CONTEMPORARY DYNAMICS OF COASTAL BENTHIC COMMUNITIES OF THE NORTH CAUCASIAN COAST OF THE BLACK SEA

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ABSTARCT

The study of the North Caucasian coastal benthos, carried out by Institute of Oceanology RAS in 1999-2003, showed strong changes in biodiversity and species structure of coastal communities. The rise of the muddiness that coincided with the introduction of *Mnemiopsis leidyi,* invoked moving of phytal zone, claying of coastal sands and disappearance of the communities, which were known for the Caucasian coast from the beginning of the 20th century. Nowadays, the most depressed communities are at the south of the explored area, where the absence of dominants and subdominants of coastal communities, the decrease of coastal benthos biodiversity and quantitative abundance can be observed. At a depth of 15-25 m, where previously the core of the rich and diverse community with bivalve *Chamelea gallina* dominance was located, now an exotic bivalve *Anadara inaequivalvis* dominates.

In the North, near Anapa, along with practically the same decrease of biodiversity, there is no decrease of benthos biomass in comparison with the data obtained in 1989 and during the earlier years.

Keywords: Black sea, zoobenthos, biodiversity, exotic species, *Anadara inaequivalvis*.

INTRODUCTION

Until the 1980s the species composition and quantitative distribution of the Black sea macrozoobenthos could have been characterized as seasonally stable with comparatively small annual fluctuations in density and biomass. Strong changes began in the year 1989. Some species disappeared while others were introduced and became dominant. The biomass of *Chamelea gallina* biocenosis increased in more then 4 times, comparing with 1960-1970s, and a new bivalve appeared in the community – *Anadara inaequivalvis* (Alekseev R.P., Sinegub I.A., 1992). The arc shell *Anadara*

inaequivalvis (*Bruguière*, 1789), is an Indopacific Arcidae which first appeared in the Black sea near the Bulgarian coast in 1983. It is known in the Mediterranean sea since the end of the 1960s. Immigration of the species was most likely due to the accidental transportation of juvenile stages in the ballast water of tank ships coming from the Pacific. This Indopacific bivalve was not only well adapted in the new habitat, but in recent years its density has so increased that the community of *Chamelea gallina* seems to be seriously compromised by its presence (Figure1).

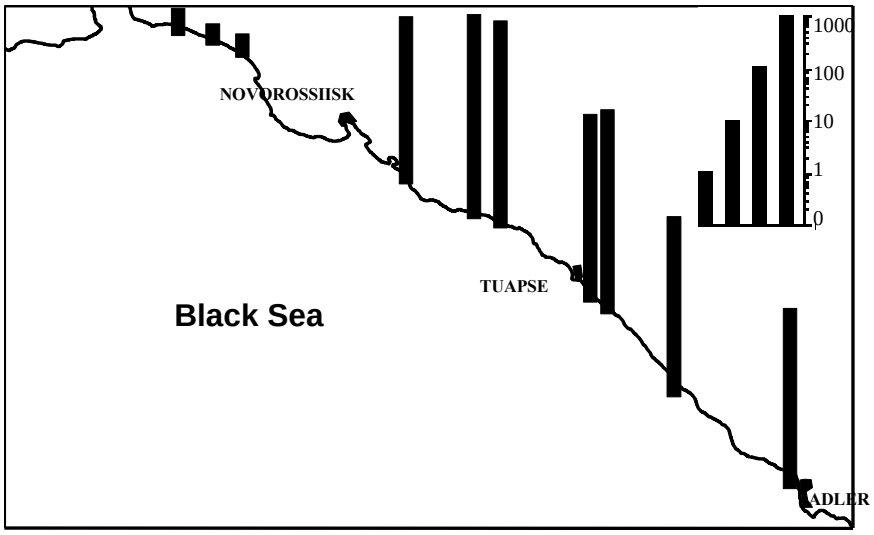

Figure1. The distribution of the biomass of *Anadara inaequivalvis* along the North Caucasian coast (logarithmic scale).

We suppose that it is connected with abiotic factors, like organic carbon content and the grain-size structure of sediments, which are different in those parts (sands near Anapa and rocks to the south from Novorossiysk). The investigated area to the south from Novorossiysk is more eutrophic, rich in organic matter and anoxic crises due to massive algal blooms are frequent. At the same time, the area near Anapa is hydrologically separated from the main Black sea current due to the quasistable anticyclone circulation and has smaller concentrations of organic matter. And *Anadara inaequivalvis* is apparently better adapted to anoxia then *Chamelea gallina*, due to the presence of hemoglobin in the ark shell erythrocytes. Therefore long life spans and reduced mortality rates, coupled with greater respiratory efficiency, most likely endows *A.inaequivalvis* with a high resistance to environmental stresses (Cortesi P. et al., 1992). So, the local overwhelming of other bivalve species by the arc shell seems to be the consequence of both ecological and anthropogenic factors.

The purpose of this work is to study contemporary conditions of zoobenthos and to make analysis of changes in benthic communities, observed near the North Caucasian coast during last several years.

MATERIAL AND METHODS

Material was collected in five cruises of R/V "Akvanavt" in summer and autumn each year from 1999 to 2003. It was taken more then 100 stations along the North Caucasian coast from Adler to Kerch Strait (Figure2).

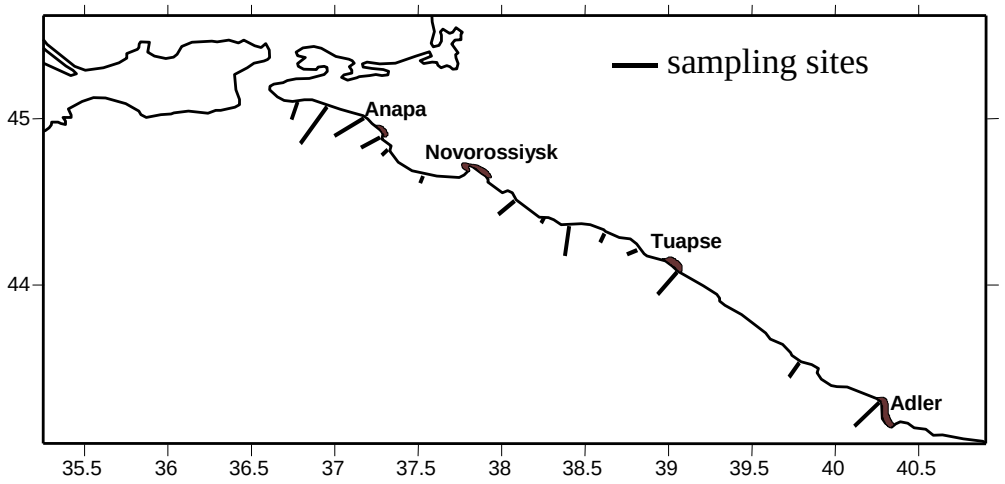

Figure2. Location of the sampling sites on the North Caucasian coast in 1999-2003

Five diver grabs with sampling area 0,1 m^2 were taken at each station. Samples were sieved through a 0,5 mm sieve and preserved in 4% formaldehyde, for subsequent sorting in laboratory.

RESULTS AND DISCUSSION

Investigations produced an unexpected result. The North Caucasian coast now can be divided into two quite different parts, according to the state of coastal benthos, the first one – from Anapa to Kerch Strait, the second one – from Novorossiysk to Adler.

The southern part of the shelf have undergone especially strong changes. The rise of the muddiness that coincided with the introduction of *Mnemiopsis leidyi*, invoked moving of phytal zone, destroy of algae communities at a depth of more than 10 m, and that opened for Rapana the way to the large amount of food objects and caused drastic increase in the number of this predator In 1999 density of its population on hard bottom ran up to 50 specimens per square meter. Community with *Chamelea*

gallina dominance was obtained only at shallow depth of 5-11 m, biomass and abundance of *C.gallina* corresponded with the data, cited for this depth range in 1963 (Kiseleva M.I., 1977). But at a depth range of 20-30 m, which was mentioned by Kiseleva as the "core of *C.gallina* biocenose", the situation was quite different: *C.gallina* has completely disappeared. (Figure3).

A range of species, for example, bivalves *Gouldia minima* and *Acanthocardia paucicostata*, which were the community subdominants in 1980-1989, were absent too. However, in 2000 the situation again radically changed. The enormous quantity of juvenile *Chamelea* (up to 13000 sp/m^2) was observed at a depth 10-18 m and deeper – at a depth of 20-35 m a large amount of juvenile specimens of an alien bivalve *Anadara inaequivalvis* (up to 3000 sp/m^2) was found out.

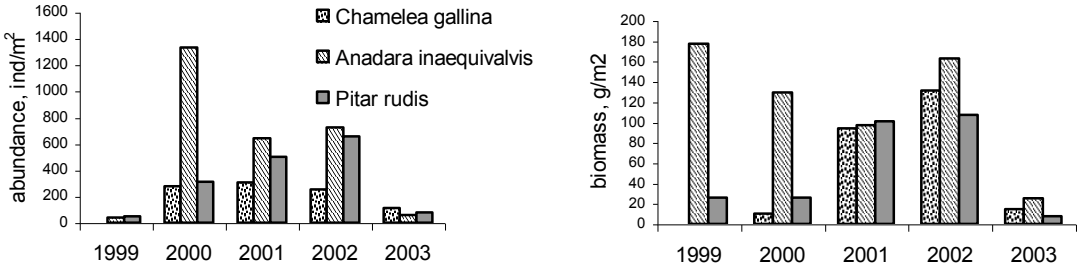

Figure 3. The dynamics of biomass and abundance of dominant species during last years (20-30m).

C.gallina in the Black sea spawns in August-September (Zahvatkina K.A., 1963) and *A.inaequivalvis* in September-October (Kazankova I.I., 2002), therefore, in our probes bivalves, which have settled one year ago, are presented. This conclusion is confirmed with the size-structure analysis of *C.gallina* and *A.inaequivalvis* populations. Individuals of *C.gallina* in the second autumn of life are about 6-10 mm (Chukhchin, 1965), and individuals of *C.gallina* and *A.inaequivalvis* in our samples are about 5-10 mm. We concern the mass settlement of bivalve larvae to be the result of abrupt decrease of ctenofore *Mnemiopsis leidyi* in autumn 1999 due to the invasion of obligate ctenoforefagous ctenofore *Beroe ovata*. Omnivorous ctenofore *Mnemiopsis* eats pelagic bivalve larvae, and its elimination permitted bivalve larvae to settle.

During next two years we didn't observe any new recruitment, neither *A.inaequivalvis*, nor *C.gallina*. Probably that it is connected with large amount of bivalves from elder age groups, which prevent larvae to settle. However such mass settlement led to the delay of bivalve growth, and that became the reason for the reproduction and development of small *Rapana*, which obtained admittance to the large amount of food objects. In normal communities the abundance of young *Chamelea* (5-10

mm) is about several dozens per square meter. As a result, in 2002 we observed very high density of young *Rapana* – from 60 to 120 ind/m^2. And together with high density of *Chamelea* and *Anadara* – about several thousands per square meter, that led to almost complete eating away of bivalve populations in 2003 (Figure3).

The extensive collected material also allowed us to show the decrease of coastal benthos biodiversity (Figure4), comparing with 1960s, when there were several large-scale investigations of the North Caucasian coast (Kiseleva M.I., 1981). Along with the equal total probe square, the number of species in 2001 is half as great as in the year 1963.

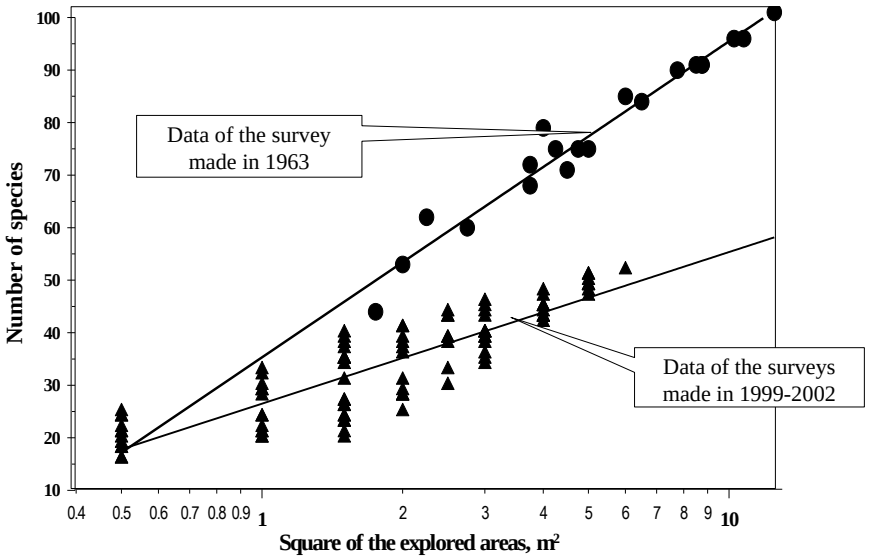

Figure4. The decrease of coastal benthos biodiversity

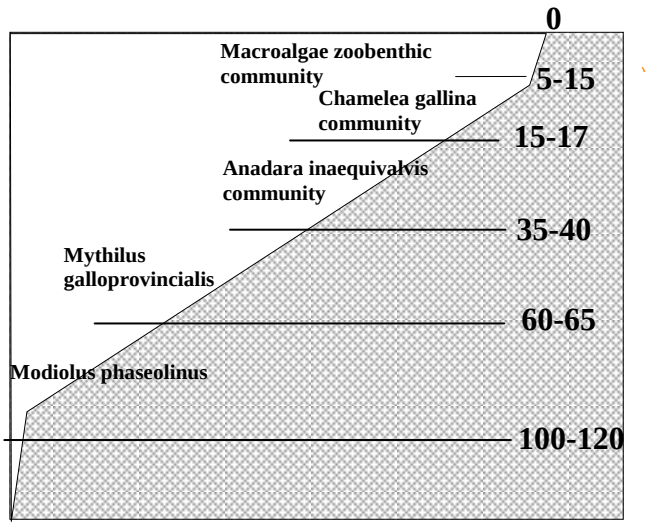

Figure5 Vertical distribution of the coastal benthic communities

Nowadays, the picture of the communities distribution to the south from Novorossiysk is as follows (Figure5): shallow-water sands less then 15 m depth are occupied with *Chamelea gallina* community, at a depth of 15-35 m there is a new community with dominance of *Anadara inaequivalvis*. The *Mytilus galloprovincialis* community exists only at narrow zone between 40 and 50 m.

CONCLUSION

Thus, the contemporary condition of soft bottom benthic communities depends on three factors connected with pelagic and benthic alien species:

1. The replenishment of bottom juvenile bivalve populations depends on the *Mnemiopsis-Beroe* interactions in pelagic zone.

2. Predator *Rapana*, which eats large specimens of benthic bivalves, controls further development of mollusk populations.

3. The ability of *A.ineaquivalvis* to resist the environmental stresses better then the native species do permitted it to become a dominant at a depth range from 15 to 30 m.

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