ABOUT PROBLEMS OF THE BIOCOMPLEXITY OF MARINE ECOSYSTEMS ON THE EXAMPLE OF THE OKHOTSK SEA

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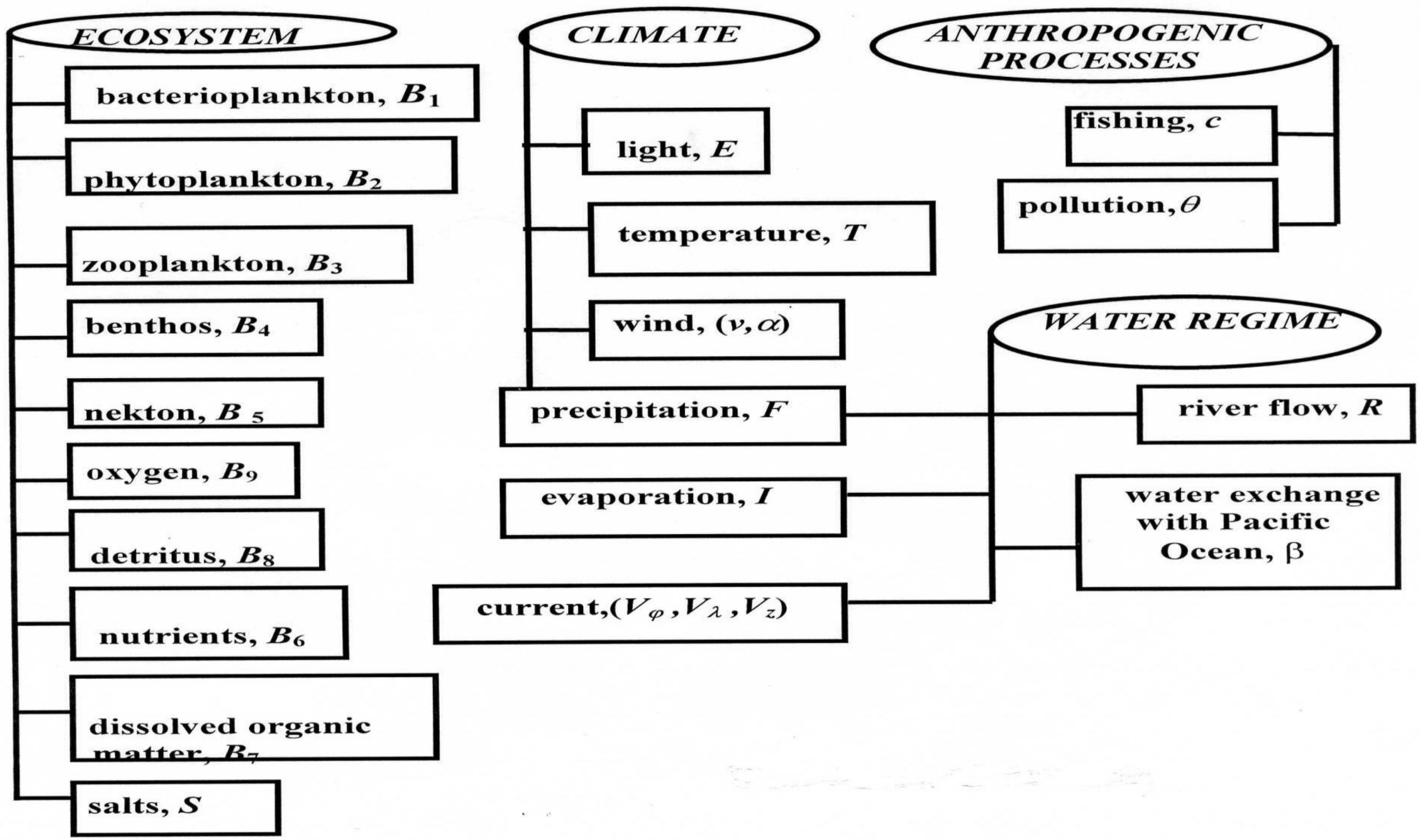
ABSTRACT

Biocomplexity of the environment is an indicator of the interconnectedness of its systems. Biocomplexity is an integral indicator of the state of the environment as a whole, taking into account biological bioavailability, biodiversity and survivability. The manifestation of biocomplexity is a characteristic feature of all environmental systems related to life. The elements of this manifestation are studied within the framework of the theory of stability and vitality of ecosystems. This paper is oriented on the development of biocomplexity indexes basing on the remotely measured environmental characteristics. Microwave radiometry is used as effective technique to assess the sea water parameters. As an example, the biocomplexity model of the Okhotsk Sea ecosystems is considered

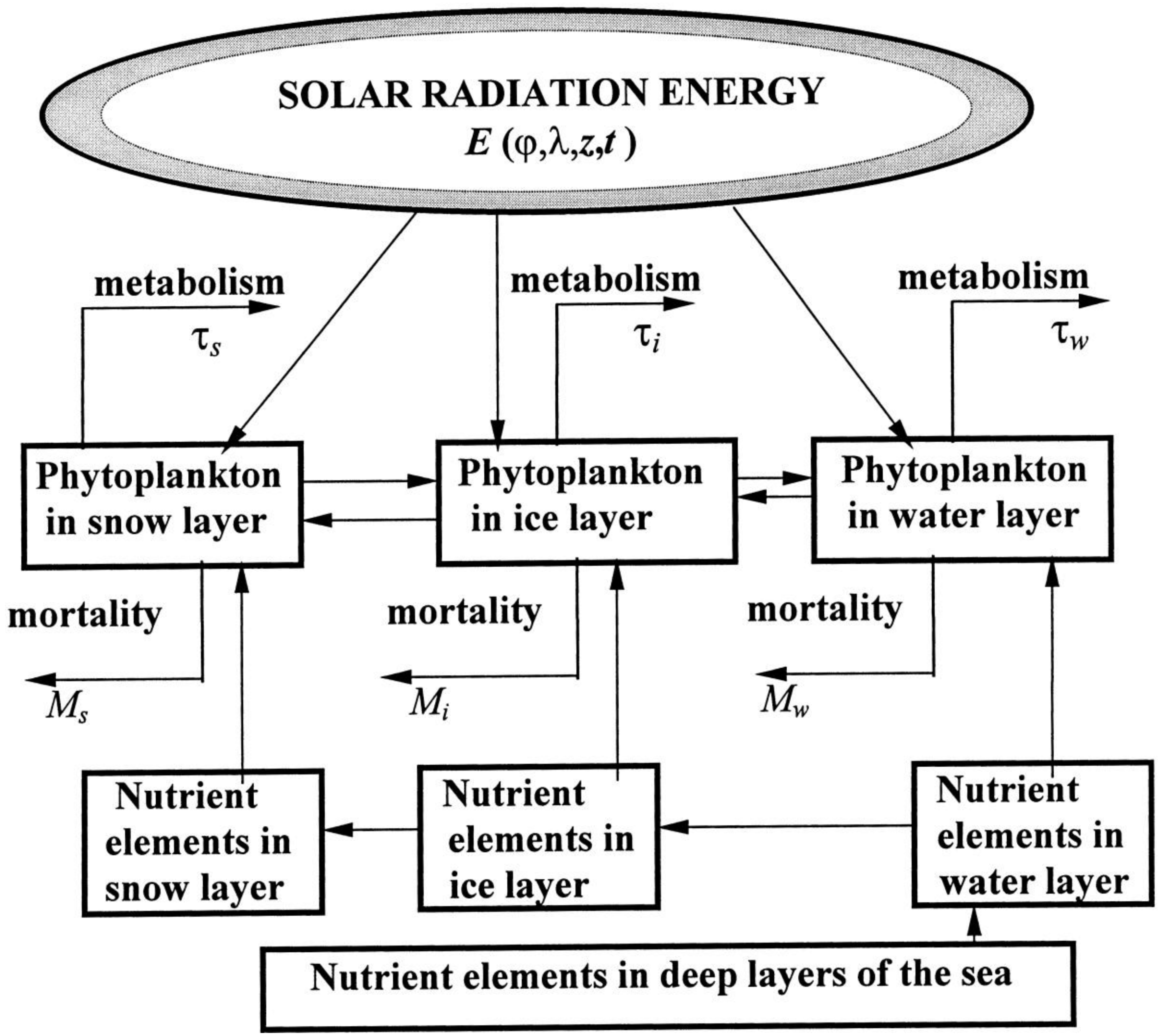
INTRODUCTION

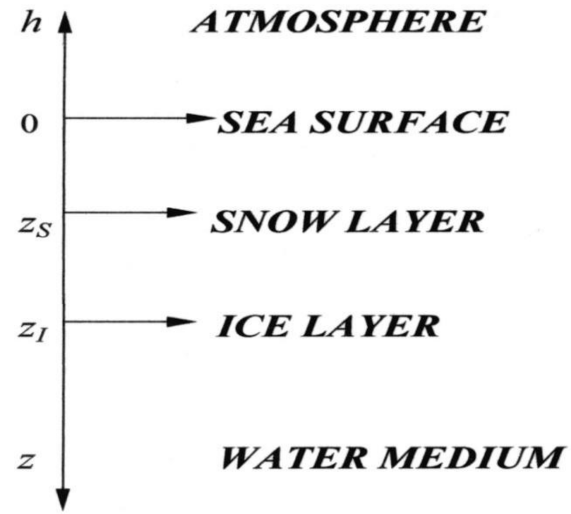
Attention to the Okhotsk Sea, as a unique ecosystem, is addressed in many studies. It is connected with the desire to understand the climate and environmental processes taking place here and to establish their interconnection with global processes, especially in the Arctic basin. For Russia and Japan, this is also important for economic reasons. Therefore, the synthesis of the simulation model of the Okhotsk Sea Ecosystem (SMOSE), which allows predictive assessment of the state of the ecosystem depending on global and regional changes in the environment, is certainly an urgent task. With the help of this model it is possible to establish some regularities in the dynamics of the trophic pyramid of the sea, and also to understand the mechanisms of regulation of the sea community due to external influences.

THE *SMOSE* STRUCTURE



CONCEPTUAL STRUCTURE OF THE BIOMASS KINETICS MODEL OF PHYTOPLANKTON UNDER CLIMATIC CONDITIONS OF THE OKHOTSK SEA ZONE

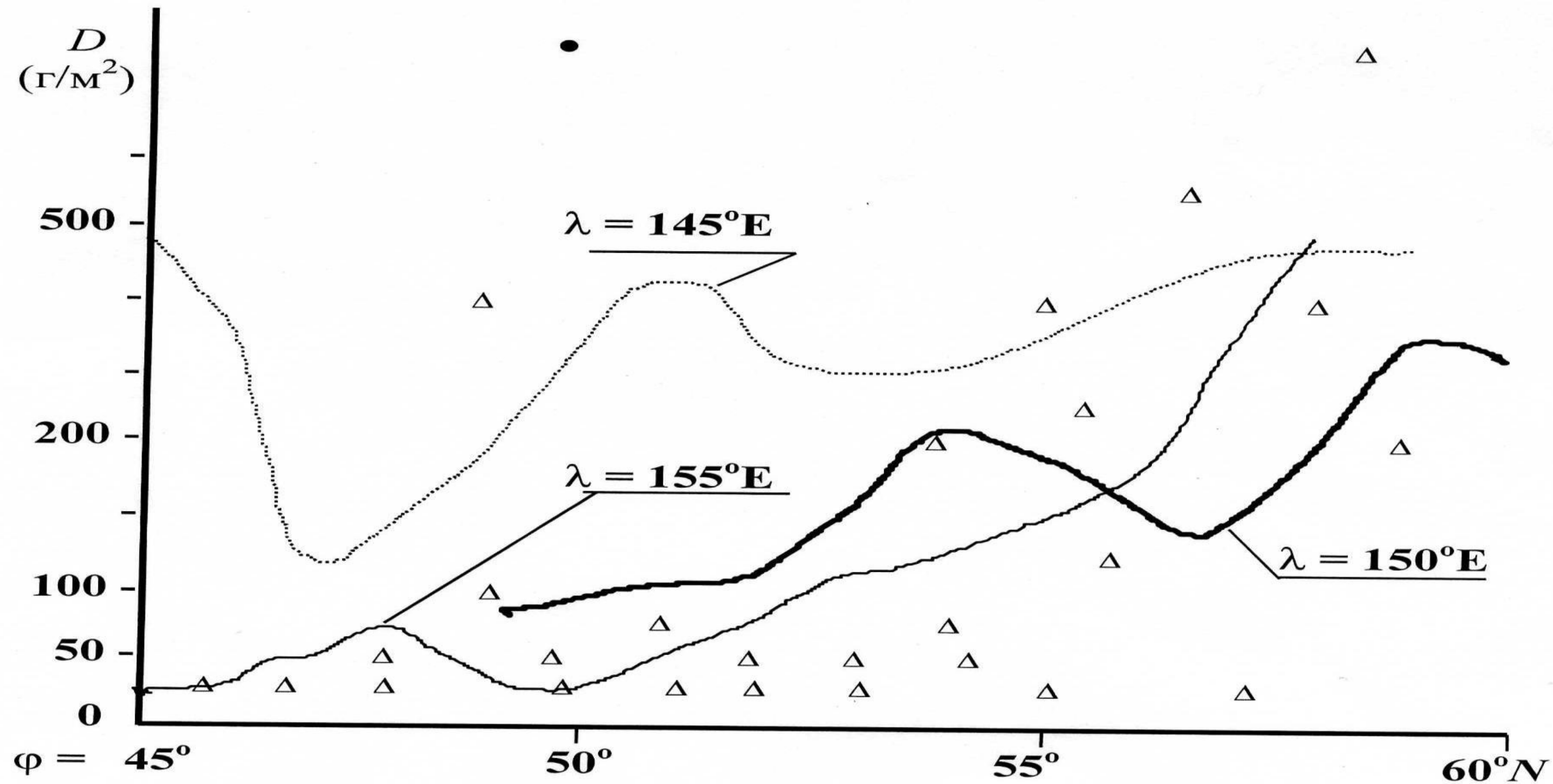




The source of external energy is solar radiation E (φ,λ,z,t),, whose intensity varies in latitude φ and longitude λ, with the depth of the sea z and in time t.

SPATIAL DISTRIBUTION OF A BIOMASS BENHTOS IN OKHOTSK SEA

Symbol Δ marks experimental or theoretical estimations, published by other authors for last 5 years.



INDICATOR OF BIOCOMPLEXITY

The biocomplexity model in the domain of concepts and attributes subject to a formalized description and transformation is as follows:

m elements - subsystems of the lower level, the interaction between which is defined by a binary matrix function: X=|| x_{ij} || , where x_{ij} = 0 , if the elements i and j do not interact; x_{ij} = 1 if the elements i and j are in interaction. In the general case, the exponent xij can be interpreted as the level of interaction between the elements i and j.

$$\xi = \sum_{i=1}^{m} \sum_{j>i}^{m} k_j x_{ij} \qquad \xi_\Omega(\varphi, \lambda, t) = (1/\sigma) \int_{(\varphi,\lambda)\in\Omega} \xi(\varphi, \lambda, t)\, d\varphi\, d\lambda$$

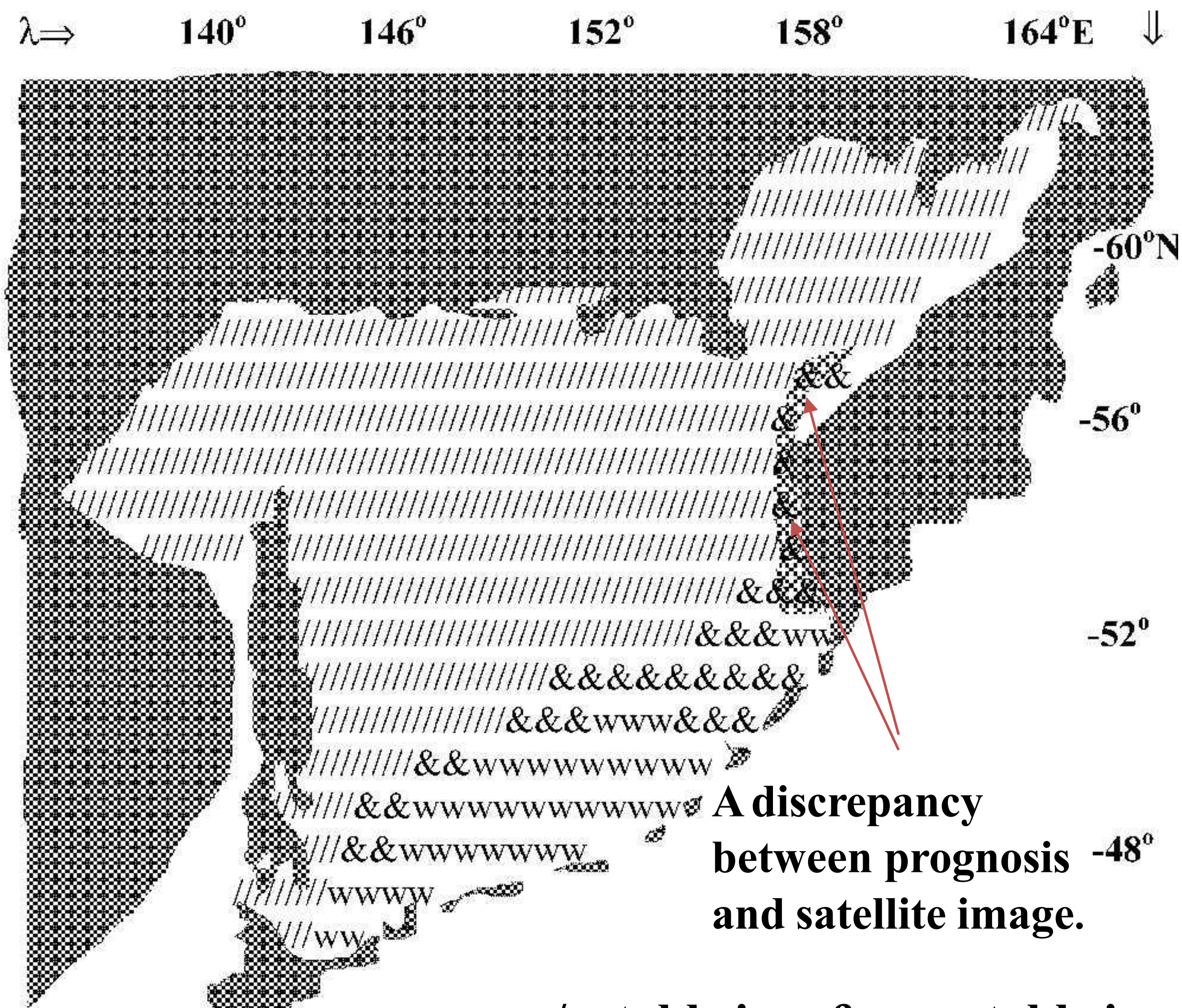
$$X = \|x_{ij}\|, \qquad x_{ij} = \begin{cases} 0 \text{ if subsystems } B_i \text{ and } B_j \text{ do not interact;} \\ 1 \text{ if subsystems } B_i \text{ and } B_j \text{ are interacting.} \end{cases}$$

THE TROPHIC PYRAMID OF OSE

Consumers of energy and substance	Source of energy and substance																		
	B_1	B_2	B_3	B_4	B_5	B_6	B_7	B_8	B_9	B_{10}	B_{11}	B_{12}	B_{13}	B_{14}	B_{15}	B_{16}	B_{17}	B_{18}	B_{19}
Phytoplankton, B_1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Bacterioplankton, B_2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Microzoa, B_3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Microzoa, B_4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carnivores, B_5	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Zoobenthic animals, B_6	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Flat-fish, B_7	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0
Coffidae, B_8	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
Ammodytes hexapterus, B_9	0	0	0	0	0	1	1	0	0	1	1	1	0	0	0	1	0	0	0
Mallotus, B_{10}	0	0	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0
Theragra chalcogramma, B_{11}	0	0	0	0	1	0	0	0	0	1	1	1	0	0	0	0	0	0	0
Salmonidae, B_{12}	0	0	0	0	0	1	1	0	0	1	1	1	1	0	0	1	0	0	0
Coryphaenoides, B_{13}	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
B_{14}	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
B_{15}	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0
Crabs, B_{16}	0	0	0	0	0	1	0	1	1	1	0	1	0	0	0	1	1	0	0
Laemonema longipes, B_{17}	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0
Biogenic salts, B_{18}	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Detritus, B_{19}	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
People, B_{20}	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

B_{14}-Reinchardti ushippoglossoi des matsuurae, B_{15}-Clupeapallasi pallasi Val.

THE ICE COVER PROGNOSIS OF OKHOTSK SEA



Global Model makes it possible to reconstruct the ice fields with high precision basing on the operative meteorological data and satellite observations with time interval equaled two months.

February, 2004 on initial data of the Japanese meteorological system for November, 2003.

/- stable ice; & - unstable ice; W- water surface

BIOCOMPLEXITY OF THE OKHOTSK SEA

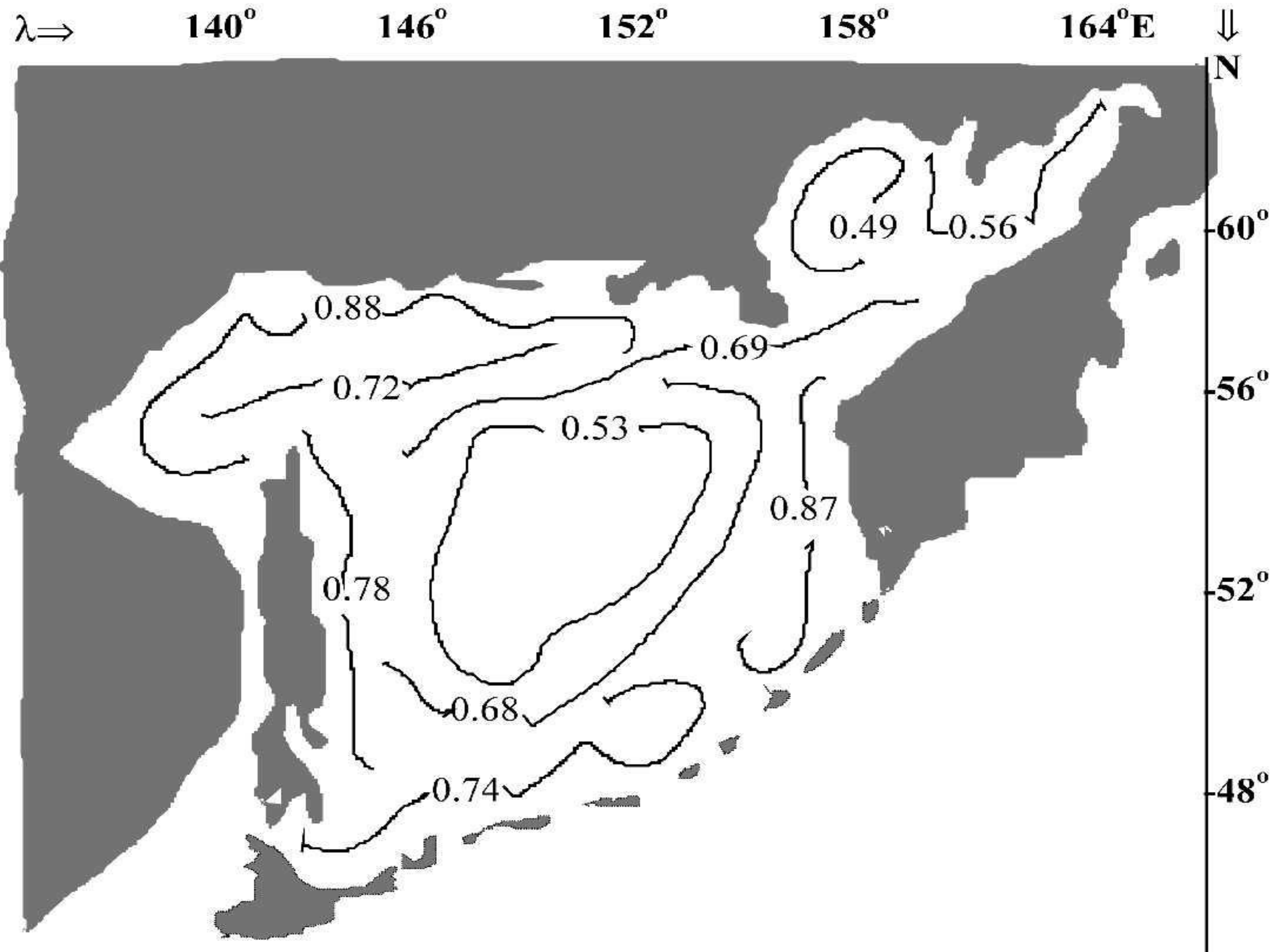
Trophical piramid Of the Okhotsk Sea ecosystem is described by the matrix $X = || x_{ij} ||$, where x_{ij} is binary value equaled to «1» or «0» under existence or absence of nutritive correlation between the *i*th and *j*th components, respectively. Define the biocomplexity as function:

$$\xi(\varphi,\lambda, z, t) = \sum_{i=1}^{20} \sum_{j=1}^{19} xij \cdot C\,ij \qquad x_{ij} = \begin{cases} 1, \text{if } B_m \geq B_{m,\min}; \\ 0, \text{if } B_m < B_{m,\min}; \end{cases}$$

where φ and λ are geographical latitude and longitude; t is current time; z is the depth; $B_{m,\,min}$ is the minimal biomass of the *m*th component consumed by other trophic levels; $C_{ij} = k_{ji}\, B_{i,*} / \Sigma_{j+}$ is the nutritive pressure of the *j*th component upon the *i*th component;

SPATIAL DISTRIBUTION OF THE INDICATOR OF BIOCOMPLEXITY OKHOTSK SEE

$$\xi_\omega(z_1, z_2, t) = (1/\sigma_\omega) \int_{(\varphi,\lambda)\in\omega} \int_{z_1}^{z_2} \xi(\varphi,, \lambda, z, t)\, d\varphi dz$$ **The biocomplexity indicator**



It reflects the level of complexity of the sea ecosystem. The basic variability in ξ is caused by migration process.

CONCLUTION

Marine environmental research methods include the mathematical models as main component giving the possibility to reconstruct the spatial image of sea ecosystem on the base of fragmentary information. Biocomplexity is clearly important characteristic of the NSS dynamics. It has importance for complex study of interactions between living and non-living elements of environment and, more significantly, it is can use make valuable contributions to the understanding and solution key socio-economic and environmental problems.

This paper proposes global model and biocomplexity indicator only one category in which biospheric processes are considered as predominating. Further study is to be oriented on the expansion of information taking into account in the global model and it is necessary the correlation dependencies between socio-economic and biospheric components make more precise.