NDE)
Multilingual Services Division
Department of the Secretary of State of Canada

Department of Fisheries and Oceans
Marine Ecology Laboratory
Dartmouth, N.S.

1980

12 pages typescript

DEPARTMENT OF THE SECRETARY OF STATE
TRANSLATION BUREAU

MULTILINGUAL SERVICES DIVISION

CANADA

SECRÉTARIAT D'ÉTAT
BUREAU DES TRADUCTIONS

DIVISION DES SERVICES MULTILINGUES

CTFAS 4673

TRANSLATED FROM – TRADUCTION DE	INTO – EN
Russian	English

AUTHOR – AUTEUR

T.A. Gorelova

TITLE IN ENGLISH – TITRE ANGLAIS

Feeding of deep-water fishes of the genus Cyclothone (Gonostomatidae, Pisces)

TITLE IN FOREIGN LANGUAGE (TRANSLITERATE FOREIGN CHARACTERS)
TITRE EN LANGUE ÉTRANGÈRE (TRANSCRIRE EN CARACTÈRES ROMAINS)

O pitanii glubokovodnykh ryb roda Cyclothone (Gonostomatidae, Pisces)

REFERENCE IN FOREIGN LANGUAGE (NAME OF BOOK OR PUBLICATION) IN FULL. TRANSLITERATE FOREIGN CHARACTERS.
RÉFÉRENCE EN LANGUE ÉTRANGÈRE (NOM DU LIVRE OU PUBLICATION), AU COMPLET, TRANSCRIRE EN CARACTÈRES ROMAINS.

Okeanologiya

REFERENCE IN ENGLISH – RÉFÉRENCE EN ANGLAIS

Oceanology

PUBLISHER – ÉDITEUR	DATE OF PUBLICATION / DATE DE PUBLICATION			PAGE NUMBERS IN ORIGINAL / NUMÉROS DES PAGES DANS L'ORIGINAL
not available	YEAR / ANNÉE	VOLUME	ISSUE NO. / NUMÉRO	321-328
PLACE OF PUBLICATION / LIEU DE PUBLICATION				NUMBER OF TYPED PAGES / NOMBRE DE PAGES DACTYLOGRAPHIÉES
USSR	1980	XX	2	12

REQUESTING DEPARTMENT / MINISTÈRE-CLIENT: DFO

TRANSLATION BUREAU NO. / NOTRE DOSSIER N°: 341003-2

BRANCH OR DIVISION / DIRECTION OU DIVISION: Sc. Info. & Pub.

TRANSLATOR (INITIALS) / TRADUCTEUR (INITIALES): N. De.

PERSON REQUESTING / DEMANDÉ PAR: M. Landry

YOUR NUMBER / VOTRE DOSSIER N°: --

DATE OF REQUEST / DATE DE LA DEMANDE: June 24, 1980

UNEDITED TRANSLATION
For information only
TRADUCTION NON REVISÉE
Information seulement

SEP 18 1980

SOS-200-10-6 (REV. 2/68)
7530-21-029-5333

Okeanologiya (Oceanology), 1980, v. XX, No. 2, pp. 321-328

UDC 597.639.304

Feeding of deep-water fishes of the genus Cyclothone (Gonostomatidae, Pisces)

by T.A. Gorelova

The P.P. Shirshov Institute of Oceanology
of the USSR Academy of Sciences, Moscow

This paper looks at the feeding of seven species of Cyclothone measuring from 12 to 60 mm. It has been established that, in the tropical part of the Atlantic and Pacific oceans, Cyclothone feed mainly on copepods, less frequently on ostracods, and large individuals also feed on euphausiids and fish. The size of the plankters consumed increases with the size of the fish, but does not exceed 15-16 mm. The diurnal rhythm of feeding is not pronounced in any of the species studied. The indexes of fullness and the proportion of feeding fish are higher in the Cyclothone found closer to the surface, C. alba and C. pseudopallida. For comparison, we present the quantitative feeding indices for two species of Myctophidae from the same areas as the studied species of Cyclothone.

Cyclothone is one of the most prolific groups of fish inhabiting the meso- and bathypelagic zones of the ocean. The members of this genus do not perform diurnal vertical migrations (5-7, 13), though the depth range of the habitat of some species is quite extensive. Because the feeding of Cyclothone has been poorly studied, we do not have a sufficiently clear picture of their position in the trophic system of the deep-water communities.

The present paper discusses the food composition, indexes of fullness and some of the other quantitative feeding indices of the Cyclothone species prolific in the tropical part of the Atlantic and Pacific oceans.

Material and Method

The material was collected during the 14th trip of the "Akademik Kurchatov" research vessel in the Caribbean Sea in 1973, and during the 57th trip of the "Vityaz" research vessel in the tropical western part of the Pacific and the seas of the Malayan archipelago in 1975. The cyclothones were selected from the catches of a midwater Isaacs-Kidd trawl (MIKT) and partially from a ring-trawl. Fishing with a MIKT was carried out at depths of 100, 200, 500, 1000 and 1500 m, without the use of a closing device. During the 14th trip, the fishing with a MICT was carried out around the clock. The lower depths (1000 and 1500 m) were usually fished during the day. During the 57th trip, fishing with a MICT was carried out only during the dark hours (from 19.00 to 07.00), and the deepest layers were fished at sunrise.

The fish caught were fixed in Formalin, and then transferred to 70% alcohol. We examined the stomachs of 1213 fingerlings and adult individuals belonging to seven species of Cyclothone, measuring from 12 to 60 mm (table 1). The less abundant species of Cyclothone were processed completely, while the species represented by several hundreds of specimens were processed partially, care being taken to study fish of different sizes.

Processing of the stomachs was carried out by the gravimetric method (3). The data on the amount of food found in the stomachs were expressed by the indexes of fullness (weight of food in the stomach as a percentage of body weight). The food organisms in the stomachs were

determined and measured. Only the copepods and euphausiids were determined to the genus and species.

Table 1

Qualitative composition of the food consumed by Cyclothone species

Food objects	Species of fish									
	C. alba		C. pallida		C. pseudo-pallida		C. acclini-dens		C. atra-ria	C. obs-cura
	1	2	1	2	1	2	1	2	2	2
1. Copepoda:	—	—	—	1	—	—	—	—	—	—
Calanoida	4	5	1	1	5	4	—	6	—	1
Calanoida juv	—	4	1	—	1	2	—	2	—	1
Candacia aethiopica	—	—	—	—	—	1	—	—	—	—
C. pachydactyla	—	—	—	—	—	1	—	—	—	—
C. longimanna	—	1	—	—	—	—	—	—	—	—
Scolecithrix danae	—	—	—	—	—	1	—	—	—	—
Metridiidae	—	—	—	—	—	1	—	—	—	—
Pleuromamma sp.	2	5	1	—	2	2	1	1	—	—
P. abdominalis	—	1	—	—	—	—	—	—	—	—
Rhincalanus sp.	—	—	—	—	—	1	—	—	—	—
Nannocalanus minor	—	—	—	—	—	1	—	—	—	—
Neocalanus gracilis	—	1	—	—	—	1	—	—	—	—
Heterorhabdus sp.	—	2	—	—	—	1	—	1	—	
Euchaeta sp.	—	1	—	—	1	1	1	—	1	
E. marina	—	—	—	—	—	—	1	—	—	—
E. biloba	—	1	—	—	—	—	—	—	—	—
E. spinosa	—	—	—	—	—	1	—	—	—	—
Aetideidae	—	—	—	—	2	1	—	1	—	—
Chirundina sp.	—	1	—	—	—	—	—	—	—	—
Undeuchaeta sp.	—	—	—	—	—	2	—	—	—	—
Centropages sp.	—	1	—	—	—	—	—	—	—	—
Scaphocalanus sp.	—	—	—	1	—	—	—	—	—	—
Haloptilus sp.	—	—	—	1	—	—	—	—	—	—
Lucicutia sp.	—	—	—	—	—	—	—	1	—	—
Cyclopoida	—	—	—	—	1	—	—	—	—	—
Oncaea sp.	—	2	—	—	—	—	—	—	—	—
Corycaeus sp.	—	—	—	—	1	—	—	—	—	—
2. Ostracoda	2	5	6	6	2	9	2	1	—	2
3. Amphipoda:	—	1	—	1	—	—	—	—	—	—
Primno macropa	—	—	—	—	—	2	—	—	—	—
4. Decapoda	—	—	1	—	1	—	—	—	—	—
5. Euphausiacea:	—	—	—	2	—	—	—	—	1	—
Stylocheiron sp.	—	—	1	—	—	—	—	—	—	—
S. maximum	—	—	—	—	—	1	—	—	—	—
6. Chaetognatha	—	—	1	—	—	—	—	1	—	—
7. Polychaeta	—	—	—	1	—	—	—	1	—	—
8. Pisces	—	—	1	1	—	1	—	—	—	—
No. of dissected fish	54	126	277	122	81	123	82	157	91	76

Note: 1 - data on the 14th trip of the "Akademik Kurchatov" research vessel; 2 - data on the 57th trip of the "Vityaz" research vessel; 24 of the dissected specimens of C. braueri were found to be empty.

Results and Discussion

As we can see from table 1, the food of all the studied species of Cyclothone consists mainly of small crustaceans, i.e copepods, ostracods and euphausiids. Copepods were found in the stomachs of all the cyclothones, but they were particularly abundant in C. alba and C. acclinidens. The weight and abundance ratio of copepods to ostracods was approximately the same in small C. pseudopallida and C. pallida (table 2). The proportion of euphausiids and fish was quite high in large C. pseudopallida and C. pallida[1] The stomachs of the majority of C. atraria and C. obscura were found to be empty. Copepods were found in only 5 specimens.

Judging by the literature, copepods constitute one of the main food items of cyclothones (8, 10-12, 14, 16). Ostracods should be regarded as the second most frequently encountered and proportionally abundant group of plankters in the food spectra of small fishes (regardless of the species) (5, 10), and euphausiids[2], fish (table 1) and amphipods in the food spectra of larger fishes (15). The other groups of invertebrates (decapods, chaetognaths, mollusks) are encountered in very small numbers.

---

[1]We were unable to identify the latter, as only muscle strands, vertebrae and chrystalline lenses had been found.

[2]According to Roger's data (17), euphausiids are not included in the food spectra of Cyclothone species; however, it should be said that the author examined individuals up to 30 mm in length. On the basis of our own data, euphausiids become a common food item in larger fishes.

Table 2

Food spectra of Cyclothone species belonging to different size groups

1 Виды рыб	2 Размер рыб, мм	$\frac{Nf}{N}$	3 Пол	4 Кормовые организмы *								
				5 копеподы	6 остракоды	7 хетогнаты	8 декаподы	9 амфиподы	10 эвфаузиды	11 полихеты	12 рыбы	13 неидентиф. остатки
C. alba	11—20	19/56	juv ad ♂♀	74/61	15/16	—	—	—	—	—	—	11/23
	21—30	26/122	ad ♂♀	75/60	12/20	—	—	3/6	—	--	—	10/14
C. pseudopallida	11—20	6/23	juv	57/50	40/20	—	—	—	—	—	—	3/30
	21—30	18/71	juv ad ♂	47/65	9/15	—	30/5	12/5	—	—	—	2/10
	31—40	22/98	ad ♀	53/60	12/14	—	—	6/5	22/7	—	—	6/14
	41—50	4/12	ad ♀	1/17	20/50	—	—	—	40/17	—	39/16	—
C. pallida	11—20	5/23	juv	32/25	26/25	—	---	—	—	—	—	42/50
	21—30	10/118	juv ad ♂♀	14/15	58/38	—	—	—	—	—	5/10	23/37
	31—40	3/75	ad ♂♀	—	69/66	—	—	—	—	31/34	—	—
	41—50	11/132	ad ♀	6/23	5/23	1/8	17/8	—	45/8	—	24/15	2/15
	51—60	3/51	ad ♀	12/33	11/33	—	—	66/34	—	—	—	—
C. acclinidens	21—30	10/117	juv ad ♂♀	75/50	5/10	5/10	—	—	—	2/10	—	13/20
	31—40	9/84	ad ♂♀	65/70	30/22	—	—	—	—	—	—	5/8

*Numerator - wt.% of individual groups of food organisms; denominator - the same based on abundance (each stomach containing digested food was equated to one food unit).

Key to table 2: 1 - Species of fish; 2 - Size of fish, mm; 3 - Sex; 4 - Food organisms; 5 - copepods, 6 - ostracods, 7 - chaetognaths, 8 - decapods, 9 - amphipods, 10 - euphausiids, 11 - polychaetes, 12 - fishes, 13 - unidentified remains.

The proportion of fishes with unidentified stomach contents amounted to 10-50% (table 2). The largest number of fish with unidentified stomach contents was observed in the species C. pallida. In the stomachs of 85% of the C. acclinidens and 45% of the C. signata, De

Witt (10) discovered a soft, unbroken mass with no traces of any solid formations, which, in the author's opinion, consisted of the digested remains of non-chitinous invertebrates. Marshall (16) identifies this mass as detritus. Judging by first-hand observations from a bathyscaphe in the bathypelagic region, there are accumulations of detrital aggregates measuring up to several millimetres, which can be consumed by plankton-eating fishes (18).

The copepods encountered in the stomachs of cyclothones included epipelagic, deep-water and interzonal species (see table 1). For instance, some of the specimens of C. alba and C. pseudopallida were found to contain epipelagic (Candacia pachydactyla, C. aethiopica) and interzonal (mainly of the genus Pleuromamma) copepods. Typically deep-water representatives of the families Aetideidae and Heterorhabdidae were found alongside interzonal ones in C. pallida and C. acclinidens.

Therefore, the collection of copepod species found in the stomachs of cyclothones corresponds, in general terms, to the data on their vertical distribution. The mesopelagic (according to Mukhacheva's terminology, ref.4) species C. pallida and C. acclinidens feed mainly on interzonal and bathypelagic copepods, and C. alba, which is found closer to the surface (300-600 m) (15, 16) is known to feed on interzonal and epipelagic Copepoda. The fact that the food spectra of C. pseudopallida, which is usually concentrated at depths of 500-800 m (6), bears greater similarity to that of C. alba than to any other species of Cyclothone probably indicates that the vertical distribution of these two species is of a similar nature in the study area, just as observed at 11° N lat. and 20° E long. in the Atlantic (7).

The size of the food organisms consumed by Cyclothone species varies from 0.3 to 16 mm. Within each species, the maximum size of the food organisms, the size range of the prey and the average weight of the latter increase with the size of the cyclothones (table 3). For example, the juveniles and males of C. pallida (measuring up to 30 mm) feed on plankters that measure from 1.2 to 3.3 mm and weigh 1.2 mg on the average; the females of this species (measuring 31-40 mm) are capable of capturing prey 1.2-16 mm in length and weighing 5.2 mg on the average. There are some specific differences in the Cyclothone with respect to the size of their food. For instance, the average weight and size of the food items consumed by the same size group of fishes (e.g. 21-30 mm) are smaller in C. alba, than in C. pseudopallida and C. pallida (table 3).

The proportion of fish with full stomachs amounted to approximately 24-25% of the total number of dissected C. alba and C. pseudopallida, 7-8% in C. pallida and C. acclinidens, and the minimum 2-4% in C. atraria and C. obscura[3]. According to the data in refs. 8 and 9, this value can be considerably higher, approximately 40%. De Witt (10) has shown that the proportion of fish with food in the stomach may diminish with depth from 41 to 22% in one species (C. signata[4]), or vary in the day (17%) and night (47%) catches in another species (C. acclinidens).

---

[3]The low percentage of individuals with full stomachs in C. atraria and C. obscura is possibly due to the fact that far less material was processed on these species.

[4]Similar to C. alba, this species belongs to the shallow-water group of Cyclothone species with respect to the nature of its vertical distribution (4).

Table 3

Size ratio of prey consumed by Cyclothone species (wt.%)

1 Виды рыб	2 Размер рыб, мм	3 Размер пищи, мм									4 Средний вес пищи, мг*
		<1	1—2	2—3	3—4	4—5	5—6	6—7	10—11	15—16	
C. alba	11—20	7	72	21	—	—	—	—	—	—	0,27
	21—30	7	40	8	7	16	22	—	—	—	0,88
C. pseudopallida	21—30	—	8	20	11	16	14	31	—	—	1,25
	31—40	—	9	35	28	6	—	—	22	—	1,67
C. pallida	21—30	—	34	26	40	—	—	—	—	—	1,18
	31—40	—	50	50	—	—	—	—	—	—	1,10
	41—50	—	3	2	9	28	—	13	—	45	5,23

*The average weight of the food was determined by adding up the weights of food particles varying in the degree of digestion.

Key to tables 3 and 4: 1 - Species of fish; 2 - Size of fish, mm; 3 - Size of food, mm; 4 - Average weight of food, mg*.

Table 4

Mean indexes of fullness (y) and the proportion of fish with full stomachs (N_f/N %) in different size groups of cyclothones

1 Виды рыб	2 Размер рыб, мм												
	11—20		21—30		31—40		41—50		51—60		11—60	
	y	N_f/N	y	N_f/N	y	N_f/N	y	N_f/N	y	N_f/N	y	N_f/N
C. alba	0,0062	34	0,0030	21	—	—	—	—	—	—	0,0040	25
C. pseudopallida	—	—	0,0051	25	0,0035	22	—	—	—	—	0,0042	24
C. pallida	—	—	0,0017	8	0,0004	4	0,0014	8	0,0002	6	0,0011	7
C. acclinidens	—	—	0,0012	9	0,0010	11	—	—	—	—	0,0011	8

Unfortunately, the fish were caught with non-closing gear, and so we cannot say how the relative number of fish with full stomachs changes with depth, but it is clear that this index is considerably higher in the species encountered closer to the surface (C. alba and C. pseudopallida), than in the other species of Cyclothone.

The number of food objects in an individual stomach did not exceed 1-2, the proportion of fish with two food objects amounting to 2% in C. alba, 3% in C. pallida, 7% in C. pseudopallida and 13% in C. acclinidens.

Table 5

Indexes of fullness in prolific species of Cyclothone at different times of the day and night

1 Виды рыб	2 Размер рыб, мм	3 Время суток, ч											
		0—2	2—4	4—6	6—8	8—10	10—12	12—14	14—16	16—18	18—20	20—22	22—24
C. alba	11—20	—	0,0053/13	0/1	0,0053/6	0,0034/5	—	—	—	0,0006/10	—	0,0079/8	—
	21—30	0,0087/2	0,0031/24	0,0064/15	0,0022/8	0,0062/10	—	—	—	0,0002/10	0,0041/22	0,0007/7	—
C. pallida	11—20	—	0,0033/6	0/1	0/3	0,0010/5	0/1	—	0/1	0/1	—	0/2	—
	21—30	0/2	0,0071/15	0,0010/6	0,0024/13	0,0005/11	0/8	0,0006/15	—	0/17	0/3	0/6	0,0006/14
	31—40	0/3	0,0030/5	0,0004/7	0,0020/8	0/4	0/4	0/10	—	0/9	0/6	0/14	0,0012/9
	41—50	0/5	0,0005/16	0/18	0,0036/8	0/9	0,0004/9	0/2	—	0,0022/11	0,0018/15	0,0017/10	0,0046/21
	51—60	—	0/5	0,0001/25	0/2	—	0/1	—	—	0/3	0,0005/11	0/3	0/1
C. pseudopallida	21—30	—	0/2	0,0057/15	0,0050/2	0/2	—	0,0006/6	—	0,0043/17	0,0133/5	0,0082/2	—
	31—40	0/3	0/1	0,0052/51	0/2	0,0016/8	—	0,0042/3	0,0050/16	0,0004/10	0,0051/7	0,0189/1	—

Note: Numerator - index of fullness; denominator - number of dissected fish.

Key to table 5: 1 - Species of fish; 2 - Size of fish, mm; 3 - Time of the day or night, hr.

The mean indexes of fullness, the same as the percentage of fish with full stomachs, are higher in C. alba and C. pseudopallida (up to 0.0060, table 4), and diminish in each species as the size of the fish increases. When the indexes of fullness are calculated with only the fish with full stomachs taken into account, they amount to 0.0100-0.0200. Similar values have been obtained by Legand (15) for C. alba (0.0270) and C. acclinidens (0.0170).

Table 5 gives the indexes of fullness for 2-hr intervals during a period of 24 hrs for three prolific species of Cyclothone i.e. C. alba, C. pseudopallida and C. pallida. The fullness of the stomachs, as well as the proportion of fish with full stomachs and the ratio of fresh and digested food vary irregularly throughout the 24-hr period, but food objects are seized at any time of the day or night.

It is interesting to compare our results with the data on the feeding of the actively migrating myctophids Ceratoscopelus warmingi and Bolinichthys longipes from the same area (1). As in the case of Cyclothone species, copepods form the most abundant group of food objects for C. warmingi and B. longipes. However, unlike that of the Cyclothone species, their food spectrum is more diverse, for their stomachs have been found to contain amphipods, euphausiids, chaetognaths, appendicularians, decapods, mollusks (including squid) and fishes in different ratios.

With respect to the species composition of the copepods, the main difference between Cyclothone species and myctophids lies in the fact that C. warmingi and B. longipes consume a much greater number of epipelagic species belonging to the genera Euchaeta (E. marina), Candacia, Oncaea and Corycaeus, though interzonal and bathypelagic species with an extensive depth range (the genera Pleuromamma, Scottocalanus, Euchirella, etc.) predominate, as in the case of the Cyclothone genus.

With respect to size composition, the food of small myctophids (up to 30 mm in length) and cyclothones of the same size is almost identical (Cf. table 2 of this paper and fig. 6 of ref. 1). However, the maximum size of the prey captured by larger myctophids is 1.5-2 times greater than in the same size group of cyclothones (2).

The average 24-hr indexes of fullness (y) and the proportion of fish with full stomachs N_f/N in C. warmingi and B. longipes amount to y=0.0135, N_f/N=77% and y=0.0096, N_f/N=94% respectively[5], which is several times higher than in the Cyclothone (see table 4).

Conclusion

Cyclothone species feed mainly on copepods. The proportion of ostracods, euphausiids and fish in their diet is significantly lower. The size of the food objects seized increases with the size of the fish, but does not exceed 15-16 mm even in the largest cyclothones.

Comparative data on the feeding of the studied Cyclothone species and mesopelagic, migrating myctophids C. warmingi and B. longipes bring us to two significant conclusions. First of all, the diet of cyclothones is more diverse with respect to species and size composition, as compared with the Myctophidae. Secondly, the index of fullness and the proportion of feeding individuals are considerably lower in cyclothones, than in C. warmingi and B. longipes.

The author wishes to thank V.B. Zeitlin for reading the manuscript, and for his valuable comments.

---

[5]This is based on the data in ref. 1, taking into account that C. warmingi has a well-defined diurnal rhythm of feeding, i.e. its fullness at night is approximately twice as high as during the day, but B. longipes feeds evenly throughout the 24-hr period (15).

References

1. Gorelova T.A. The feeding of myctophids Ceratoscopelus warmingi (Lutken) and Bolinichthys longipes (Brauer) of the family Myctophidae in the western equatorial part of the Pacific. Voprosy ikhtiologii, 1978, v. 18, No. 4, p. 673.

2. Gorelova T.A. The size structure of food organisms from the stomachs of myctophids. Okeanologiya, 1978, v. XVIII, No. 2, p. 322.

3. Methodological Handbook for Studying the Feeding and Food Relations of Fishes in a Natural Environment. Edit. Ye.V. Borutsky. Moscow, "Nauka" publishing house, 1974, p. 254.

4. Mukhacheva V.A. Cyclothones (genus Cyclothone, family Gonostomidae). IN: Biology of the Pacific Ocean. Pelagic Fishes. Book III. Moscow, "Nauka" publishing house, 1967, p. 182.

5. *Badcock J.* The vertical distribution of mesopelagic fishes collected on the SOND cruise.— J. Marine Biol. Assoc. U. K. 1970, v. 50, N 4, p. 1001.
6. *Badcock J., Merrett N. R.* Midwater fishes in the eastern North Atlantic. J. Vertical distribution and associated biology in 30° N, 23° W, with development notes on certain myctophids.— Progr. Oceanogr., 1976, v. 7, N 1, p. 3.
7. *Badcock J., Merrett N. R.* On the distribution of midwater fishes in the eastern North Atlantic. In: Oceanic sound scattering prediction. Marine Studies, v. 5, 1977. Pl. Psess. N. R. Andersen (ed). N. Y.— L., p. 249.
8. *Bradbury M. G., Abbott D. P., Bovbjerg R. V., Mariscal R. N., Fielding W. C., Barber R. T., Pearse V. B., Proctor S. J., Ogdon Y. C., Wourms J. P., Taylor L. R., Christofferson Jr., J. G., Christofferson J. P., McPhearson R. M., Wynne M. Y., Stromborg P. M.* Studies on the fauna associated with the deep scattering layers in the equatorial Indian Ocean, conducted on R/V TE VEGA during October and November 1964. In: Proceedings of an International Symposium on Biological Sound Scattering in the Ocean. (Ed.) G. B. Farquhar, Washington D. C., 1970, p. 409.
9. *Collard S. B.* Forage of some eastern Pacific midwater fishes.— Copeia, 1970, N 2, p. 348.
10. *De Witt F. A., Cailliet G. M.* Feeding habits of two bristlemouth fishes, Cyclothone acclinidens and C. signata (Gonostomatidae).— Copeia, 1972, N 4, p. 763.
11. *Fitch J. E., Lavenberg R. J.* Deep-water fishes of California. Berkley Univ. Calif. Press, 1968, p. 115.

12. Gunter K., Deckert K. A morphological-anatomical and comparative ecological study on the function of the visceral system in deep-sea fishes of the genus Cyclothone (Teleostei, Isospondyli). Z. Morphol. und Okol. Tiere, 1953, v. 42, No. 1, p. 1.

13. *Kawaguchi K.* Diurnal vertical distribution of micronectonic fishes, western North Pacific. Coll.— Rep. Ocean. Inst. Univ. Tokyo, 1970, v. 9, p. 575.
14. *Koeford E.* Isospondyli.— Rept. Sci. Res. «Michael Sars» Exped., 1960, v. 4, pt. 2, N 8, p. 821.
15. *Legand M., Bourret P., Fourmanoir P., Grandperrin R., Gueredrat J. A., Michel A., Rancurel P., Repelin R., Roger C.* Relations trophiques et distribution verticales en milieu pelagique dans l'ocean Pacifique intertropical.— Cah. O. R. S. T. O. M., 1972, v. X, N 4, p. 304.
16. *Marshall N. B.* Swimbladder structure of deep-sea fishes in relation to their systematics and biology.— Discovery Rep., 1960, v. 31, p. 1.
17. *Roger C.* Recherches sur la situation tropique d'un group d'organismes pelagiques (Euphausiacea). IV. Relations avec les auters elements du micronecton.— Marine Biol., 1973, v. 19, N 1, p. 27.
18. *Silver M. W., Shanks A. L., Trent J. D.* Marine Snow: Microplankton Habitat and Source of Small-Scale Patchiness in Pelagic Populations.— Science, 1978, v. 201, N 4353, p. 371.

Received on May 29, 1979

1. *Горелова Т. А.* Питание светящихся анчоусов Ceratoscopelus warmingi (Lütken) и Bolinichthys longipes (Brauer) сем. Myctophidae в западной экваториальной части Тихого океана.— Вопр. ихтиологии, 1978, т. 18, вып. 4, с. 673.
2. *Горелова Т. А.* Размерная структура кормовых организмов из желудков светящихся анчоусов.— Океанология, 1978, т. XVIII, вып. 2, с. 322.
3. Методическое пособие по изучению питания и пищевых отношений рыб в естественных условиях. Под ред. Е. В. Боруцкого. М., «Наука», 1974, с. 254.
4. *Мухачева В. А.* Циклотоны (род Cyclothone сем. Gonostomidae).— В кн.: Биология Тихого океана. Рыбы открытых вод. Кн. III. М., «Наука», 1967, с. 182.

T. A. GORELOVA

ON FEEDING OF DEEP-SEA FISHES OF THE GENUS CYCLOTHONE (GONOSTOMATIDAE, PISCES)

The feeding is considered of 7 species of the genus Cyclothone of the size from 12 to 60 mm. The main object of feeding of the cyclothones in the tropical part of the Atlantic and the Pacific oceans is established to be copepods, more seldom ostracods, and in large specimens also euphausiids and fishes. The sizes of the consumed plankters grow with growing sizes of the fishes, yet they do not exceed 15—16 mm. The diurnal feeding rhythm is not pronounced in any of the species studied. The indices of stomach filling and the number of feeding fishes is higher in C. alba and C. pseudopallida inhabiting waters closer to the surface. Quantitative feeding indices of two species of lantern fish from the same regions where cyclothones were studied are given for comparison.