CHANGES IN THE LARVAL NUTRITION OF BLACK SEA FISHES WITH RESPECT TO PLANKTON

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Abstract. Data on the nutrition of the larvae of main Black Sea fish species (*Engraulis encrasicolus* (L.), *Trachurus mediterraneus ponticus*, Aleev) and some species of Blenniidae and Gobiidae occuring in the Black Sea are presented in this article. It is shown that changes which took place in the plankton community due to stress caused by anthropogenic impact considerably influenced the feeding of fish larvae. Food items which dominated in the 1950's and 1960's disappeared. Larvae began to eat organisms which were earlier considered to be of secondary importance for their nutrition. The number of larvae with empty guts increased, thus adversely affecting their survival.

1. Introduction

The growth and survival of fish larvae are determined by many factors, most importantly by nutrition which is vital for the functioning of any organism.

Studies of the nutrition of fish larvae in the Black Sea were particularly widespread during the 1950's. The main objects of studies were the larvae of mass pelagic fishes: *E. encrasicolus* and *Tr. mediterraneus* [3, 7, 8]. The feeding of larvae of from other groups such as: Gobiidae, Blenniidae, Labridae etc. was also studied [3]. In all studies, the main food of larvae at the earliest stages of development were nauplii of small copepoda species. At later developmental stages of larvae, their importance in feeding lessened and larvae began to eat bigger-sized food organisms (copepodite stages of copepods, adult stages of small copepods such as *Oithona nana, Paracalanus parvus* and Cladocera). The feeding spectrum of larvae was quite wide [2, 3, 5, 6, 7].

Abundance of larvae in the 1950's and 1960's permitted to elaborately study not only qualitative composition of utilised organisms, daily rhythms in mass fish species feeding, their selective ability, but also to calculate daily feeding ratio, which served as absolute measure of feeding intensity.

From the beginning of the 1970's, a deterioration in the ecological condition of the Black Sea was observed. It took place as a result of over-regulation of river discharge,

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intensive use of chemicals in agriculture, movement of soil and sand along the coastal areas and intrusion of the ctenophore *Mnemiopsis mccradyi* into the Black Sea. These events led to considerable changes in plankton community, which greatly influenced nutrition of fish larvae. Revealing the changes in the feeding of the Black Sea fish larvae is the purpose of this study.

2. Materials and Methods

The data on fish larvae nutrition covers the period between 1986-1996. For the first time we got a possibility to conduct studies all over the Black Sea. Larvae were towed in 9 cruises on board R/V "Prof. Vodyanitsky" in the northern half of the sea and in 2 cruises in the southern part on board R/V "Bilim". Besides these cruises, the data obtained from monitoring studies in the bays and shelf regions near Sevastopol was also utilised. Sampling details of these data are given elsewhere [15].

A total of 7000 larvae from 28 fish species was analysed for their digestive track contents (Table 1). Feeding peculiarities of larvae of *E. encrasicolus, T. mediterraneus*, Blenniidae and Gobiidae were presented in Table 2 for different size groups [3, 7]. The size group I have no external feeding. It is also known that at night larvae do not feed. That is why we used only feeding larvae (size groups II-V) and juvenile specimens, towed at day time for the analysis (Table 1). For comparison we used data obtained in the Black Sea in the 1950's and 1960's. The weight of food organisms from the digestive track was determined using the tables on average weights for each food item from the literature [9]. Values of abundance and biomass of food organisms are given in percentages. Small number of larvae had not permitted us to determine their exact weight. In these cases an approximation was made to calculate the consumption index of small larvae (Uptake index is a relation of calculated mass of food organisms in the digestive track to the mass of larvae * 10000).

3. Results and Discussion

Since 1988 *Mnemiopsis* has affected the population structure of the Black Sea zooplankton.. The studies conducted testified the all-day round feeding of mesozooplankton by *Mnemiopsis* [13, 14]. The composition of fish larvae ration correlated with that of *Mnemiopsis*. In larval intestines we generally observed small copepods, copepod eggs, nauplii, copepodites, cladocera and mollusc larvae. In summer period the share of copepods in the *Mnemiopsis* ration was 56.4% in coastal waters, and 74.7% in the open waters [13]. Based on dominant food items, *Mnemiopsis* seems a real food competitor for the larvae and young fish. Partly because of *Mnemiopsis* feeding quality and quantity of crustacean zooplankton reduced greatly. This reduction was particularly evident for the nauplii and copepodite stages of copepods, whose numbers decreased more than 5 times in the open waters, and 10 times at the northwestern shelf,

if compared with summer 1988. The copepod *O. nana*, which represented the most numerous group among copepods until 1989, now is absent in plankton [1]. The changes, which took place in plankton community, might have been reflected on number and nutrition of fish larvae. Indeed, the average number of larvae of all fish species decreased 1-2 orders of magnitude when compared with the 1950's or 1960's [4].

To reflect the present condition of fish larvae nutrition under the Black Sea ecosystem degradation, we have chosen typical inhabitants for both open waters - *E. encrasicholus, Tr. mediterraneus*, and coastal waters - Blenniidae and Gobiidae.

3.1 NUTRITION OF *ENGRAULIS ENCRASICOLUS* LARVAE

The analysis of 470 *E. encrasicolus* larvae has shown that about 90% of specimens were with empty intestines. This value varied from 74 to 100%, depending on the year and size group (Table 3). The respective value for the earlier stages of larvae was even higher ranging from 90% to 100%. The food spectra of *E. encrasicolus* larvae were sometimes similar for the consecutive years where the results were united. From 1989 we observed changes in fish larvae food composition all over the Black Sea (Table 3).

It is known that in the 1950's and 1960's there were 2-3 dominating objects in the digestive track of *E. encrasicolus* larvae. But the spectrum of feeding those years made up by 13 plankton organisms. In the 1986-1988 period, based on our results, there were already marked changes in *E. encrasicolus* larvae feeding. Composition of food organisms in size groups II-III of larvae was very poor and included only 3-4 plankton organisms. These were the copepodites of *O. nana* and eggs or cysts of the copepod *Centropages kroyeri*. Food of some size group IV consisted of *O. nana, P. parvus* and eggs of *Calanus euxinus*.

It should be noted, that from 1989 food was found only in some larvae of II-III size groups, towed in Turkish territorial waters. We found in their intestines mostly nauplii and copepodites of *A. clausi* and nauplii of *Pseudocalanus elongatus*. Food objects of IV-V size groups were represented mostly by adult specimens of *A. clausi* and nauplii *C. euxinus*. Food of young fish from the northern half of the sea consisted exclusively of larvae of Bivalvia (Table 3).

3.2 NUTRITION OF TRACHURUS MEDITERRANEUS LARVAE

We analysed nutrition of 313 horse-mackerel larvae in 1986-1996. 35% of larvae had no food in their intestines (Table 4). In the 1950's and 1960's the food spectrum of *Tr. mediterraneus* larvae included about 20 different forms [3, 11]. 2-3 species formed the base of food for larvae of different size groups. The nauplii of small copepods - *O nana* and *P. parvus* - dominated (70-90%) both in number and biomass in the food of larval group II-III. The share of bigger-sized food objects increased in older groups larvae. They were presented mainly by the copepodites and adult forms of *O. nana* and *Cladocera*. We have not met any larvae with empty intestines. Up to 10-20 food items were present in the digestive track of a small larva. In big larva, tens of individuals were seen in the intestine.

The indices of uptake were from 200 to 700‱ [10, 11]. In 1988 larvae with empty intestines made 31 and 44% in III-IV size groups. The basic food for the larvae of all size groups were *O. nana*, making more than 70% in the food of larval group III and 79 (in numbers) and 56% (in biomass) in larvae group IV (Table 4). But to the contrary of previous years, bigger forms (i.e. copepodites and adults) of copepods prevailed in the food lump of larvae, Cladocera (*P. polyphemoides* and *P. avirostris*) having a secondary importance. Food spectrum decreased to 10 forms. From the summer 1989 we observed qualitative changes in the food of *T. mediterraneus* larvae. Larva group II had no food.

TABLE 1. Number of larvae studied (larvae with yolk sack and of the night caught excluded)/percent of larvae with empty intestine in the Black Sea during 1992, 1996 and 1986 - 1996.

Species	1992		1996		1986-1996
	Northern BS.	Southern BS	Northern BS.	Southern BS	
Sprattus sprattus phalericus	2/50*				166/49
Engraulis encrasicolus	30/92	22/91		43/93	471/90
Odontogadus merlangus	5/0			10/10	139/15
Syngnathus phlegon	12/42	2/0		23/17	267/29
Trachurus mediterraneus	5/0	9/0			313/35
Labridae spp.	17/94		6/83		222/81
Gobiidae spp.	216/76	52/42	69/50	14/36	1753/64
Blenniidae spp.	53/25	2/0	154/36		1549/45
Lepadogaster spp.	4/75	1/0			124/45
Other species **	9/22	1/0	2/100	2/50	139/56
Total	403/66	96/54	236/41	92/55	5141/55

** *Gaidropsarus mediterraneus* (L.), *Solea nasuta* (Pallas), *Ophidion rochei* Muller, *Belone belone euxini* Gunther, Mugilidae, *Pomatomus saltatrix* (L.), *Boops boops* (L.), *Mullus barbatus ponticus* Essipov, *Scomber scombrus* (L.), *Sarda sarda* (Bloch), *Diplodus annularis* (L.), *Callionymus sp.*, *Scorpaena porcus* (L.), *Trigla lucerna* (L.).

TABLE 2. Grouping of Black Sea larvae and their nutritional characteristics.

Larva group	Lenght, mm				Characteristics of nutrition
	E. encrasicolus	*T. mediterraneus*	Blenniidae	Gobiidae	
I	2.0-3.5	1.6-2.2	1.6-2.2	1.6-2.2	Only yolk sack
II	3.6-3.9	2.3-3.5	2.2-4.0	2.3-3.2	Yolk sack and external food
III	4.0-6.0	3.6-5.0	4.1-7.0	3.3-6.9	Feeding on small zooplakton
IV	6.1-12.0	5.1-10.0	7.1-10.0	7.1-10.0	Feeding on large zooplankton
V	12.1-25.0				Feeding on large zooplankton
VI	25.1-35.0				Feeding on large zooplankton
juvenile	> 35.0	> 10.0			

TABLE 3. Main food organisms for each group of *Engraulis encrasicolus* larvae for different years in the Black sea. N=Number of larvae, %=Percentage of larvae with empty intestine

Larva group and size (mm)	1955-1965		1986-88			1989-91			1992, 1996		
	Food	%	Food	N	%	Food	N	%	Food	N	%
II-III < 6 mm	nauplii & copepodites of small copepod species	45-59	copepod eggs, *O. nana* copepodites	70	90		16	100	eggs & nauplii of copepods, nauplii & copepodites of *A. clausi*, *P. elongatus* nauplii	43	91
IV 6.1-12.0	nauplii of copepods, copepodites of *O.nana*, and *P. parvus*	51-61	*O. nana* copepodites, *P. parvus*, *C. euxinus* eggs	64	91	*A. clausi*,	14 4	97	*A. clausi*		
V 12.1-25.0	nauplii & copepodites of *A.clausi*, *O. nana*, and *P.parvus*	41-34	*O. nana* copepodites, P. avirostris	31	74	*A. clausi*, *C. euxinus* nauplii	61	84	*A. clausi*		
juvenile > 35.0	copepodites & adults of copepods and cladocerans	0		0			0		Bivalve veliger	6	17

TABLE 4. Percentages (in terms of both abundance - A and biomass - B) of main food organisms for each group of *Trachurus trachurus* larvae for different years in the Black sea.

Food organisms	group III						group IV					
	1955-60*		1988		1989		1955-60		1988		1989	
	A	B	A	B	A	B	A	B	A	B	A	B
O. nana and *P.parvus* nauplii	31.0	8.0					12.0	4.0				
O. nana and P.parvus (copepodites & adult)	47.0	83.0	93.1	79.7			48.0	65.0	79.0	56.9		
C. euxinus (eggs & nauplii)					39.1	24.0					39.4	14.5
A. clausi					36.2	52.4					18.1	44.2
Cladocera (*P. polyphemoides, P. avirostris*)			3.5	16.5	18.0	21.4	10.0	10.0	14.9	21.4	36.1	35.9
Other**	22.0	9.0	3.4	3.7	6.7	2.2	30.0	21.0	6.3	21.7	6.4	5.4
Number of larvae, ind.			55		75				25		99	
Larvae with empty intestines, %	0		31		49		0		44		26	
Average index of uptake, ‰			260		99				220		105	

* Data of Duka & Sinyukova [3]; ** 18 forms in 1955-60; *Centropages ponticus* in 1988, miscellaneous copepoda species in 1989.

The nutrition spectrum of the larva group III-IV shortened to 3-5 forms of zooplankters. Eggs and nauplii of *C. euxinus* and *A. clausi* dominated in this group (Table 4). Average index of food uptake was 99-105‰.

In 1992, ichthyoplankton abundance was very low in the Black Sea and therefore we managed to analyse nutrition of only 14 specimens of *Tr. mediterraneus* larvae. 7 individuals of larva group II were towed in the southern part of the sea. Nauplii of *A. clausi* dominated in their food (62% in number and 99.7% in biomass). The number of mollusc eggs was quite high in the digestive tracks, but due to their small weights, they made only 0.3% of total biomass. This confirms that their role in nutrition is not great. Five larvae of size groups III-IV from the northern half of the sea were found to feed mostly on *P. polyphemoides* (90% in number and 97% in mass), with 1-2 individuals in each intestine. Besides *P. polyphemoides* we marked *P. elongatus* in larva group IV from Turkish waters. In 1996 *Tr. mediterraneus* larvae were absent in our towings.

3.3 NUTRITION OF BLENNIIDAE LARVAE

Food spectrum of different species of Blenniidae (*Blennius tentacularis, B. pavo, B. sanguinolentus* etc.) was identical. That is why all species are united. In the 1960's, food composition in larva groups II-III of Blenniidae contained 20 forms of zooplankters. Small copepod species dominated in food at all stages of development (*O. nana* and *P. parvus*). They made up from 70 to 90% of all food lump by number and biomass (Table 5, 6). In 1986 food spectrum decreased to 6 forms for larva group II, and to 10 forms for the larva group III.

Nauplii of small copepod species were the main food for the size group II, similar to the 1960's. By number they made up 69.5% and by biomass 82.0%.

We marked a high number (20.3%) of eggs and larvae of bivalves consumed by larvae, however their share in biomass was only 1.6%. The copepodites of *O. nana*, and an of unidentified copepod, together with nauplii of Cirripedia and Tintinidae made up 10.1% of total number and 21.5% of total biomass of the food. *O. nana* and *P. polyphemoides* (all stages of development) dominated in the food of size group III with the 78.5% as number and 76.1% as biomass (Table 5). From 1989 up to present time food spectrum of larvae of Blenniidae has changed considerably (Tables 5, 6). The importance of *P. polyphemoides* was considerable in the nutrition of blennid larvae. Eggs of larvae of Lamellibranchiata, eggs of *Synchaeta*, copepodite and adult forms of *A. clausi* were also significant. Even in the smallest larvae (size group II), nauplii and copepodites of *A. clausi* dominated the food. Usually we observed 1-2 food objects in food lump.

3.4 NUTRITION OF GOBIIDAE LARVAE

We have analysed 1753 larvae of Gobiidae, towed from all over the basin during 1986-1996. 64% of larvae were with empty intestines (Table 1). In the 1950's and 1960's larvae with empty intestines had never been met. Food spectrum then included about 34 forms of food organisms. Nauplii of small copepod species, copepodites and adult forms of *O. nana, P. parvus* and Cladocera dominated in food (by number and biomass they made up 70-80%). Uptake indices in larva group II was 128 ‰, in larva group III 180‰ [3]. In the last decades there were considerable changes in the nutrition of Gobiidae larvae in the Black Sea. In 1992, share of larva group II with empty intestines was 94.4% in the northern Black Sea. In food lump we registered only eggs of *Synchaeta* (Table 7). 70% of larva group III had their digestive track empty. The main food was *A. clausi* copepodites and the cladoceran *P. polyphemoides* (total 41% in number and 80.7% in mass). *Synchaeta* eggs had high abundance percentage with a value of 29, but their share in biomass was inconsiderable (1.6%) (Table 8). In the same year in the southern Black Sea, the share of larva group II with empty intestines was 54% and larva group III 36%. Food composition differed between larva group II and III. Food in larva group II was presented exclusively by eggs and larvae of Bivalvia, and food spectrum of larva group III was characterised by seven forms of zooplankters. Among them eggs and larvae of Mollusca dominated in number with a 53.5%, and unidentified nauplii and copepodites in biomass with a 53.3%. Due to later stages of digestion, species identification of food items was problematic, however they resembles *A. clausi* forms.

In 1996 in the northern half of the sea, 75% of the larva group II was without food in their digestive track. *A. clausi* nauplii dominated the food in terms of biomass(92%). Lamellibranchiata eggs and larvae had the highest numbers with a 64.8%. In the southern Black Sea, percent of larvae without food appeared to be only half of that in the north for this group (40%). Food consisted of 50% in number and 57.3% in biomass by the nauplii of *A. clausi*, and eggs of copepods (mainly *P. elongatus*). Percentages of larvae without food were almost the same for the larva group III from the southern and northern Black Sea (37.5% and 40.8% correspondingly). For both regions, the dominant food items were the nauplii and copepodites of the *A. clausi*. Nauplii and copepodites of *P. elongatus* formed a considerable share in the southern part, along with *A. clausi* (Table 8). Average indices of uptake in the larva group II in the northern half are less than 1‰, in the southern 12‰. Respective values for the larva group III were 3‰ and 66‰, correspondingly.

Considerable decrease in the average biomass of Gobiidae larvae in 1990-1991 in Sevastopol bay testifies to deterioration of food base. For example, in 1955 larvae with a size of 3-4 mm weighed average 0.21 mg, but in 1989-1990 only 0.12 mg. Corresponding values for the larva size of 4-5 mm was 0.39 mg and 0.25 mg, and for the larva of 5-6 mm 0.63 mg and 0.52 mg [12].

TABLE 5. Percentages (in terms of both abundance - A and biomass - B) of main food organisms for the larva group II of Blenniidae in Crimean coastal waters.

Food organisms	1962*		1986		1989		1991		1996	
	A	B	A	B	A	B	A	B	A	B
O. nana nauplii, *P.parvus*,	78.2	85.9	69.5	82						
A. clausi nauplii					28.6	45.3	71.4	87.8	44.5	26.7
A. clausi copepodites							7.1	10.9	11.1	22.2
Cladocera (*P. polyphemoides, P. avirostris*)	9.3	0.6							11.1	44.5
Bivalve eggs & veligers	2.9	2.6	20.3	1.6	71.4	54.7	21.5	1.3		
Syncnaeta eggs									33.3	6.6
Other **	9.6	10.9	10.2	16.4						
Number of larvae, ind			117		28		51		23	
Larvae with empty intestines, %	0		78.6		79		70.6		78.3	

* - Data of Duka & Sinyukova [3]; ** 12 forms in 1962, Tintinnidae, copepodites of *O. nana* and other copepod sp., and cirriped nauplii in 1986

TABLE 6. Percentages (in terms of both abundance - A and biomass - B) of main food organisms for the larva group III of Blenniidae in Crimean coastal waters.

Food organisms	1962*		1986		1989		1991		1993		1996	
	A	B	A	B	A	B	A	B	A	B	A	B
O. nana nauplii, *P. parvus*	57.3	16.2	7.3	2.0								
O. nana copepodites			16.5	2.7								
O. nana	30.6	40.0	26.8	34.7								
A. clausi nauplii									4.3	19.4	71.1	38.1
A. clausi copepodites					12.5	9.3	48.0	40.8			11.8	18.9
Cladocera (*P.polyphemoides*, *P. avirostris*)	9.6	41.2	27.8	36.7	12.5	26.7	40.0	42.6			17.1	43.0
Bivalve eggs & veligers					75.0	64.0	8.0	0.1	4.4	6.4		
Syncnaeta eggs									91.3	74.2		
Harpacticoidae sp.			9.3	11.6								
Other**	2.5	0.7	12.3	12.3			4.0	16.5				
Number of larvae, ind.			91		26		38		10		12.1	
Larvae with empty intestine, %	0		40.7		80.8		36.9		0		29.8	

* - Data of Duka & Sinyukova [3]; ** 8 forms in 1962, copepodites of copepod sp. in 1986, copepodites of *P. elongatus* and copepod eggs in 1991.

TABLE 7. Percentages (in terms of both abundance - A and biomass - B) of main food organisms for the larva group II of Gobiidae in different regions of the Black sea in 1992 and 1996.

Food organisms	Southern BS				Northern BS			
	1992		1996		1992		1996	
	A	B	A	B	A	B	A	B
P. elongatus eggs			33.3	38.2				
A. clausi nauplii			50	57.3			36	92
Copepoda sp eggs			16.7	4.5				
Synchaeta eggs					100	100		
Bivalve eggs & veligers	100	100					64	8
Number of larvae, ind.	26		5		36		20	
Larvae with empty intestine, %	54		40		94.4		75	

TABLE 8. Percentages (in terms of both abundance - A and biomass - B) of main food organisms for the larva group III of Gobiidae in different regions of the Black sea in 1992 and 1996.

Food organisms	Southern BS				Northern BS			
	1992		1996		1992		1996	
	A	B	A	B	A	B	A	B
P. elongatus nauplii			30.8	14.6				
copepodites			7.7	7.3				
A. clausi nauplii			30.8	9.5			92.4	62.4
copepodites	3.6	24.1	23.0	67.1	12.0	47.4	3.8	27.0
Copepoda sp. eggs	14.3	1.9						
nauplii	7.1	8.6	7.7	1.5				
copepodites	17.9	44.7			6.0	2.5		
Cladocera	3.6	15.5			29.0	33.3	3.8	10.6
Synchaeta eggs					29.0	1.6		
Bivalve eggs & veligers	53.3	5.2			12.0	11.0		
Number of larvae, ind	22		8		34		49	
Larvae with empty intestine, %	36		37.5		70.6		40.8	

4. Conclusions

The changes in the Black Sea plankton community considerably influenced the nutrition of fish larvae. In the1950's and 1960's no empty intestines from the larvae of *T. mediterraneus*, Blenniidae, Gobiidae were met. At the present time larvae of this fish with empty intestines make average 55% of total. This value varies from 15 to 90%, depending on species, year, region and larvae size group The percentage of *E. encrasicolus* larvae with empty intestine in recent years increased substantially compared to the 1950's and 1960's. (Table 1). Besides increased number of empty intestines, there were many larvae with singular food object in their intestines (e.g. eggs of *Synchaeta* or Molluscs) which is far from being sufficient to meet nutritional demand of the larvae.

In the 1950's and 1960's, food spectrum was quite diverse in different species; for example in *E. encrasicolus* about 13 food organisms, in *T. mediterraneus* 10-20 food organisms. Food composition was even more diverse (from 20 to 34 forms) for the larvae of coastal fish species (Gobiidae and Blenniidae), and for their young fish (up to 40-50 forms). At the present time composition of food is represented maximum by 4-5 forms of zooplankters in larvae and 7-10 in young fish.

In the Black Sea ecosystem unfavourable conditions for fish larvae were formed under the influence of anthropogenic press and intrusion of *Mnemiopsis*. Mass spawning of *Mnemiopsis* coincide in time with spawning peak for a majority of the Black Sea fish (second half of June and July). *Mnemiopsis* is distributed in the upper quasi-homogenous layer, where larvae of most warm-water species dwell. *Mnemiopsis* is most important food competitor of larvae consuming up to about 80% of fodder zooplankton. As a result, small forms of zooplankters; nauplii of all species of copepods and copepodite and adult forms of *O. nana* and *P. parvus* were either observed to disappear from food composition, or met very seldom.

These food organisms especially in younger larva groups (II-III) earlier made up 80-90% of total food content. The studies of morphological peculiarities of *E. encrasicolus* larvae in the 1950's have shown that larvae with 4-10 mm size (group II-III) preferred to feed on small food organisms of 0.18-0.20 mm (nauplii of *A. clausi* and *Centropages kroeri* and young forms of *O. nana*). It was marked that copepodite stages of the same species (even if they are as abundant as nauplii in plankton) were taken by larvae considerably less. Among copepodites, only the smallest forms, not bigger than 0.3-0.35 mm in cephalothorax length, were consumed. A larva of 8-9 mm in length can eat adult forms of *O. nana, P. parvus*, but generally smaller individuals. During all investigation period, bigger-sized individuals of these species with cephalothorax length of 0.55-0.60 mm were found only in 4 larvae of which intestines was elongated for about 2 times compared to usual [8]. Before 1988, all developmental stages of *O. nana* dominated in larvae food, however, from 1989 to 1996 this species were almost absent in the digestive track of different species of fish larvae. *P. parvus* is also virtually absent, especially during the last few years. Due to near-absence of these small copepods, larvae had to begin feeding on bigger-sized organisms (in the intestines of a 10 mm long *E. encrasicolus* larvae we marked *A. clausi* of 0.75 mm).

Disappearance of *O. nana* and *P. parvus* from intestines of early stages of larvae must have resulted in adversely on the survival of larva group II-III. In the last years, the bulk (94%) of these groups were with empty intestines. Their abundance was also very low.

The average number of food items in intestines was also low in the last years; 1-3 food items in small and 1-8 food items in big specimens (max. 20). In the 1950's and 1960's we marked in small *T. mediterraneus*, Gobiidae, Blennidae larvae intestines mostly 4-8 food items (up to 18-37) and in *E. encrasicolus* larvae 2-4 food items (maximum 7-9). In bigger-sized larvae, tens of food organisms of different species were usually counted. For example in the intestine of a 10 mm long *T. mediterraneus* specimen (larva group IV), 91 food items were present; 53 nauplii, 16 copepodite forms, 12 *O. nana* and 10 *Coscinodiscus* [7]. In the digestive track of a juvenile of 20 mm, more than two thousand food items (605 adult *O. nana*, 1098 *P. parvus*, 170 *P. elongatus* etc.) were noted (unpublished data of IBSS).

In 1996, digestive tracks of the larvae sampled from the Crimean region had mainly nauplii and copepodites of *A. clausi* and the cladoceran *P. polyphemoides*. Other species were presented by the eggs of *Synchaeta* and Molluscs. In the southern part of the sea, besides all *A. clausi* developmental stages, *P. elongatus* took a considerable place (both nauplii and copepodites). *C. euxinus* and *E. spinifera* were rarely occurred whilst *P. polyphemoides* were absent. In the whole, we noticed bigger-sized organisms as the food of younger larva groups, previously met only in the late stages of larvae. This shows that when the preferred food items were not available under unfavourable conditions, a limited feeding occur on other items which must evolutionarily less nutritious for these larvae. During our sampling (which was sometimes all day round) we did not met freshly eaten preys in the northern Black Sea but in the south.

Numerical indices of nutrition have sharply changed. Unfortunately there was not sufficient material to calculate rations. An indication on food quantity consumed is given by indices of uptake; the low index referring to low nutrition intensity. In the 1950's and 1960's uptake index for *E. encrasicolus* larvae was around 35-200%oo, however, at present time they ranged 11-37%oo. In *T. mediterraneus* it was 99-260%oo recently, as opposed to earlier estimates varying from 200 to 700 %oo. Corresponding figures for Gobiidae larvae was 128-178%oo, now averaging from 2 to 66%oo. In different species and larva groups of Blenniidae it varied from 100 to 600%oo in the past and from 9 to 260%oo at present time.

Quantitative and qualitative deterioration of rations due to shortage of favourite food for fish larvae resulted in a decrease in growth rate. The complete disappearance of the main food organisms had negative influence on the survival of fish larvae, which led to a significant decrease in their number.

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