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MEROPLANKTON OF THE BLACK SEA AND SEASONAL DYNAMICS OF MUSSEL LARVAE AT EXPERIMENTAL MARIFARM REGION

Abstract

The distribution of meroplankton at the Black Sea is described. Seasonal dynamics of larval number and juvenile settlings in the region with experimental mussel farming are discussed.

The formation processes of benthos settlements on natural and artificial substrates are much defined by number, distribution and ecology in meroplankton, i.e. by a community of pelagic larvae of bottom invertebrates. Bivalvia larvae dominate in the Black Sea meroplankton.

The most intensive meroplankton investigations were developed at one of the oldest biological stations, Biostation in Sevastopol founded in 1871. In the 50-70th years there were studies the pelagic larvae of all the big taxons from multicellular invertebrates: bivalves and gastropoda (Zahvatkina, 1959, 1963; Kiseleva G., 1965; Chuhchin, 1960), polychaeta (Kiseleva G., 1967; Kiseleva M., 1957, 1958), decapoda (Dolgopolskaya, 1948, 1954).

In the last few years new publications appeared relating to meroplankton at the Black sea. In their number are papers on mussel *Mytilus galloprovincialis* larval distribution, the main object for mariculture (Alexandrov, 1987; Ivanov, 1965, 1978; Kiseleva G., 1972; Konsulova, 1984, 1988; Konsulov and Konsulova, 1982; Murina, 1987, 1989; Murina and Kazankova, 1987; Chuhchin, 1984; Petran, 1977).

More detailed knowledge on meroplankton distribution at the Black sea was obtained during scientific cruise «Akademik Kovalevsky» (Autumn 1984). 269 samples were taken at 57 stations. Fig. 1 shows the larval distribution of bottom invertebrates in the richest layer at 0-10 m depth.

In the eastern region, transect Tuapse-Sarich cape, maximal larval number was found at the station located 1.7 miles off the shore over 40 m depth. With distance growing apart from the Caucasus coastline the larvae density decreased and over 2100 m depth, 44 miles offshore, there was only 47 specimens per m^3. Taxonomic content exhibited distinct domination of Bibalvia larvae, veligers and veliconchi of which in some samples reached 99.6% of the total meroplankton number. Larvae of Gastropoda, Bryozoa, Decapoda, Cirripedia and Polychaeta were met in small quantities. Figure 2 illustrates mussel larval number in the eastern sea region.

Six stations were made in the region of Sarich cape at depth profiles from 30 to 2100 m. Apart from the Crimean coastline towards the sea centre the larval density was gradually reduced from 4215 to 52 specimens per m^3. Though domination of bivalvia larvae in meroplankton was evident (mean 85%) the mussel number was not high. It ranged from 1 to 30 specimens per m^3 increasing at precoastal stations.

The north-western stations, transect Sarich cape - Constantsa, were located mainly over high depths. Therefore the larval density was not numerous (13-55 specimens per m^3), except some stations (station 35 gave 172 specimens per m^3).

In October the well-expressed autumn peak for bivalvia number was observed at the Zernov's phyllophora field and Carcinitsky gulf region. Bivalvia comprised 92 and 93% of total meroplankton (781 and 3639 specimens per m^3, respectively). In August 1957 bivalvia concentration numbered 1100 specimens per m^3 in

plankton sampled at Tarhankut cape vicinity (KISELEVA G., 1965). The highest number 51 533 specimens per m^3 was registered in September 1967 at Romanian shores (PETRAN, 1977).

The south-western Black Sea region was studied especially in details. 21 stations were made here, half of them - over 45-300 m depth, and half - 500-2100 m depth. Of interest is to compare the mean larval number per 1 sq.m of water column in shallow and deep-sea regions. The shallow region showed 16 811, the latter - 2487 specimens per m^3, i.e. seven times less. This evidences the further the distance from parent population dwellings the littoral, the less larval concentration is, which decreased gradually due to disperse, predation, settlings to bottom and natural death. Larvae of neretic species of bottom invertebrates which were brought to chalistic regions at late developmental stages of metamorphosis sank to depths deeper than 200 m into anoxic H_2S zone seeking for a substrate to settle where they perished.

The south-western region is characterized with high numbers of meroplankton (Fig. 1). The main part of meroplankton consisted of bivalvia. Their maximal concentration 1222 specimens per m^3 was noticed at Caliacre cape. In August 1957 pelagic larvae of bottom invertebrates equalled 8000 specimens per m^3 at Bulgarian shores (KISELEVA, 1965).

KONSULOVA (1985) gave interesting data referring bivalvia larval number at Caliacre cape in 1981-1983. In April at 9.15°C veligers numbered 40 specimens per m^3. In May at 14.7°C it increased to 1918 specimens per m^3 and gradually decreased to 148 specimens per m^3 in August. The second peak for veligers in plankton 4085 specimens per m^3 KONSULOVA marked at 21.7°C in September. Regretful species composition for bivalvia larvae was not defined though it may be proposed that in this region where mussel plantation was placed, larvae of *Mytilus galloprovincialis* prevailed (Caliacre cape).

We determined mussel larval concentration as 50 specimens per m^3 in the south-western region. Mussel veliconchi were found at all depth profiles from 1-10 m to 200-250 m. In deeper layers larvae were of big sizes (veliconchi with eye). This testified their durated presence in the pelagial.

Meroplankton taxonomic content in the south-western region did not differ from other

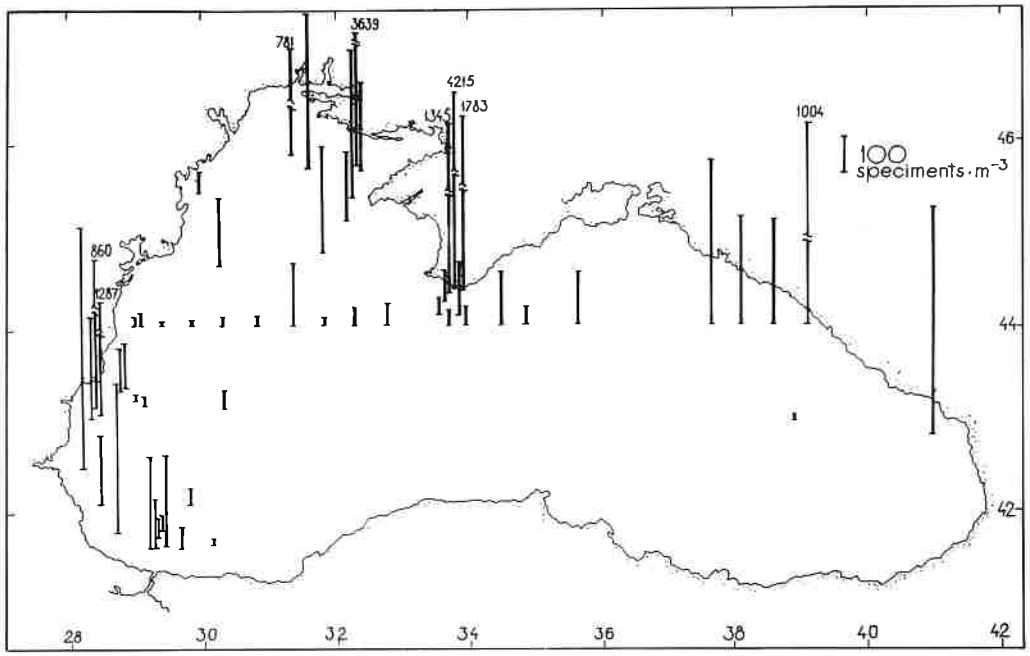

Fig. 1 - Meroplankton distribution in 10-0 m layer at the Black Sea in Autumn 1984.

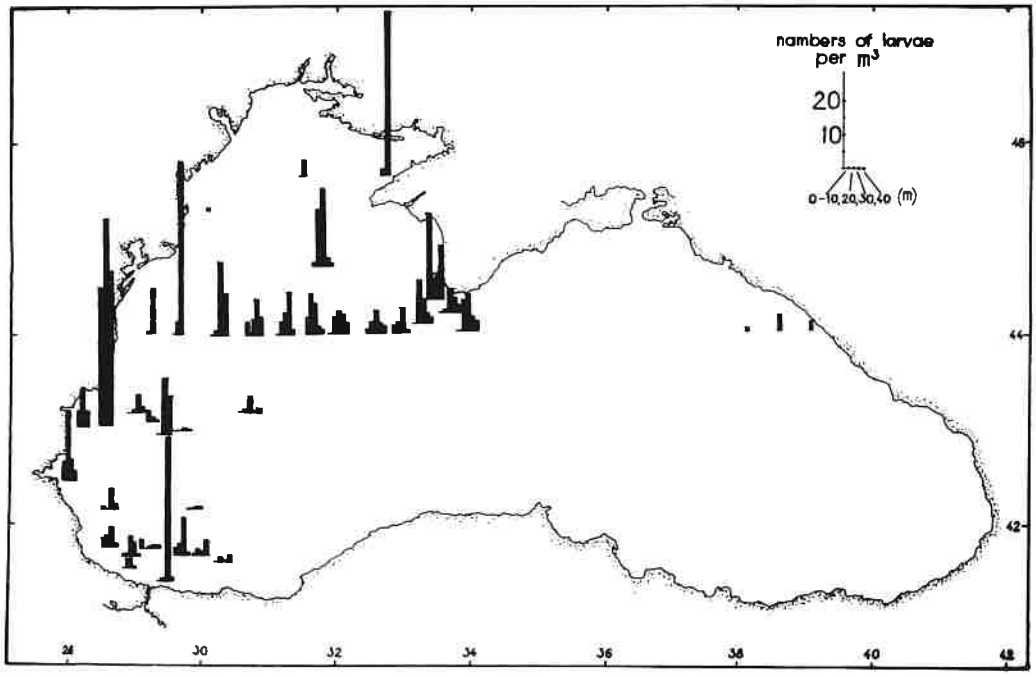

Fig. 2 - Mussel larval distribution at a stage of veliconcha with eye in 10-0 m layer at the Black Sea in autumn 1984.

regions - bivalvia larvae dominated distinctly in zooplankton. So, 20 out of 21 stations resulted 77.4-98.6% of all veligers and veliconchi. Other groups of bottom invertebrates were represented by Gastropoda veligers, Polychaeta nectochaetsa and trochophores, mainly *Polydora ciliata* and *Prionospio sp.* as well as Decapoda rare zoeae, Nemertini pelidiums and *Phoronis* actinotrochas.

Larval vertical distribution in plankton illustrated vividly the preponderance of main larval number to the upper 10-metered layer for all regions. Having the prolonged pelagic developmental stage - till one month - mussel larvae were transported far offshore. They were revealed in samples taken 90 miles off. These passive migrations are of interest in view of gene exchange among separate mollusc beds (IVANOV and BULATOV, pr. publ.).

In 1983 the experimental mussel mariculture farming was founded in Laspy bay (the South Crimea, Sarich cape vicinity). Its goal is to study regularities for mussel larval distribution in plankton and mussel settlements developing on collectors. Researches were conducted monthly in 1984-1985 and 1988-1989. More than 400 zooplankton samples were treated collected with Judday net, gas N 49 & 61, at all standard profiles using 3 control stations located at different depths: Batiliman bay, Laspy bay near the farm and Ajya cape (SHALYAPIN, pr. publ.).

Formation of mussel larval pool in the researched region had three main sources: maternal settlements on littoral rocks; mussel clusters on collectors and larvae brought by currents. Sharp fluctuations in mussel larval concentrations were exhibited in dependence on the season.

At the mariculture farming region mussels started their mass spawning in spring at 7-8°C; the autumn spawning - when water temperature lowered to 17- 18°C. If temperature was optimal for the spawning then there occurred winter and autumn flashes in number of spawning molluscs (PIRKOVA, pr. publ.). At low 3-6°C temperature the spawning impeded. So, in 1985 the peak in spring spawning appeared in April as water was cool and the reproductive period durated till mid-June (Fig. 3). Respectively the number peak for mussel veligers was in April. In 1985 it came up to May.

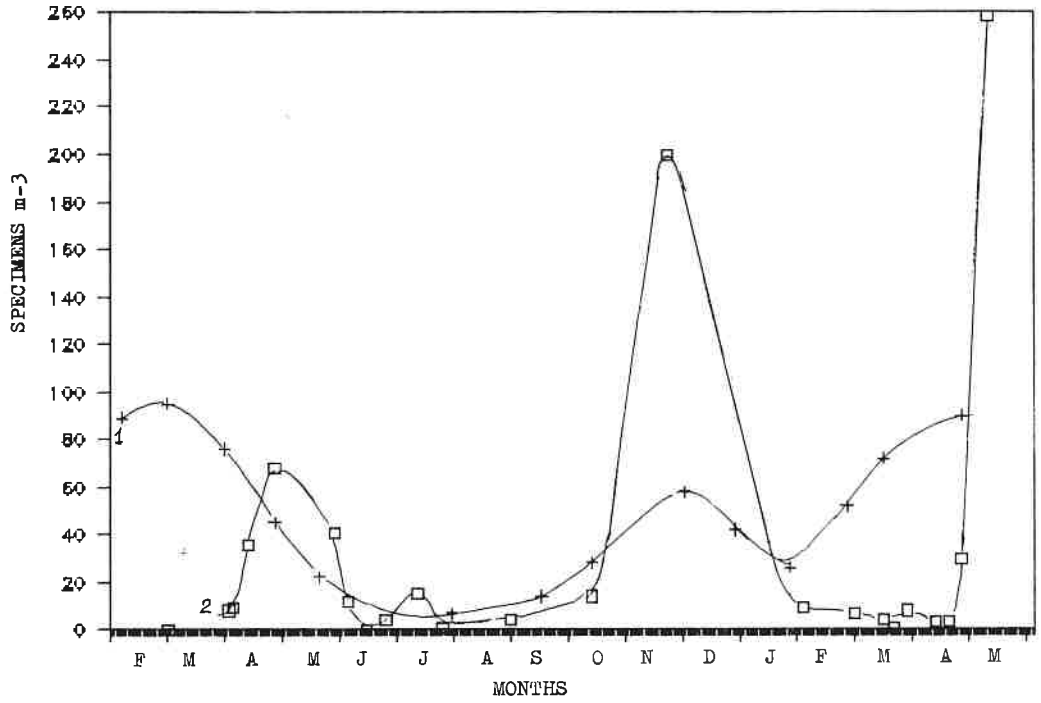

Fig. 3 - Rocky mussel spawning and veliger concentration in plankton sampled in 10-0 m layer at the marifarm region in 1984-1985:
1 - percentage of spawning molluscs of the total sampling number, 100 specimens;
2 - veliger concentration, specimens per m^3.

In plankton from the Crimean coast mussel larvae were met all-year-round. But the ratio for different-aged larvae (developmental stages) was unlike in various seasons. During spring mollusc reproduction the larvae in samples were mainly represented by veligers. Their number reached 68 specimens per m^3, in some samples - 110 specimens per m^3. In April 1984 and in May 1985 - 258 specimens per m^3.

What period is the best for establishment of collectors it ought to be studied the mussel larvae ratio in plankton at two late stages of metamorphosis: veliconchi with eye and veliconchi without it. The former - are the larvae which prepared to settle on a substrate. They were absent in spring 1984 and appeared only in July when their concentration averaged 39 specimens per m^3 (Fig. 4). The second type of veliconchi had 2 peaks in number- April and July. They disappeared completely in end-August and appeared only in May 1985 reaching 52 specimens per m^3.

Another picture was shown in 1989: only one spring peak was marked at a late stage. It was in May and resulted 160 specimens per m^3. Uneyed veliconchi had 2 peaks: April and June - 570 and 540 specimens per m^3, respectively; for cold period - a small increase in December - 60 specimens per m^3 (Fig. 5).

If in 1984-1985 veliconchi of both stages showed an equal low concentration unexceeding 40-60 specimens per m^3, then in 1989 the maximal number of the «eyed» veliconchi surpassed that of the «uneyed» ones by 3 times. The given data is evidenced exclusive seasonal and interyear changes for mussel larvae pooling. This must be taken into account while planning biotechnical works.

Mussel larval vertical distribution at a stage of settling was different for various aquatorium sections. Near the shore (deeper 30 m) veliconchi of a total mussel larval number (veliconchi + veligers) in zooplankton composed approximately equal shares at all depth profiles. In offshore

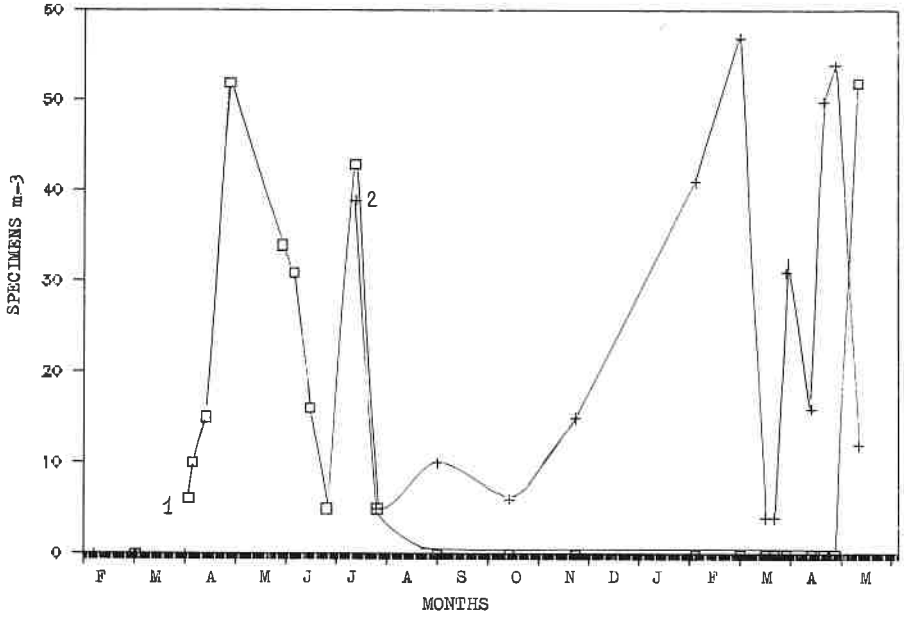

Fig. 4 - Mussel larval concentration at late developmental stages in plankton sampled in 10-0 m layer at the marifarm region in 1984-1985:
1 - veliconchi without eye, specimens per m^3;
2 - veliconchi with eye, specimens per m^3.

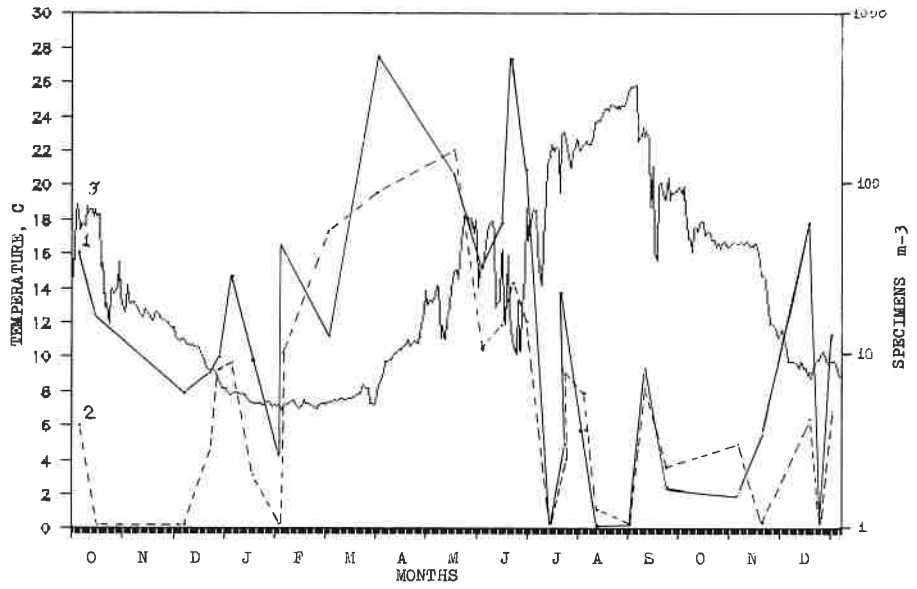

Fig. 5 - Mussel larval concentration at late developmental stages in plankton sampled in 10-0 m layer at the marifarm region in 1988-1989:
1 - veliconchi without eye; 2 - veliconchi with eyė (expressed in logarithm scale); 3 - temperature.

site (depth 40-60 m) this share was higher. The latter may be explained by larval floatation decline at later developmental stages.

While studying settlings of mussel juveniles on experimental collectors (dim glass slides were placed at depth from 1 m till 10 m) no confident distinctions were noted in settling intensity with depth dependence of the submerged slides. Possible that equal distribution of veliconchi in this layer was the reason for that. Study of larval settlings onto slides with accumulated mussel aggregations showed that more intensive settlings occurred at lower depths beginning from 12-15 m. The slides were placed at depth profiles from 3 to 19 m.

Thus, bivalvia larval pooling, mussels first, represents a rather dynamic system fulfilling from different sources and depending on many ecological factors. The revealed common regularities in larval distribution and local peculiarities defining larval settlings and mussel settlement formation on mariculture collectors permit to predict many circumstances while establishing mussel mariculture.

References

ALEXANDROV B.G., 1987: *Diurnal dynamics of Bivalvia larval vertical distribution at the Black Sea.* Proc. 8 Panel on Mollusc Study, Leningrad. Leningrad:Nauka, 1987: 355-356.

CHUHCHIN V.D., 1960: *Gastropoda pelagic larvae at the Black Sea.* Trudi Sevastopol Biol. St. 13: 92-113.

CHUHCHIN V.D., 1984: *Ecology of the Black Sea gastropoda.* Kiev:Nauk. dumka, 1984: 175 p.

DOLGOPOLSKAYA M.A., 1948: *Materials on phenology of decapoda larval stages.* Trudi Sevastopol Biol. St. 6: 236-255.

DOLGOPOLSKAYA M.A., 1954: *Metamorphism of the Black Sea decapoda.* Trudi Sevastopol Biol. St. 8: 178-213.

IVANOV A.I., 1978: *Biological grounds for commercial mollusc cultivation at the Black Sea.* Proc. 6 Soviet-Japan Symp. Aquaculture and Bioproduction Increase in the World Ocean. Moscow:VNIRO, 1978: 211-215.

KISELEVA G.A., 1965: *Distribution of polychaeta larvae and mollusc larvae in plankton of the Black Sea.* Benthos. Kiev:Nauk. dumka, 1965: 38-47.

KISELEVA G.A., 1972: *Rocky and silty mussel multiplication at the Black Sea.* Biologiya morya (Kiev) 26: 88-97.

KISELEVA M.I., 1957: *Polychaeta pelagic larvae of the Black Sea.* Trudi Sevastopol. Biol. St. 9: 58-112.

KISELEVA M.I., 1959: *Polychaeta pelagic larvae in the Black Sea plankton.* Trudi Sevastopol Biol. St. 12: 160-167.

KONSULOV A., KONSULOVA Ts. H., 1982: *Cultivation of mussels and their biological reproduction increase.* Proc. Nat. Conf., Nov. 1982, Moscow:Nauka, V. 1: 257-263.

KONSULOVA Ts. H., 1984: *The Black Sea Mytilus galloprovincialis development while culturing in storm-resistant installations at Caliacre cape.* Isz. IIR (Varna) 21: 119-144.

KONSULOVA Ts. H., 1988: *Multiplication and development of cultivated mussels Mytilus galloprovincialis at bulgarian shores of the Black Sea.* Hidrobiol. (Sofiya) 33: 75-86.

MURINA V.V., 1987: *Vertical distribution of polychaeta pelagic larvae in the western region of the Black Sea.* Ecologiya morya 26: 31-37.

MURINA V.V., 1989: *Spionid (Polychaeta) pelagic larvae distribution and their number at the Black Sea.* Ecologiya morya 31: 35-41.

MURINA V.V., KAZANKOVA I.I., 1960: *Bottom invertebrate larvae in the Black Sea plankton.* Ecologiya morya 25: 30-37.

PETRAN A.A., 1977: *Variations de la densité des veligeres de bivalves, dans la zone a petite profondeur du littoral roumain de la mer Noire.* Rapp. et Proc. verb. Reun. Commis. Int. Explor. sci. Mediter., Monaco: FAO 24(10): 153-154.