TEN-YEAR VARIABILITY OF BIVALVIA TAXOCEN IN PETER THE GREAT BAY (JAPAN SEA)

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Introduction

Main sources of pollution of the coastal zone of Peter the Great Bay were industrial enterprises of cities Vladivostok, Nakhodka and settlements located in the coastline. On data of Primorsky branch of Far-Eastern basin management the coastal zone of Peter the Great Bay was thrown off 150 thousands m^3/24 hours of polluted waste waters including about 30 thousands m^3/24 hours in Amursky Bay and about 50 thousands m^3/24 hours in Golden Horn Bay.

Control for pollution of water objects only through chemical indexes is not sufficient. Control through hydrobiological indexes is preferable, because one provides possibility of straight estimation of water ecological systems condition under anthropogenic influence.

Marine organisms and their populations are sensitive to presence of environmental pollutants. Zoobenthos shows quality of sea waters and condition of ecological system most clearly. Bottom communities consisting of mainly little motion and attached animals are sensitive system, which is able to reflect new chemical conditions in marine environment. As result there happen qualitative and quantitative changes, *i.e.* disappearance of the most pollution sensitive organisms and keeping of organisms, which have adapted to new conditions (Instruction, 1980).

In this connection authors set a task for themselves to clear whether *bivalve molluscs* (*Bivalvia*), one of the most important and mass group of marine benthos of Peter the Great Bay, serve indicators on presence of environment pollutants. For answer, on base of ten-year variations of quantitative indexis, authors have tried to reveal tendency of development of this taxocene with help of “trend” calculating. “Trend” is random, slowly changing component of temporal row, on which random variations and seasonal effects may be laid on.

Material and Methods

This work was made through results of observations of Vladivostok Center of gydrobiologic laboratory on studing and controlling environmental marine pollution. Laboratory organized and carried out expeditions from 1979 to 1988 in areas of north-western part of Pacific ocean, in open part of the Japan sea and its bays.

Taking and working of samples were made according to widespread methodic (Instruction, 1983). Benthos was sampled in different yeas by grabs with area of catching 0.025, 0.083, 0.1 m^2 (with subsequent recounting of all quantitative indexes on 1 m^2). Benthos organisms were washed through system of sieves with mesh size 2 mm^2 and 1 mm^2.

For investigation we have examined only Amursky, Ussurisky and Golden Horn Bays exposed to influence of anthropogenic pressure. Observations were taken every year in spring, summer and autumn for ten years (1979-1988) at standard stations (Fig. 1).

These data have been tested on presence of “trends” (*T*) and seasonal variability (*S*) by help of computer program MESOSAUR 1.0. For calculation there were used number of species (*N*), biomass (*B*), abundance (*A*), index of species diversity Schennon-Viner (*H*).

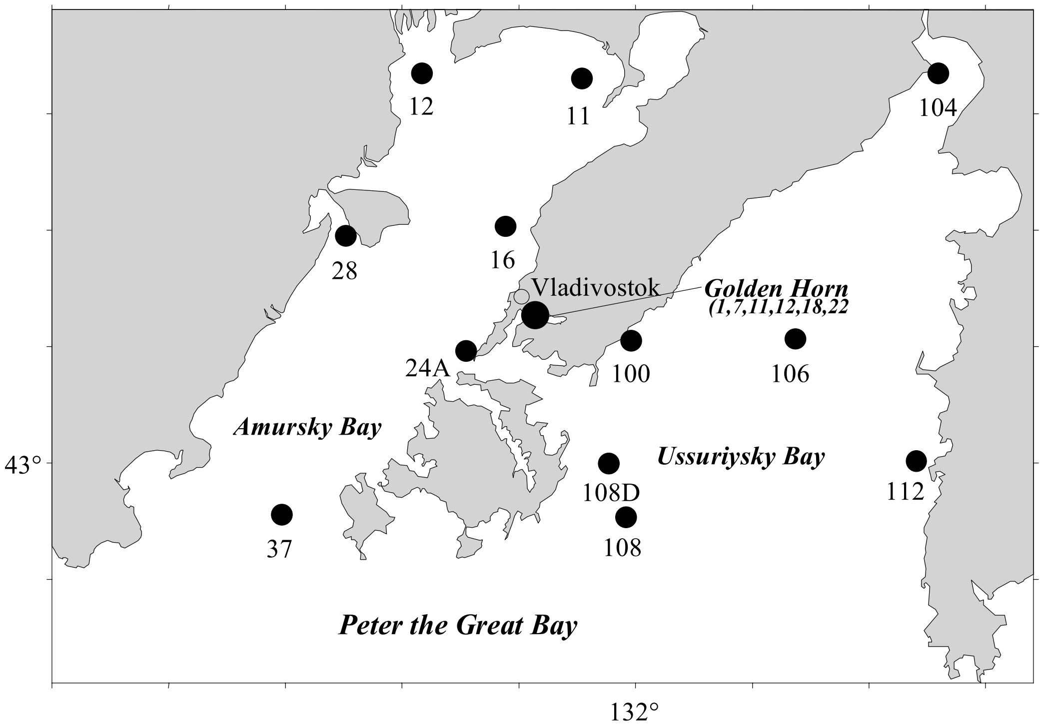

Fig. 1. The map of standard stations location

Results and Discussion

For discussion of results it is necessary to give short summarized information about ecological situation of Amursky, Ussurisky and Golden Horn Bays. On level of contamination Amursky Bay was considered as “moderate contaminated”, except separate areas with very high level of contamination (area of dumping – station 24A, the eastern coast). On level of contamination by priority pollutants Ussurisky Bay may be considered relatively “clear” (Tkalin *et al*., 1993), except the coastal zone near western shore (Yearbook, 1979).

The most dirty area of Peter the great Bay is Golden Horn Bay accepting big quantity of waste waters of city Vladivostok and being place of stopping of numerous fleet. Average level of pollution of sea water here by oil products and phenols exceeds limit permissible concentrations continually (Yearbook, 1979).

For Golden Horn Bay “trends” were not calculated, because mollusks were found here only in two samples. We could not use stations 108D and 112 of Ussurisky Bay also because of absence of necessary information. For other stations of Amursky and Ussurisky Bays “trends” were calculated.

Table 1 shows, that “trends” (both positive and negative) exist in a few cases, – frequency of meeting for Amursky Bay is 33% and for Ussurisky Bay – 19%.

For stations located near eastern coast of Amursky Bay (st. 16 and st. 24) and near western coast of Ussurisky Bay (st. 100) “trends” are either negative or absent.

For stations near western coast of Amursky Bay and control station 37 “trends” are either positive or absent. In Ussurisky Bay positive “trend” of species number is observed for stations 104 and 108 located far from industrial zone of the bay, and negative “trend” of abundance – at station 106 located in the center of Ussurisky Bay.

The most demonstrative graphs of “trends” are shown in Fig. 2-5: negative “trend” of abundance at st. 16 of Amursky Bay (Fig. 2); positive “trends” of species number, biomass and index of species diversity at st. 37 of Amursky Bay (Fig. 3); positive “trends” of species number at stations 104, 108 of Ussurisky Bay (Fig. 4, 5).

As for seasonal variability, it is either expressed clearly or disturbed (Table 1, Fig. 2-5).

Table 1

Results of examination of taxocene Bivalvia variations on presence of "trend" (T) and seasonal variability (S)

Station	Parameter	*N*	*B*	*A*	*H*
11	*T*	0.139	*(+) 0.040*	0.185	*(+) 0.011*
	S	*0.001*	*0.000*	*0.000*	0.063
12	*T*	0.231	*(+) 0.050*	0.122	*(+) 0.044*
	S	0.176	*0.000*	*0.010*	0.075
16	*T*	0.674	0.133	*(-) 0.003*	0.087
	S	0.532	0.822	*0.001*	0.410
24	*T*	0.925	0.840	0.594	0.979
	S	*0.012*	*0.000*	*0.000*	*0.004*
28	*T*	0.681	0.498	0.416	0.846
	S	*0.036*	*0.017*	0.140	0.408
37	*T*	*(+) 0.002*	*(+) 0.042*	0.340	*(+) 0.003*
	S	*0.001*	*0.000*	*0.000*	*0.000*
100	*T*	0.174	0.119	0.708	0.320
	S	*0.028*	*0.000*	*0.000*	*0.017*
104	*T*	*(+) 0.049*	0.359	0.195	0.083
	S	0.565	*0.001*	*0.000*	*0.002*
106	*T*	0.823	0.584	*(-) 0.003*	0.939
	S	*0.000*	*0.000*	*0.000*	*0.000*
108	*T*	*(+) 0.003*	0.476	0.313	0.454
	S	0.126	*0.000*	*0.000*	*0.023*

Note: levels of significance are made by italics print in case of significant ($p \leq 0.05$) *T* and *S*; character of "trend" is pointed in parenthesis: (-) – negative, (+) – positive

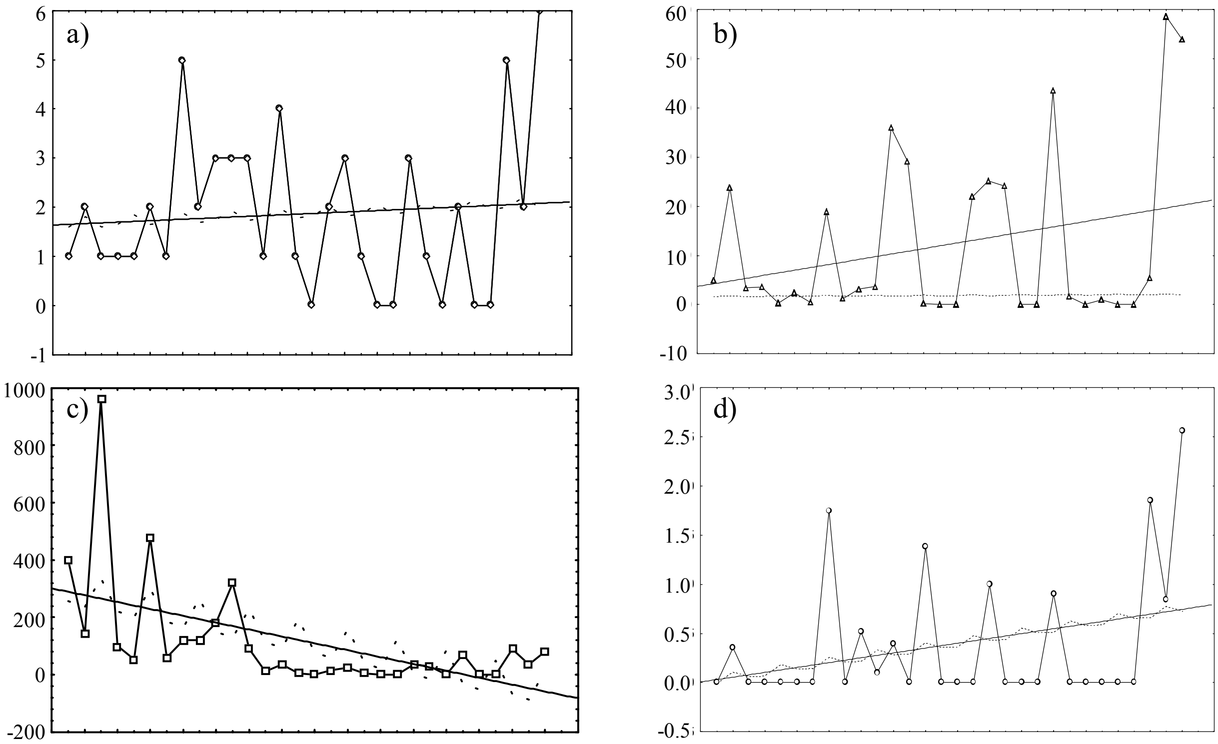

Fig. 2. Graphics of "trends" at station 16 for: (a) species number, (b) biomass, (c) abundance, (d) index of species diversity; dotted line - seasonal variability

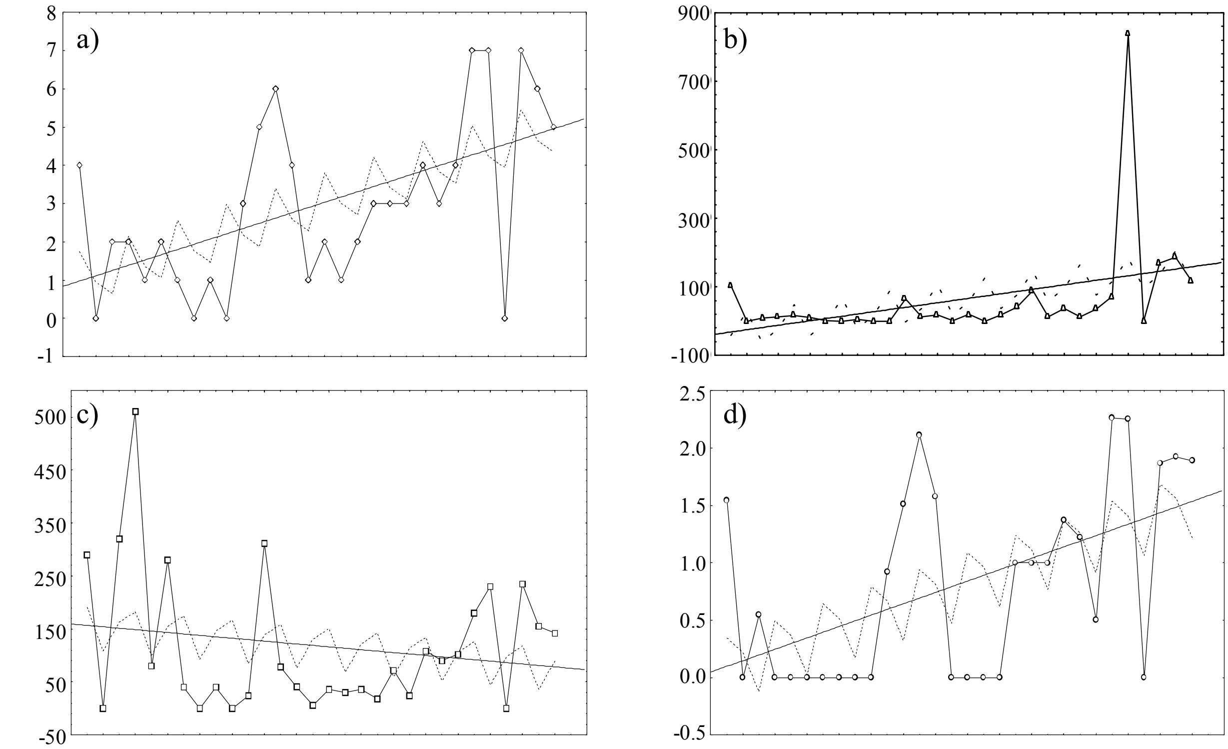

Fig. 3. Graphics of "trends" at station 37 for: (a) species number, (b) biomass, (c) abundance, (d) index of species diversity; dotted line - seasonal variability

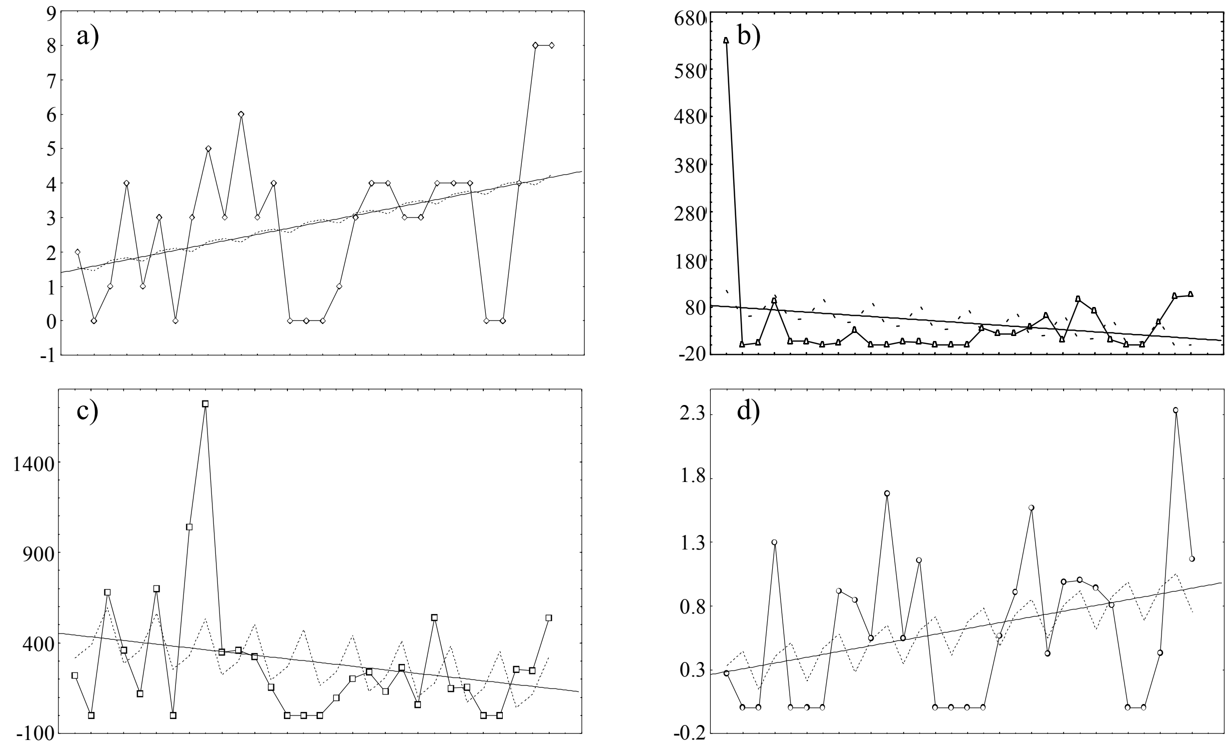

Fig. 4. Graphics of "trends" at station 104 for: (a) species number, (b) biomass, (c) abundance, (d) index of species diversity; dotted line - seasonal variability

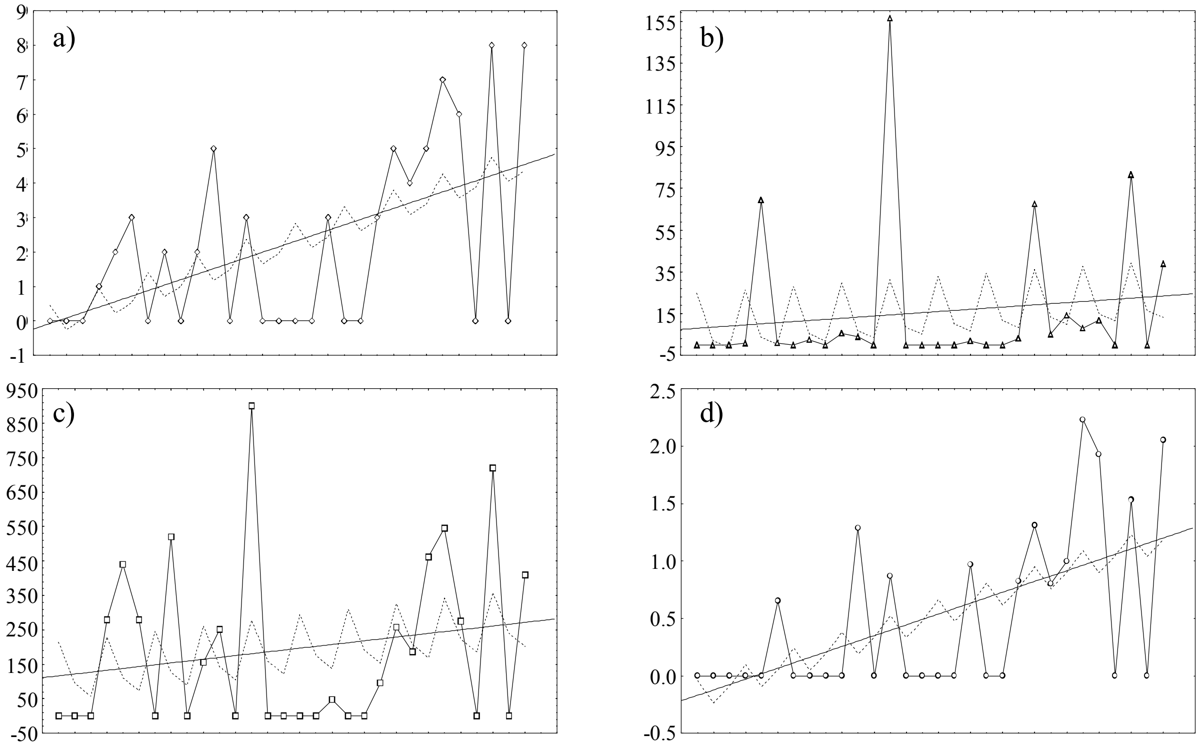

Fig. 5. Graphics of "trends" at station 108 for: (a) species number, (b) biomass, (c) abundance, (d) index of species diversity; dotted line - seasonal variability

Conclusion

Summarizing all of that we must admit we have not discovered tendency of decrease in quantitative indexes for Bivalvia, even at stations located near industrial zone of bays. On the base of our study we can't say about *bivalves molluscs* as indicators of environmental pollution.

That may be bad for researchers of ecology, but this fact may be good for nature. Absence of any "trends" in most cases and even existence anywhere positive "trends" testify that improvement of ecological situation in Peter the Great Bay (for exception probably Golden Horn Bay) can bring Bivalvia taxocene to initial, unimpacted conditions.

Facts showed that every dirty reservoir may become clear again, with diverse fauna, with recruitment of valuable commercial objects. For that depending on quality and degree of pollution various time is needed for recovery of cleanliness of water in reservoir (Stroganov, 1976).

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