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### OCCURRENCE OF THE BATHYPELAGIC LARVAE OF THE POLYCHAETE, *VIGTORNIELLA ZAIKAI* IN THE SOUTHERN PART OF THE BLACK SEA

The bathypelagic larvae of the polychaete, *Vigtorniella zaikai*, were found in the southern part of the Black Sea for the first time. The findings were made in the depths from 85 – 110 to 150 – 180 m at 14 stations. Maximum density (119 ind m<sup>-3</sup>) of the larvae was registered in suboxic zone (<10mM dissolved oxygen content, DOC), immediately above the hydrogen sulphide seawater layer. Vertical distribution of pelagic larvae of other polychaetes associated with *V. zaikai* was also studied. The deepest seawater layer adjoining redox zone was inhabited by *V. zaikai*, *Protodrilus* sp. and the larvae of Phyllodocidae gen. sp. These taxa compose the bathypelagic polychaetes fauna.

**Key words:** Polychaeta, *Vigtorniella zaikai*, bathypelagic larvae, Black Sea

The first finding of the bathypelagic larvae of *Vigtorniella zaikai* was made by M. Kisseleva [2] over 50 years ago. Studying the samples of plankton taken from the deep-water areas of the Black Sea, M. I. Kisseleva had found formerly unknown larvae and tentatively defined them as trochophora “C” and nechtochaeta “B” without identifying the species, genus and family. Later, Murina [6] gave a detailed description of these larvae based on examination of more recent samples collected from deep-water locations of the Black Sea. She suggested that the “B” and “C” larvae were two different developmental stages of one and the same species, and identified them as *Pelagobia serrata* Southern, 1909. The smaller, spherical trochophora larva is 220 μ in diameter, and the larger, 5-segment nechtochaeta – 700 μ in length. Later, Kisseleva [3] had re-identified *P. serrata* as a new taxon, *Victoriella zaikai* (fam. Chrysopetalidae). However, a genus of Protozoa had early been given the same generic name

*Victoriella*; therefore, Kisseleva [4] had to rename her finding as *Vigtorniella*.

Description of the new taxon of Polychaeta was based on examination of the larvae, which were brought by the adult polychaetes, *V. zaikai*, grown by V. I. Zaika in the laboratory and fed for a year on benthic diatoms and organic matter. Pelagic larvae for the experiment were collected alive from 100 – 130 depth at a deep-sea station located in the central Black Sea. The holotype of *V. zaikai* Kisseleva, 1992, is 1000 μ in length and consists of 10 segments. As to the distribution of *V. zaikai* in the Black Sea, it is noteworthy that the larvae have never been found in the depths 0 – 50 (75) m either in coastal seawater or in the open sea. Numerous samples were collected during research expeditions to different locations of the Black Sea and thoroughly studied [6, 7, 8] and the obtained results allowed to have outlined the entire distribution area of this pelagic larva. However,

the seawater above the continental slope of Turkey has not been investigated until the present study.

**Materials and methods.** Samples of zooplankton were collected on 16 stations during the research cruise of the R/V *Knorr* in the Black

Sea in the south-western (Table 1) and in south-eastern (Table 2). The pelagic larvae of *V. zaikai* were found on 14 stations (Fig. 1). Samples of meroplankton were collected with a Nansen net with 135  $\mu$  mesh size.

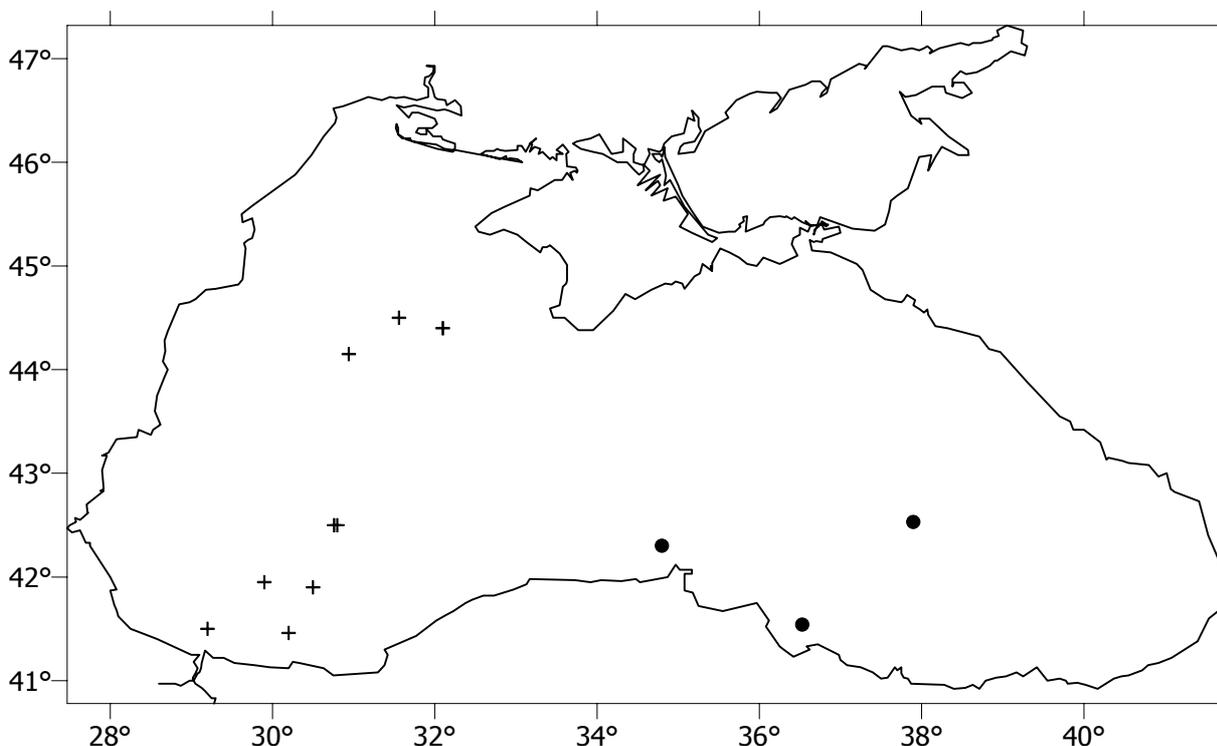


Fig. 1 The stations of the R/V «Knorr» at which the pelagic larvae of *Vigtorniella zaikai* were found during the Black Sea cruise in April 1998 (●) and in May – June 2001 (+)

Рис. 1 Схема станций, на которых найдены пелагические личинки *Vigtorniella zaikai* во время исследований в Черном море э/с «Кнорр» в апреле 1998 г. (●) и в мае – июне 2001 г. (+)

**Results.** Larvae of *V. zaikai* were found at 11 of 13 stations made during the expedition on board of the R/V *Knorr* (Table 1). At stations 5 and 8 located in shallow seawater areas (the depths of 112 and 38 m, respectively) the larvae were absent in the samples collected from the 30 – 0 and 100 – 0 m depths. At station 11, where the depth was 2168 m, the total numbers measured in the sampled seawater layer (0 – 130 m) was the highest – 250 ind. (Table 1).

Meroplankton was studied using samples collected from 13 stations. For the majority of the stations the pelagic larvae of the bivalve mollusc, *Mytilus galloprovincialis*, were the most abundant component of meroplankton. Second in the

prevalence were polychaete larvae which divided into two communities. The first community was represented by the neritic warm-water larvae of *Harmothoe* aff. *reticulata*, *Pholoe synophthalmica*, *Phyllodoce maculata*, *Microspio meznikowianus*, and the second by the bathypelagic cold-water larvae of *Vigtorniella zaikai*, *Protodrilus* sp. and larvae of the family Phyllodocidae not identified to species. At stations 6 and 8, planulas of Hydroidea were enormously abundant. The rest of the meroplankton – *Polititapes aures* (Bivalvia), *Morhensternia* (= *Rissoa*) *parva* (Gastropoda), *Upogebia pusilla* (Decapoda) and *Balanus improvisus* (Cirripedia) – were only rarely found.

Occurrence of the bathypelagic larvae of the polychaete, *Vigtorniella zaikai* ...

Table 1 The numbers of *Vigtorniella zaikai* and other meroplankton (ind.m and % of the total abundance in the sample, respectively) in the zooplankton samples from the Western Black Sea (R/V "Knorr", May – June 2001)  
Табл. 1 Численность личинок *Vigtorniella zaikai* и других организмов меропланктона (экз.м и в % от общего числа в пробе) в пробах зоопланктона из западной части Черного моря (НИС "Кнорр", май – июнь, 2001 г.)

Stn.	Date	Time	Max depth, m	Layer, m	Hydroidea, planula,	Mollusca, mainly <i>Mytilus galloprovincialis</i>	Cirripedia, Decapoda	<i>V. zaikai</i> larvae	Other species Polychaeta	Total number of larvae
1	24.05	18:30	300	250-0	0	101 (63)	0	26 (16)	34 (21)	161
2	25.05	16:00	1740	140-0	0	29 (76)	0	6 (16)	3 (8)	38
3	27.05	13:00	2200	140-0	0	88 (90)	0	4 (4)	6 (0)	98
4	29.05	13:00	2270	150-0	0	96 (60)	10 (7)	19 (12)	34 (21)	158
5	30.05	6:30	112	100-0	0	38 (59)	11 (17)	0	15 (24)	64
6	30.05	11:30	400	170-0	740 (79)	60 (6)	15 (2)	98 (10)	29 (31)	942
7	04.06	16:30	500	170-0	0	12 (10)	0	83 (71)	22 (19)	117
8	05.06	12:45	38	30-0	2530 (98)	22 (1)	0	0	1 (1)	2553
9	06.06	16:35	910	150-0	0	11 (34)	0	10 (31)	3 (10)	32
10	07.06	12:00	1400	170-0	0	104 (84)	0	18 (14)	2 (1)	124
11	08.06	12:15	2168	130-0	0	161 (39)	0	250 (60)	4 (1)	415
12	08.06	12:30	2168	170-0	0	64 (82)	0	13 (17)	1 (1)	78
13	09.06	12:20	2180	170-0	56 (26.5)	113 (54)	1 (0.5)	30 (14)	11 (5)	211

Table 2 Vertical distribution of *Vigtorniella. zaikai* larvae in the South-eastern Black Sea (R/V "Knorr"; April, 1998)

Табл. 2 Вертикальное распределение личинок *Vigtorniella zaikai* в юго-восточной части Черного моря (НИС "Кнорр", апрель 1998)

St.	Date	Time	Max depth, m	H <sub>2</sub> S, zone depth, m	Seawater layer, m Density of <i>V. zaikai</i> ind m <sup>-3</sup> , (% from total meroplankton)		Seawater layer, m Other species of meroplankton	
M 15 R 45	20.04	14.00	400	180	120 - 145 47.6 (84)	145 - 180 71.1 (99)	120 - 145 Phyllodocidae g. sp. <i>Protodrilus</i> sp. <i>Harmothoe</i> sp.	145 - 180 <i>Protodrilus</i> sp.
	21.04	20.00	400	180	125 - 150 5.2 (8.7)	150 - 185 58.6 (99)	125 - 150 <i>Protodrilus</i> sp. <i>Harmothoe</i> sp.	150 - 185 <i>Protodrilus</i> sp.
M 30 V 45	22.04	13.00	2200	140	85 - 110 0 (0)	110 - 140 35.3 (94)	85 - 110 <i>Protodrilus</i> sp. <i>Harmothoe</i> sp.	110 - 140 Phyllodocidae g. sp. <i>Protodrilus</i> sp.
	22.04	21.00	2200	140	85 - 110 2.8 (2.3)	110 - 140 119 (9.2)	85 - 110 Phyllodocidae g. sp. <i>Protodrilus</i> sp. <i>Harmothoe</i> sp.	110 - 140 <i>Protodrilus</i> sp.
L 30 T 28	24.04	10.00	500	180	125 - 150 1.2 (12)	150 - 180 43.7 (96)	125 - 150 Phyllodocidae g. sp. <i>Protodrilus</i> sp. <i>Harmothoe</i> sp.	150 - 180 Phyllodocidae g. sp. <i>Protodrilus</i> sp.
	24.04	19.00	500	180	125 - 150 2.8 (39)	150 - 180 108.3 (100)	125 - 150 <i>Protodrilus</i> sp. <i>Harmothoe</i> sp.	150 - 180 Absent



At stations 7 and 11, the share that *V. zaikai* contributed to the total abundance of larvae was highest (Table 1).

Remarkably interesting data were obtained from examination of samples collected during the Black Sea expedition (the R/V *Knorr*, April 1998) from the 25 m thin seawater layer in the locations with maximum depths of 400, 500 and 2200 m (Table 2). Two stations, M15R45 and L30T28, were located in the close proximity to the southern coast of the Black Sea (fig.).

Meroplankton was collected through the entire seawater column by depths beginning from the 0-25-m layer and deeper. Not a single larva of *V. zaikai* had been found in three subsurface layers down to 85 – 110 m depth as well as in the samples taken at 13.00 at the deep-water station M30V45 from the final, 85 – 110-m deep, layer (Table 2).

As regards vertical distribution, *V. zaikai* occupied the depth with the upper boundary going at 85-110 m depth at the deep-water station M30V45; at two other, relatively shallow-water, stations it descended deeper (Table 2). The lower depth of the occurrence had not been determined because the samples of zooplankton were collected only down to hydrogen sulphide zone. It should be noted that the lower depth at which these polychaetes occurred depended upon the station; the difference was especially pronounced between the depth of 140 m at the open-sea station M30V45 and the depth of 180 m at two stations in the coastal zone of sea water. It is noteworthy that maximum density of the larvae of *V. zaikai* (119 ind.<sup>-3</sup> was regularly measured in the oxycline overlying the hydrogen sulphide zone (Table 2). The obtained estimate is slightly greater than the early record of 113 ind.m<sup>3</sup> [6], and has been the acknowledged maximum for *V. zaikai* in the Black Sea as yet.

Vertical distribution of the pelagic larvae of companion polychaete species was studied, too. Trochophores, metatrochophores and nectochaetes (fam. Phyllodocidae g. sp), all developmental stages of *Harmothoe* sp. (*H* aff. *reticulata*) and

nectochaetes *Protodrilus* sp. (fam. Protodrilidae) inhabited the seawater layer of 120 – 145 m. In greater depths (145 – 180 and 150 – 185 m) only the larvae of *Phyllodocidae* g.sp. no identified to species and *Protodrilus* sp. were found. M. I. Kisseleva [5] suggested that the larvae of *Protodrilus* sp. were a new species. From the typical *P. flavocapitatus* they differed in that their trunk was 2 – 3 times smaller as usual, the eyes were often absent, the adhesive organs unusually shaped, and eggs smaller and more numerous. Probably, this taxon should be given name in honour of M. I. Kisseleva, but this hypothesis requires more detailed study. It is noteworthy that larvae of other polychaetes associated with *V. zaikai* were mostly solitary and rarely found. Presumably, the larvae of *V. zaikai*, *Protodrilus* sp. and *Phyllodocidae* g. sp., are the polychaetes which have evolved the tolerance for the oxygen-deficient environment.

During the 45<sup>th</sup> expedition of the R/V *Professor Vodyanitsky*, along with *Protodrilus* sp. different developmental stages and adults of the benthic form of *V. zaikai* were found in the narrow depth range (117 - 151 m) in the northwestern Black Sea ([16]. These findings have confirmed the early hypothesis about the occurrence of adult *V. zaikai* in the interface layer (120 - 150 m) between the aerobic oxic and the anaerobic anoxic (hydrogen sulphide) zones along the continental slope [6]. Maximum density (9140 ind.m<sup>-2</sup>) of the adults of *V. zaikai* was registered at the depth of 139 m. It is noteworthy that the polychaetes inhabited the 1 - 2-cm thick uppermost layer above grey silty mud [12].

Early, a hypothesis was advanced about a benthic transition belt going along the Black Sea and populated by the polychaetes *V. zaikai* and *Protodrilus* sp. However, only one location has been detected in the Black Sea as yet that is, probably, because in taking samples for the investigation special box-corer and multicorer were used [16].

**Discussion.** The trochophores and nectochaetes of *V. zaikai* occur in the depths from

50 - 75 to 200 -250 m [8] under the temperature of 6.3 - 9.0 °C, the salinity of 18.2 - 21.1‰, in the presence of hydrogen sulphide and low DOC (0.18 - 0.25 and 0.05 - 0.06 ml/l, respectively). Maximum density of the larvae (113 ind.m<sup>-3</sup>) was measured in the sample taken with a water bottle from the 111 - 96-m layer (st. 4632, the maximum depth of 2062 m) during the expedition of the R/V "Mikhail Lomonosov" in 1985. The proportion between the trochophores at junior developmental stages and the nectochaetes at senior stages was 38 : 75.

Experiments were conducted to learn more about the survival rate, nutrition and oxygen consumption rate in *V. zaikai* kept under oxygen deficiency and in the presence of hydrogen sulphide [9, 10, 11]. Results of the investigation point out that under those conditions *V. zaikai* can survive for a longer time than other zooplankton, e.g. Copepoda (adults of *Oithona nana*, juvenile stages of *Pseudocalanus elongatus* and *Calanus euxinus*). Larvae of *V. zaikai* exhibited highest resistance to the adverse environment, staying alive for 5 hours under the concentration of hydrogen sulphide greater than 1.6 ml/l and DOC lesser than 0.3 ml/l.

Two opposite opinions have been offered to explain why some mesozooplankton organisms concentrate in the redox zone: Sorokin [13] suggested that this is owing to the feeding selectivity of the mesozooplankton feeding on thiobacteria, while Vinogradov and Flint [14] rejected the very possibility that the mesozooplankton might consume the production of thiohaemosynthesis.

The findings of numerous dense populations of mesozooplankton, including copepods and the larvae of polychaetes, in the redox zone have allowed to hypothesise about a "false bottom" situated at a local oxycline in the depth of oxic zone [14], i.e. in the lower depth limiting the vertical distribution of the dominant mesozooplankton organisms. For example, copepods can migrate through seawater column, ascending from the depth to the layers more enriched with dissolved oxygen [14, 15]. Unlike copepods, the larvae of *V. zaikai* rare have been found in the subsurface overlying the 50 - 75 m depth, their dense populations are the major component of bathypelagic fauna in redox zone of the Black Sea.

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**Встречаемость батипелагических личинок полихеты *Vigtorniella zaikai* в южной части Черного моря.**

**В. В. Мурина, А. Е. Кидейс, Ф. Устун, Б. Токлу.** Батипелагические личинки *Vigtorniella zaikai* впервые отмечены в южной части Черного моря. Они были найдены на 14 станциях в слоях от 85 - 110 до 150 – 180 м. Максимальная численность личинок *V. zaikai* (119 экз.м<sup>3</sup>) отмечена в зоне с минимальным количеством кислорода над верхней границей сероводородного слоя. Одновременно было изучено вертикальное распределение личинок других видов полихет *Protodrilus* sp., *Phyllodocidae*.g. sp., встреченных вместе с *V. zaikai* Подтверждено высказанное раньше мнение, что наиболее глубокие слои, расположенные на границе с редокс зоной, содержат специфическую для Черного моря батипелагическую фауну. Расширен ареал пелагической личинки *V. zaikai*, оконтуривающий все Черное море.

**Ключевые слова:** батипелагические личинки, полихеты, *Vigtorniella zaikai*, Черное море

**Зустрічальність батипелагічних личинок поліхети *Vigtorniella zaikai* в південній частині Чорного моря.**

**В. В. Мурина, А. Е. Кидейс, Ф. Устун, Б. Токлу.** Батипелагічні личинки *Vigtorniella zaikai* уперше відзначені в турецьких водах Чорного моря. Вони були знайдені на 14 станціях на глибині від 85 - 110 до 150 - 180 м. Максимальна численність личинок (119 осіб / м<sup>3</sup>) відзначена в зоні з мінімальною кількістю кисню над верхньою границею сірководневого шару. Одночасно був вивчений вертикальний розподіл личинок інших видів поліхет *Protodrilus* sp., *Phyllodocidae*. g. sp., зустрінutih разом з *V. zaikai*. Підтверджено висловлену раніше думку, що найбільш глибокі шари, розташовані на границі з редокс зоною, містять специфічну для Чорного моря батипелагічну фауну. Розширено ареал пелагічної личинки *V. zaikai*, що оконтурює все Чорне море.

**Ключові слова:** батипелагічні личинки, поліхети, *Vigtorniella zaikai*, Чорне море.