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CLIMATIC AND PHYSICO-GEOGRAPHICAL CONDITIONS FOR MUSSEL MARICULTURE AT THE BLACK SEA

Abstract

Climatic and physico-geographical peculiarities of some regions define feasibilities of mussel mariculture development at the Black Sea. Diurnal and seasonal changes of thermochaline water structure in the region with experimental mussel marifarming are given.

From a morphological viewpoint the Black Sea is a significantly isolated water body with limited water exchange through shallow-watered straits connected with the Mediterranean and Azov seas. The summarized yearly effluents are evaluated as 370 m^3 (approx.). This defines positive freshwater balance and low salinity relative to World Ocean waters (BLATOV et al., 1984). Water masses with relatively homogeneous characteristics are involved into the system of cyclonic currents induced by prevailing sea winds.

Sharply differed in temperature and salinity the estuaries of the Danube and Dnieper rivers, Karkinitsky and Sivash gulfs are considered to be unsuitable for mussel mariculture. In these sites water salinity drops sharply in spring till 5-10% or elevates higher to 40% in summer. Water temperature may be below zero (till -5°C). Ice formation was watched at large-scaled shallow areas.

The most suitable area for mussel cultivation are regions of Caucasus, Crimea, north-western and western Black Sea with temperatures from 2-3°C up to 24°C, salinity from 14-15% up to 18.4%. However these regions are affected by stormy winds, that is why storm-resistant constructions, sequently money-expensive, must be established for the cultivation.

Climatic and physico-geographical conditions of some regions form local ecological climates.

To solve mariculture problems we are to have sufficient detailed knowledge regarding seasonal, inter-year and other external factor varieties - the source for great perturbations in thermocline structure of Black Sea waters.

A more important task is to find out the reason-consequence correlation between oceanological factors and biological processes for mussel fodder formation, larval pooling, growth seasonal rates, biodeposit dispersion and dissolution.

In connection with the organization of experimental mussel-culture farming by the Institute of Biology of Southern Seas (Sevastopol) the region Sarych cape - Laspi bay was thoroughly studied.

It is situated in a climatic zone of the Crimea that is the analog to a mediterranean dry subtropical type: hot summers and moderate warm winters (Fig. 1) (VAZHNOV, 1983).

Mountain massif (to 663 m height) protects the aquatorium against western and northern winds. Ilyas-kaya mountain (679 m) and other mountain peaks (to 625 m) prevent from eastern and south-eastern winds. The mean sunlight duration comprises 2400 hours a year. A total bay bottom slope surpasses 2%. This allows to consider the shore as a pre-deep type for which heavy wave loadings are typical for storms induced by S-SE towards W-SW winds. The offshore depths reach 55 m. At Laspi shores the upwelling induced by western winds occurs the same way as in any region of the Crimean South coastline (BOGDANOVA, 1959).

Significant variations within a year in water masses' influence induced by winds define the unsteadiness of water thermochaline structure at Laspi Bay. The fluctuations will impact on the bay hydrobiological regime including phyto- and

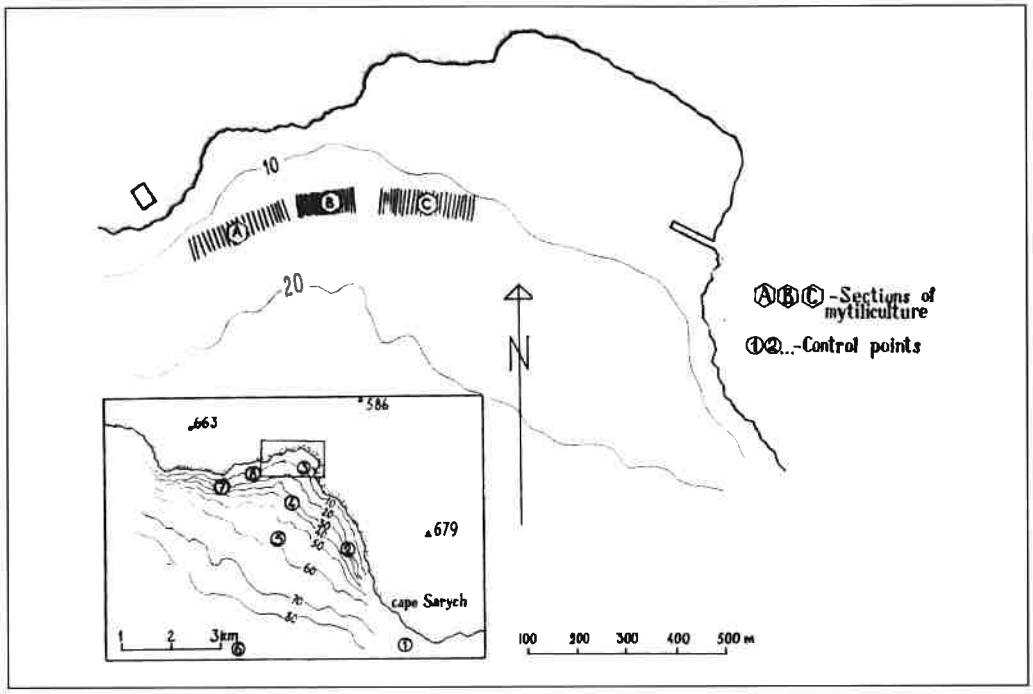

Fig. 1 - Location of experimental mariculture farming of the Institute of Biology of Southern Seas and control watch points.

zooplankton concentration and status of ichthyofauna. For example, high upwelling and subwelling induced by winds incurred complete vanishment or sharp increase of mussel larval number (KAZANKOVA and PIRKOVA, 1987). In September 1985 high up-welling entailed water temperature drop till 16°C and caused fish mass mortalities.

Fig. 2 illustrates the mean reiteration of winds at Sarych cape for many years. It demonstrates insignificant dominance of the eastern wind. Fig. 3 a,b shows the long-term mean

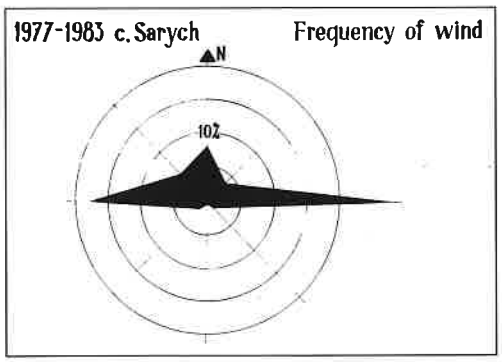

Fig. 2 - Reiteration of winds at Sarich cape.

monthly surface water temperatures and anomalies noted by us in 1985-1989.

In spring-summer period negative anomalies corresponded to W wind prevailance; in autumn-winter - to NE, N winds.

In contrast, in the same period (spring-summer) positive anomalies corresponded to subwelling induced by NE, E and SE winds or related to a small-gradient field of the atmospheric pressure.

In the autumn-winter period positive anomalies in surface temperatures were defined with W wind high repeatedness. Compared with inter-year changes in temperature anomalies corresponding change in salinity is no less complicated. This related to a dominant advective character of salinity pool formation. Synoptical changes in Black Sea water circulation much affected the inter-year changes, and in its turn the ciruclation itself underwent these changes too (BLATOV and BULGAKOV, 1984). Analogically to variations in salinity pool formation it's noteworthy to account variables of passive mixtures during the pool formation. Phytoplankton and zooplankton may be related to mixtures.

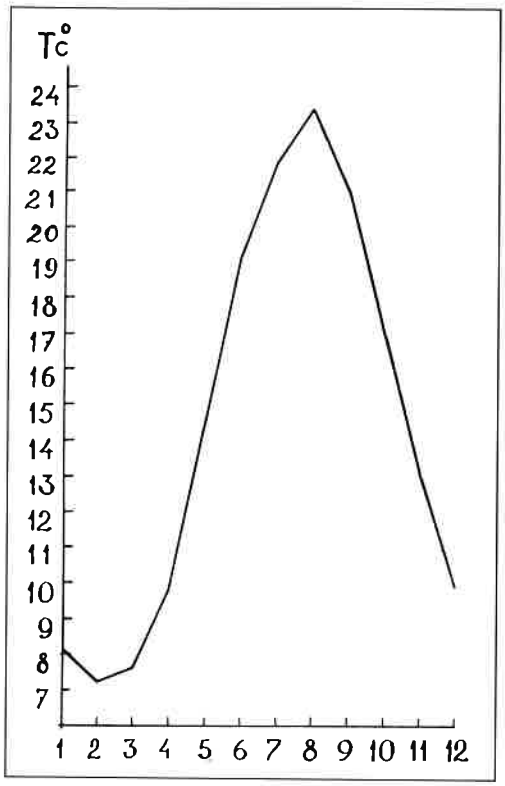

Fig. 3a - Mean many-year-monthly surface sea water temperature in Laspy Bay

Thus it is feasible to predict ecological and productive conditions basing on synoptical prognosis.

In hydrobiological regime of Laspi Bay the role of a breeze effect, more expressed within warm season was very significant. As a result - wind rechanged twice a day that was concomitant with alterations in current and thermochaline structures. The most significant changes were revealed in spring-summer period when the upper boundary of the autumn thermochaline surfaced or submerged 15-20 m in precoastal bay zone.

During the same period coastal currents were registered with speed sometimes higher than 0.5-0.6 m/sec. Those currents were formed during morning or evening changes in wind and current fields.

The most repetitive character for current distribution in upper profiles at daytime is represented in Fig. 4. Night-time current spread is shown in Fig. 5. Current velocities fluctuated from 0.03 to 0.35 m/sec.

Current systems to be formed in the bay and in close distance to the main Black Sea current provided abundant water exchange. This may reason the absence of the accumulated suspensions released by mussels under cultivation technical constructions.

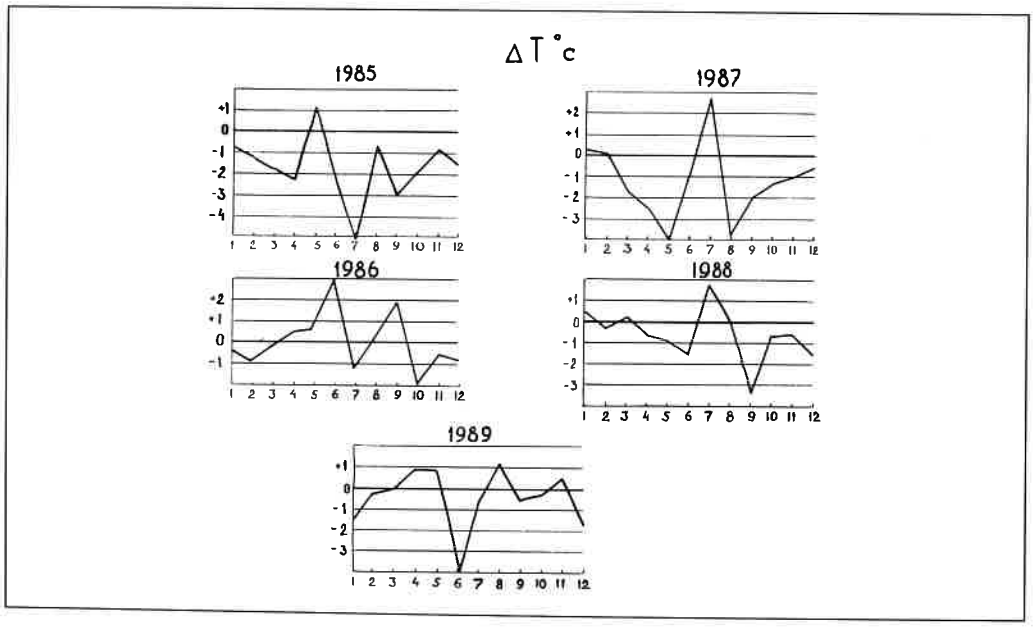

Fig. 3b - Anomalies in mean-monthly surface water temperature in Laspy Bay during 1985-1989.

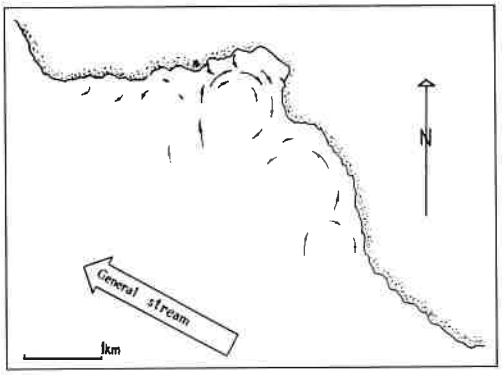

Fig. 4 - Daytime most often reiterated system of currents.

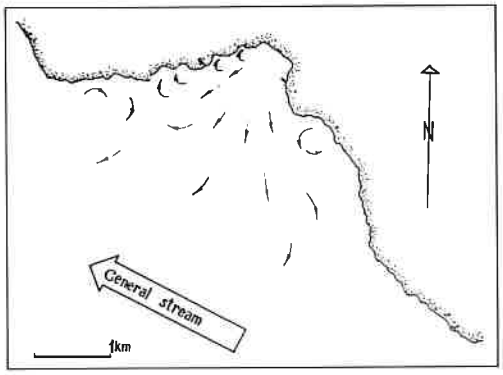

Fig. 5 - Night-time most often reiterated system of currents.

The establishment of experimental mariculture farming (Institute of Biology of Southern Seas, Sevastopol) with the account of potential wind direction and wave loadings allowed to provide satisfactory storm-resistancy for technical equipment able to withstand storms force 5 which occur more than 4 times at Laspi Bay. The wave height of one yearly observed storm within 1985-1989 storms reached 4 m, length - 75 m. Independently cold or warm seasons storms entailed heavy changes in temperature and salinity pool structures along the whole Crimean coast as well as in Laspi Bay. All the foregoing affected mussel growth rates, their spawning and phytoplankton supply at the farming.

Thus, Laspi bay gives large-scaled potentials for experimental researchings in mariculture thanks to great diversities in hydrological parameters which may be met at relatively small aquatorium.

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