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INSTITUTE OF MARINE BIOLOGY

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Primorsky Aquarium

Abstracts of the International Conference

Unique Marine Ecosystems: Modern Technologies of Exploration and Conservation for Future Generations

August 4–7, 2016
Vladivostok
Russia

UNIQUE MARINE ECOSYSTEMS: MODERN TECHNOLOGIES OF EXPLORATION AND CONSERVATION FOR FUTURE GENERATIONS

August 4-7 2016,
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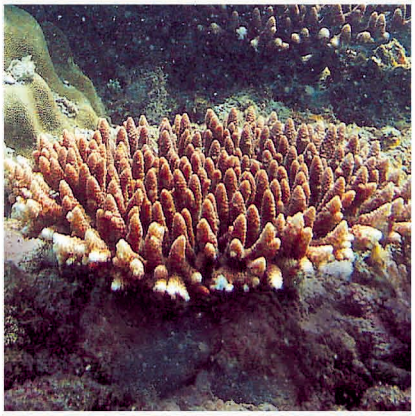

Federal Agency of Research Organizations
A.V. Zhirmunsky Institute of Marine Biology
Far Eastern Branch, Russian Academy of Sciences

Research and Educational Centre “Primorsky Aquarium”
Far Eastern Branch, Russian Academy of Sciences

Far Eastern Federal University

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Contents

Deep-sea investigations in the North-West Pacific: marine expeditions of the A.V. Zhirmunsky Institute of Marine Biology FEB RAS

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Within the last few years, a series of deep-sea expeditions to the Far-Eastern seas of Russia has been organized by the A.V. Zhirmunsky Institute of Marine Biology (IMB) FEB RAS. The main objectives of the expeditions were to study the biological diversity of the deep-sea and to examine the unique ecosystems of the northwestern Pacific Ocean using the most up-to-date underwater robotics and deep-sea sampling techniques. Three of these expeditions were international and organized together with our foreign partners, German research team headed by Prof. Angelika Brandt. These expeditions were implemented within the frameworks of the joint Russian-German scientific project on biodiversity studies of the deep-sea benthos in the North-West Pacific according the Memorandum of Understanding signed in 2007.

In 2010, the study of the biodiversity along deep-water transects (from 500 to 3660 m) in the deepest northwestern part of the Sea of Japan has been performed during the joint Russian-German expedition SoJaBio (Sea of Japan Biodiversity Study) onboard the RV *Akademik M.A. Lavrentyev*. Using the same most up-to-date gears and a sampling methodology standardised for all expeditions of the international programme CeDAMar (Census of the Diversity of Abyssal Marine Life), unique samples of marine biota were collected and high biological diversity (earlier unanticipated) on the continental slope and the abyssal plain of the basin was revealed. A total of 621 species of invertebrates were collected; of these, 201 species are new to science, and 105 species are new records for the Sea of Japan. Previously, only about 100 species of invertebrates were described from the depths of >500 m of the Sea of Japan. As a result of merely one expedition with using of the modern equipment, the number of species known for the deep-water part of the Sea of Japan has increased by 6 times. Detailed reports of the results of this expedition have been published in a special volume of the "Deep-Sea Research. Part II" (V. 86–87, 2013; 23 papers).

In 2011 and 2013, two expeditions onboard the RV *Akademik M.A. Lavrentyev* (owned by FEB RAS) to the Sea of Okhotsk have been organized together with the Research and Education Center "Primorsky Aquarium" FEB RAS. For the first time, complex investigations of the deep-sea ecosystems of the Derjugin Basin (1700 m) of the sea were performed using underwater robotics, including a ROV, which is capable of sampling bottom substrates and certain marine invertebrates (Fig. 1). Biological diversity was examined in active gas emission zones with high methane concentrations and in heavy-hydrocarbon seep areas. The so-called Barite Mountains (massive barite "smokers"), which provide the substrate for numerous benthic invertebrates, were examined with the use of

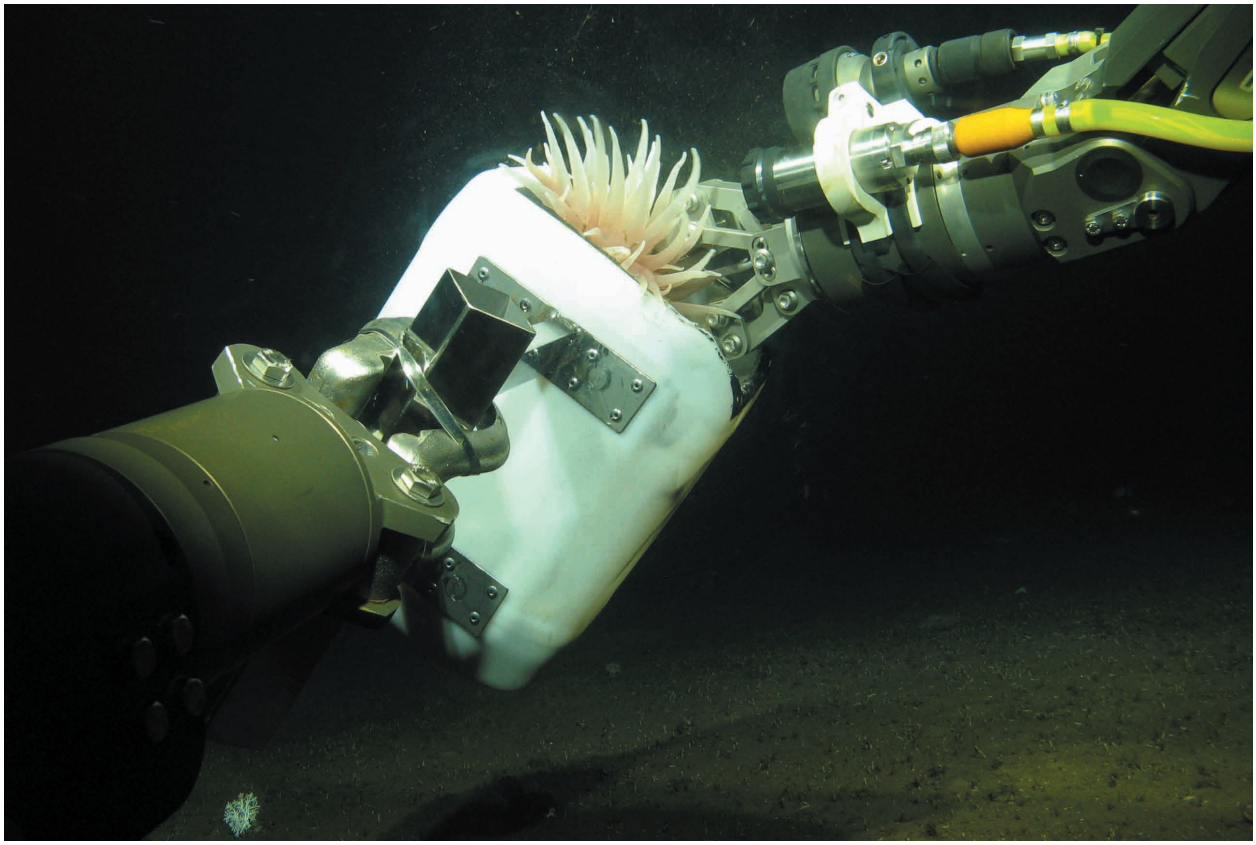

Fig. 1. Sampling of sea anemones, Sea of Okhotsk, depth 1600 m.

remotely operated robotics for the first time (Fig. 2). The peculiarities of the bottom landscapes of the Derjugin Basin were for the first time described in detail with the use of high resolution video equipment. Unique bottom communities with high densities and biomass of sea organisms that are supported by bacterial chemosynthesis and methanotrophy were described. About 200 species of deep-sea organisms were recorded, which is indicative of the high biological diversity of these deep-water communities (Figs 3–5). Abundant assemblages of the Okhotsk Sea endemic mollusks that are maintained due to chemoautotrophic symbiotic bacteria were discovered. Aggregations of pogonophore worms that are also nourished by symbiotic bacteria were discovered. Remarkably, the most active zones marked by molluskan assemblages are characterized by the seeping of heavy hydrocarbons resembling petroleum or bitumen. A similar phenomenon is known for the low-temperature seep area in the Gulf of California, where the thermal solution passing through the thick sediment layer causes the heavy-hydrocarbon enrichment of the sediment. Investigations of marine mountains in the North-West Pacific were continued in the deep-water expedition in the Bering Sea (Piip Volcano) aboard the RV *Akademik M.A. Lavrentyev* in Summer 2016. Researches of hydrothermal communities on the volcano slope along the deep-water transect from 4278 to 349 m were performed using the ROV *Comanche*. Great abundance of marine creatures was collected for further researches.

In 2012, the German-Russian expedition KuramBio (Kurile Kamchatka Biodiversity Studies) onboard the German RV *Sonne* has been carried out with the aim to examine deep-sea benthic communities at 5000–6000 m depths in the area of the Kuril-Kamchatka Trench. Deep-sea investigations on twelve stations revealed high biodiversity of benthic organisms of all size classes on

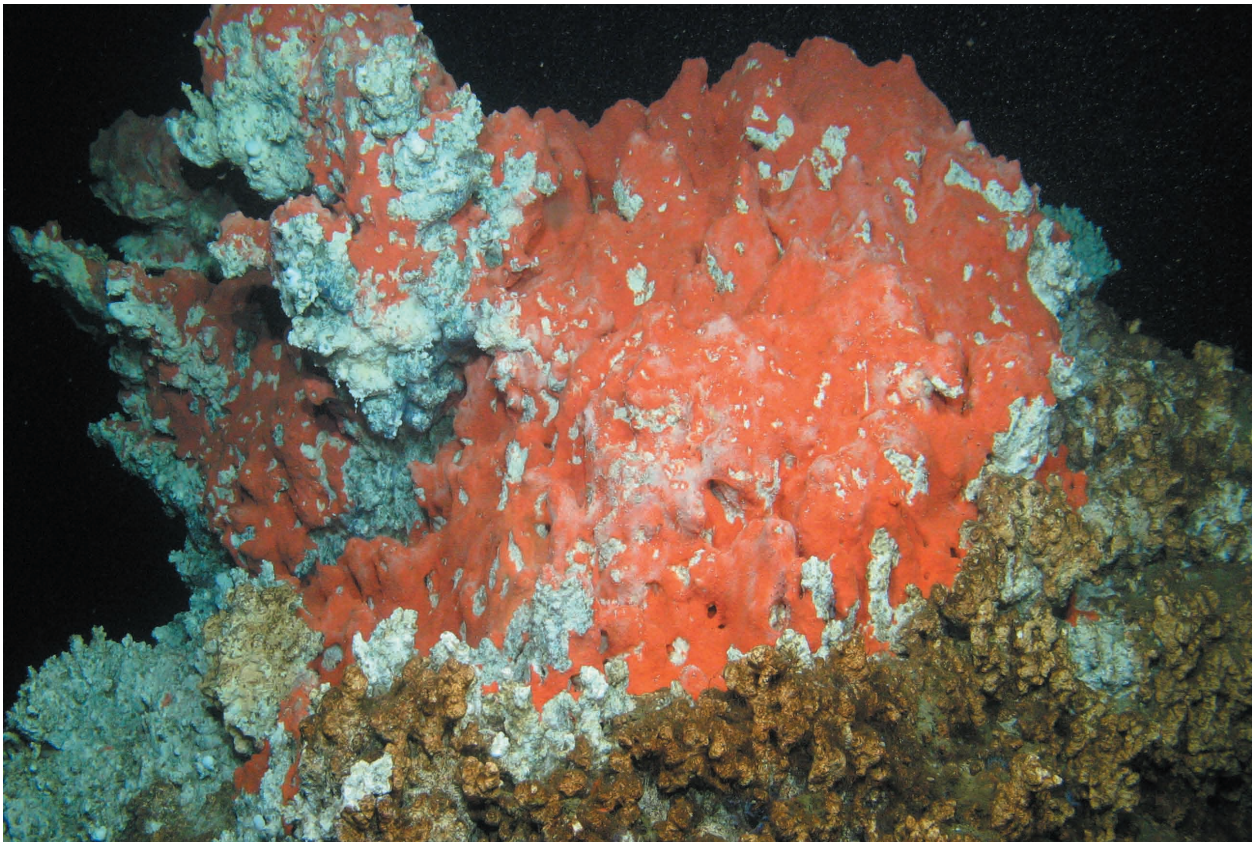

Fig. 2. Barite mountains, Sea of Okhotsk, depth 1550 m.

the trench slope and the adjacent abyssal plain. The number of species collected using the most up-to-date equipment during this expedition greatly exceeded the total number of species of deep-sea biota previously collected by the traditional deep-water methods during the entire period of research in the North-West Pacific (nearly 660). Only about 300 deep-water species were known from the same area, all of them been collected during about 40 years of RV *Vityaz* explorations in the North-West Pacific. During the KuramBio expedition1780 species of deep-water creatures were collected. About 60% of these species were designated by taxonomists as new to science and some of them are already described. Particularly great abundance and species richness was observed on the western slope of the trench, which makes further studies of the biodiversity of the hadal depths of the Kuril-Kamchatka Trench and adjacent deep-sea areas of the Russia Far-Eastern seas very promising and necessary. Detailed reports of the results of this expedition have been reported in a special volume of the "Deep-Sea Research. Part II" (V. 111, 2015; 34 papers). The investigations of the hadal depths of the Kurile-Kamchatka Trench will be continued in the next joint German-Russian expedition KuramBio II onboard of the new RV *Sonne* in August-September 2016.

In 2015, the joint Russian-German expedition SokhoBio (Sea of Okhotsk Biodiversity Studies) on board of the RV *Akademik M.A. Lavrentyev* to the Kurile Basin of the Sea of Okhotsk was successfully fulfilled. The first two joint expeditions have studied two rather different abyssal environments: young semi-enclosed deep-sea Basin of the Sea of Japan (SoJaBio-2010) and the open ancient Pacific abyssal area (KuramBio-2012). Compared to these two environments, the Sea of Okhotsk has somewhat intermediate characteristics. Its basin has a similar depth (3372 m) like the Sea of Japan, but it is less isolated from the ocean because of deep-sea straits to the Pacific, the Bussol Strait (2318 m) and

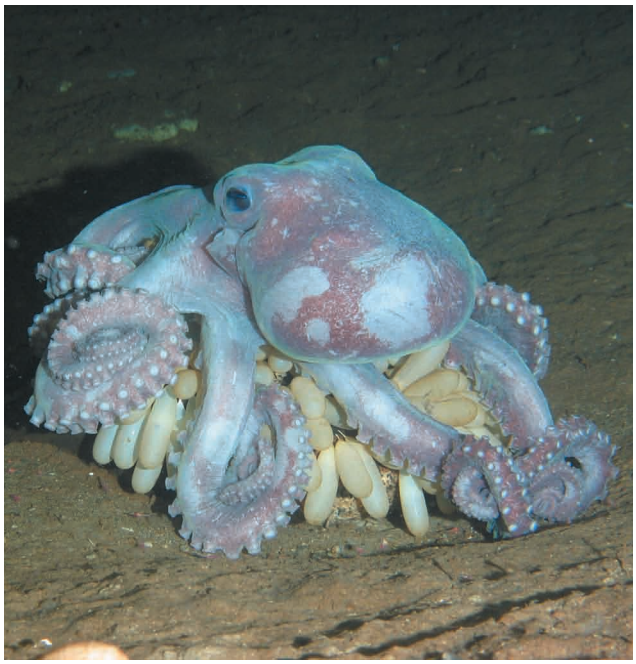

Fig. 3. Female of *Benthoctopus* sp. with egg laying, Sea of Okhotsk, depth 1550 m.

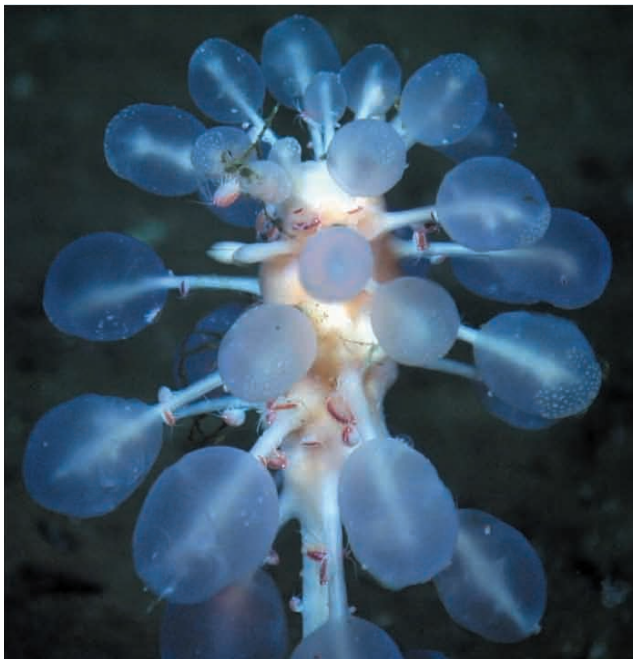

Fig. 4. Carnivorous sponge *Chondrocladia lampadiglobus*, Sea of Okhotsk, depth 1550 m.

Fig. 5. Sea anemone *Actinostola callosa*, Sea of Okhotsk, depth 1600 m.

the Krusenstern Strait (1920 m). Very few deep-sea investigations in the the Kurile Basin have been performed and only about 50 species of deep-water creatures were known for the depths >3000 m in this region. During the SokhoBio, 11 stations at depths between 1700 to 4700 m were accomplished and more than 1000 species of organisms have been sampled. About 50% of these species were designated by taxonomists as new to science and have to be described. The preliminary data illustrate that the abyssal macrofauna of the Sea of Okhotsk is fairly rich, specially comparing to that of the Sea of Japan. It shows similarities in species composition to the abyssal Pacific Ocean fauna. The fauna is mainly composed by cold-adapted eurybathic species and also of some true abyssal species that indicates to the close connection with the ocean fauna via the deep-sea straits. The results of this expedition will be published in a special issue of the "Deep-Sea Research. Part II".

The joint investigations in the deep-sea NW Pacific with our German colleagues will be undoubtedly continued in the near future. We hope to prolong the productive cooperation and expect new unique findings and new evidences of wonderful biological diversity of the ocean depths.

The study of deep-sea biota is very important not only from the viewpoint of expansion of our knowledge of global biodiversity, of biological resources for solving food security problems, but also for obtaining new types of biologically active compounds with the aim of developing new medicines.

Primorsky Aquarium of Far East Branch of the Russian Academy of Sciences – preserving unique aquatic ecosystems technologies

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Aquariums are the popular objects of the world's entertainment industry. In the aquarium's activities, there is a present-day trend to the raising environment education and public environmental awareness, and to development of scientific research within their verge.

Primorsky Aquarium FEB RAS being a part of the Russian Academy of Sciences is a separate research institution (Figs 1, 2). In 2016, the Primorsky Aquarium FEB RAS, the Institute of Marine Biology FEB RAS, and the Far Eastern Marine Biosphere Reserve FEB RAS are planned to be merged into National Scientific Center of Marine Biology (NSCMB). Priority areas of the Primorsky

Fig. 1. Main building of the Primorsky Aquarium FEB RAS.

Fig. 2. The promenade area side view of the Primorsky Aquarium FEB RAS main building.

Aquarium FEB RAS science activities within the NSCMB will be fundamental and applied research in the acclimatization, naturalization, and reintroduction of the marine biota species; development of scientific basis and modern technologies of husbandry and breeding of the threatened and endangered marine biota species; reproductive biology of the threatened and endangered species; research in the marine animals' physiology, ethology, and in the veterinary science; studying the marine animals higher nervous activity and behavior; research in molecular genetics, biochemistry, and biotechnology of the threatened and endangered marine organisms.

The Primorsky Aquarium's tanks and reservoirs will contain about 500 species of the marine and fresh-water organisms including invertebrates, seaweeds, marine mammals, and fishes (Figs 3–6). Representatives of all oceans and climatic zones of the Earth inhabiting aquariums of the Primorsky Aquarium FEB RAS will allow scientists to study them on the spot, without being in long-term expeditions. The Primorsky Aquarium FEB RAS provides radical new opportunities for hydrobiont cultivation to obtain new biologically active compounds; it is planned to perform research on cultivation in the aquaculture environment of organisms with specified productive characteristics and high disease-resistance. It becomes possible to conduct research in the aquatic mammal physiology, etiology, and veterinary science. A cryobank for long-term storage of the marine mammal biologic material including the threatened and endangered species – only one in Russia – is being founded. Tissues and cell culture of marine and freshwater mammals are collected to preserve the threatened and endangered species of Russian Far Eastern seas for future generations.

Located at the Primorsky Aquariums's areas, there are up-to-date equipped laboratories for conducting research in the field of biology, physiology, oceanology, and ecology. The educational unit with its auditoriums, a conference hall, and exhibition stock for realization of unique educational programs on the marine biology and ecology is an integral part of the Primorsky Aquarium FEB RAS. Using Aquarium's facilities, students and schoolchildren will have an opportunity to get into real scientific research process during their practical trainings. Advanced educational technologies in the system of affordable multilevel ecological education and awareness will focused on raising population's ecological consciousness and forming of new ideology of the human-nature relationship.

The Prymorsky Aquarium FEB RAS complex is composed of two buildings. The Exhibition building (Aquarium and Dolphinarium) has 37000 m^2 in area and 10000 m^3 of the total aquarium's water volume with about 15000 m^3 of the Dolphinarium water volume; a Scientific-and-adaptation building where new inhabitants are kept in quarantine has more than 7000 m^2 in area.

The Prymorsky Aquarium's display area is divided into three zones, each of which integrates several exhibits (Figs 7–11).

Fig. 3. Giant Pacific Octopus *Octopus dofleini*.

Fig. 4. Lion's mane jellyfish *Cyanea capillata*.

Fig. 5. Shoal of Pacific mackerel *Scomber japonicus*.

Fig. 6. Sea-anemone *Metridium senile* and sea squirt *Halocynthia aurantium*.

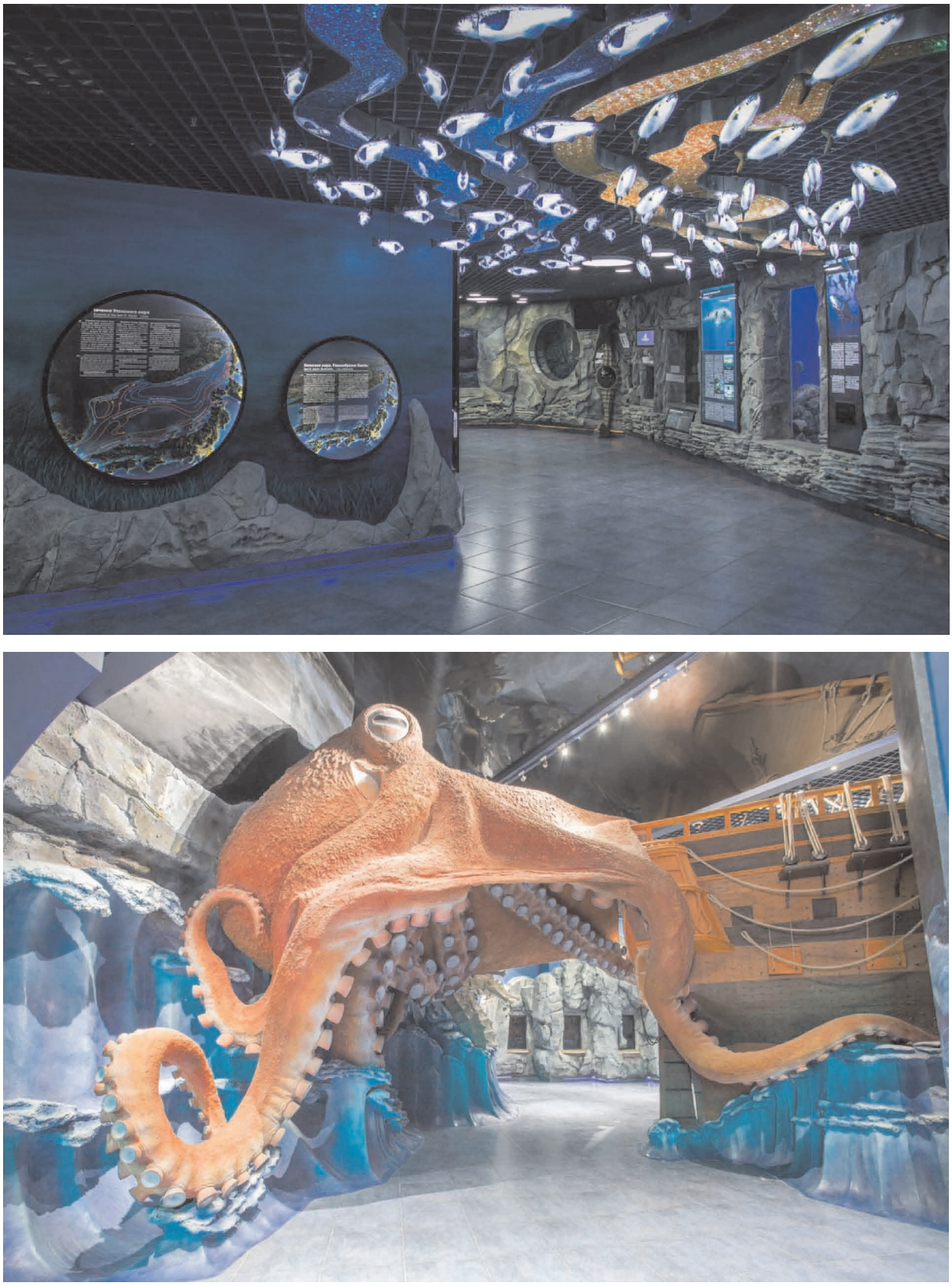

Fig. 7. Sea of Japan Exhibit.

Fig. 8. Amur River and Khanka Lake Exhibit.

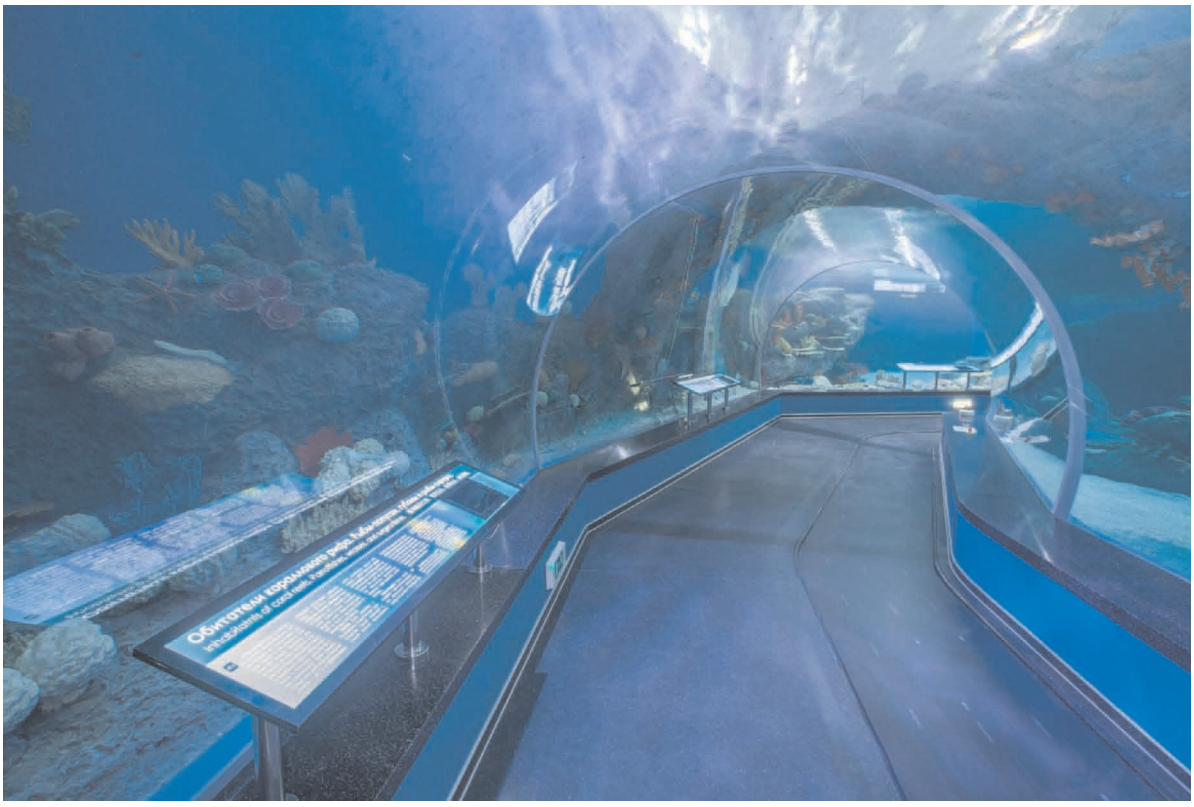

Fig. 9. The Coral Reef Exhibit and Acrylic Tunnel.

Fig. 10. Dolphinarium's Show Hall with a seating capacity of 800 seats.

The Evolution of the Ocean Life Zone

The Evolution of the Ocean Life Exhibit informs about origin of the Solar System 4.6 billion years ago and gives modern conceptions of the Earth history, formation of the World ocean, and origin of life on our planet. The Exhibit is filled with models, multimedia devices, and information stands.

The Marine MicroWorld Exhibit illustrates amazing world invisible to a naked human eye. The microworld originates all food chains in the ocean and determines existence and stability of the marine ecosystems. The exhibit displays enlarged models of the microscopic organisms. Using an optical (light) microscope, visitors can see with their own eyes the whole world in a water drop. They can get to know how an electron microscope works allowing them to see the smallest representatives of the organic world.

Russian Water Space Zone

Amur River, Lake Baikal, and Khanka Lake Exhibit introduces to variety of the natural landscapes, animals, and plants of Amur River basin. Amur River is one of the world's largest water artery having the biggest basin among all rivers running into the Pacific Ocean. The richest ichthyofauna among Russian rivers with about 150 fish species, including kaluga (*Amur sturgeon*) – the largest freshwater fish in Russia – belongs to Amur River.

Khanka is the biggest lake in the Russian Far East. The lake swamp plains surrounded with the largest wetlands in the East Asia provide a shelter to hundreds thousands of birds. In the Khanka Lake basin, 378 birds species are found, among them 55 species are listed in the Russian Red Book.

World's deepest Lake Baikal is the largest natural reservoir with pure fresh water. With its unique flora and fauna, Baikal houses 2600 animal species, more than a half of them are found only in Baikal being its endemics.

The Polar World Exhibit creates Arctic and Antarctic atmosphere, shows uniqueness of the region wildlife and narrates about Russia's role in the exploration of the high latitudes. There are models of technical means and vehicles of the exploration presented in the exhibit, from a Pomorie koch to a nuclear-powered ice-breaker. And the most fascinating part of the exhibit dedicated to Antarctic is a **Penguinarium**.

The Bering Sea and the Sea of Okhotsk Exhibit tells visitors about high-productive seas that provide large proportion of the fish and seafood caught in the Russian Federation. This exhibit shows northern fur seals.

The Sea of Japan Exhibit narrates about the warm and cold ocean currents giving rise to its wealth and abundance of species. 1170 fish species are found in the Sea of Japan including 365 species inhabiting the Russian Federation territorial waters.

Fig. 11. Conference hall with a seating capacity of 200 seats.

The World's Water Space Zone

Tropical Rain Forest Exhibit simulates a picture of the upland equatorial forest with a waterfall. The exhibit's demonstration reservoirs house tropical freshwater fishes, amphibians, and insects. The exhibit shows extraordinary beauty, specificity, and biodiversity of the tropical rainforest levels.

The Tropical Seas Exhibit offers the visitors to look closely at the tropical sea inhabitants' life. A tunnel made of thick acrylic glass with moving walkway will guide the visitors through a huge aquarium crowded with colourful coral fishes.

The Ocean Abyss Exhibit is the largest tank of the Primorsky Aquarium FEB RAS which contains more than 3000 tons of water held by acrylic glass 60 cm in thickness. Fast moving amberjacks, majestic sharks and rays, gigantic rock basses can be seen through the glass. Sense of immersion deepens when a visitor gets to the transparent acrylic capsule "soaring" in a water body.

The Primorsky Aquarium FEB RAS is fully engaged in solving problems on protecting the threatened and endangered marine and freshwater animal species. With opening the aquarium, new opportunities for a wide range of activities in the fundamental and applied sciences opened up for Far Eastern research and educational institutions, and for all activities to raise the level of population's ecological education and ecological awareness.

Educational function of artificial marine ecosystems: evidence from Finnish Maretarium

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For young generation, perception of nature is not only development of biological knowledge and acquisition of skills to use nature rationally, but also demonstration of love and care, as long as the reasons of poaching, contamination of environment, and excessive resources consumption are in thoughtlessness of people and their irresponsible attitude towards natural heritage. Society needs environmental education for life and well-beingin conditions of ecological crisis. Among the actions taken to preserve water environment is organization of aquariums and creation of artificial ecosystems where the most peculiar specimen of underwater world are demonstrated.

The most compelling example of public aquarium systems is Maretarium situated in Kotka, Finland. The center is organized for development of educational process. It is a place of interest both for all the guests of the cityand forlocal residents, who visit the aquarium regardless ofits collections' renovation. There are 22 thematic aquariums, and the most remarkable of them is a hugecylindrical 500 000 litres pool, devoted to underwater world of Baltic Sea. The depth of the pool is 7 meters, which is an average depth of Finish lakes. Besides, there are 20 small aquariums with hydrobionts of the region. Visitors of Maretarium can observe all the changes in life of the living organisms and see, for instance, fish species spawning eggs.

Maretarium gives an opportunity to learn and better understand aquatic environment. This kind of continuing education can affect one's actions in real life.

In addition to aquariums, there is a sea cinema with daily presentations and exhibitions, devoted to results of the recent researches of ichthyologists. Besides, there are halls for scientific seminars and natural history classes. It is in a sense a school for naturalists, where thematic lessons "Our River" and "The Gulf of Finland" take place.

Speaking of fish species and aquatic nature, Maretarium implements Finnish law concerning preserving nature. One of its five goals is to raise awareness of issues affecting the natural heritage and to increase recreational potential of nature.

Each Russian region also has special characteristics, that one needs to know. Baltic Sea plays a significant role for Northwestern Federal District: it is rich with natural resources and influences climate of the neighboring countries. Moreover, the ecological condition of many lakes and rivers of Leningrad Oblast raise concern. That is the reason why the possibility of creating an aquarium of this kind in Northwestern Federal District is being discussed.

Treatment of liquid radioactive waste containing seawater

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The analysis of the major problems encountered in management of liquid radioactive waste containing seawater has been considered. The sources of such wastes have been examined. It was found, that over the past half-century, the world has seen its share of incidents in which radioactive material has been dumped or discharged into the oceans. A British nuclear fuels plant has repeatedly released radioactive waste into the Irish Sea, a French nuclear reprocessing plant has discharged similar waste into the English Channel, and for decades the Soviets dumped large quantities of radioactive material into the Arctic Ocean, Kara Sea, and Barents Sea. That radioactive material included reactors from at least 16 Soviet nuclear-powered submarines and icebreakers, and large amounts of liquid and solid nuclear waste from USSR military bases and weapons plants. Still, the world has never quite seen an event like the one unfolding now off the coast of eastern Japan, in which thousands of tons of radioactively contaminated water from the damaged Fukushima Daiichi nuclear power plant are pouring directly into the ocean. Due to large-scale emissions of radioactive wastes into the World Ocean in last century, one of the important tasks is the development of technologies for seawater purification from hazardous radionuclides – ^{137}Cs and ^{90}Sr. Mentioned problem is also actual due to processing of liquid radioactive wastes, containing seawater that are formed during exploitation, maintenance and utilization of transport reactors of vessels.

The authors' experience is concerned with removal of long-lived radionuclides of cesium and strontium by sorption methods from LRW of salinity higher than 1 g/L). The paper describes the most commonly used sorbents for cesium removal and their shortcomings. The example demonstrates application of the sorption-reagent materials in ^{90}Sr extracting: these ones work efficiently not only in seawater but also at the concentrate salinity about 60 g/L. The characteristic sorption-reagent mechanism of ^{90}Sr removal from the solutions containing sulfate ions was experimentally corroborated and found similar to earlier studied amorphous barium silicate. The results of studies of composite materials based on barium silicate and resorcinol-formaldehyde resins to be applied for removal of cesium and strontium radionuclides from seawater are presented. It has been demonstrated that composite sorbents of this type are capable to efficiently decontaminate seawater at high rate providing very high decontamination factors. Experience of purification of water from hazardous radionuclides and industrial treatment of LRW, containing seawater, allows concerning selective sorption as the most successful approach. Sorption technology used nowadays for processing of water of high salinity and of complex chemical composition, including seawater, allows purifying medium-activity LRW with activity to 10^7 Bk/L, enabling to drop pure waters into basin (lower than 10^2 Bk/L with respect to ^{90}Sr, ^{137}Cs, ^{60}Co, lower than 0.1 Bk/L with respect to main transuranium elements). Materials used there are ferrocyanide sorbents and sorption reagent materials, produced by FEC "Dal'RAO" according to technology, developed in the Institute of chemistry FEB RAS.

The work is supported by Ministry of Education and Science (MES) RF (Decree P218, Agreement 02.G25.31.0166 at 01.12.2015 between Company Far Eastern plant "Zvezda" and MES).

Epibiotic algae on Japanese scallops from natural and cultivated populations in southern Primorye, Sea of Japan

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One of the problems of cultivation of the scallop *Mizuhopecten yessoensis* is shell fouling by other aquatic organisms. This study focuses on the epibiotic flora of cultivated and natural scallop populations in coastal waters of southern Primorye. The survey of scallop populations was carried out by the diving hydrobiological method in 7 areas. The depth and the type of bottom substrate were determined at each station; samples of live scallops together with epibiotic seaweeds were taken. The sample size ranged from 10 to 72 individuals.

The total number of epibiotic macroalgae species varied from 12 to 25 in natural populations, from 10 to 36 in mixed settlements, and from 12 to 36 in suspended and on-bottom scallop cultures. Rhodophyta predominated in terms of the number of species (see Figure); Phaeophyta species were the fewest. In most areas, *Polysiphonia morrowii*, *Palmaria stenogona*, *Sparlingia pertusa* (Rhodophyta), *Codium fragile*, and *Ulvaria splendens* (Chlorophyta) were predominant in terms of the occurrence frequency and biomass.

The contribution of Rhodophyta to the species richness of epibiotic flora was 58–64% in most of the studied areas; it was the greatest (70%) in the mixed scallop population in Voevoda Cove (Amur Bay) and the smallest (41.5%) in the suspended scallop culture in Podyapolskiy Cove (Ussuri Bay).

The proportion of Chlorophyta in the species richness of epibiotic flora was typically 20–25%. The maximum (42%) was observed in the native scallop population in Vostok Cove (Vostok Bay) and the minimum (18%) in Voevoda Cove.

The proportion of Phaeophyceae in the species richness of epibiotic flora in most of the studied areas was 12–17% with the maximum (20%) in the mixed scallop population in Kievka Cove (southern Primorye) and the minimum (0%) in the natural scallop population in Vostok Cove (Vostok Bay). This value was low (8%) in the on-bottom scallop culture in the Strait of Stark (Peter the Great Bay).

In the mixed scallop settlement of Sivuchya Bay (southwestern part of Peter the Great Bay), the total number of algal species was 36, including 22 Rhodophyta, 5 Ochrophyta, Phaeophyceae, and 9 Chlorophyta. Based on the results of long-term studies in Sivuchya Bay, we analyzed the proportions of the main algal groups in the structure of epibiotic flora of the scallop *Mizuhopecten yessoensis* in different periods of its life cycle.

In cultivated scallop settlements, the maximum number of epibiotic Rhodophyta and Chlorophyta species was observed in the 4th year of life of the host scallop; 40% of the examined scallops

Red algae on the Japanese scallop.

were fouled by them. In natural scallop populations, the maximum number of species of Rhodophyta and Chlorophyta was found in the 9th year of life (13% of individuals).

No distinct maximum of the number of Phaeophyceae species, depending on the longevity of the scallop, was found in natural scallop populations. Approximately the same number of Phaeophyceae species was recorded on the shells of 5-, 6-, 7- and 8-year-old scallops; 15–20% of all individuals were fouled. In cultivated populations, the maximum number of epibiotic Phaeophyta species occurred on 4-year-old scallops (10% of the studied individuals).

Thus, the long-term studies in Sivuchya Bay and other areas of southern Primorye have shown that cultivated scallops were fouled by macroalgae at a much earlier age than native mollusks.

Influence of warm-acclimation on molecular species composition and thermotropic behavior of major polar lipids of marine macrophytes *Saccharina japonica* and *Ulva lactuca*

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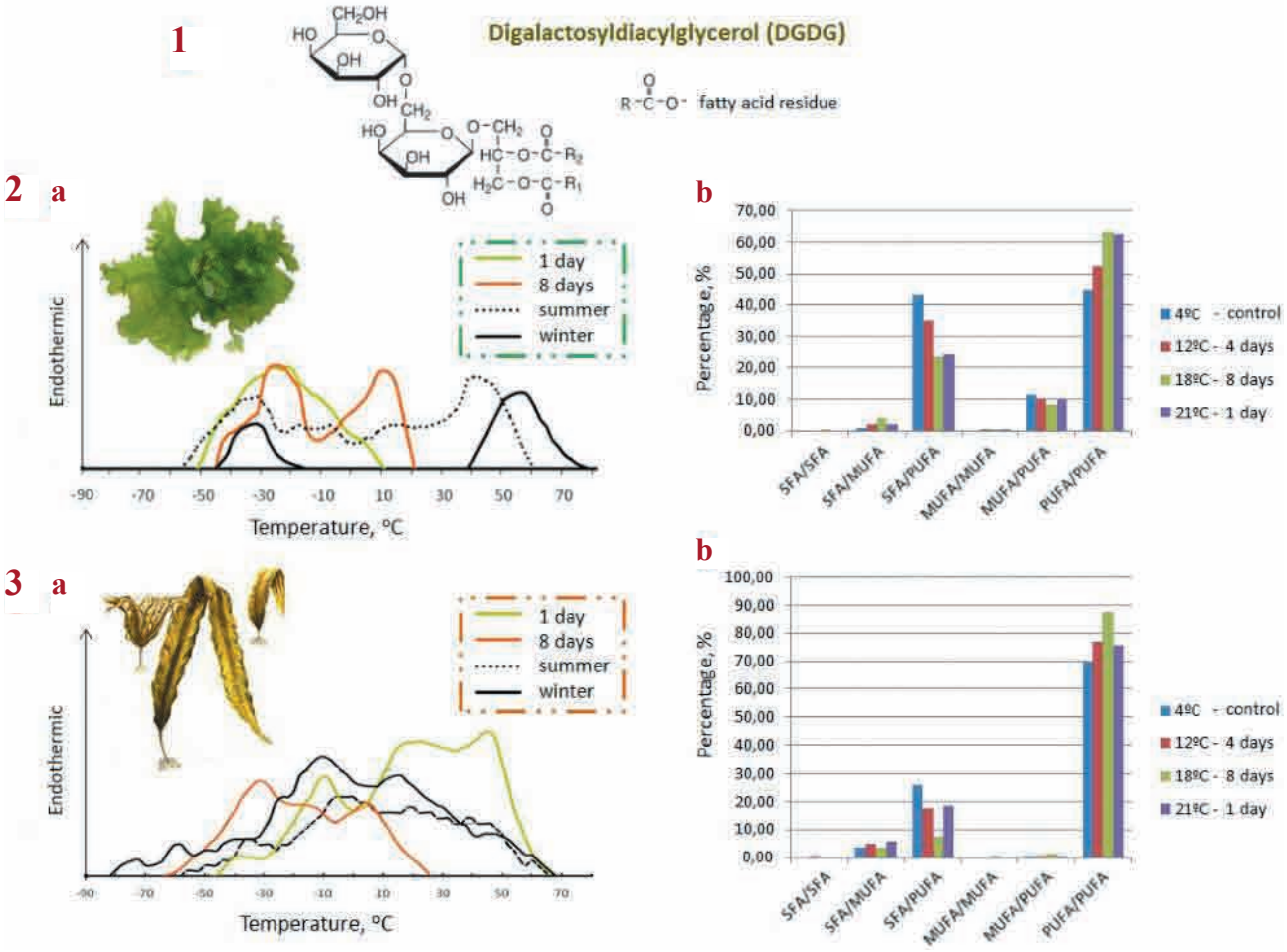
Marine macrophytes are major producers of organic matter and oxygen in the ocean. Growth and development of these poikilothermic organisms mainly depend on the ambient temperature. Lipid matrix of biological membranes plays a key role in the adaptation of living cells. Adaptive changes are aimed to preserve the liquid crystalline state of lipid bilayer, which is optimal for functioning of living cells. Major membrane lipids of plants are glycoglycerolipids, which are mainly included in thylakoid membranes of chloroplasts and are involved in photosynthesis. Due to physical state of glycolipids and other polar lipids is regulated by their fatty acid (FA) residues, the present work was aimed to observe the adaptive changes in molecular species composition to interpret thermal phase transitions of major glycoglycerolipids (monogalactosyldiacylglycerol (MGDG), digalactosyldiacylglycerol (DGDG) and sulfoquinovosyldiacylglycerol (SQDG)), as well as betain lipid 1,2-diacylglycerol-O-4`-(N,N,N-trimethyl)-homoserine (DGTS) from two species of marine macrophytes *Saccharina japonica* and *Ulva lactuca* in the condition of warm-acclimation. Algae were harvested in winter at 4°C in the Sea of Japan. Then plants were acclimated to 20°C for 1 day (rapid acclimation) and 8 days (slow acclimation).

Analysis of molecular species compositions of polar lipids carried out by high-performance liquid chromatography (HPLC-MS) showed that percentage of molecular species with two polyunsaturated fatty acid residues increased in DGDG and slightly in MGDG of *S. japonica* and *U. lactuca* after warm-acclimation (see Figure). Differential scanning calorimetry (DSC) of the crystalline-liquid crystalline phase transiton of these lipids showed that these changes in molecular species composition contributed to the increase of the low-temperature peak and to the shift of the transition temperature range and T_{max} to the side of lower temperatures. This effect occurred at falling unsaturation index (UI) of major polar lipids at the rapid acclimation according to the trend observed at acclimatization from winter to summer. The trend was disrupted at the slow acclimation. Adaptive changes of molecular species composition are the same at 1-day and 8-days warm-acclimations, but these changes were more pronounced at the slow acclimation probably due to the longer running time of enzymatic systems. The thermogram profiles of polar lipids from algae slowly acclimated were more similar to ones of summer samples compared with ones from algae acclimated rapidly. In general, acclimation changes in FAs of glycolipids and DGTS from *U. lactuca* were more



DSC thermograms (2a, 3a) and molecular species composition (% of the sum molecular species) (2b, 3b) of digalactosyldiacylglycerol (DGDG) isolated from marine macroalgae *Ulva lactuca* (**2**) and *Saccharina japonica* (**3**) after the 1-day (rapid) and 8-days (slow) warm-acclimation. **1** – general structure of DGDG. SFA – saturated fatty acids, MUFA – monounsaturated fatty acids, PUFA – polyunsaturated fatty acids.

adequate unlike those from *S. japonica.* This is probably due to the adaptation of *U. lactuca* to more stressful conditions of the shallow zone.

Accumulation of molecular species with two polyunsaturated FA residues is a possible regulatory mechanism of inhibiting desaturases. This leads to the lower UI of major polar lipids and membrane viscosity that is necessary at the increase of the environmental temperature according to mechanism of "homeoviscous adaptation". Results of this research confirm that changes of the major polar lipids of algal thylakoid membranes are related with the role of these lipids in maintaining optimal functional state of membranes enzymes at fluctuations of ambient temperature.

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The comparative characteristic of mussel *Crenomytilus grayanus* microflora from areas with different anthropogenic load

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The raised anthropogenic press changes the structure of microbial communities, causes reduction of marine microflora biodiversity and increase the percent of alien microbiota. As sea water is a habitat for many trade hydrobionts, it is important to know whether pollution influences their normal microflora which is carrying out a number of important functions for the host. Because of the prompt growth of trade fishing and intensively developing of mariculture, interest of researchers increases in estimation of seafood quality. The aim of work is to study the taxonomical structure of bacterial communities associated with mussel *Crenomytilus grayanus* from the bays with different anthropogenic influence.

For this purpose the coastal water areas of the Sea of Japan differing on level and character of anthropogenic pollution have been chosen. The area of works included a bay with considerable influence of household drains (Ayaks Bay) and comparatively pure zone (Severnaya Bay). Intestines of mussels were excised with a lancet under sterile conditions and homogenized. Serial dilutions of the tissue homogenate and of the sediment suspension were plated on solid modified marine broth (MMB) medium and cultured in a thermostat for 2 days at 25°C. The obtained isolates were identified based on their morphological, cultural, physiological, and biochemical traits.

In this work, a total of 66 bacterial strains were isolated and characterized – 39 from Severnaya Bay and 27 from Ayaks Bay. Microbial community of mussels from Severnaya Bay included microorganisms belonging to genera *Actinomyces*, *Sarcina*, *Micrococcus*, *Moraxella*, *Acetobacter*, *Arthrobacter*, *Corynebacterium*, *Bacillus*. *Bacillus* was dominated group in community of hydrobiont from this location. Intestinal microflora of mussels from Ayaks Bay consisted of bacteria *Actinomyces*, *Bacillus*, *Pseudomonas*, *Klebsiella*, *Escherichia*, *Listeria*. The high share of opportunistic microorganisms (63%) among associated microbiota indicates the adverse sanitary and epidemiologic situation in the studied water area. Pollution of the Ayaks Bay by household drains leads not only to emergence of opportunistic and pathogenic bacteria in microflora of mussels, but also to disappearance of some native groups of the microorganisms which are typical for mollusks of pure areas. Most likely, *Sarcina*, *Micrococcus*, *Moraxella*, *Acetobacter*, *Arthrobacter*, *Corynebacterium* found in a digestive tract of animals of the Severnaya Bay are minor components of *C. grayanus* normal microflora, and are most sensitive to change of environmental conditions.

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Biological deep-sea expeditions with focus on the northwest Pacific

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The deep sea is the largest ecosystem on earth and we know very little about the organisms living in this vast environment. We have therefore initiated several deep-sea expeditions to abyssal basins of the Atlantic and Pacific Oceans in order to gain information on species and patterns distribution of invertebrates living down there. These expeditions have retrieved high abundance and diversity of marine invertebrates in most deep-sea areas and we suppose that the lower numbs of species reported in the past are due to sampling bias caused by large mesh sizes. Our working group uses Isopoda (Crustacea, Malacostaca) as a model group to study patterns and processes of deep-sea biodiversity. Some examples from recent expeditions to the Southern Ocean, the Vema Fracture Zone as well as the northwest Pacific and the Sea of Ochotsk will be presented and the importance of natural history collections for biodiversity research will be outlined.

In the northwest Pacific, a first joint German/Russian expedition to the Kuril-Kamchatka Trench (KKT) and adjacent abyssal plain was performed in 2012 onboard of the R/V *Sonne* (SO 223) KuramBio (Kurile Kamchatka Biodiversity Studies). The aims of this R/V *Sonne* expedition to the Kuril-Kamchatka region were to investigate the biodiversity and community patterns of the meio-, macro- and megafauna for the test of the following hypotheses:

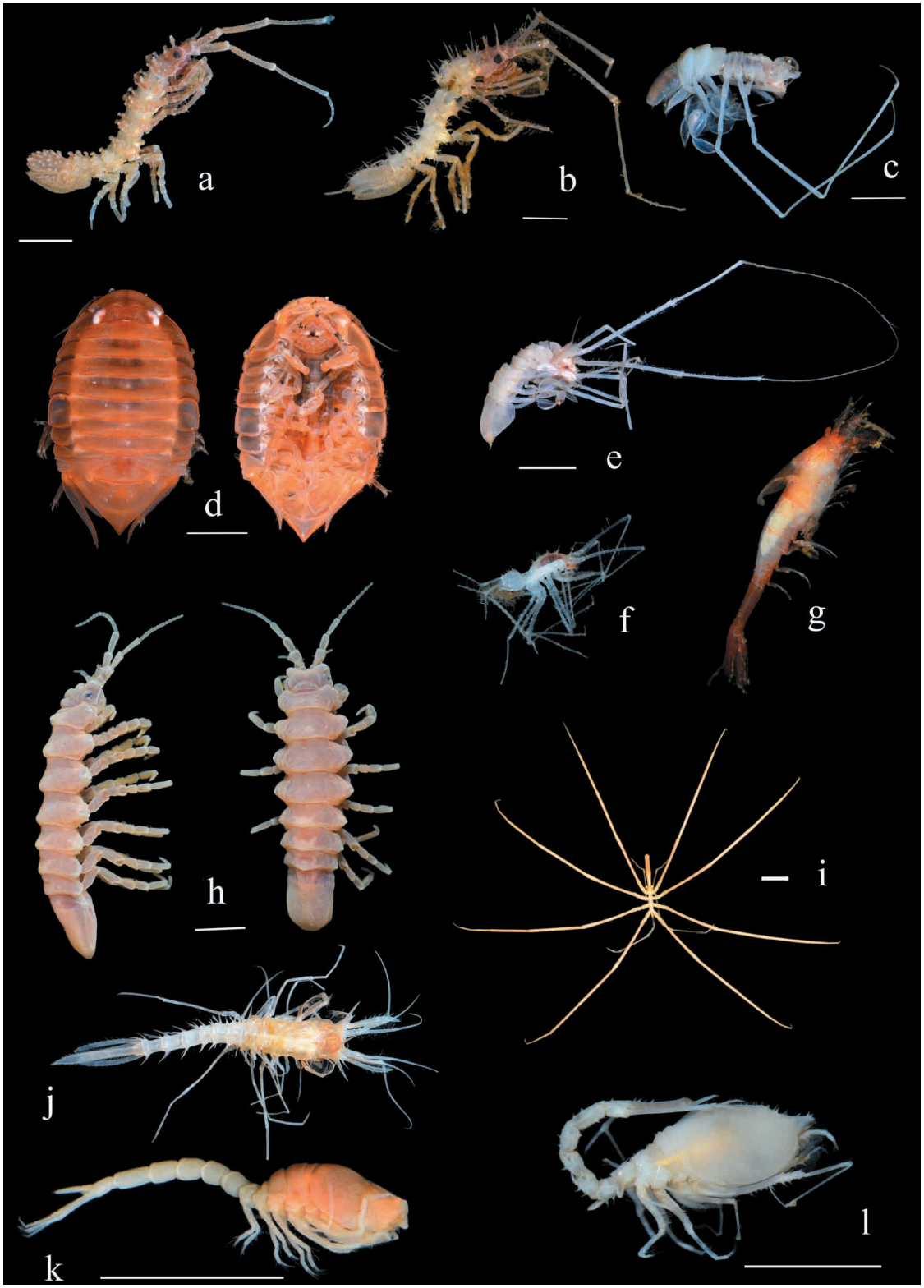
1. Communities of the Kuril-Kamchatka stations differ in terms of species composition and richness.

2. The non-isolated abyssal plain of Kuril-Kamchatka area causes an increase of the abyssal biodiversity in comparison to the geographically more isolated Sea of Japan.

3. In the Kuril-Kamchatka Trench and abyssal plain we will sample around 50% of new species in the different taxa.

4. The standardized sampling techniques will increase the faunistic knowledge about that region.

The KuramBio expedition with R/V *Sonne* was the first extensive biological expedition in the abyssal plain of the northwest Pacific since the R/V *Vityaz* expeditions in the mid twentieth century (Bogorov, 1972). After more than 40 years of investigations, about 660 species were recorded in the collections of the *Vityaz* expeditions from the extensive area of the northwest Pacific where the sampling depth ranged from bathyal to hadal. During the KuramBio expedition, we sampled a more restricted area with a depth range between 4,830 to 5,780 m by means of an epibenthic sledge and collected 85,651 invertebrates (23,432 invertebrates standardized for 1000 m²) which represent more than 1780 species. Of these >869 species (~50%) are new to science and more



Crustacea and Chelicerata collected during the SokhoBio expedition. **a**. *Arcturus pacificus*, **b**. *Arcturus* sp., **c**. *Munnopsurus giganteus*, **d**. *Tecticeps leucophthalmus*, **e**. *Munneurycope* sp., **f**. Haplomunnidae, **h**. *Synidothea pulchra*, – Isopoda; **g**, **j**. Mysidacea; **k**. Lampropidae, **l**. *Makrokylindrus* sp. – Cumacea; **i**. Pantopoda. Scale bar: 0.5 cm. Photographed by Anna Lavrenteva.

than 90 of the known species are new for the area, while only about 300 species were known from the northwest Pacific and the KKT area.

The richest samples, however, have been collected at the slope of the KKT, therefore we assume that the v-shaped topography of the KKT might enhance food availability and lead to an even higher biodiversity at larger depths. During the expedition KuramBio II we would therefore like to test the following hypotheses:

1. The hadal of the KKT is characterized by a high number of species (not lower than in the abyssal plain near the KKT).

2. The number of endemic species will increase with increasing the depth in the KKT.

3. The hadal depths of the KKT isolate benthic species of the Sea of Okhotsk (which has also be investigated with our international team in 2015 and retrieved a wealth of invertebrates from bathyal and abyssal depths (see Figure) from species of the abyssal northwest Pacific.

The expedition KuramBio II will be performed from board of the new R/V *Sonne* between 16.7.–26.9.2016 in the KKT.

The intertidal flora of Shikotan Island (southern Kurile Islands) before and after earthquake

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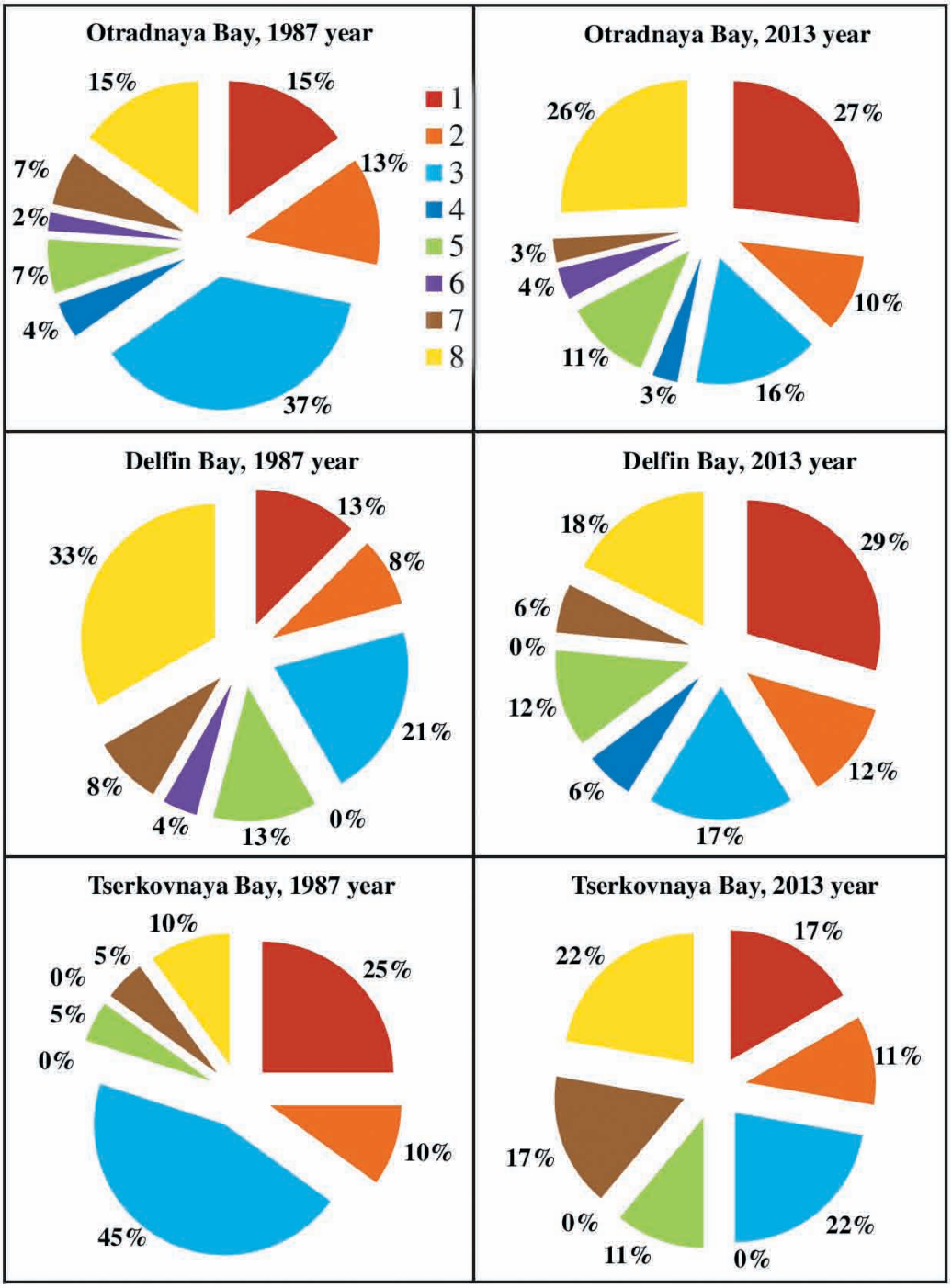
Heterogeneity of the intertidal flora was revealed on different coasts of the Shikotan Island before and after the earthquake that took place in 1994. The taxonomic composition of the intertidal flora on the Sea of Okhotsk, northwestern, coast of Shikotan is the most diverse. Successive changes in the taxonomic composition of flora are most pronounced off the Pacific, southeastern, coast of Shikotan, and are manifested as a depletion of the flora in genera, families, and series. Thus, the flora of the Pacific coast can be considered as its depleted derivative.

The latitudinal and zonal features of the intertidal flora consist in the dominance of Pacific wide-boreal and amphiboreal wide-boreal species that are distributed throughout the boreal zone. In stable conditions (before earthquake), near-Asian low-boreal and Pacific low-boreal species usually comprise the second dominant group.

Earthquake results in creation of favorable conditions for development of two complexes of species in the considered intertidal flora: (1) "local" species of Pacific origin; (2) species that are common either in the Northern Hemisphere or all over the World Ocean. These species share between each other the first and second greatest contribution to the species composition of flora, reaching or surpassing the group of Pacific wide-boreal species, which are usual dominants. Low-boreal and widespread species dominate together and are represented by an equal number of species in the flora of Otradnaya Bay on the northwestern coast (see Figure).

Low-boreal species dominate in the number of species, while wide-boreal species and widespread ones share the positions of the second and third dominant groups in the flora of Delfin Bay on the southwestern coast. Widespread and wide-boreal species together dominate the flora in Tserkovnaya Bay on the southeastern coast; low-boreal ones are the third group. In the bays Gorobets and Krabovaya on the northwestern coast, wide-boreal species traditionally dominate, while low-boreal and widespread species are the second and third dominant groups.

The cenotic composition of flora, i.e. the total number of species, on Shikotan Island generally remained at the same level after the earthquake. The percentage of red algae slightly increased (from 44 to 46%), and that of brown algae decreased (from 35 to 31%). At the same time, the species composition has changed considerably: some species disappeared, giving place to others. In the local floras of the bays Otradnaya, Delfin, and Tserkovnaya, the total number of species reduced; the number of red alga species decreased 1.2–1.5 times. In Krabovaya Bay, it increased from 43 to 47 species, and the number of Rhodophyta species did from 21 to 24. The number of Rhaeophyceae species decreased 1.2–1.5 times in all the bays. The number of Chlorophyta species in the bays Tserkovnaya and Krabovaya increased; in Otradnaya Bay, it did not changed; in Delfin Bay, it decreased 3 times.



Zonal-geographic composition of the intertidal local floras of Shikotan Island before and after the earthquake: 1 – Asian low-boreal, 2 – Asian wide-boreal, 3 – Pacific wide-boreal, 4 – boreal-notal, 5 – subtropical-low-boreal, 6 – subtropical-wide-boreal, 7 – boreal-Arctic, 8 – widespread species.

Seismically induced transformations of islands, causing changes in the coastline topography and emergence of available substrates, result in dramatic structural rearrangements in intertidal communities. This considerably changes the species and phytogeographical composition, as well as the cenotic structure of the intertidal flora.

Biofilm forming by pathogens and saprotrophic microorganisms in marine communities

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Existence of pathogenic microorganisms in sea water is proved in a number of experimental studies. Their introduction into the marine environment can be connected with flood and ground waters, with pollution of waters by sewer drains. Pathogens contacting with hydrobionts can be dangerous both for inhabitants of the sea and for human eating the infected marine animals. The outbreaks of infections of a sea origin caused by infected marine hydrobionts – mussels, shrimps, oysters were registered in New Zealand, Italy and the USA.

The marine environment isn't optimum for existence of pathogens and, in this regard, it is obviously necessary to conduct the researches to search for ways of their adaptation in sea biocenoses. It is possible to refer their interaction with marine micro seaweed to the biotic factors saving population of pathogenic bacteria in the marine environment. For example, they play an important role in supporting of *Listeria monocytogenes* viability. The last decade is conventional that 99% of bacteria exist not in a planktonic form but in the form of biofilms. Forming of biofilms by pathogenic bacteria in association with marine microorganisms isn't studied and was the aim of research.

For studying of biofilm forming properties we used the method based on dying of bacterial cells. To evaluate the intensity of biofilms formation we measure by the optical density of eluate. It is shown that pathogenic microorganisms of genera *Listeria*, *Salmonella*, *Yersinia*, *Staphylococcus* form biofilms both in a monoculture, and in consortium with saprotrophic bacteria. Such abiotic factors of the environment as temperature, salinity, pH impact on biofilm formation. Intensity of biofilm formation depends on specific properties of species and strains. *Listeria* is more capable to form biofilms in comparison with other pathogens. It is established that certain species of marine bacteria can stimulate growth and reproduction of *Listeria* in consortium. Set of biotic and abiotic factors impact on dynamics of development and level of biofilms maturing.

Thus, existing of pathogens in community with marine microorganisms promotes their more stress-resistant state and allows them to survive in the marine environment for a long time that can be the reason of an unsuccessful ecological and epidemiological situation and can be dangerous for marine animals and human.

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The effect of ethanol extracts of abyssal marine hydrobionts on Wnt signaling in triple negative breast cancer cell line

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High biodiversity of the World Ocean provides an array of novel compounds, which are exclusive for marine organisms. These products usually are low molecular metabolites in common ecological relationships and are used for defense from predators, mating purposes or hunting as well as for general metabolism. Biochemistry of abyssal hydrobionts provides a broad field for study, for they may contain unique metabolites capable to serve as potential drugs. According to USA National Cancer Institute preclinical cytotoxicity screen, the probability of antitumor activity of marine natural compounds is higher than of terrestrial ones. Thus, marine natural products have a great potential in target cancer therapy.

The Wnt signaling pathways are essential in many biological processes. It regulates embryogenesis, homeostasis, cell fate differentiation and stem cell proliferation. When Wnt signaling is activated, beta catenin diffuses to the nucleus and interacts with T-cell factor/Lymphoid enhancing factor to express target genes that control cell cycle and growth. Canonical Wnt signaling plays a crucial role in several types of cancer. In the other hand, since Wnt signaling regulates renewal of different types of stem cells, the activation of Wnt signaling pathways may be used in regenerative medicine.

Breast cancer is the most invasive form of cancer for women and is the second leading cause of death of women in developed countries. Triple negative breast cancer (TNBC) is a form of mammary cancer, which does not express the estrogen receptor, progesterone receptor and HER-2. Triple negative breast cancer does not respond to standard hormone therapy and is responsible for every second case of mortality from breast cancer. Wnt signaling components are overexpressed in TNBC cells. Moreover, Wnt transduction regulates transcription of oncogenes, such as Myc and CyclinD1. Thereby Wnt signaling pathways are plausible target for TNBC treatment.

We used the luciferase reporter assay where the triple negative breast cancer cell line HTB-19 was stably transfected with a TOPFlash plasmid (expressing the firefly luciferase gene under Wnt-dependent promoter) and then additionally transfected with the *Renilla* luciferase plasmid (expressing the *Renilla* luciferase gene under constitutive promoter), so that the firefly luciferase luminescence reflected the activity of Wnt pathway, whereas *Renilla* served as a control for general viability and protein biosynthesis.

The invertebrate hydrobionts were collected from the Kuril Basin of the Sea of Okhotsk during the SokhoBio expedition (July–August 2015). 102 crude ethanol extracts of abyssal hydrobionts were screened, namely extracts of Hexactinellid sponges, Polychaetes, Demosponges, Ascidians, *Actiniaria*, Sipunculans, Isopodes, including *Psychropotes longicauda*, *Molpadia musculus*, *Hymenodora glacialis*, *Benthodytes incerta*, *Calocarides quinqueseriatus*, *Munidopsis antonii*, *Scotoplanes* aff. *theeli*, *Phelliactis callicyclus*, *Atolla*, *Umbellula*, *Gephyrothuria*, *Psychropotes*, *Caprella*, *Eunephthea*, *Peniagone*, *Corallimorpharia* and *Ophiuroidea*.

As a result, seven extracts of hydrobionts have shown Wnt signaling modulating activity. The extracts of *Ophiuroidea* species (including *Ophiura irrorata*), marine decapod – *Calocarides quinqueseriatus* and abyssal crab – *Munidopsis antonii* inhibited Wnt signaling pathway for more than 80 percent in series of dilutions of the extract. The extracts of two *Actiniaria* species (including *Phelliactis callicyclus*) activated Wnt signaling further in presence of active Wnt3a.

Content of 4-nonylphenol in sea waters of Amur Bay (Sea of Japan/East Sea)

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The organic compound 4-nonylphenol is a breakdown product of nonylphenol ethoxylates (NPEs). NPEs have many uses including emulsifiers, wetting agents, in pesticide production, and etc. The major part of the NPEs used as surfactants appear as pollutants in coastal water. 4-nonylphenol has an effect upon aquatic organisms including bioaccumulation in the tissues and due to xenoestrogenic effect can cause the feminization of marine organisms.

Levels of 4-nonylphenol were determined in the waters of the Amur Bay. Analysis has been developed using liquid-liquid extraction with methylene chloride, after concentration samples are analyzed by HPLC with fluorescence detection. Water samples were collected in 2008–2011.

In result of the researches performed it was established that content of 4-nonylphenol in the area of eastern coast of the Amur Bay makes 0.44 μg/L. One of 4-nonylphenol income sources is the cardboard factory located in Ussuriysk constantly discharging the waste waters heavily contaminated with organic substances to the Razdolnaya River. Additional contamination sources may be industrial wastes from some other enterprises as well as domestic waste water. By results of the complex assessment in 2003, the waters of the Razdolnaya River are classified as “very dirty”, MPC of phenols was six fold increased: this river delivers 26–28 fold more contaminants to Amur Bay in comparison with all industrial and household city drains of Vladivostok.

Existing currents in Amur Bay, transfer water of the Razdolnaya River along the east coast, and it evidences the presence of 4-nonylphenol in the coastal waters of the islands. The concentration of 4-nonylphenol in the seawaters of these stations are less than 0.01 μg/L. In the central part of the Amur Bay and in area of the western coast, content of 4-nonylphenol is lower than the detection level. It is probably caused by the large area, depth of the bay and system of surface and underwater circulating currents owing to which the significant dilution of the polluted waters take place, and by significant remoteness of sources of 4-nonylphenol emission. Content of 4-nonylphenol in the Zolotoy Rog Bight makes 1.22 μg/L. Specificity of this bay concerning the human impact is that the same is one of the old-developed area and consequently is the most exposed to the city waste waters. City ports and ship repair yards discharging bilge waters, technical oils and fuel to Amur Bay water area exert a huge negative influence. The Ob`yasneniya River which waters contain 1.24 μg/L of 4-nonylphenol makes the significant contribution to the bay pollution. Probably, one of the basic contamination sources is thermoelectric plant. According to the above presented classification, waters of the Amur Bay may be referred to “poorly contaminated waters”. The existing concentrations of 4-nonylphenol in Amur Bay waters are not capable to give any significant negative

influence on the endocrine system of marine organisms and much less to cause their death. Waters of the Zolotoy Rog Bight and the Ob'yasneniya River, content of 4-nonylphenol is at a subcritical level and it is capable to cause some changes in structure of marine organism communities. These waters are classified as "contaminated".Marine organisms are one of the important links in a food chain when toxicants get into a human organism. Thus the existing situation predetermines the necessity of carrying out of high-grade monitoring works, revealing and classification of sources of pollution by the substances showing xenoestragenic effect.

Underwater volcanic gas seeps alter behavior and morphology in predatory dog-whelk *Nucella heyseana* (Dunker, 1882) (Mollusca: Gastropoda): ecological plasticity of species or early stage of sympatric speciation?

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We have investigated the population of *Nucella heyseana* of southwestern shore of Sakhalin Island in Nevelsk and Kholmsk towns area, including Antonovo (formerly Rakuma) – the site where *N. elongata* paratypes were collected. This shore is known with its recent earthquakes, coastal sea floor shifts, and local seeps of volcanic gas, which contains hydrogen sulfide and carbon dioxide. In Yasnomorskaya Bay and adjacent areas north of Nevelsk and north of Kholmsk, coastal water is heavily saturated with hydrogen sulfide: this can be easily detected with specific odor in the area and whitish tan of sea water; the chains of gas bubbles rising from the bottom can be also detected during scuba diving observations. The bottom in volcanic gas saturated sites is 1–3 m deep, covered with dense vegetation of sea grass and weeds spreading on the surface; some of these shallows are separated from open sea with rocky chains elevating above sea level. Such environment impedes washout of hydrogen sulfide and concomitant substances outside these shallow areas severely depleting coastal animal diversity. Few intertidal species, e.g. *Littorina sitkana* and *Homalopoma amusittata* survive there escaping onto the rocks above sea level being able to enter sea water during the storms when sea water becomes diluted with water masses brought from open sea.

In studied localities, we have found two forms of *N. heyseana*: typical "small" (shell length not exceeding 45 mm) inter- and upper subtidal form, which inhabits the depths of 0–1.5 m, and "large" lower-subtidal form with more slim and expressively sculptured shells reaching 115 mm in length, which was found at the depths of 3–19 m. As noted above, despite their superfivcial differences, both forms developed almost no genetic variation assuming their species identity – although they were never found together at the same sites. The "small" form occurs in volcanic gas-free or poor inter- and upper subtidal with good water circulation due to strong wave activity. The other form occurs beyond and below hydrogen sulfide rich shallows, where lower sulfide concentration allows most animal species to survive. Thus, volcanic gas seeps prevent "large" form access to upper subtidal and intertidal, where it could feed on typical prey and possess typical habitat choice and behavior. In fact, sandy bottom of the depth below 3 m adjacent to hydrogen sulfide rich shallows provides unusual preys that were never recorded for *N. heyseana.* This menu comprises relatively large sand-dwelling bivalves of Veneridae, Mactridae, and Cardiidae families. Despite these prey

taxa and their body sizes are not characteristic for most *N. heyseana* populations, the snails are adapted for foraging such kind of prey due to growing to larger sizes, and developing absolutely novel behavior of complete or partial shell immersion into sand mass and searching for its inhabitants. The "small" form inhabiting volcanic gas poor waters demonstrates feeding on typical rocky shore dwelling taxa. Interestingly, allowed access to intertidal habitat in gas-free sites prevents *N. heyseana* from inhabiting at deeper depth and foraging on large sand dwelling invertebrates. Thus, we discovered probably early unstable stage of sympatric speciation promoted by the adaptations to alternating local environments, i.e. sea floor elevations coupled with volcanic gas supply at part of ancestor species area.

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Octocorals Alcyonacea in tropical and cold water ecosystems: biodiversity and pathways for dispersal

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In the South East Asia is found the highest marine biodiversity of the world. This is consistently seen in other taxa such as for the scleractinian corals with over 400 species while in the GBR would be around 400 species and only half as much in the Caribbean (only 100–200 species; Veron, 1995). Since Ekman in 1953 considered the Malay Archipelago as the faunistic centre of Indo-West Pacific (IWP) from where species dispersed to peripheral areas, the position of this area was discussed by many authors during last decades. The high-usage opinion is that this Indo-Malayan Centre of Maximum Marine Biodiversity (or Coral Triangle) can be found where most Indo-West Pacific species show overlaps of their distributional ranges. The studying of the Octocorallia species richness is substantially in the frame of the worldwide and local biodiversity problems. However, the solving of the complex problems of the taxonomy, genetic diversity and species-specific ecology is needed to trace the possible ways for the soft corals dispersal. For example, the *Sinularia* genus containing more than 128 nominal species is the largest among the zooxanthellate soft corals. *Sinularia* species are widely distributed throughout the Indo-Pacific and inhabit the various reef biotopes (Fig. 1). The latest revision of the genus allows identifying specimens of *Sinularia* with reasonable certainty (Ofwegen, 2002). Due to it the *Sinularia* local faunas as well as those of another common soft coral genus *Sarcophyton* could be the useful instrument to trace the dispersal patterns of soft corals in the tropical Pacific zone (Fig. 2). However, the range of problems in *Sinularia* identification continuously complicates their listing. Another substantial question is – what ways may be usable for species dispersal from Coral Triangle to periphery. The study of distribution patterns requires the good understanding both detailed records of the coral fauna throughout the distribution range and high quality oceanographic data to be correlated with these distributions.

Trends for the Octocorallia dispersal in the temperate waters also require the newest understanding of biogeographic boundaries. The geographic location of the coral communities which exist in South Korea waters has produced coral fauna of special biogeographical interest. The tropical and the subtropical marine invertebrates are being distributed together with the temperate ones in the southern part of Cheju Island at south of Korea peninsula, as this place is directly being affected by the Kurioshio Current. The typical temperate gorgonian genus *Calcigorgia* has the range restricted to the south by the Sea of Japan too. This genus can indicate the possible dispersal way for temperate Octocorallia in the northern Pacific. Two *Calcigorgia* species including *C. spiculifera* are occurred in Aleutian Islands area. However, the list of gorgonians of Kurile Islands is richer because of includes five new *Calcigorgia* species in addition to *C. spiculifera*. The waters of the Oyashio Current form probably the richest fishery in the world owing to the extremely high nutrient content of the cold water. This current circulating counterclockwise in the north-western Pacific by Kurile

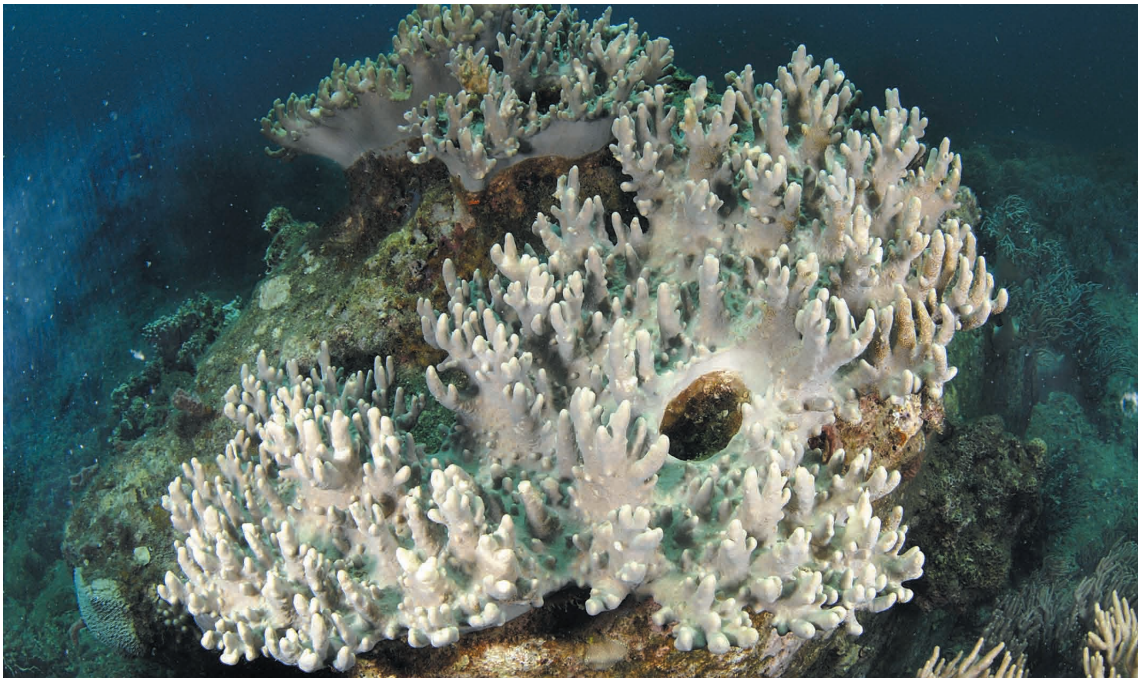

Fig. 1. Mass settlements of soft coral *Sinularia polydactyla*, Nha Trang Bay, South China Sea. Depth 10 m.

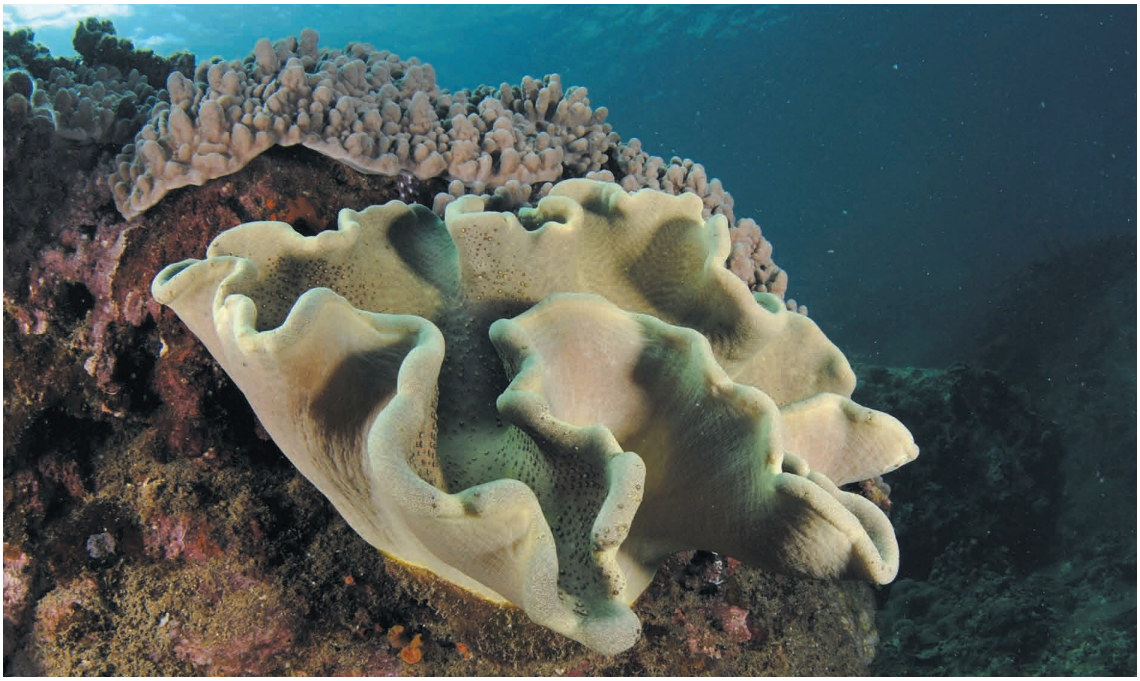

Fig. 2. Soft coral *Sarcophyton* in coral reef community, South China Sea, Nha Trang Bay. Depth 9 m.

Islands had the intrusion into the Sea of Japan across the Tsugaru Strait during the Holocene history. Does the centre of temperate coral diversity take place in the northern Pacific as the source of dispersal? It can be the subject of the future investigations using model taxa which are well revised equally with molecular and paleooceanography data.

Morphology and chemical composition of silica-organic spicules from sponges

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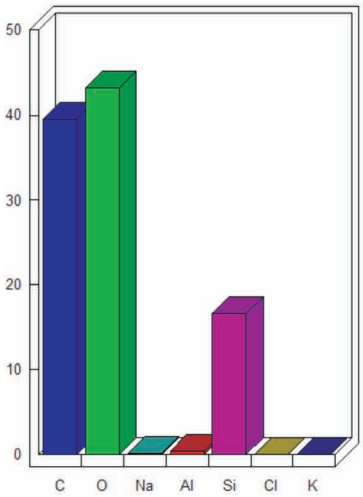
Morphology, elemental composition and electrical qualities of spicules of Hexactinellid sponges (*Asconema setubalense*, *Farrea* sp., *Sarostegia* sp., *Hyalonema sieboldy*) and Demospongia: freshwater *Lubomirskia baikalensis* and marine *Craniella sigmoancoratum* were studied.

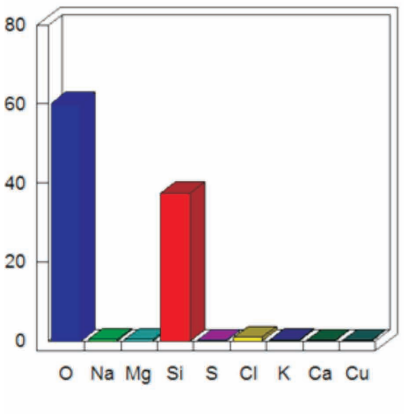
Six-rayed, or glass sponges (Hexactinellida) are mostly found in the seas deeper than 200 m, however in polar seas, whether Sothern or Northern, some of them may be also found in shallow waters. Around 600 species of them are described. Approximately 43 species can be found in Russian seas, and more than 30 of the, inhabit Far Eastern Seas (Koltun, 1967). Skeleton of such sponges is built from silicon organic material and contains lots of six-ray spicules and their derivatives, based on six-ray spicule. Some kinds of spicules get their ends coalesced in such a manner, that it forms a latticed frame with rectangular cells, or the coalesced skeleton looks like an irregular, entangled network of silicon bars.

Needles of glass sponges are formed in syncytium and have a complicated microscopic structure. Each spicule has an organic pivotal thread, around which silica is applied in layers. Layers are divided from each other by interlayer of organic substances. Glass sponges live in loose and silty grounds. In order to survive in such grounds, sponges form some kind of root system, which do not allow the body to plunge into the ground. Such root system is formed by megascler spicules.



Element	%
C	39.51
O	43.20
Na	0.13
Al	0.41
Si	16.66
Cl	0.03
K	0.05
In total	100.00

Fig. 1. Percent ratio of elements in spicule *Hyalonema sieboldy*.



Element	%
O	60.20
Na	0.42
Mg	0.43
Si	37.42
S	0.18
Cl	0.84
K	0.27
Ca	0.06
Cu	0.17
In total	100.00

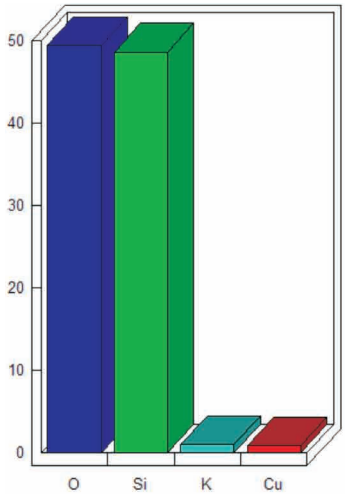
Fig. 2. Percent ratio of elements in spicule *Asconema setubalense*.

Demospongias also have silicon-containing spicules, but they are formed by solid composite not layered material.

Spicules of studied sponges (Hexactinellida and Demospongia) differ morphologically. Demosponges have them formed in the simplest way – those are linear spicules, whereas Hexactinellids sponges have the most complicated formation. Their morphology of spicules is very vast: from multi-layered single-ray ones, organized in "cylinder in cylinder" way to solid spicules, which form one solid net.

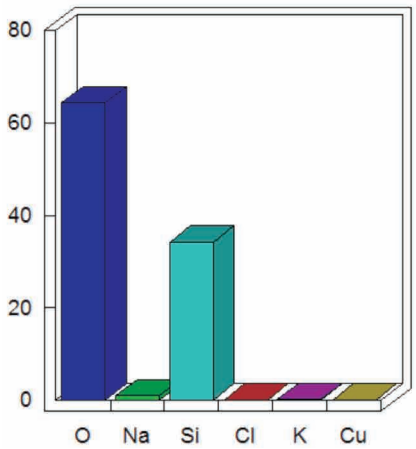
Spicules of conventional and six-ray sponges are dielectrics. However, multi-layered long and elastic spicules of six-ray sponges have a piezoelectric effect and condense charge. Short, thick and non-elastic spicules do not show the piezoelectric effect. Because of piezoelectric effect spicules of sponges, which inhabit in aphotic area, which lacks in light, can luminesce.

Spicules of six-ray sponges are formed by composite silicon organic material. It usually contains up to 80% of silicon.



Element	%
O	49.42
Si	48.67
K	1.04
Cu	0.87
In total	100.00

Fig. 3. Percent ratio of elements in spicule *Farrea* sp.



Element	%
O	64.35
Na	0.96
Si	34.20
Cl	0.13
K	0.20
Cu	0.17
In total	100.00

Fig. 4. Percent ratio of elements in spicule *Sarostegia* sp.

Moreover, they contain admixture of ions of Na, Al, K, Cl, Mg, S, Ca, Cu. Impurity ratio in spicules from differ species varies (Figs 1–4). Such micro elemental mixtures influence on electric qualities of spicules, allowing part of them to form piezoelectric effect.

Assessment of the effect of nanoparticles on the change in the trace metal composition in organs of the mussel *Crenomytilus grayanus*

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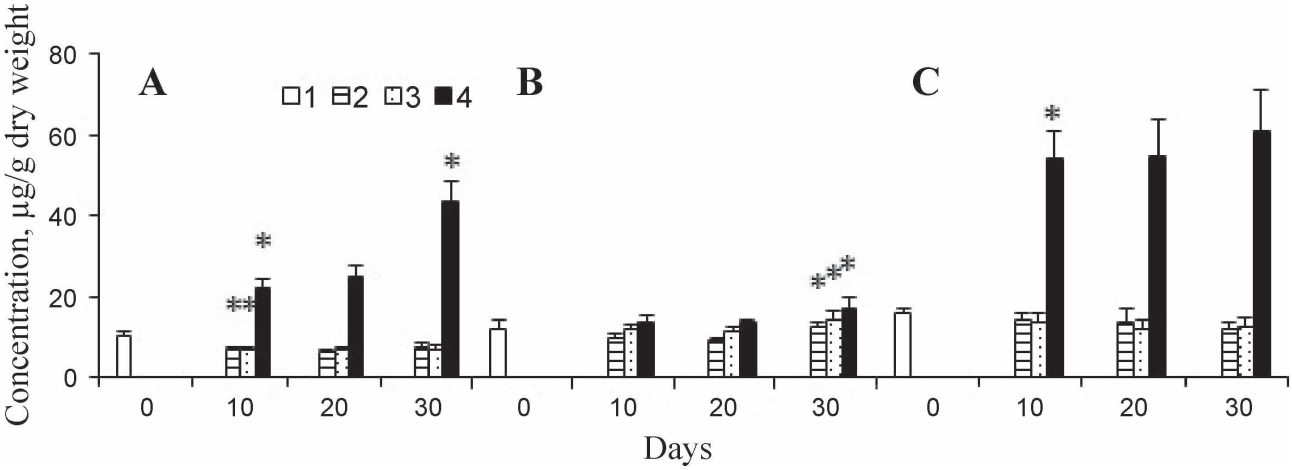
A small size of nanoparticles (NPs) gives them the unique properties that are different from the properties of particles of the same substances of micron and larger size. Owing to this, they are used in various fields of industry, medicine and cosmetology, and enter into composition of many products. The intensive production and use of NPs may cause their input into coastal waters and subsequent penetration into aquatic animals. It is known that an excessive intake of one of the trace elements by an organism leads to its inevitable participation in competitive relations with other physiologically essential elements. In general, to date, little information has been accumulated concerning the trace element NPs entering the aquatic environment, as well as their bioaccumulation in the organs and tissues of marine organisms, bioavailability, and effect on the organisms' trace element composition, especially under chronic exposure.

The objective of our study was to compare the bioavailability of NPs of CuO and ions of Cu^{2+} and their effect on the trace element ratio in the gills, digestive gland (DG), and kidney of *Crenomytilus grayanus* in a laboratory experiment. To this end, mollusks collected from waters around Reineke Island were placed in three 100-liter aquaria with aquarium seawater. During the first 30 days, to two aquaria each were added 20 ml of a solution of NPs of CuO (20 µg/L) and $CuSO_4$ (12 µg/L); the control group was maintained in the third aquarium. Five mussels from each aquarium were collected every 10 days in the course of the experiment. Mussels were dissected; the gills, digestive gland, and kidney were separated.

A 30-day exposure of mussels to the two forms of copper in aquaria allowed us to compare their bioavailability. A comparison of the dynamics of trace-element composition in the organs of mussels exposed to NPs of CuO and that of the control group is indicative of no substantial accumulation of this form of copper in the studied organs (see Figure). This may be due to low bioavailability of the NPs of CuO and their ability to form precipitable aggregations, as well as to species-specific defensive strategy of the mollusks studied. Despite the fact that no significant accumulation of copper occurred in the organs of mussel, the dynamics of trace-element content (Fe, Zn, Cd, Mn) showed a number of specific changes, which differed from those in the control group and were caused by the form of CuO NPs we used.



Dynamics of copper concentration in organs *Crenomytilus grayanus*: **A** – gills, **B** – digestive gland, **C** – kidney. * – significant differences from the control assessed Student t-test.

The mechanisms of possible covert manifestation of biological activity (toxicity) of nanoparticles are currently not clear, although the importance of research in this area causes no doubt, taking into account the huge scale of production of nano particles and their input of into the biosphere. Further in-depth studies are needed in order to fully clarify and assess the significance of the changes in copper metabolism revealed in our research.

Some ecological features of northern Pacific seastar

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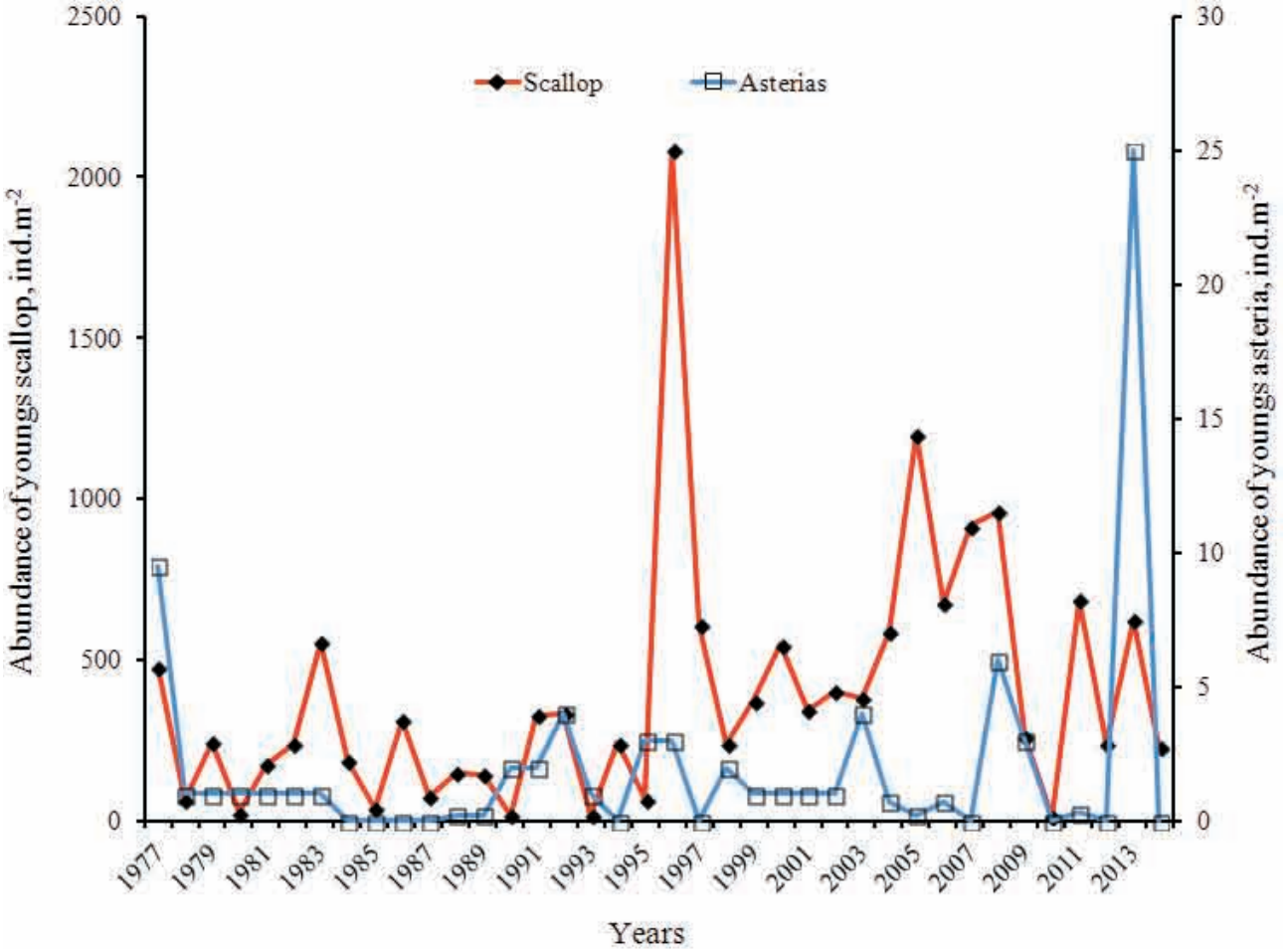
The northern Pacific seastar, *Asterias amurensis* (L.), is a predator having a substantial impact on aquaculture objects. To date, its international significance has greatly increased due to the introduction of larvae with ballast water to Tasmania, south of Australia, Europe, and North America (Foram, Surati, 2013). The goal of this report is to study the ecological characteristics of this seastar for creating the technologies that would mitigate its negative effects. The ecology of northern Pacific seastar was studied from 1977 to 2014 by exposing scallop spat collectors of a Japanese design at a horizon of 0–16 m at 19 stations along the Primorsky Krai coast. After 4 months of their exposition in the sea, or twice a year in 1977–1984, the substrates were hauled up to the surface, and their content was retrieved. Live and dead scallops, as well as all seastars, were counted and measured. The range of food preference in *A. amurensis* was evaluated according to (Murdoch, 1969); the range of diet, by the preference index α: (Chesson, 1978, 1983). The obtained materials were processed statistically using the software STATISTICA 6.0 (StatSoft Inc., Tulsa, Oklahoma, USA). The regression analysis values were tested at α=0.05.

During the 38-year-long studies, the abundance of juvenile seastars on the artificial substrates manifested periodical variations (see Figure). At this stage, seastars cannot cope with one-year-old scallops, and thus, the dynamics of abundance of both species coincided (Gabaev, 1982). Subsequently, the evident relationship between the predator and the prey smoothed as a result of the measures taken to reduce the predator's abundance. When another 22-year cycle of solar magnetic activity is coming, the dynamics of abundance of strong year-classes in these two species change from odd-numbered to even-numbered years, and vice versa. The most of northern Pacific seastars settle on substrates in bays with the highest water salinity (Ussuri Bay). In waters with strong near-bottom hydrodynamics, neither adult breeding individuals occur nor do larvae settle on collectors. The greatest recorded depth of larval seastar's settlement on collectors was 14.5 m, which can be used for decreasing its abundance. The damage caused by seastar varies between years. It becomes lower in the years of low scallop harvest that indicates optimization of seastar's consumption of its trophic resources.

Single seastars with low variability in their growth rate are able to use the available food rationally. After a high-harvest year, the mortality of Yesso scallop from one seastar on a substrate, exposed for a year, reached 47.2%; Pacific bay mussel, 22.5%; Japanese scallop, 30.8%. After a low-harvest year, it decreased to 2.4, 2.3, and 4.7% , respectively. In nature this has a certain biological sense, which results in stabilization of the community. Seastar's favorite prey items are Yesso scallop and Pacific bay mussel. After having been born in a year of a medium harvest, one seastar can kill 59 Yesso scallops, 44 bay mussels, and 12 Japanese scallops on the same substrate within three years. The total wet weight of animals consumed by a seastar amounts to 870 g, i.e. its annual food consumption is 400 g, being close to the ration of seastars in aquarium (Burulina, 1972). For these three years, the seastar reached 271 g wet weight with the assimilability of food of 31%. Processing



Dynamics of recruitment of the *Patinopecten yessoensis* and of the *Asterias amurensis* at artifical substrates in Posyet Bay (Japan/East Sea).

of the material collected during the entire period of observations (1977–2014) showed that the mean long-term mortality of Yesso scallop on collectors constitutes 31.9%; Swift's scallop, 26.9%; Arctic hiatella, 23.2%; Pacific bay mussel, 10.8%; and Japanese scallop, 6.6%. Taking into account that the average scallop mortality in the absence of seastars is 1.48 %, the net mortality from seastars becomes equal to 30.4%. This confirms the statement that Yesso scallop is the most preferable food item for northern Pacific seastar.

Peculiarities of size distribution and organic matter of bottom sediments, as factors predetermine the risk of accumulation of heavy metals in the Vladimir Bay ecosystem (Sea of Japan)

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Vladimir Bays water area is deeply cut into the shore and has a rather narrow entrance. Geomorphological type of the bay is ria, i.e., formed upon flooding by the sea of the valley between submerged ridges coming to the shoreline. Maximal depths are close to 40 meters. Water is exchanged with the open part of Sea of Japan through water body's entering a rather narrow bottleneck between Vatovskiy and Balyuzek capes. In 1939 (40), Vladimir-Olga Pacific Navy base was set in Vladimir Bay. However, after a few restructurings it was closed in 1999. Currently, a military unit is located on the bay's shore, berthing of vessels and machinery is terminated, but there are some sunk ships, hydro-engineering facilities, etc. It should be stressed that the influence of Navy on Vladimir bay's ecosystem had begun much before it became a naval base and affecting the bay for over 100 years. Besides that, the anthropogenic press on that water area includes household impact due to settlements located on the coast and basin. In summer, the shore is a popular recreational area. Local inhabitants and guests actively use small water vehicles. Greatly cut shoreline and at the same time narrow entrance to the bay create the specifics of its hydrodynamic mode which manifests in the mechanical (granulometric) composition of soft soils and distribution of organic matter in their upper layer. The study of basic features of bottom substrates is greatly important from both fundamental point of view and in connection with planning and exercising a few kinds of natural resources use, in particular, seafood catching and recreation.

The objective of this paper was to study granulometric composition of soft bottom sediments of Vladimir Bay's sublittoral shelf, and to determine their peculiarities, as a factors, which are predetermine the risk of accumulation of heavy metals in bay's ecosystem

Bottom sediments of upper layer (10–15 cm) amounting to 17 samples were taken by scuba divers in the horizon of upper sublittoral 2–20 m deep in July 2012. Granulometric composition was found by screening (GOST 12536-79). Gross content of organic carbon (C_{org}) was found by chromate combustion followed by Tyurin titration in CINAO modification (GOST 26213-91). Totally, some 153 tests were made.

Granulometric analysis allowed to classify bottom sediments of Vladimir bay as five types which comprise size range from psephite pebbly small to pelite siltstone. Small fractions tend to be rather deep. Organic carbon content reaches high values (3.64%). Its maximums are seen in samples with dominating fine fractions in three bays of the bay where sedimentation conditions are the most

manifested. Those areas are the zones of organic matter concentration (C_{org} in our case), as sorption capacity increases along with decrease of particles diameter.

In the row of maximal values of organic carbon content obtained for various water areas of Primorsk Krai's sea coastal zone, Vladimir Bay is between Nakhodka Bay (except for Nakhodka bight) and Amursky Bay, where the values are 3,20% and 5,41% respectively. Higher C_{org} concentrations are a factor of various elements accumulation including heavy metals which are able to form metal-organic compounds with humic acids. However, with the decrease of hydrogen index which is continuous along with organic matter toxicants return to aquatic media of the water areas. Those processes should be accounted for in planning monitoring, study of pollutants accumulation, dredging, planning seafood and catch of biological resources.

The immune parameters displaying the physiological state of bivalve mollusks from impacted and non-impacted water areas

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Environmental monitoring remains significantly underdeveloped in Russia in general and in the Russian Far East in particular. The reasons for that lie in the paucity of appropriate methodological approaches for assessing a condition of various habitats and their components. Effectiveness of mariculture and fishery also depends on the necessity of the timely assessment of food species health and regular monitoring of ecosystems. The central system that is responsible for the formation of physiological adaptations of mollusks to environmental changes for the maintenance of homeostasis and the immune defense is hemolymph, which is a transport and protective tissue of the internal environment. Therefore, the activity rates of cellular and humoral immunity factors in mollusks can be used as objective diagnostic criteria of their physiological state.

Sexually mature *Modiolus kurilensis* bivalves with a shell length of 75–95 mm were collected from wild populations in non-impacted water areas (the Vostok Bay) and impacted area of Amursky Bay (the Sportivnaya Gavan Bay) of the Sea of Japan. To assess the immune status, the parameters of the cell-mediated (phagocytic activity (PA), phagocytic index (PI), reactive oxygen species (ROS), total hemocytes counts (THC)) and humoral immunity (hemagglutination (HA), hemolytic activity (HL), protein concentration (PC)) were measured. To test the significance of the hypothesis of either the absence or the presence of differences between the studied samples we used the paired t-test and the Mann-Whitney test. The average values with standard error of PA (0.62±0.02), PI (8.40±0.26), THC (1507500±72690), ROS (10.63±1.26), HA (5.54±0.25), HL (31.11±5.39), PC (1.04±0.04) of bivalves from non-impacted water areas were established. In comparison with mollusks from the Vostok Bay *M. kurilensis* from the impacted water area had considerably ($p<0.05$) lower values of average PA (0.44±0.02), ROS (4.26±1.43), HL (20.73±5.57). Hemocytes concentration (1974193±119559) and PI (10.31±0.49) of bivalves from impacted water areas was considerably higher ($p<0.05$).

Based on these results, we can recommend the PA, PI, ROS, THC, HL and PC, which is a relatively stable parameter under normal environmental conditions and significantly alters under conditions of prolonged stress, as a measure that objectively differentiates the physiological state of bivalves from non-impacted and impacted water areas. Complex immunological criteria determined for health abnormalities will be used as reliable indicators in diagnosing homeostasis shifts leading to the development of histopathologies and establishing the causes of population fluctuations.

A unique case of imposex in deep-sea gastropods

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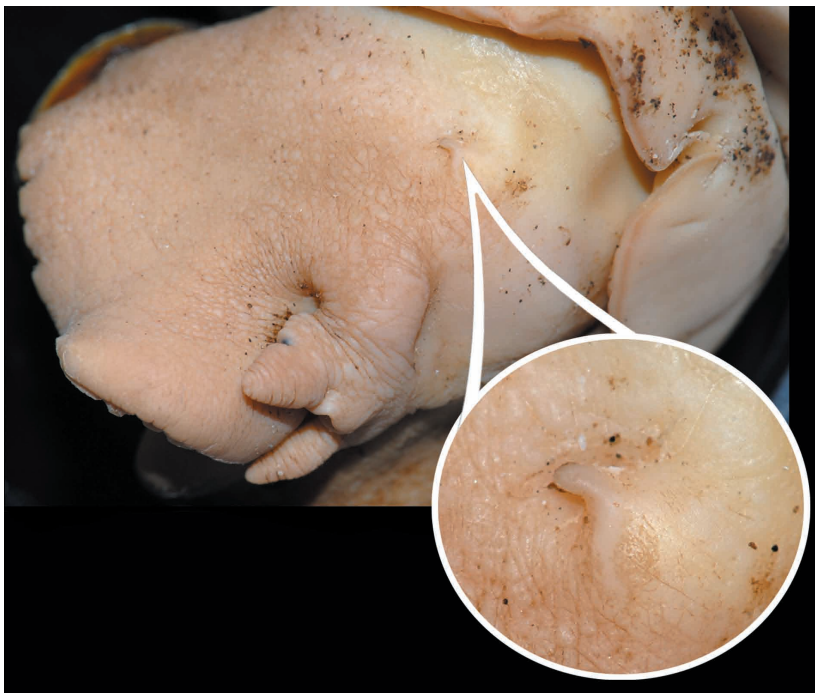
Imposex, or pseudohermaphroditism (imposition of characters of male reproductive system in females of dioecious gastropods), was first described in the 1970s. It has been shown that imposex is caused by chemicals based on tributyltin (TBT), a common contaminant of marine ecosystems used as an anti-fouling agent. Its wide distribution, high hydrophobicity, persistence, as well as capacity for bioaccumulation and potential biomagnification in food webs, produce adverse effects on the environment and human health. TBT causes endocrine disruption with abnormally high levels of androgen which lead to masculinization of females. In the recent decades, imposex has been used as an indicator of environmental pollution. Most cases of imposex were observed in waters of seaports and at depths shallower than 100 m. To date, gastropods have been reported as organisms affected by TBT most frequently (more than 150 species, predominantly belonging to Neogastropoda) and acutely.

Our study reports about the first recorded case of imposex in the deep-sea buccinid whelk *Neptunea convexa* (Buccinidae) (see Figure). The material was collected during the 61st research cruise on R/V "Academik M.A. Lavrentiev" in 2013. The main objective of this cruise was to investigate the unique deep-sea benthic ecosystems that have formed at sites of active cold seeps and are characterized by large amounts of gas, mainly methane, in their composition. In particular, zones of gas emission with a high methane concentration were examined in Deryugin Basin (Sea of Okhotsk), at depths of up to 1500 m. At the point with coordinates 54°00.6′ N, 146°25.6′ E (depth 1431–1448 m, 2.3°C, salinity 34.4‰), 5 big *N. convexa* specimens were sampled by means of a remotely operated underwater vehicle. Those were 3 males with normally developed penises and



Imposex female of *Neptunea convexa*. Penis enlarged in the circle.

2 females with normally developed gonads, capsule glands, and signs of imposex in form of small penis on the head behind the right tentacle. The very small size of penises and the absence of any characters of seminal duct indicates the first stage of imposex development. A heavy metal analysis of the whelks revealed no tin in their foot and digestive gland, but the concentrations of zinc (10 573 and 1407.3 μg/g dry weight in digestive gland and foot, respectively) and cadmium (373.3 and 43.8 μg/g dry weight in digestive gland and foot, respectively) were unusually high even for hydrothermal vents. Since the material was fixed not for metal analysis (in 70% alcohol instead of freezing), we also analyzed the alcohol in which the material was stored to test if these metals could diffuse from it to molluskan tissues. As a result, the values of zinc and cadmium were found to be 10–20 times as low.

Neptune whelks are typically dioecious animals, having neither the sex change nor planktonic larvae during the lifecycle. Their feeding habits are still poorly studied, but there are evidences of their predation on benthic invertebrates and scavenging. The recent determinations of the TBT half-life have shown that it lasts 8 years in sediments and 4–17 years in bivalves; the latter are usually filter-feeders capable of bioaccumulation. These facts give reason to believe that TBT enters whelk's body with eaten benthic organisms, which feed on detritus with trace concentrations of TBT. At the same time, we cannot exclude other causes of imposex such as high concentrations of other heavy metals (zinc and cadmium).

Gas-lift upwelling generated by methane seeps in the Black Sea: mechanism of formation and ecological role

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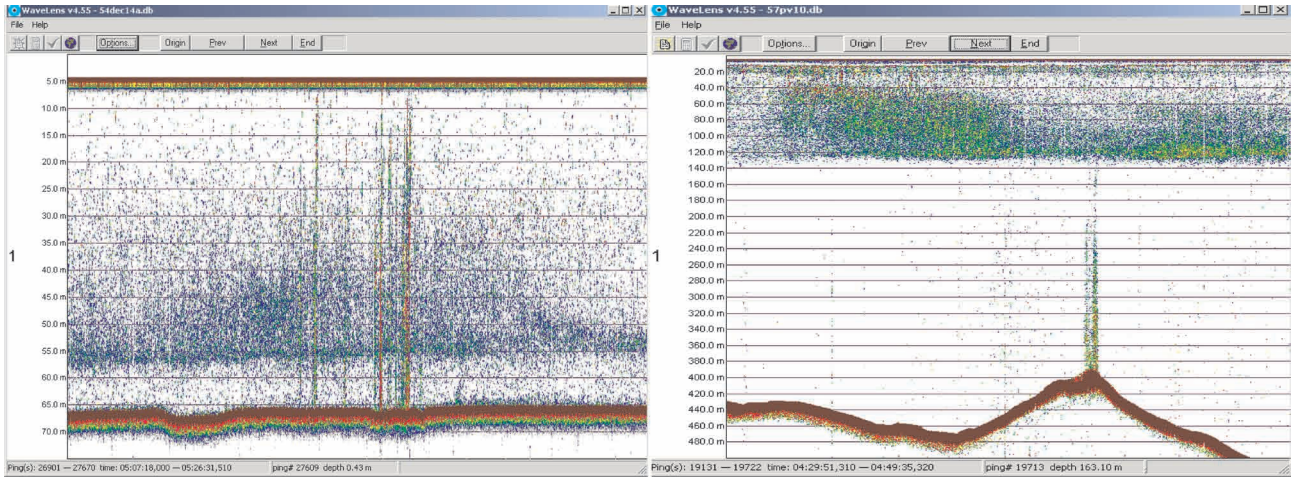
The significance of research of the gas seeps at the seabed is supported by their important role as a source of methane for the water column and the atmosphere, where it exhibits the properties as one of the strongest greenhouse gases, and by the fact that methane seeps may be applied as signs for detection of marine hydrocarbon deposits including gas hydrates, which are considered as a promising source of energy in a future. The Black Sea is the largest anoxic water body in the World, containing significant amounts of methane dissolved mainly in the deepwater, as well as existing in form of deposits of gas hydrates in the subsurface sediments. In the open part of the Black Sea, the gas seeps were discovered for the first time in 1989 by scientists of Institute of Biology of the Southern Seas (IBSS, since April 2015 – IMBR) using acoustic methods.

During the following years, more than 4160 sites of the gas seeps have been found at depths from 14 to 2084 m, and it was showed that the seeps are located mainly along the ridges and slopes of the seafloor, and they correspond to the paleo-deltas, the edge of the continental shelf and to geodynamic nodes of various scale. The first visual inspection of seeps at the Black Sea floor was carried out in 1990 by specialists from IBSS/IMBR and Institute of Microbiology of RAS (INMI, Moscow) during an expedition on research submarine "Benthos-300", when the massive carbonate structures formed by methanotrophic microorganisms were found. During these research, the IBSS/IMBR scientists have discovered that methane seeps in the Black Sea can generate upwelling due to the gas-lift effect leading to the upraise of the deep water enriched of nutrients, causing thereby a local eutrophication of the surface seawater. This may affect on thickness and density of the plankton backscattering layers and on the thermocline in surrounding water column (see Figure).

This has to be taken into account during the development of technologies for possible exploitation of the Black Sea hydrates, as these deposits are not yet fully tested source of marine hydrocarbons. This primarily relates to the measures for providing the environmentally safety for such projects. Moreover, there is still no clear idea about the possible consequences of the industrial exploitation of gas hydrates for the unique ecosystem of the Black Sea.

If to consider that gas hydrate deposits are distributed source of methane, then in the case of their spontaneous degassing caused by geological events or human activities the uncontrolled emissions of free gas over broad areas of the seabed may occur, that will lead to a sharp change in the balance of methane in water column of the Black Sea, to enter its excess amount to the atmosphere (with



Effect of the Black Sea gas seeps on backscattering layer of plankton.

possible firing, as it was already happen during the Crimean earthquake in 1927) as well as to the gas-lift upwelling of deeper waters contaminated with hydrogen sulfide and containing large amounts of nutrients.

Natural limitations of full-cycle eukaryotic life under permanent anoxia in the marine water and seabed sediments

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The question of possible full-cycle eukaryotic life under anoxia is much debated during last decades. Progress of evolutionary biology has recently support that all eukaryotes are arose just after "oxygen revolution" on the Earth. They have been first appeared not long-standing of 2.1 billion years ago. Targeted field studies performed by A. Azovsky, G. Polikarpov and M. Gulin groups suggests that any live Protists or Metazoans in the anoxic deep waters of the Black Sea does not exist. Nevertheless, a number of studies reported the findings of obligatory marine anaerobic eukaryotes at diverse deep sea-floor habitats in the Black and Mediterranean seas, when the authors concluded about full-cycle animal and protist life under permanent anoxia. The key problem regarding this last hypothesis is that the most of searching cases for eukaryotic anaerobes weakly linked not only with macroevolution basis, but also with the majority of current eco-physiological data. To this, our modeling experiments as well as natural observations do not support mentioned evidences of permanent anaerobic activity and growth of *Ciliophora*, *Nematoda* and some other benthic taxa (Fig. 1).

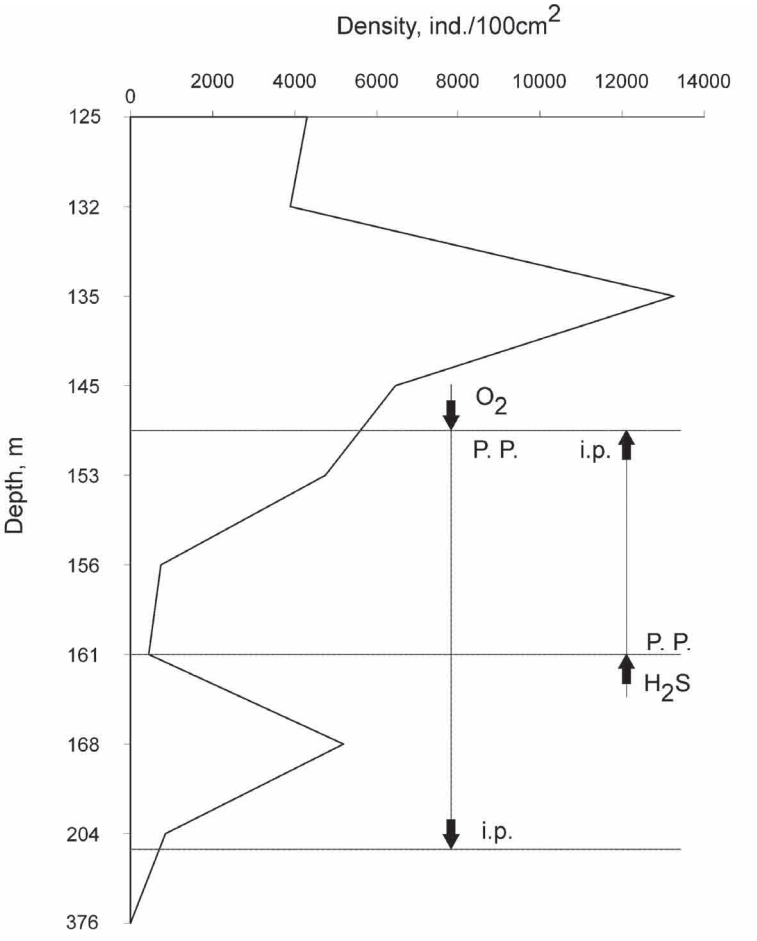

Fig. 1. Location of active alive forms of zoobenthos in the uppermost sediments along the seabed slope in the NW Black Sea. P. P. – boundaries of the zones with a permanent presence of dissolved oxygen or hydrogen sulfide, i.p. – spatial limits of their periodic inter-penetrations within the near-bottom water layer.

The intravital observations of micro- and meiobenthos in the redox-gradient hypoxic benthal of the deep Black Sea has shown the highest abundance of alive, locomotory-active benthic organisms within the suboxic and redox zones at continental slope SW Black Sea – a little more than 1500 ind./100 cm^2 at the depth 172 m (upper H_2S-surface was detected near sea-floor depth 185–188 m). Nonetheless, any alive eukaryotic organisms never been met below 204 m in the Crimea region (Fig. 1), and 251 m near the Bosphorus. Similarly, at the high-sulfidic microbial mats of seashore methane gas seep sediments the only 4% of found meiofauna was identified as alive. During *in vitro* experiments it was established that *Euplotes* (dominated by the *E. octocirratus*), one of the Black Sea free-living benthic ciliates, was identified as the most tolerant species to oxygen depletion. Nevertheless, in the isolated anoxic glass chambers the 100%-mortality of all *Euplotes* has been observed after 7-week incubation (Fig. 2).

Thus, mainly the deficit of dissolved oxygen and especially cases of its complete absence (anoxia) is one of the principal limiting factors for spatial distribution and growth of marine eukaryotes in extreme aquatic redox-ecosystems: stratified water columns and seabed sediments, gas seeps etc. It should be noted that general misunderstanding of the terms "hypoxia" and "anoxia" occurs in publications concerning the Black Sea oxic/anoxic interface as well as spatially low-sized biotopes: fjords and shallow gas seeps. Environmentally speaking, it could be determined that hypoxic ecotops refers to transient zones between normoxic and anoxic environments. Waters where dissolved oxygen concentration measured below 2 ml/L, are generally regarded as hypoxic. With that important, all poorly oxygenated ocean areas still remain an aerated waters, no matter how low the concentration of oxygen it contained. In sharp contrast, according the direct translation "anoxia" means the "absence of oxygen", the term with a single meaning, it can not be graded by the oxygen concentration' levels. What is predominate for Metazoa of anoxic habitats – active life forms, ontogenesis diapause, anabiosis or dead bodies – that is the subject to establish.

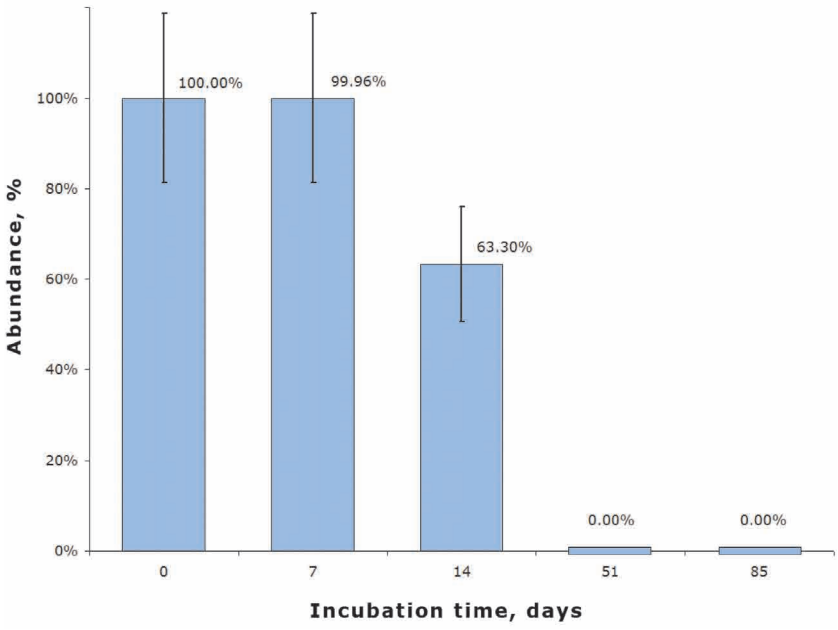

Fig. 2. The temporal dynamics of inactivation rate of the ciliates *Euplotes* sp. during the long-time experimental isolated incubation under anoxia.

Hidden diversity and phylogeographic history provide conservation insights for the edible seaweed *Sargassum fusiforme* in the northwest Pacific

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The premise of biodiversity conservation is to not only preserve the species itself, but also the evolutionary processes that have created diversity and the genetic potential of species to adapt to environmental change. Herein, we used mitochondrial *trn*W–M and *cox*3 and plastid *rbc*L–S data sets to analyze population genetic variation and phylogeographic history of the brown alga *Sargassum fusiforme* whose natural resource has been largely exterminated in the Asia-northwest Pacific in the past decades. Phylogenetic trees and network analysis consistently revealed three major clades (A, B and C) in *S. fusiforme*, with A and B distributed in the Japan – Pacific Ocean. Clade C consisted of three sub-clades (C1, C2 and C3) which distributed in the Sea of Japan, Korea and China coasts, respectively. IMa analysis revealed an approximate mid-Pleistocene genetic divergence (*c*. 0.858–1.224 Ma) between the three clades, while the divergence within the clade C was *c.* 0.106–0.128 Ma. Extended Bayesian skyline plots (EBSP) showed that clades A and B underwent relatively long-term stable population size and a subsequent rapid demographic expansion at *c.* 0.13 Ma, and sub-clades C2 and C3 underwent a sudden expansion at *c.* 0.26 Ma. F_{ST} and AMOVA analysis detected low population-level genetic variation and high degrees of divergence between clades. The cryptic diversity and phylogeographic patterns found in *S. fusiforme* are prerequisites to understand how environmental shifts and evolutionary processes shaped diversity and distribution of coastal seaweeds, which in turn can provide crucial insights for conserving and managing seaweed resource and facilitate predictions of their responses to future climate change and habitat loss.

Shallow methane cold seeps as environment of "ecological compromise"

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A natural coastal methane seepage spots has formed the highly site-specific seabed conditions. The active microbial processes of CH_4 anaerobic oxidation (AOM) at the seeps spot are basis for the significant organic matter accumulation at benthic environment. Within the seeps field off NW Crimea Peninsula (Black Sea), mean values of total organic matter (TOM) contents were measured 5.58% at the seeps sediments while at the reference site its values were 0.60% only. However, AOM processes around the seeps leads to appearance of sulfurettes with a high concentration (up to 3 mM) of hydrogen sulfide in their pore waters. Also, the redox potential (Eh) values, being related with this accumulation of sulfides, may be reduced here until – 460 mV. Concentration of dissolved oxygen, which utilized not only by biological respiration, but also by oxidation of large amounts of H_2S, is markedly lower in the bottom water above the seep spot and rapidly disappears in the upper few millimeter's layer of seafloor sulphidic sediments. As a result, meiobenthic seep communities are depressed in numbers (589 spsm./0.01 m^2) if compare with the bottom zoocenoses at the references substrates (17245 spsm./0.01 m^2). Density peaks of seeps meiofauna at the fixed samples were extended down to 3-cm sediment layer of the microbial mat. The dominant taxa and subdominant meiobenthos taxa were *Nematoda*, *Foraminifera* (*Allogromiida*) and *Polychaeta*. On the contrary, our direct microsopic observation of natural non-fixed samples showed that the active live representatives of the benthic meiofauna were found only at thin surface layer 0–0.5 cm depth of seep sediments. We focus our attention on this contrast in results of meiobenthic counts by using different methodological approaches (fixed or native benthic samples). These distinctions are most likely signaled that large number of dead meiobenthos bodies can stay undecomposed into the sulfidic sediments. We can conclude that methane seeps habitats are correspond to zone of "ecological compromise" as a result of the interaction between environmental factors – the both of limiting (H_2S presence and O_2 deficiency) and attracting (increased level of organic loads as a trophic supply) for benthic biota.

From an evil of marine ecosystem to a potential marine bioreactor: a case study of modern algal biotechnology

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A unique ecotype of *Ulva prolifera* (Ulvophyceae, Chlorophyta) has been confirmed to be responsible for the world-largest green tide occurred in the Yellow Sea, which attacked the coastline of Shandong Province every year. This ecotype has great capacity of growing fast with high protein content, and culture of *U. prolifera* in closed land-based tank has been verified to make commercial production available. However, technical improvements to develop genetic engineering for *Ulva* have long been ignored. Here, we report a transformation model for *U. prolifera* in which the *in situ* germination of vegetative cell of fronds was proved as an effective generation pathway for seedlings of transformants, and herbicide Basta as a screening reagent. After introduction of GUS reporter gene by particle delivery system, completely stained seedlings in blue colour could be obtained which exhibiting the stable expression and potential integration of foreign gene at one-cell stage. This pathway was further confirmed by introduction of *bar* gene which conferring Basta resistance to the positive transformants. Techniques of genetic engineering for *Ulva* would help to transfer this evil of marine ecosystem to a potential bioreactor which can produce high-value recombinant proteins at lower cost.

The genus *Hyalopecten* (Bivalvia: Pectinidae) from the abyssal and hadal zones of the northwestern Pacific

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Pectinidae, along with Thyasiridae, Cuspidariidae and Verticortiidae are, is one of the richest in the number of species among the lamellibranches. However, most of deep-water pectinids inhabit the bathyal zone. A small number of representatives of this family, most of them belonging to the genus *Hyalopecten* Verrill, 1897, have been found in the abyssal zone of the World Ocean (depths below 3000 m).

The genus *Hyalopecten* comprises 10 species, of which *Hyalopecten frigidus* (Jensen, 1904), *Hyalopecten neoceanicus* (Dall, 1908), *Hyalopecten profundicola* (Okutani, 1962), *Hyalopecten pudicus* (Smith, 1885), and *Hyalopecten strigilatus* (Dall, 1886) were recorded in the abyssal zone, and *Hyalopecten hadalis* (Knudsen, 1970) in the hadal zone. Most *Hyalopecten* species are very rare in samples and were generally described from a minimal amount of material (1–2 specimens).

Until recently, only one species of *Hyallopecten, H. profundicola*, has so far been recorded in the northwestern Pacific. It was found off the shores of Japan at depths of 3150–3450 м. Probably, this is a rare abyssal species, as in the course of intensive studies of the bathyal, abyssal, and hadal zones of the Pacific Ocean Japanese investigators have found only 4 its specimens in a narrow depth range.

During the period from 1949 to 1990, numerous Russian (more than 20) expeditions have explored the deep-water benthic fauna of the Sea of Japan, the Sea of Okhotsk, the Bering Sea, and the northwestern Pacific, including the abyssal plain and oceanic trenches. Starting in 2010, investigations of the deep-sea fauna of this extensive region have been continued by joint expeditions of Russian and German researchers. A thorough examination of the entire extensive material of bivalves collected by different expeditions during the period from 1949 to 2015 in the abyssal and hadal zones of the Sea of Japan, Sea of Okhotsk, Bering Sea, and the northwestern Pacific has revealed three new species of *Hyalopecten.* Two species were found on the abyssal plain (depth 4550–5045 m) adjacent to the Kuril-Kamchatka and Aleutian trenches and one species was discovered in the hadal zone of the Kuril-Kamchatka and Aleutian trenches (depth 6090–8100 m). The latter species is the most deep-water species of the order Pectinida.

To date, 4 species of the genus *Hyalopecten* have been recorded in the abyssal and hadal zones of a relatively small region of the northwestern Pacific Ocean (from Japan to the Commander and Aleutian Islands). This is almost half (44.4%) of all species of the genus *Hyalopecten* discovered in the abyssal and hadal zones of the World Ocean. The relatively high species richness of deep-water *Hyalopecten* species in this region of the northwestern Pacific is not a unique phenomenon and

reflects high species richness of both the entire abyssal and hadal fauna of the region and individual taxonomic groups of animals. Examination of the materials collected only by one KuramBio expedion on the abyssal plain (4861–5787 m) adjacent to the Kuril-Kamchatka Trench has revealed 55 species of bivalves belonging to 21 families, which is much more diverse at the family level than the Atlantic bivalve fauna. The high species richness of the abyssal and hadal faunas in the Kuril-Kamchatka Trench region may be connected with the fact that the region is one the Pacific's most productive areas where favorable conditions are created for the feeding of bottom animals.

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Bivalve feeding experiments as a useful tool for investigation of marine phycotoxins' biotransformation

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The problem of transport and accumulation of marine phycotoxins, causing harmful effects on human have been investigated for more than 50 years with the remarkable progress and mostly by the methods of monitoring in environmental conditions and revealing of the substances by chemical methods. This provides proves for the transport of toxins from microalgae to bivalves and some indices that bivalves are capable of transformation of toxins. However, this approach does not help to reveal mechanisms of toxin biotransformation by bivalves. To access this the experiments *in vitro* must be held with the control of certain conditions.

Bivalves are relatively complicated organism, and specific measures should be taken to assure that the experimental data would be robust. The following characteristics should be taken into account: changes in physiological state (periods of gametogenesis and preproduction), time for acclimatization, feeding habits and rates. Underestimation of the influence of any of these factors can lead to acquisition of incorrect data.

The latest research based on the feeding of bivalves by microalgae in the controlled conditions showed the differences in accumulation and depuration rates of common diarrheic shellfish toxins for mussels in relation to *Dinophysis acuta*, and scallops in presence of *D. fortii*. With the development of modern approaches in genomics, proteomics, lipidomics and metabolomics and application them *in vitro* experiments the potential for revealing exact mechanism of bivalve response to the toxic microalgae is increasing.

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Trophic structure of cold-seep communities in the Sea of Okhotsk

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Cold-seep communities are now known to be distributed worldwide in the deep-sea environment. Chemoautotrophic vesicomyid and mytilid bivalve molluscs, as well as siboglinid tube worms, usually dominate the biomass in cold seeps, providing microhabitats for diverse benthic communities.We identified the main food sources and analysed the trophic interactions of the common benthic species collected near methane seeps in the Sea of Okhotsk using stable isotopes and fatty acid analysis. Analysis of the fatty acid composition of vesicomyids *Akebiconcha soyae* and *Archevisica* sp. revealed very low concentration of ω-3 and ω-6 polyunsaturated fatty acids and the presence of unusual polyunsaturated fatty acids ω-1, ω-4 and ω-7 series. The extremely low level of C_{20} and C_{22} polyunsaturated fatty acids indicates a negligible role of particulate organic matter as food for these species. All studied specimens of giant thyasirid *Conchocele bisecta* are characterized by a high content of monounsaturated fatty acid 16:1ω-7 and very low content of ω-3 and ω-6 polyunsaturated fatty acids. This is a specific feature of the lipid composition of all bivalves that feed upon chemoautotrophic symbionts. Furthermore, neither fatty acid composition nor isotopic content provided evidence for photosynthetic sources as food nutrients for these bivalves using filter feeding. Unusual fatty acid profiles were also found in polychaete *Pavelius uschakovi* and in pogonophora *Sclerolinium*, both living near methane outlets. Using isotopic analysis it was found that Buccinum sp. feeds on organic matter obtained by chemosynthesis. Most species of invertebrate (Asteroidea, Ophiuroidea, Actiniaria, Echinoidea, Polychaeta, Porifera, Ascidiacea and Hydrozoa) living in these areas do not use the organic matter obtained by chemosynthesis. therefore they have usual for deep-sea animals fatty acid compositions. Conclusions based on fatty acid analysis have been confirmed by data on isotopic analysis. It was shown that the methane seeps have little impact on the trophic structure of surrounding ecosystem however they might be important as a habitat for many invertebrate and vertebrate species.

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The abyssal ecosystems of neighboring Kurile Basin and Japan Basin have very different trophic structures

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Most abyssal ecosystems have relatively simple trophic structures characterised by the predominance of deposit feeders. Organic substances are deposited mainly as a seasonal pulses of diatoms and zooplankton faeces and consumed by bacteria and zoobenthos. An abyssal ecosystem of the Kurile Basin has such trophic structure. Data on fatty acid compositions and the carbon and nitrogen stable isotope ratios of key invertebrate species allowed to assume that they are surface and subsurface deposit feeders. The echiuran *Pseudoikedella achaeta* and holothurians of the genus *Molpadia* have very high levels of $\delta^{15}N$ and very low levels of $\delta^{13}C$ which are typical for subsurface deposit feeders. Lipids of holothurians of the genus *Molpadia* were distinguished by the highest content of 20:4(n-6) and the highest ratio of 20:4(n-6)/20:5(n-3). We suppose that *P. achaeta* uses more upper sediment layers than holothurians of the genus *Molpadia* does; this is seen in increased concentrations of planktonic origin PUFAs such as 20:5(n-3) and 22:6(n-3).

The same analysis did not reveal any surface and subsurface deposit feeders among key invertebrate species of abyssal ecosystem of the Sea of Japan. We found also no isotopic or fatty acid indications of feeding on allochtonous detritus of seagrasses and macroalgae among abyssal consumers. Various key consumer species of the Sea of Japan abyssal food web occupied similar trophic positions and fed predominantly on descended zooplankton. We hypothesise that the specific food web structure is the result of a very short historical development of this isolated abyssal community following a deep-water anoxic event during the Last Glacial Maximum. It is likely that we have observed only the initial step of the abyssal succession in which endemic carnivores have been developed. They use the most valuable sources of food, while the trophic niches of deposit-feeders remain unoccupied.

These results show how regional changes in the pelagic food web and connection with ocean waters can affect the structure of the abyssal food webs.

This work was supported by Russian Science Foundation (project no. 14-50-00034).

Macrobenthos of the intertidal gas-hydrothermal vent areas in some locations of the Kurile Islands

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A description of the macrobenthic intertidal biota of the Goryachiy Plyazh (Hot Beach, Kunashir Island; 43°59′32.3″ N, 145°47′55.5″ E) and Kraternaya Bight (47°30′32.6″ N, 152°49′08.6″ E) on volcanic Yankich Island (Ushishir Islands) is given. The intertidal macrobenthos of the Goryachiy Plyazh is under the influence of the thermal springs of the Mendeleeva Volcano. The springs are observed among the rocks, boulders and sand as the seeps of a hot water (up to 80°C) containing H_2S (Fig. 1). The macrobenthos is absent in the sites directly influenced by high temperature (above 40°C) and impoverished in the vicinity of the gas-hydrothermal vents and seeping volcanic waters. Two tide pools up to 1.5 m depth with seeps of volcanic fluid and a sulfuric acid stream are in the Goryachiy Plyazh. In one of the pools (sea water temperature is 5°C in March and 25°C in October) (Fig. 2A), there are only a few species of macrobenthos: algae *Chaetomorpha melagonium*, covering with thick layer of diatoms, and *Fucus evanescens*, barnacles *Semibalanus cariosus* and *Chthamalus dalli*, sea anemone *Diadumene lineata*, and the isopod species *Synidotea lata* and *Tecticeps glaber*. But a population density of *D. lineata* reaches above 2000 ind. m^{-2} (Fig. 3). In the others locations of

Fig. 1. The intertidal zone of the Goryachiy Plyazh. Photograph by Alexander Omelyanenko.

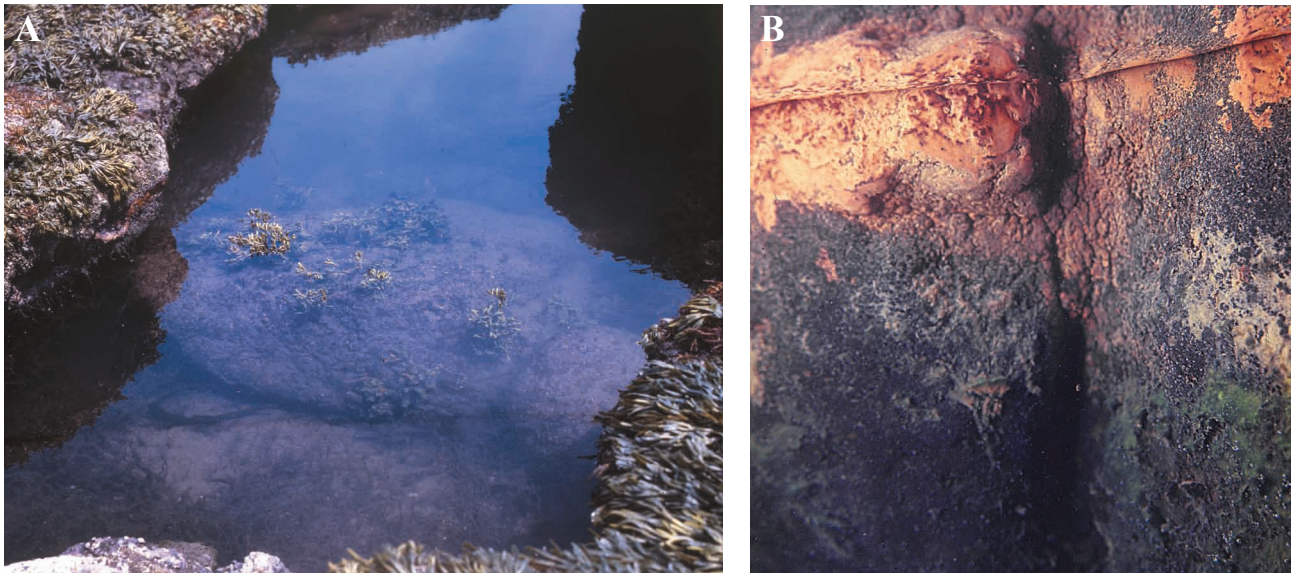

Fig. 2. The tide pools on the Goryachiy Plyazh. **A** – the tide pool with "cold" volcanic H_2S seeps; **B** – the tide pool with "hot" volcanic H_2S seeps. Photograph by Alexander Omelyanenko.

Fig. 3. Sea anemone *Diadumene lineata* in the tide pool. Scale bar: 10 mm. Photograph by Alexander Omelyanenko.

Kunashir Island, *D. lineata* is not found. In the tide pool with the sea water temperature from 25°C to 60°C in different seasons, macrobenthos is absent, and only the algal-bacterial mats are covered the walls of the tide pool near a hydrothermal vents (Fig. 2B). In the streambed, only the solitary algae *F. evanescens* and *Ulva prolifera* dwell. At the same time, there are no marked changes of the intertidal communities in the sites of volcanic springs characterized by temperature below 10–15°C, and, in general, the species composition and distribution of the intertidal biota of the Goryachiy Plyazh are common for the rocky intertidal zone of Kunashir Island.

The intertidal zone of Kraternaya Bight is mainly composed of pebbly, gravel, and boulders, often with underlying sand. Insignificantly indented coastline of the bight and an almost homogeneous granulometric sediment structure determine well marked the vertical stratification of the macrobenthic intertidal communities. The intertidal zone with sediments and numerous gas-hydrothermal vents containing H_2S (hydrosolfatar field) is along the south-eastern coast of the bight (Figs 4, 5A). Macrobenthos is not found in the mouth of the thermal stream at sea water temperature of 30–40°C. However, in the vicinity of the mouth of the stream, the upper intertidal subzone is inhabited by the belt-forming community of small sea snail *Littorina sitkana*, the midlittoral occupies by the *F. evanescens* community and also the spionid polychaete *Polydora vulcanica* forming compact mats with density up to 100,000 tubes/m^{-2}, and in the lower intertidal subzone, there is the belt-forming community

dominated by the brown algae *Alaria paradisea+A. marginata*. In the middle and lower intertidal subzones, some boulders and the *Fucus* thalli are covered by barnacle *Balanus crenatus* (Fig. 5B). The thalli of the seaweeds are also often covered with bacterial mats. In the northern part of the bight,

Fig. 4. Kraternaya Bight. The intertidal zone is indicated by arrows. **F** – the hydrosolfatar field. Photograph by Alexander Omelyanenko.

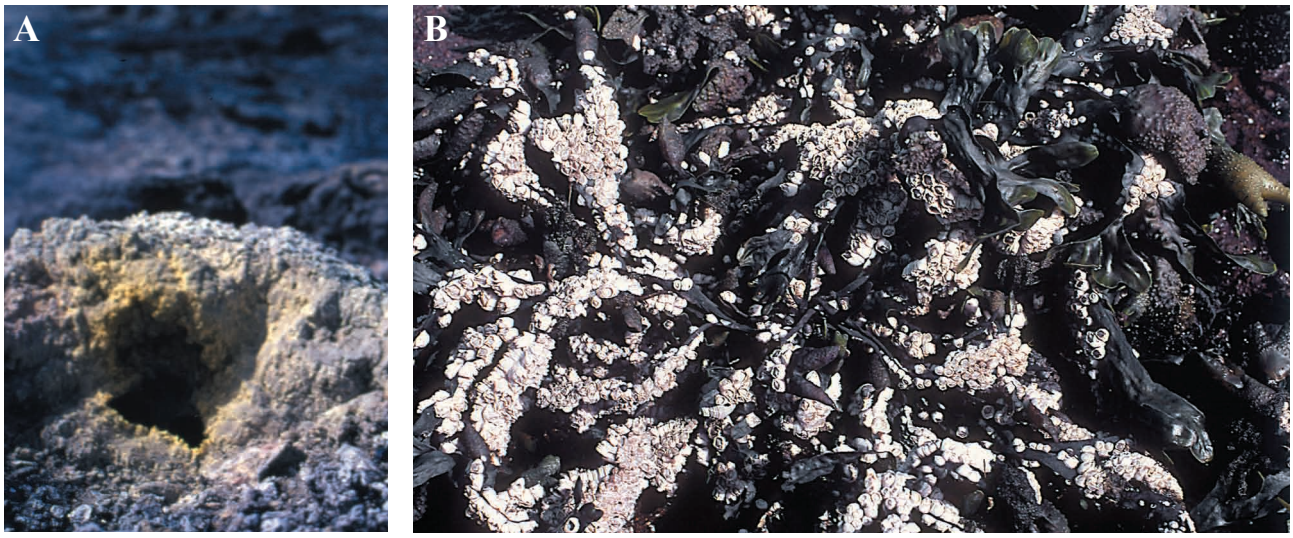

Fig. 5. The gas seep containing H_2S (**A**) and *Fucus evanescens* heavily overgrown by *Balanus crenatus* (**B**). Photograph by Alexander Omelyanenko.

there are comparatively cool intertidal vent seeps (about 10°C) without H_2S containing high concentrations of Fe, Mn, Zn, and compounds of other metals. The species composition and the dominant species of the macrobenthic communities does not vary noticeably here from coasts of Kraternaya Bight located outside of zones of volcanic influence. However, there are populations of the *Alaria angusta* with the total alga biomass above 25 kgWW m^{-2}. Algae and some animals are covered with a rusty lamina of ferric oxide.

Cultivation of the brown alga *Stephanocystis crassipes* (Sargassaceae, Phaeophyceae) in a combined way (the aquarium – the sea)

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Sargassaceae is a widespread economically important alga in China, Korea, Japan and other countries of northwest Pacific coast. The detailed methods of Sargassaceae cultivation were developed for *Sargassum horneri*, *S. thunbergii*, *S. fulvellum*, *S. muticum*, *Hizikia fusiformis*. However, the Far Eastern brown algae *Stephanocystis crassipes* was not the subject of cultivation. Therefore, techniques developed for Sargassaceae we tried to adapt for cultivation of *S. crassipes*.

The plants with immature receptacles were collected in Sobol Bay (Ussuriysky Bay, Sea of Japan) in 6 June 2014. Apical branchlets with an average length of 15 cm were isolated from the plants and inoculated in 5 L glass beakers with sterile seawater at 18–20°C and solar light. Irradiance levels could reach 230 μmol photons m^{-2} s^{-1} on a sunny day.

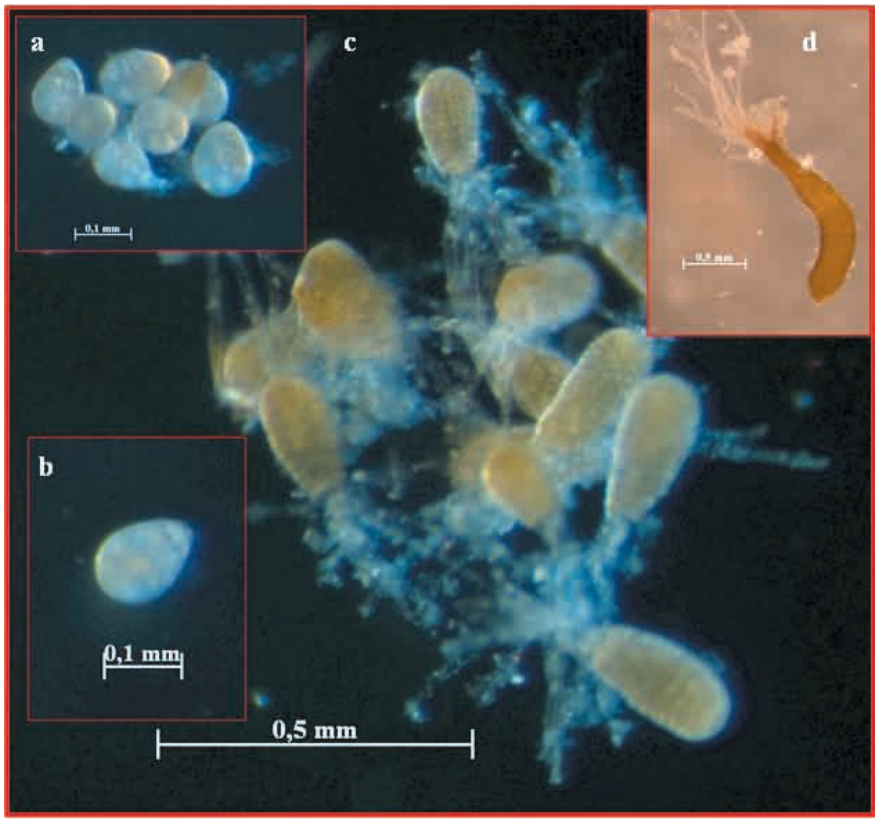

Fig. 1. The formed embriospores (**a**, **b**) at 2 days and young seedling of *Stephanocystis crassipes* at 7 (**c**) and 68 (**d**) days post-fertilization.

The largest number of gametes released on the third day, the next day the branchlets were removed. The formed zygotes and embriospores settled on the bottom of beaker as a light yellow precipitate. Precipitate was collected and placed on plexiglass slides without aeration for three days. Embriospores were incubated at 10±1°C and 24 μmol photons m^{-2} s^{-1} in aquaria (Fig. 1). Under these conditions the average length of the seedling increased from 58.48±0.84 μm on 16 June 2014 to 18±0.98 mm on 7 July 2015 (Fig. 2a). Thus, the seedlings did not develop into adult plants.

Fig. 2. On 7 July 2015, all seedlings (**a**) were transferred to open sea (**b**) and were vertically hung in surface water. The longest seedling reached 26 cm (**c**, **d**) and 53 cm (**e**) in the sea after a 10-month and 12-month open-sea cultivation, respectively.

Then (one year post fertilization) algae were out-door cultivated on were vertical long lines at Marine Biological Station "Vostok" (Vostok Bay, Sea of Japan) (Fig. 2b). After five month plant length and weight was reached in average 16 cm and 6.2 g, respectively (November, 2015). In April 2016 the maximal plant length was 26 cm and weight was 66.7 g (Fig. 2c, d) and end May length was 53 cm and average weight was 58.8 g (Fig. 2e). At that time algae had the pneumatocysts as well as plants in natural population.

Thus, germlings of *S. crassipes* did not developed into adult plants under cultivation in aquaria. The transfer of algae in open sea stimulated development of the alga, so in spring habitus of cultivated plants was similar to wild ones.

Laminaria thickets recovery in dependence on abiotic and biotic environments

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Thickets of kelps degrade recently in many coastal areas, including the Sea of Japan, and are replaced by weed non-commercial algae. As the result, the stock of laminaria at the coast of Primorye decreased significantly since 1990s, and its annual production became generally lower since 2000, with prominent year-to-year fluctuations. Its reproductive thalli are absent or sparse in many coastal areas, in particular on traditional landing-grounds, or are located too shallow (<5 m depth) that is unfavorable for the thickets recovery. The grounds free of laminaria are occupied by concurrent species, mainly coralline algae, which additionally prevent recovering of the laminaria thickets.

The lower stock of laminaria is the reason of its landing reducing, so is negative for processing industry and employment in coastal villages. Besides, laminaria is a species-edificator that determines the bottom biocenes, as the substratum for settling of fish and invertebrates eggs and larvae, as the shelter for their juveniles, and as the food for sea urchins. That's why the problem of laminaria thickets recovery is actual and important both for fishery industry and for productivity of the coastal waters, on the whole.

Pacific Fisheries Research Center (TINRO) conducts the surveys and experiments on possibility of the laminaria thickets recovery on its natural grounds and in marine farms since 2005. Mechanisms of its zoospores spreading from the reproductive thalli is determined, dynamics of the coralline algae and other competitors for substratum as *Phyllospadix* and *Costaria* is traced, experiments on the laminaria re-cultivation on the substrata partially covered by coralline algae are conducted, and finally a technology for the thickets recovery is developed and tested for closed and semi-closed bays and the areas without strong waves. These results are generalized as a Biotechnology for Laminaria Thickets Recovery, based on settling of the laminaria reproductive thalli stimulated for zoospores production on the grounds, previously covered by this species. The Biotechnology is a complex of recommendations, partially constant (as how to choose the reproductive thalli, how to transport them, how to stimulate them for zoospores production, how to settle them to the sea bottom, etc.) and partially dependent on real environments (as terms of the zoospores release that depend on meteorological and oceanographic conditions). Implementation of these recommendations allows to get high harvests of the laminaria and to provide good feeding base for sea urchins.

The study of biodiversity corals community on coral reefs of Vietnam

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Dynamics of biodiversity research traced reef-building scleractinian on the reefs of Vietnam for more than 30 years. Found 358 corals species, pertaining to 80 genera (including nine ahermatypic corals), of which 153 species, belonging to 28 genera, were not previously known for that region, and 16 species from six genera were described for the first time. As in most Indo-Pacific reefs, the species diversity of Vietnam's reefs consists mainly of the members of five families: Acroporidae (98 species), Faviidae (42 species), Fungiidae (32 species), Poritidae (31 species), and Dendrophylliidae (26 species), making up altogether 64.48% of the total scleractinian species composition (Figs 1–3).

Fig. 1. The common coral reef of Vietnam.

Fig. 2. Monospecific settlement on the reef. Mieu Island, Nha Trang Bay, depth 2 m.

Fig. 3. The richest coral settlement on the reef, Re Island, depth 9 m.

The species composition and high diversity of Vietnam's coral fauna, as well as its close similarity to the southwestern Pacific coral fauna, allow one to refer it to the Indonesia-Polynesian center of origin of the coral faunas of the tropical Indo-Pacific. The whole Vietnam coast, from the Gulf of Tonkin to the Gulf of Siam, is a biogeographically single whole and is part of the Indo-Polynesian Province of the Indo-Pacific Area.

Macrobenthos structure under the impact of mariculture farm in Minonosok Bight, Posyet Bay, Sea of Japan

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The structure of coastal communities depends on the effect of climatic and anthropogenic factors. The impact of mariculture farms on the native organisms is usually drastic. A semicommercial farm for raising marine invertebrates was set up in 1971 in Minonosok Bight, Posyet Bay, Sea of Japan. This is one of a few bights in Primorye where the storms are minimal. The annual yield of Japanese scallop (*Mizuhopecten yessoensis* Jay,1857) spat ranges from 6 to 10 million individuals in different years. Two thirds of this amount were placed in cages, and the rest was sown onto the bottom or transferred elsewhere to other parts of Primorye. The composition and structure of benthic communities in Minonosok Bight have been studied in 1990 and 2012.

In 1990, on five basic hydrobiological transects in Minonosok Bight, bivalve and gastropod mollusks and seaweeds dominated in terms of species number, frequency and biomass. Common mollusk species were *Littorina brevicula*, *L. squalida*, *Falsicingula* sp., *Homalopoma sangarense*, *Crenomytilus grayanus*, *Modiolus kurilensis*, *M. yessoensis*, *Musculista senhousia*, *Pusilina plicosa*. Common macrophyte species were brown algae *Analipus japonicus*, *Chordaria flagelliformis*, *Sargassum pallidum*, *S. miyabei*, green algae *Codium fragile*, *Ulva lactuca*, and seagrass *Phyllospadix iwatensis*. In total, 140 taxa of organisms were found; their total biomass was high, up to 29 kg/m^2. In 2012, remote research revealed changes in the composition of bottom sediments as well as benthic communities.

The dominant and subdominant species in modern benthic communities in Minonosok Bight are ecologically flexible invertebrates. These are the mollusks *L. brevicula*, *Tegula rustica*, *C. grayanus*, *M. kurilensis*, *M. yessoensis*, spirorbid polychaetes, echinoderms *Mesocentrotus nudus*, *Asterias amurensis*, and *Asterina pectinifera* (see Figure). They are characterized by a wide food spectrum and natural variability, which is caused by seasonal and local variations in their forage base. Mussels, due to their biochemical characteristics, easily switch from aerobic to anaerobic metabolism also. The sparse mussel druses registered at all the transects in 2012 indicate the stability of the population. However, juvenile mussels cannot survive heavy silting resulted from marine farm activities.

On basic transects, changes occurred in "unstable" zones in which the bottom substrate structure was transformed. The taxonomic diversity of benthic organisms in the upper intertidal and subtidal zones was markedly reduced. Plant communities were replaced with animal or mixed communities. On all transects, the biocenotic role of macrophytes was decreased and, as a consequence, the total biomass of macrobenthos declined. The mosaic distribution of macrobenthos was increased. Monodominant communities were mainly replaced with polydominant ones. Because of silting of the bottom on transects of the southern shore of Minonosok Bight, macroalgae were attached not to

Macrobenthic organisms of the Minonosok Bight, Posyet Bay, Sea of Japan.

the bottom, but to mussel druses in the lower horizons. The trophic structure of subtidal communities in upper horizons was changed. Sestonophages, detritophages and predators became predominant instead of producers.

Thus, the negative impact of the scallop farm on the macrobenthos structure in the study area is manifested in reduction of species and taxonomic diversities, decrease in the total biomass of benthic organisms, and as the change of dominant species of communities. The polyculture farms could diminish this impact by increasing the detritophages' activity.

Biogeography of bivalve fauna of Peter the Great Bay (Sea of Japan): a zonal-geographical approach

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Peter the Great Bay (southern Primorye) bivalve molluscan fauna is one of the richest faunas among the Russian Far Eastern areas, and its biogeographical traits are of great interest. Scarlato (1981) recorded 135 species of bivalves in the bay whereas we recently updated the list to 158 species (Lutaenko, Noseworthy, 2012; one is not identified to species level). Results of zonal-biogeographical analysis show that among 157 species, boreal species have a share of 50% and, combined with boreal-arctic ones, 65%, whereas the proportion of warm-water mollusks is 35% (Fig. 1). There are nine tropical-subtropical bivalves in SP (6%), and more subtropical species (23, or 15%). This clearly shows the important role of semi-enclosed inlets and inner parts of large ria-type bays with an intense summer warming, as well as the Holocene climatic warming, in the formation of the fauna of Peter the Great Bay. These interzonal species give the fauna a mixed character, boreal in general, but with a significant number of boreal-arctic mollusks on the lower shelf and warm-water species in the upper subtidal zone. According to Scarlato (1981) analysis, the proportions of zonal-geographical groups are similar to ours: 69.5% boreal and boreal-arctic species and 30.5% warm-water species.

Embaymental faunas are an interesting phenomenon in the bivalve molluscan biogeography of the Japan Sea. At present, the ecological zoogeography of embaymental faunas of secondary bays of Peter the Great Bay: Possjet Bay (Scarlato, 1981), Amursky Bay (Lutaenko, 2003), and Ussuriysky Bay (Lutaenko, 2006), is well-known. In general, in outer parts of these bays, boreal species along with boreal-arctic are predominant, whereas in inner parts, subtropical, subtropical-boreal, and tropical-subtropical play a dominant role, and the share of boreal-arctic species significantly decreases. As an example can be taken Amursky Bay bivalve fauna (Fig. 2). This pattern is connected with the heterogeneity of summer temperatures in bays, which allows the warm-water taxa to concentrate in semi-enclosed inlets and inner parts under favourable conditions for spawning.

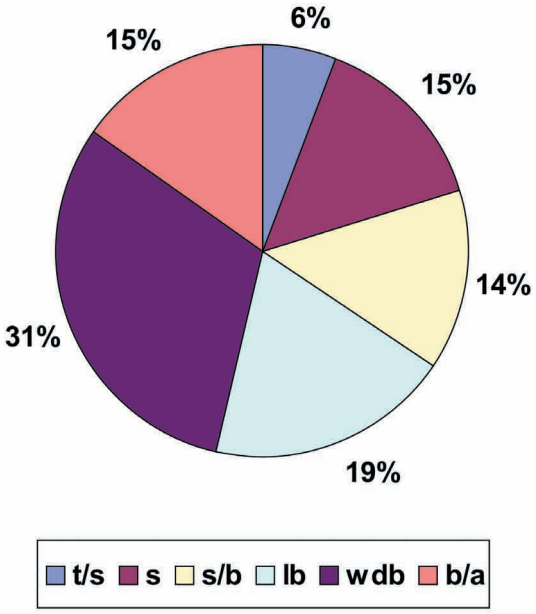

Fig. 1. Zonal-geographical composition of bivalve molluscan fauna of Peter the Great Bay (Sea of Japan); **t/s** – tropical-subtropical species; **s+s/b** – subtropical and subtropical boreal (mainly subtropical-lowboreal) species; **lb** – lowboreal species; **wdb** – widely distributed boreal and circumboreal species; **b/a** – boreal-arctic species.

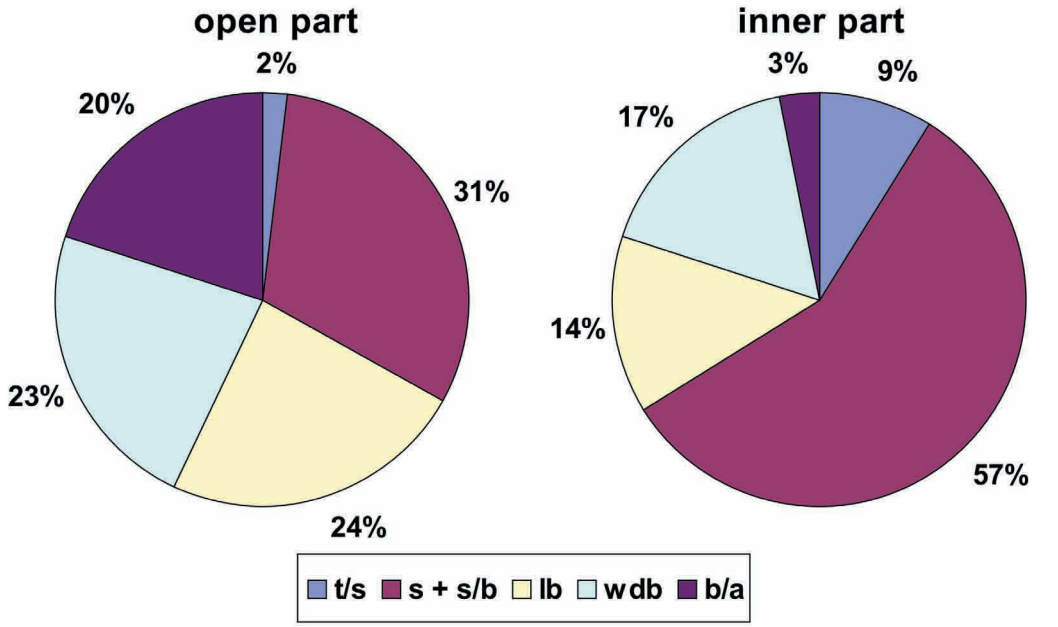

Fig. 2. Zonal-geographical composition of bivalve molluscan faunas of open and inner parts of Amursky Bay (Peter the Great Bay, Sea of Japan); for explanation of abbreviations, see Fig. 1.

Bathymetric distribution of species and biogeographical complexes is known in secondary bays, but we do not know well bathymetric patterns in a scale of entire Peter the Great Bay. We compile at present an updated database of depth ranges of bivalves from various sources including our unpublished data, to analyze the bathymetric patterns. In Amursky Bay, bathymetric distribution of mollusks shows the highest species richness at depths down to 30 m (90 species); below, at depths of 31–60 m and deeper than 61 m, species number decreases to 17 and 23 species, respectively. Zonal-geographical composition of the fauna also changes with depth, and this allows us to consider the upper subtidal bivalve molluscan fauna of the area studied as boreal, and lower subtidal (deeper than 60 m) as boreal-arctic (subarctic), which can be explained by the influence of the cold Primorskoye Current. In Ussuriysky Bay, the bathymetric distribution of biogeographical complexes shows that warm-water species prefer the upper subtidal zone while cold-water species concentrate deeper. For instance, an overwhelming majority of subtropical and subtropical-lowboreal mollusks (39) inhabits the depth range of 0–30 m but are rare below 31 m; tropical-subtropical species are not recorded deeper than 61 m. In contrast, the number of boreal-arctic species increases with depth. The same trend is observed for the molluscan faunas of Possjet Bay.

Thus, the zonal-geographical analysis reveals three important patterns of Peter the Great Bay bivalve fauna: **1)** the fauna has mixed character, boreal in general, but with **2)** a significant number of boreal-arctic mollusks on the lower shelf and warm-water species in the upper subtidal zone; **3)** in outer parts of secondary bays, boreal species along with boreal-arctic are predominant; in inner parts, subtropical, subtropical-boreal, and tropical-subtropical play a dominant role, and the share of boreal-arctic species significantly decreases. These conclusions update the Scarlato (1981) analysis.

Comparison of octocoral biodiversity between the Sea of Japan and Pacific side of Japan, with a revision and new species

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The Sea of Japan is located between Far East Russia and Japan Islands. There is less information about a faunal comparison between the Sea of Japan and Pacific side of Japan. Only 8 species of gorgonians (*Melitodes dichotoma*, *Paragorgia* sp., *Anthomuricea aberrans*, *Calcigorgia japonica*, *Elasmogorgia filiformis*, *Euplexaura abietina*, *Primnoa pacifica*, *Thouarella superba*) have been reported from the Sea of Japan, in contrast, more than 250 species has been reported from Pacific side of Japan. In this manuscript, we are going to report some of these species are revised and also show additional records of octocorals from the eastern side of Sea of Japan.

Melithaea japonica (Verrill, 1865) (Melithaeidae, Octocorallia) is synonymized and is reported from the northeastern part of Sea of Japan. *Melithaea mutsu* (Minobe, 1929) from Tsugaru Strait, which connects Sea of Japan and Pacific Ocean is re-described. New species *Melithaea sagamiensis* Matsumoto, Ofwegen, 2015 is described from both Pacific side and Sea of Japan side. One genus *Melithaea* of the family Melithaeidae exist in Japanese water and all new species from Japan are endemic. Therefore, total 14 species of Melithaeid corals are reported from Pacific side of Japan, and two species are reported from Sea of Japan side. Northern most recorded species of the family Melithaeidae in this study is *M. sagamiensis* with the latitude 41.59′ N. Nutting (1912) reported *Melitodes dichotoma* from the Sea of Japan, but this is likely to be a misidentification. *Elasmogorgia filiformis* reported by Nutting (1912) is also unlikely genus *Elasmogorgia*. The genus *Filigella* (Plexauridae, Octocorallia) is synonymized as *Euplexaura* and *E. mitsukurii* is first reported from the southern area of Sea of Japan.

Our results suggest that the warm Kuroshio water current which has sourced from North Equatorial Current can affect up to latitude 41.59′ N. And it brings the total number of gorgonian species from Sea of Japan to 9 with one additional species at Tsugaru Strait.

Adaptation strategy of *Bathymodiolus platifrons* in the cold seep ecosystems revealed by comparative transcriptomics

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With endosymbionts in their gills, *Bathymodiolus* mussels thrive in both hydrothermal vents and methane seeps. They can survive from harsh environments with highly toxic chemical conditions. To unveils possible molecular processes involved in environmental adaption and symbionts-host mutualism, we sequenced transcriptome from seven tissues of *Bathymodiolus platifrons* from a cold seep in the western Pacific shelf regions, and compared with its coastal relatives *Modiolus kurilensis* (transcriptome from seven tissues). 137591 and 136955 transcripts were assembled for *Bathymodiolus* and *Modiolus* respectively. Large number of genes related to microbe recognition, heavy metal binding, detoxification, immunization and defense were annotated through KEGG and GO analysis. Our relaxed Bayesian molecular clock estimates a late cretaceous appearance of the *Bathymodiolus* crown group (~90 Mya). The *Modiolus* and *Bathymodiolus* diverged at approximate 250 Mya. After the speciation of *Bathymodiolus* species, more than 500 genes were found to undergo positive selections, including gene groups involved in the oxidation of sulfur, monocarboxylate transporter and metal ion binding. Compared to its coastal relatives (*Modiolus*), 1786 genes participating in the biological processes of apoptosis, anti-pathogen infection and et al were absent in *B. platifrons*. In contrast, more than 800 *Bathymodiolus*-specific genes were observed, which may play important roles in the regulation of innate immune response and peptide glycosylation. Some *Bathymodiolus*-specific genes have been found to facilitate the infection of microorganism in other bivalves. We also reported a potential oxygen binding protein with high similarity with fish hemoglobin in two mussels. The isoform numbers of the globin-like protein extended significantly in *B. platifrons* compared with the coastal mussel and showed a gill-specific expression pattern. Overall, the present study provided new insights into molecular strategies on hypoxia and heavy-metal adaption, as well as sulfur metabolism, and may shed light on the mutualism mechanism of *Bathymodiolus* and its endosymbiots.

Black corals from topographic highs found in the Rockall Trough and the adjacent continental slope

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Black corals (Antipatharia: Anthozoa) are an important and rich component of the suspension feeding fauna of the North-East Atlantic seamounts, banks and carbonate mounds. They often play host to a rich and diverse associated fauna. Until recently black corals were only sporadically reported from higher latitudes of the North Atlantic. In February 2016, a Marine Alliance for Science and Technology for Scotland Deep Sea Forum Fellowship awarded to TM, resulted in us being able to study and summarize the collection of black corals (Antipatharia). These had mostly been collected from Rockall Bank, the Hebridean Shelf – as well as Rosemary Bank Seamount and also included a large historical collection from the North Atlantic. A representative collection from the depth range 187–2000 m included 10 species from six genera of black corals of the families Antipathidae, Cladopathidae, Leiopathidae, Stilopathidae and Schizopathidae, and these agree well with results obtained earlier for Hatton Bank. A full list of black corals of the area based on material studied has now been compiled. In addition for the first time, symbiotic scale-worms (Annelida, Polynoidae) were reported from colonies of the black corals, *Stauropathes arctica* and *Parantipathes larix*.

Research of seamount and oceanic rise fauna at P.P. Shirshov Institute of Oceanology, Russian Academy of Sciences

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Over almost 70 years of deep-sea research at the P.P. Shirshov Institute of Oceanology (IORAS) a range of unique deep-sea biotopes has been studied, including abyssal plains, trenches, continental margins, seamounts, mid-ocean ridges, hydrothermal vents and cold seeps (Figs 1, 2). Active studies of seamount and mid-ocean ridge biota at IORAS began in the 1980s. Among the most explored regions were the seamounts of the North-East Atlantic, the Reykjanes Ridge, Markus-Wake seamounts and Mid-Pacific Mountains, seamounts of the West Indian Ocean, Sala-y-Gomez and Nazca ridges. In the 1990s major exploratory attention was given to the Mid-Atlantic Ridge (MAR), especially owing to discovery of hydrothermal vent communities in the Atlantic. Since the beginning of the XXI century the IORAS was involved in series of large international programs on photosynthesis-based ecosystems of the MAR, including the MAR-ECO, ECOMAR and South-Atlantic MAR-ECO initiatives. In the last few years the MAR appeared in the growing focus of international attention because

Fig. 1. Bezrukov seamount (Broken Ridge, Indian Ocean). RV *Akademik Mstislav Keldysh* 7th cruise. Photo: *Pisces* 1984.

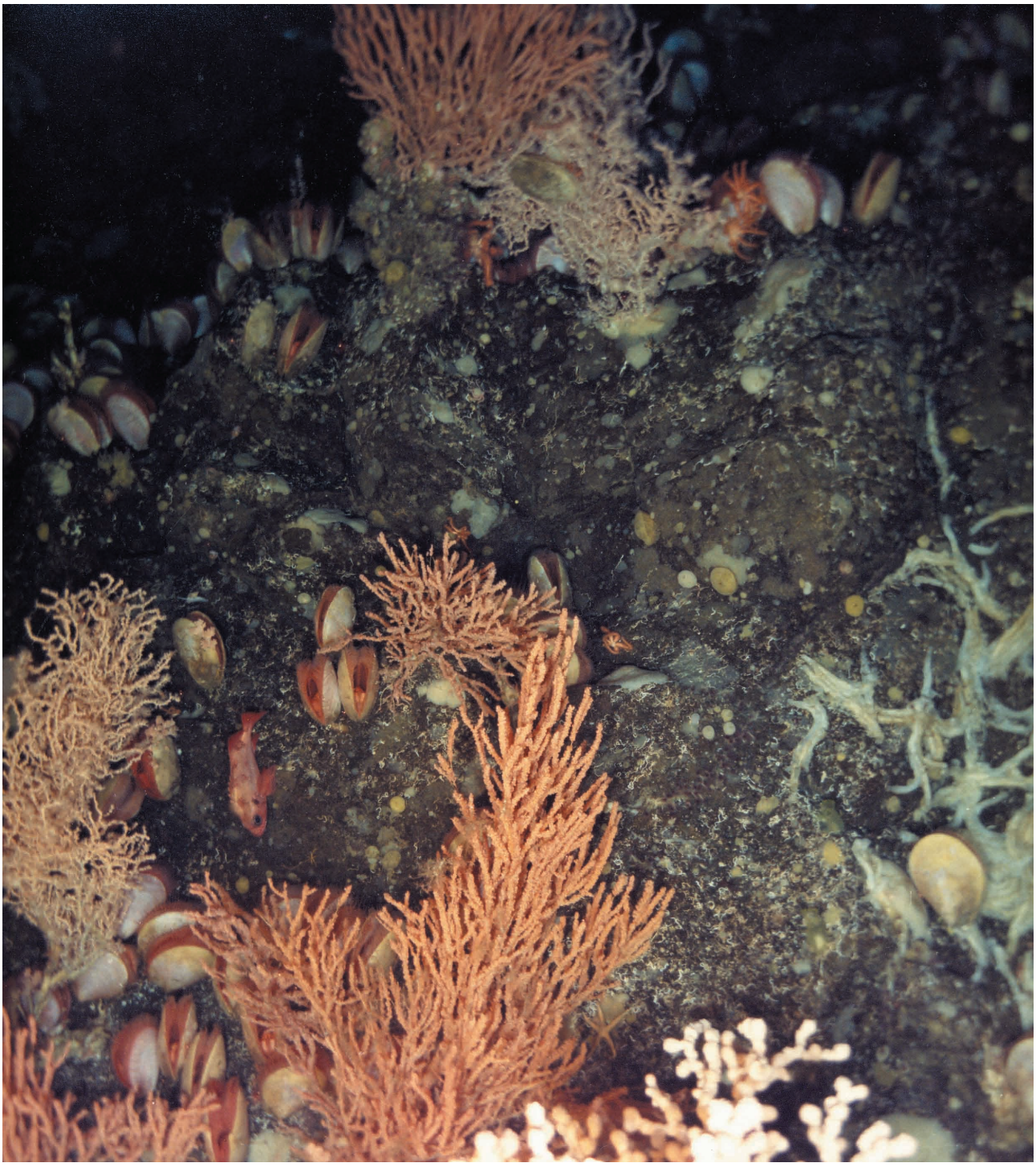

Fig. 2. Reykjanes Ridge (North Atlantic). RV *Akademik Mstislav Keldysh* 28th cruise. Photo: *MIR* 1992.

of accelerating interest of deep seabed mining of seafloor massive sulphides. The latest IORAS activities in this field concern the fauna of soft sediments in the ridge environment and epifauna of inactive hydrothermal sulphide structures.

The hydrobionts existence condition change in the Sea of Japan northeast part under the cold water intrusions through La Pérouse Strait at warm half-year

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La Pérouse (Soya) Strait and the Sea of Japan adjacent zone are characterized by high rate of the spatial-temporal variability of the water structure and dynamic parameters. Multivarious factors (first of all climate conditions combining with tidal events) define environmental impact in these areas.

Using the hydrological and meteorological long-term data combined with the materials of field observations over a period of half a century in the Sea of Japan northeast part and La Pérouse Strait the thermohaline water structure peculiarities variability were investigated.

Annually summer short-term cooling coastal waters marked at the southwest coast of Sakhalin. The water temperature sometimes can be lowered on 10–15 degree for 1–2 days. Sharp change of the thermal conditions is fatal reflected on hydrobionts. This leads to instability of the fishery.

The studies shown, that the temperature change of the water beside southwest seaside of the Sakhalin is connected with the Sea of Okhotsk cool and fresh water breakout in this region. Breakouts cause is a system of winds, occurred during the passage of typhoons or deep cyclones through the northern part of the Sea of Japan combining the tide increasing. When such cyclone traveled across the Hokkaido Island and induced strong easterly winds over the La Pérouse Strait, these winds forced the water transport from the Sea of Okhotsk to the Sea of Japan. When tide acquires tropical (diurnal) characteristics the period of high tide is increased almost twice and consequently increases the amount of cold water with the tide from the Sea of Okhotsk. There are installed links between water thermal regime, a deep cyclone travel and Okhotsk High development. It was revealed, that the summer Okhotsk High intensification is an important condition such anomalous inrusions.

Anomalous penetration of the cold Sea of Okhotsk water into the Sea of Japan through La Pérouse Strait was founded on infrared satellite images last some years. Modern satellite information allows revealing operative such penetrations. The obtained results can be used for developing the forecasts of hydrological conditions in this area.

New species records as an indicator of climate change caused by global warming

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Jeju Island, Korea's largest and southernmost island is situated about 80 km south of the Korean peninsula. The Tsushima Current, which branches from the strong, northeastward-flowing Kuroshio Current, flows past Jeju Island, giving the island a warm maritime climate. In 2007 a catalogue was published listing the island's mollusk fauna, a combination of warm temperate and tropical and subtropical species The great majority of Jeju mollusks are gastropods, followed by bivalves, and the three smaller classes, Cephalopoda, Polyplacophora, and Scaphopoda respectively.

Since the publication of the above catalogue, 28 new species have been added to the Korean fauna, both from unpublished field records and literature. Most are recorded from Jeju Island and the rest from the mainland, with the great majority ranging south to subtropical and tropical areas, and only three species reported from the mainland having a more northerly range. The largest number (78%) are gastropods, representing 13 families: the Ranellidae with 3 species, the Strombidae, and Triphoridae with 2 each, and the remaining families with one species each. There are four bivalve families, each with a single species, one polyplacophoran, and one cephalopod.

A zonal-geographical analysis based on the known distribution ranges of those species reveals that almost all (25) are tropical-subtropical or subtropical in distribution. What is of most interest are the many species with a southerly distribution, ranging south to northern Australia and Indonesia. The Kuroshio Current, transports the larvae of many warm water marine organisms, including mollusks, to southeastern Japan, and the branching Tsushima Current transports the larvae to the region around Jeju Island and Korea's south coast.

Climate change caused by global warming is a strong possibility for the addition of new species to Jeju Island's fauna. Since 1960, the average annual rate of sea-level rise around Jeju Island has been approximately 6 mm, which is about three times the global average, and there has also been an increase in the flow of the Kuroshio Current. Furthermore, it has also been demonstrated that sea temperature in the southern Yellow Sea area, including Jeju Island, has risen by 1.2°C in the past 100 years. This has implications for the transfer of tropical and subtropical mollusk larvae to the shores of Jeju Island. The increase in sea surface temperature would allow more warm water mollusk larvae to remain viable in the water column for longer periods, and the increase in current flow would enable the larvae to move further north. The discovery of such a large number of southern species new to the Korean fauna indicates the influence of climate change caused by global warming. However, the addition of new species records to a particular fauna can also be the result of insufficient sampling as well as genuine invasive species. The three gastropods with a northern distribution were obtained

from Kangwando province, the northernmost South Korean province in the East Sea/Sea of Japan, which is under the influence of the North Korean Cold Current. This suggests that increased surveys in this area could result in new species records. Insufficient sampling may also apply to new species records for Jeju Island which were previously reported only from the mainland, e.g. *Conasprella orbignyi* (Audouin, 1831), newly obtained from the south coast.

In conclusion, the influence of the Tsushima Current has given Jeju Island a rich mollusk fauna. It is expected that, with the increase in global warming and with more extensive fieldwork, the number of southern species will increase.

Taxonomy and distribution of the *Lineus alborostratus*-group (Nemertea: Lineidae)

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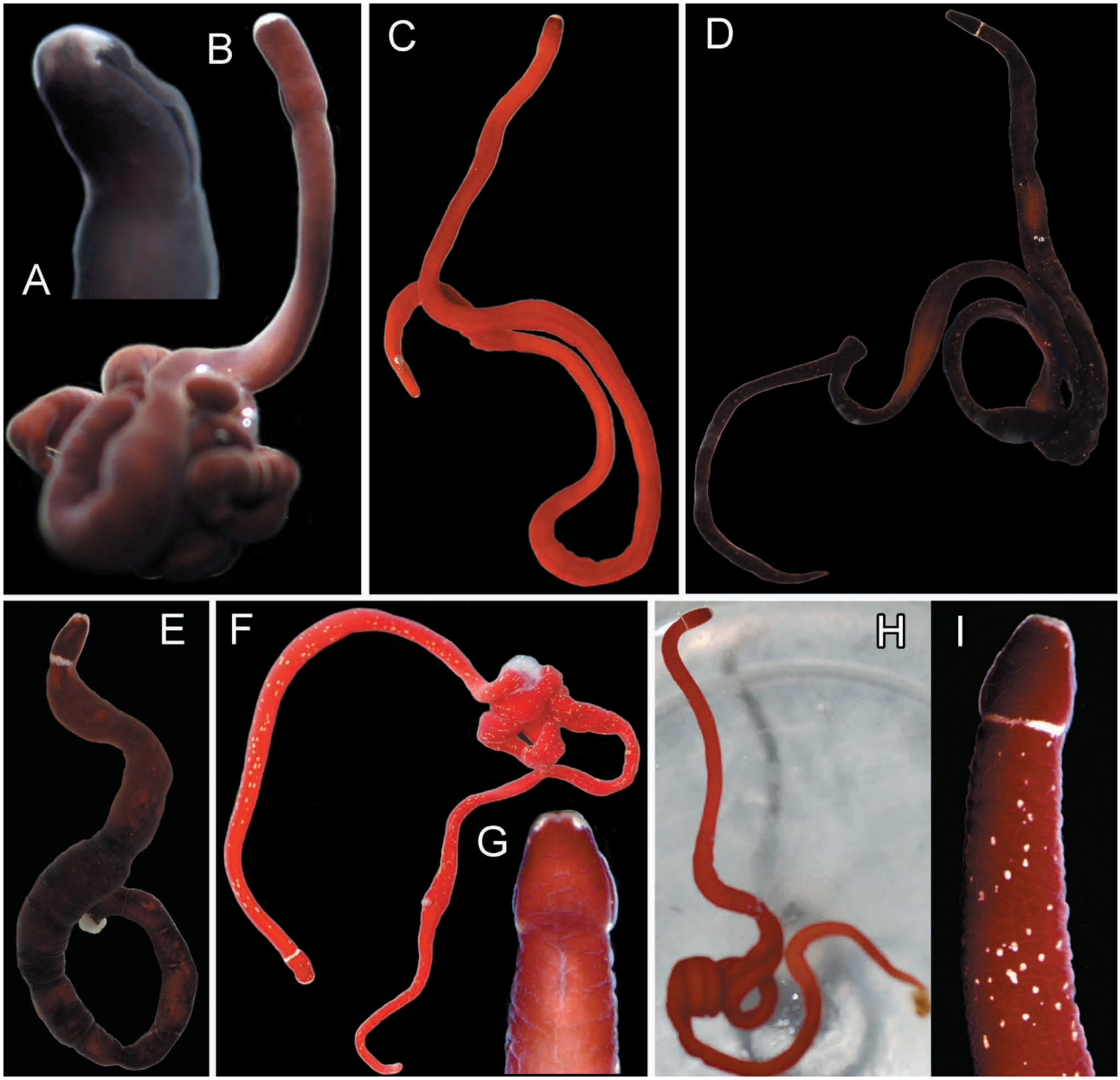
The genus *Lineus,* which currently contains about 20% of all described heteronemertean species, is poorly defined and certainly non-monophyletic. As in the case with two other heteronemertean genera, *Cerebratulus* and *Micrura,* the diagnosis of *Lineus* is based on the combination of non-unique characters. The solution of this taxonomic problem is to redefine the genus *Lineus* with inclusion only those taxa that are closely related to the type species, *Lineus longissimus*, and to transfer all the rest into a new genus or existing genera. Unfortunately, the taxonomic revision of the genus is still impossible because in GenBank there currently are nucleotide sequences only for 11 out of about 80 described species of *Lineus*.

According to molecular phylogenetic analysis, the heteronemerteans *Lineus alborostratus* Takakura, 1898, *L. torquatus* Coe, 1901, *Cerebratulus motgomeryi* Coe, 1901, and one species cryptic to the *L. torquatus* form a clade named *Kulikovia* gen. nov. The species of the genus *Kulikovia* have boreal distribution in the North Pacific substituting here species of the *Lineus*-clade, which are common for the intertidal zone of the North Atlantic. The cherry and reddish forms of *Kulikovia torquata* (Coe, 1901) are described as *Kulikovia torquatica* sp. nov. based on the external characters (body colour), internal morphology (arrangement of the subepidermal glands) and divergence of four genetic markers (mitochondrial cytochrome *c* oxidase subunit I COI, 16S rRNA, nuclear internal transcribed spacer region ITS, and histone H3). Different molecular data sets identify two species within the *Kulikovia torquata*-clade. Hence, we show a clear splitting of the *Kulikovia torquata* clade into two species: one of them is true *Kulikovia torquata* and the other is *Kulikovia torquatica.*

K. torquatica was found in Peter the Great Bay and the Tatar Strait (Sea of Japan), Akkeshi Bay (Hokkaido), Aniwa Bay (South Sakhalin) and near the south Kurile Islands (Kunashir and Iturup islands). It was not found north of Iturup Island. Sibling *Kulikovia torquata* is a more cold-water species; it is widely distributed from Peter the Great Bay to the Commander Islands and from Alaska to North California, but it disappeared in Peter the Great Bay in the last 15 year. In contrast to the species pair *K. torquata*-*K. torquatica* the reddish form of *K. alborostrata* (Takakura, 1898) does not differ genetically from typical (brown-violet) form of this species (see Figure).



Living specimens of the nemerteans. **A**, **B** – typical colour form of *Kulikovia alborostrata* (Peter the Great Bay), head, ventro-apical view (A), full specimen (B). **C** – reddish form of *Kulikovia alborostrata* (Peter the Great Bay). **D**, **E** – *Kulikovia torquata* (D – LtIt1; E – LtUr3). **F**–**I** – *Kulikovia torquatica* (F, G, I – Peter the Great Bay; H – LtIt2), ventral view of the head (G).

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The potential of Raman spectroscopy for the identification of diatom species (Bacillariophyta)

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Diatoms are unicellular or colonial forms of algae, distinguished by their cell wall, or frustule, having a unique form, structure, and pattern of ornamentation, which can be used for identifying their species. Diatoms' cytoskeleton is composed of 95.6% silica nanoparticles. During morphogenesis, these nanoparticles become organized into a strictly regular structure due to molecular proteins referred to as silaffins. Raman spectroscopy provides individual signature Raman spectra for each type of biomolecules of the object under study that makes it possible to use them as an additional character, along with traditional morphological parameters, for the species identification of diatoms. One of the advantages of Raman spectroscopy is that the method does not require preliminary sample preparation for further analysis.

The study was conducted on a laboratory clone of planktonic diatom of the genus *Skeletonema*, Sk021002, deposited in the collection of the A.V. Zhirmunsky Institute of Marine Biology, Far Eastern Branch, Russian Academy of Sciences. A use of both light and electron-scanning and transmission-microscopy did not allow identification of the Sk021002 clone to species. The characteristic feature of the Sk021002 clone that distinguishes it from the morphological description of the genus *Skeletonema*, published in literature, is a large number of marginal processes (19 to 26). The number and shape of marginal processes are species-specific for members of the genus *Skeletonema* and considered as traditional morphological characters.

Based on Raman spectroscopy, a kind of molecular passport of the Sk021002 clone was created. Its valve and cell membrane differed in the pattern of spectral peaks. In addition to the pronounced range for silica compounds, peak values of the following bands were also characteristic for the spectrogram of organic membrane: band at a wavenumber of 1323 cm^{-1}, which indicates presence of lipids, and band at 1449 cm^{-1}, which corresponds to $\delta(CH_2)(CH_3)$ bond stretching vibrations in proteins and lipids found as components of the studied object. There were amid bands at a wavenumber of 1597 cm^{-1}. The range observed at the peak value of 1711 cm^{-1} is associated with the formation of carbonyl-containing compounds. The range 475–1100 cm^{-1} is most informative for elucidating the structural status and can serve a model for diatom species identification in case of Raman spectroscopy.

The use of traditional methods alone proved to be insufficient to identify the Sk021002 clone. Raman spectroscopy has been applied in the study of frustule of *Skeletonema* diatoms for the first time. Thus, a synthesis of modern methods of diatom studies, which has provided their new diagnostic characters, allows a qualitative improvement of species identification.

The work was financially supported by the Russian Foundation for Basic Research (grant no. 15-04-04838).

Distribution, morphology and shell colour diversity of the intertidal gastropod *Batillaria attramentaria* (G.B. Sowerby II, 1855) (Caenogastropoda: Batillariidae)

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Intertidal temperate-low boreal mud snail *Batillaria attramentaria* (G.B. Sowerby II, 1855) (syn.: *Lampania cumingi* Crosse, 1862; *L. cumingii* (erroneous spelling after Sowerby, 1866)) is widely distributed in northern Pacific, where inhabits the littoral zone to a depth of 3 m, lives in marine to brackish water, often forming a dominate group in both muddy and rocky tidelands and estuaries.

The native range of *B. attramentaria* extends from China and Japan to the Russian Far East, including southern Sakhalin and southern Kurile Islands (Shikotan and Kunashir). As a result of accidental introduction in North America *B. attramentaria* has become established in California and British Columbia northwards Boundary Bay (49° N). The most northern population of *B. attramentaria* on Asian continent is found in Olga Bay of Central Primorye (43.7° N). Bousse Lagoon in southern Sakhalin is the northern extremity of the species native range. Southern extreme distribution in accordance with DNA barcoding data is continental coast of Taiwan Strait. South China Sea coast is inhabited by vicariing enigmatic *Batillaria* species segregated from *B. attramentaria* based on mitochondrial 16S rRNA and nuclear 28S rRNA gene data set. In a total, native latitudinal range of *B. attramentaria* is from 26.5° N in China (Fuqing, Fujian Province) to 46.6° in the southern Russian Far East (Sakhalin Is.).

Distribution, morphology and phylogeography of the species in the southern Japan in well studied. Here we present a new data on Russian, South Korean and Hokkaido populations. In Russia *B. attramentaria* is the only batillariid species. In Japan that may be found in sympatry with 3 other congeneric species *B. multiformis* (Lischke, 1869), *B. zonalis* (Bruguière, 1792) and *B. flectosiphonata* Ozawa, 1996. In China and Korean Peninsula along its western and southern coast *B. attramentaria* coexists with the first two species. In eastern coast of Korean Peninsula *B. attramentaria* occurs sympatrically with *B. multiformis* and *B. zonalis* northwards 35.5° N in Gyeongnam Province. During field survey in southeastern Gangwon Province around Gangneung and Donghae (36–37° N) in May 2016 the only species *B. attramentaria* was found.

Shell color variations of *B. attramentaria* in Japan were found to correlate with the temperature of the population locality. From other side, not only ecological factors, but population bottlenecks can reduce colour variations. Like in western Honshu, in both Korean and Russian populations darker morphs predominate in colder regions, and number of colour patterns decreases northwards. In South Korean populations we found all six colour variations of the species shell, described for

Japanese specimens inhabiting eastern oceanic coast. In Jeju Island, which southern extreme of studied area, blackish unbanded shells comprise 64–88% of all individuals. In populations from Gangwon Province of South Korea nearly 80% of specimens have dark shells lacking in lighter bands. In Southern Primorye percentage of specimens with blackish unbanded shells is over 90%. Other specimens have shells with white line on the upper side of each whorl or very rarely two white lines on both upper and lower sides of each whorl. In Central Primorye, Sakhalin, northeastern Hokkaido and southern Kurile Islands we found *B. attramentaria* only with dark unbanded shells.

Shell shape of the species correlates well with the temperature of the population locality as well. In northeastern Hokkaido, Kuril Islands, Sakhalin and Primorye impacted by cold water currents Oyashio and Liman correspondently northern ecological form of *B. attramentaria* occurs. That form is characterized by a tall (25–35 mm height) and slender shell with apical angle 20–25°. Other regions are inhabited by less tall (20–23 mm height) wider ecological form with apical angle of the shell 28–33°. Vicinities of Gangneung and Donghae impacted by warm East Korean Current are inhabited by southern ecological form of *B. attramentaria*. That fact rejects our earlier supposition that northern ecological form of the species is distributed southwards Gangwon Province.

Presented data on geographic correlation of shell morphology and coloration of *B. attramentaria* with its locality temperature provide basis to use the species for evaluation of impact of climate change on mollusk fauna in future studies.

Strengthening of subsurface intrusion of less saline shelf water into the Kuroshio in the East China Sea during strong La Niña years

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When the Kuroshio flows through the East China Sea (ECS), it exchanges extensively with ECS shelf water. Part of the saline Kuroshio water intrudes onto the shallow shelf of ECS. Meanwhile, part of the less saline shelf water leaks to the subsurface layer of the Kuroshio region. Three-dimensional gridded data over the period January 1958 – December 2008 from Simple Ocean Data Assimilation (SODA) are used to investigate variability of subsurface intrusion of less saline shelf water into the Kuroshio in the East China Sea. Applying a neutral density variable γ^n and the Empirical Orthogonal Function (EOF) analysis, dominant spatial features and corresponding temporal variability are revealed on neutral surfaces 23.0–24.5 γ^n. The most remarkable characteristic of variability on interannual time scale is the anomalous strengthening of subsurface intrusion of less saline shelf water into the shelf edge and the Kuroshio region during strong La Niña years. Possible causes inducing the strengthening are found to be associated with extraordinarily large discharge of the Changjiang in the following years of the strongest 1997/1998 El Niño as well as the variability of the Yellow Sea bottom cold water modulated by La Niña Events.

Culture of *Zostera marina* L. in a closed-system aquarium

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The presence, abundance, diversity and physiological state of seagrasses are one of the primary indicators of the health and quality of coastal waters. *Zostera marina* L. is the dominant seagrass species in coastal and estuarine areas of the Far Eastern region of the Pacific Ocean. At present, there are many methods for cultivating *Zostera* species *in situ*. However, few attempts to maintain *Z. marina* in an aquarium system for extended time periods have been successful. Therefore the aim of this study was to determine the optimum light, hydrochemical, and hydrodynamic conditions for long-term maintenance of *Z. marina* in a closed-system aquarium. Seventeen specimens of *Z. marina* were collected at 1.5 m depth in Amursky Bay (Sea of Japan) in July 2015, and placed into a glass aquarium (V=240 L) filled with filtered seawater and supplied with constant aeration (Fig. 1).

Fig. 1. Culture of *Zostera marina* L. in a closed-system aquarium.

Fig. 2. The inflorescent shoots (known as generative shoots) of *Zostera marina* L.

Plants were cultured at 10°C and 32–33 ‰. Light was provided by a combination of five lamps: three fluorescent lamps (40 W, LD, Russia), one Aqua-glo lamp (40 W, Hagen, Canada) and one Life-glo lamp (40 W, Hagen, Canada). Light was also supplied by LED strips to provide blue (430–460 nm) and red (660 nm) spectra. The light intensity at the water surface was approximately 110 µmol photons $m^{-2}s^{-1}$ with a photoperiod 12 hrs. light: 12 hrs. dark. 1/3 of the water volume was exchanged twice a month with fresh seawater. This seawater was filtered (pore size 0.1µm) and enriched with Provasoli (1 ml per L). In January 2016, a long generative shoot and new vegetative shoots developed in one of the *Z. marina* specimens. In February 2016, three new specimens of *Z. marina* appeared in the experimental aquarium. In April 2016, more than ten vegetative and four generative shoots were observed in the old *Z. marina* specimens (Fig. 2). In conclusion, long-term cultivation of the seagrass *Z. marina* in a closed-system aquarium is possible. The cultural methods used in this experiment resulted in vegetative growth and flowering of this species.

Pollution of bottom sediments and long-term changes of pollution loading of the coastal zone of Peter the Great Bay (the Sea of Japan/East Sea)

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It is well known that the coastal ecosystems of the Japan/East Sea are very productive, diverse and rich. But over the last several decades the anthropogenic load on shelf ecosystems of the Russian Far East Seas had been increased. Therefore, ecological observations and analysis of current situation is necessary for sustainable development of the coastal zone of Japan/East Sea.

The results of environmental survey in coastal zone of Peter the Great Bay in 2013 are presented. Chemical data included contents of selected trace metals (TM), total petroleum hydrocarbons (PHCs) and chlorinated pesticides (the sum of DDTs) in bottom sediments.

The aim of this report is to review the ecological conditions in the coastal zone of Peter the Great Bay in 2013 and reveal the possible tendency in pollution loading in some areas – Golden Horn Inlet, Amursky and Ussuriysky bays.

According to available data, the most polluted area was Vladivostok inner harbour (Golden Horn Inlet). The highest content of PHCs (13.02 ppt), TM: Cu (225.0 ppm), Pb (271.0 ppm), Zn (532.5 ppm) and sum of DDTs (96.1 ppb) recorded in the middle part of the Golden Horn Inlet and exceeded the threshold concentrations causing negative biological effects. The above mentioned pollutants in bottom sediments are capable of causing mass mortality of benthic organisms. However, this is not a complete list of all pollutants entering the water and sediments Golden Horn Inlet. It should be remembered the combined impact of all kinds of chemical compounds on benthic organisms, which is definitely superior to the toxic effect of individual pollutants under consideration. Amursky Bay exhibited high to moderate levels of sediment contamination. Moderate pollution levels were observed in bottom sediments from Ussuriysky Bay.

Soils of sea coasts as the habitat of *Yersinia pseudotuberculosis*

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The question on possibility existence of pathogenic *Yersinia* in various soils was studied by many researchers. Nowadays there are some data on *Yersinia* existence in arable soils, but as for their indication from the sea coastal soils it is unknown for today. Accounting of that the necessity to study the abiotic and biotic factors of sea coastal soils and their influence on *Yersinia* growth and multiplication is obviously seen. This study contributes to reveal the factors promoting not only preservation, but also propagation of these bacteria in sea coastal soil ecosystem.

The samples of the marshland and maritime meadow soils (coast of the Peter the Great Bay, Primorye Territory), collected from the upper horizon (0–0.1 м) and the 5 strains *Yersinia pseudotuberculosis* has been studied. In the soil samples the parameters: humus by Tyurin, current acidity, the structure of soil PH, exchange acidity, hydrolytic acidity, exchange bases (Ca^{2+} and Mg^{2+}), capacity of cation exchange and degree of saturation by the bases were determined. The preparations of humus acids were received from the marshland and maritime meadow soils by using standard method. The multiplication of the studied bacteria on humus soil preparations has been researched. Special media consisting of distilled water and humus preparation (0.02%) The duration of experiments depended on change in dynamics of the researched bacteria and composed 30 day in average, inasmuch it was necessary to establish the fact of multiplication of bacteria, as it was enough to get three phases of dynamics, initial stationary phase, phase of delay of multiplication and logarithmic phase.

All researched strains of bacteria multiplied best of all in maritime soil. In addition to influence of the individual characteristics of the bacteria strains, the multiplication of *Yersinia* yet depends on influence characteristics of sea coastal soils themselves. The obtained results, namely more active multiplication of *Yersinia* in maritime soil, account for that the maritime soil has more saturation by the bases (87.35%), more capacities of cation exchange (46.08%), than marshland soil (85.99 and 6.78 accordingly). *Y. pseudotuberculosis* well multiplied both as on humates of maritime meadow soil and on humates of marshland soil, nevertheless preferring the humates, produced from maritime meadow soil.

Is established, that the abiotic characteristic of soil of sea coast render direct positive influence on preservation and multiplication in them of *Y. pseudotuberculosis*. This is promoted by a degree of saturation by the bases, capacities of a cationic exchange, quantity of humus in these soils, and as property of strain of bacteria.

Community of the scallop *Mizuhopecten yessoensis* with its epibionts under climatic and anthropogenic modifications in Amursky Bay

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The main sources of anthropogenic pollution of Amursky Bay are domestic and industrial sewages of Vladivostok city and river run-off of Razdolnaya River. This river transports terrigenous and agricultural sewages, as well as it takes away communal and industrial sewages of Ussuriisk and Suyphunkhe (China) cities to the Bay. Because of changes in an intensity of human economic activity, the level of anthropogenic pollution of Amursky Bay suffers modifications. In addition, the natural changes of abiotic factors of environment under global and small-scale natural processes influence on development of bay biota. For the last five decades, the mean surface water temperature has increased by 0.6–1.7°C. There are long-term periodic variations of environmental factors, too. At the coasts of the north-western part of the Sea of Japan the quasi-biennial and 7–8-year oscillations prevail in variations of the water temperature. The water temperature regulates other vitally important environmental factors, for example, the water oxygenation. An aim of this work was to summarize the results of 32-year studies of the community of the Japanese scallop *Mizuhopecten yessoensis* (Jay) with its epibionts that lives near Pervaya River mouth at the coasts of Vladivostok (see Figure).

The dynamics of the population age and size structures, as well as growth rates of scallops, as integral vital sign, were studied. It was found that the scallop growth rates decreased in 1982–1993. Later, in 1994–2006, the ones increased. Then in 2006–2015, there was a next period of a decline in the scallop growth rates. Also, degrees of the scallop shell bioerosion performed by endolithic polychaeta *Polydora brevipalpa* were compared. The bioerosion had increased considerably in 1982–1998. For instance, for 4-year-old individuals 21.4% and 48.3% of the upper valve areas were bioeroded in 1982 and 1998, respectively. Further, to 2005, degree of the bioerosion had decreased to 27.6%; however, to 2015 it had again increased up to 35.4%. In 1982–2015, composition and abundance of scallop shell epibionts changed more than once. At the beginning of the study, the barnacle *Hesperibalanus hesperius* was a dominant species among epibionts, then, to 1990, it was replaced by the barnacle *Balanus rostratus* that is more resistant to the organic contaminations. Later, at the end of 90th, alive *B. rostratus* occurred only singly. From 2005, *H. hesperius* again became dominant species, and in 2015, *B. rostratus* prevailed again. In 1987–2015, the subdominant species was polychaete *Hydroides ezoensis*.

Thus, three main stages are revealed in the community development. During the first stage lasting until the beginning of 90th, there was the gradual depression of the community. It was a period of an intensification of anthropogenic pollution of Amursky Bay. Further, to the beginning of 2000th, the state of the community became better. It was a period of a reduction of the pollution of the water

Scallop *Mizuhopecten yessoensis* shells with epibionts, 2015.

and bottom sediments related to decrease of industry production in the perestroika. In the third stage, which goes on to present day, the scallop growth rates declined again. It was related to the increase of the water euthrophication due to the sharp expansion of a motorization (an increase in the number of automobiles). The stream of the nitrogen dioxide in an atmosphere increased. With atmospheric precipitations this oxide tumbles down in the sea strengthening the water euthrophication. In addition, the warming caused changes in extremal seasonal temperatures. It is known, that from 1989, the positive annual anomalies of the surface water temperature increased on 1.0–1.4°C. The temperature increase results in decrease of the water oxygen concentration that negatively influences on the state of the scallop, which is sensitive to a lack of oxygen in the water.

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Bottom communities of shoals in the Prydz Bay, Antarctica

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Four diving expeditions were carried out from 2006 to 2015 in Prydz Bay, Cooperation Sea, Antarctic. Totally, 9 hydrobiological transects were made and about 200 qualitative and quantitative samples collected in depths to 42 m. Pictures were taken of the bottom sites and some benthic animals in depths to 60 m. The collected material was identified to a species level. Lists of species were compiled for all the sampling stations, and density and biomass were determined for each species.

For most stations located to depths of 29–30 m the same species dominate in biomass (*Sterechinus neumayeri*, *Laternula elliptica*, *Phyllophora antarctica*, *Leptophytum coulmanicum*, *Ascidia chellengeri*, etc.). For other stations, dominant and subdominant species may vary a little. The main reason for these differences in the species composition is believed to be the level of illumination of the bottom, which decreases with depth and is considerably lower under snow-covered ice compared to that under snow-free ice. A gradual transition to another bottom community is found in depths over 30 m. This community is dominated by various sponges, ascidians (mainly colonial forms), bryozoans, and other invertebrates common for the middle and lower Antarctic shelf zone. However, shallow-water species do not disappear abruptly, but rather decrease their density with depth.

On almost all transects the number of species differs between 45 and 65 per sampling station at depths from 0 to 25–26 m and increases to 84–118 species per station only at the deepest stations, which indicates that the fauna in depths over 30 m becomes richer. The biodiversity in these depths is higher due to several groups: Spongia, Ascidiacea, Gorgonaria, Bryozoa, and Mollusca. The deeper is the station, the more the bottom communities of Prydz Bay become similar to the typical communities of the Eastern Antarctic lower shelf zone, particularly to those of the eastern Weddell Sea shelf, where sponges, ascidians, bryozoans and other suspension-feeders predominate.

Summarizing the above-mentioned facts and the literature evidence on the composition of bottom communities and distribution of fauna within them in Eastern Antarctic (Davis, Cooperation, Cosmonaut, and Ross seas), the distribution of similar species of macrobenthos demonstrates general patterns for this area.

All the bottom communities studied in Prydz Bay are characterized by high biomass, from 400 to 2500 g/m^2 on average for complete transects, making them among the most productive marine communities in the world.

Succession of algal community of the Sobol Bay (Peter the Great Bay, Sea of Japan) after road construction

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Costal waters near Vladivostok are considered as polluted or heavy polluted. Among them the Sobol Bay, that is an open embayment subjected to significant wave action, was considered as relatively unpolluted, β-mesotrophic water area. However, in frame of large-scale construction to the APEC Summit building of the new road was undertaken from 2009 to 2012 along the coast of the Sobol Bay. The massive roadbed filling was performed from the ground up on the most part of the coastline of the bay. As a result configuration of the coastline was slightly changed; in addition made ground is strongly susceptible to water erosion that increases influx of minerals to the seawater and decreases water transparence affecting benthic organisms.

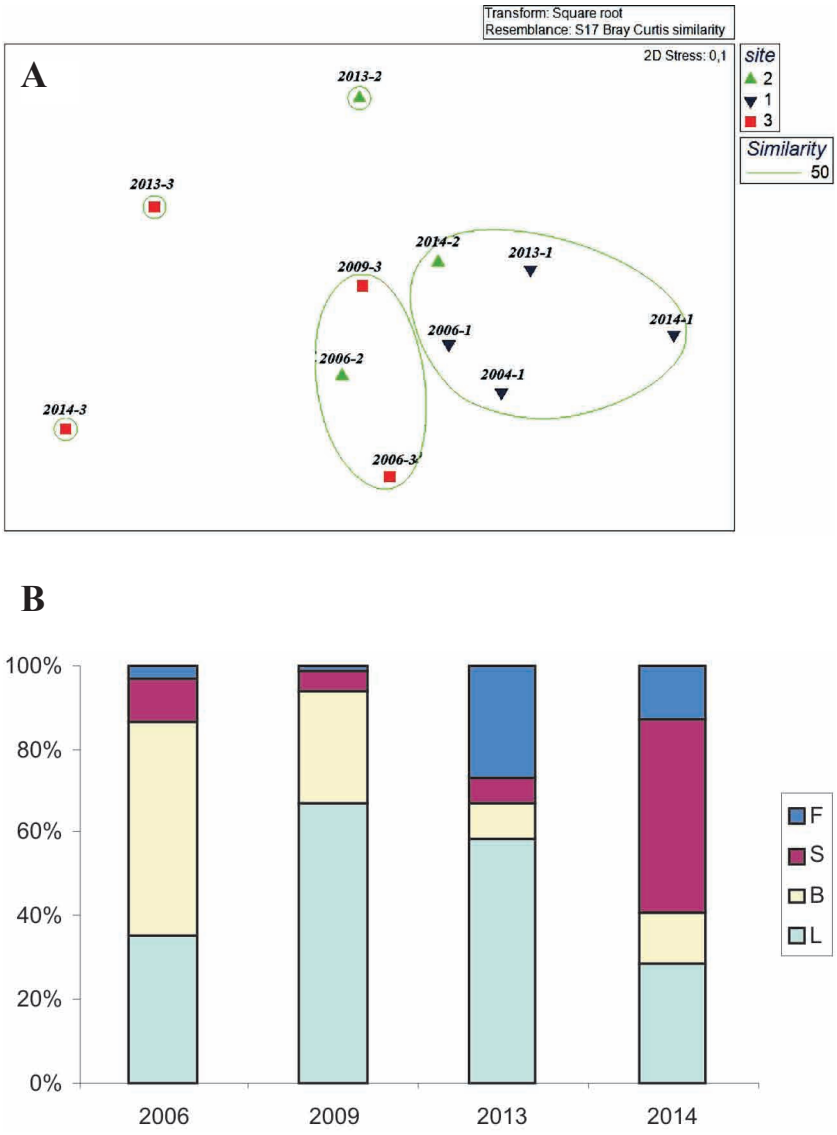
The main goal of this study was to estimate impact of the road construction on phytobenthos of the Sobol Bay. The community chosen as injury indicators was the *Costaria costata* and *Undaria pinnatifida* dominated association habits the rocky platform in mid-subtidal zone at 1–2.5 m depth. This association is common along the coast of the bay.

We examined the algal community before (in 2006 and 2009) and after road construction (in 2013 and 2014). During every sampling period samples were collected in June at three sites within Sobol Bay. Site 1 was situated 100 m to the southwest of the northern cliff of the bay. Site 2 was located in the central part of the bay. Site 3 was located in the southern part of the bay. At each site algae were collected within 0.25 m^2 quadrats randomly placed over the bottom at 1–2 m depth. From 3 to 8 samples were collected during each sampling period at each site. Within each quadrat, all visible plants were collected by hand. The samples were sorted by species and weighed. The temporal changes in algal associations were analyzed using multivariate data analysis (Clustering, nMDS) techniques.

The main finding of the study is the strong community modification at site 3, while algal association at site 1 and 2 appeared to be scantly modified.

With regard to abundance of morpho-physiological forms, several differences have been detected amongst sampling campaigns (before and after road construction) at sites 2 and 3 and no changes were found at site 1. At site 3 the coenotic role of opportunist species with filamentous and thin sheet-like thalli was increased from 6 (2006) to 59% (2014) of the total algal biomass. In addition, here the alteration of the relative biomass of Rhodophyta, Chlorophyta and Phaeophyceae was found with significant increase of the coenotic role of green algae (from 2 to 58% of the total biomass) (see Figure).

The main contribution in community change at site 3 had *Ulva lactuca*. Increase of the biomass of this species coincided with catastrophic decrease of the relative biomass of last-succession



species, such as *U. pinnatifida* and *C. costata*. These changes led to alteration of the community at the southern part of the bay. Here the association co-dominated by *C. costata* and *U. pinnatifida* was registered before road construction, by 2013 this association was succeeded by the *C. costata* and *U. lactuca* co-dominated association and in 2014 – it was dominated by *U. lactuca*.

Increase of coenotic role of green algae and opportunist species coincided with decrease abundance of last-succession species are indicate algal community degradation in the southern part of the bay.

MDS ordination plot showing square root-transformed community biomass data for three sites in the Sobol Bay before (2006–2009) and after (2013–2014) road construction (**A**) and proportion of morpho-functional forms (by biomass) at site 3 (**B**). Morpho-functional forms: F – filamentous, S – sheet-like, B – coarsely-branched, L – thick-leathery (by Orfanidis et al., 2001).

Deep-sea research activities of the Institute of Oceanology, Chinese Academy of Sciences in the West Pacific

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Since the launch of R/V "Kexue" in 2013, the Institute of Oceanology, Chinese Academy of Sciences (IOCAS) has initiated a series of deep-sea research activities to the West Pacific. To investigate the deep-sea ecosystem of the western Pacific areas, a total of six deep-sea expeditions with seventy-three remotely operated vehicle (ROV) "Faxian" diving have been performed on board of "Kexue", including 2 seep cruises to the South China Sea, 1 vent cruise to the Okinawa Through, 1 vent cruise to the Manus Basin, and 2 seamount cruises to the Yap Trench.

Significant progress has been made on the development of workflow and systemic experiment methods for the deep-sea exploration at IOCAS. During these expeditions to the western Pacific areas, a novel high-resolution (1:200) deep-sea mapping technique was developed from scratch. With this new mapping technology, two hydrothermal vent areas were detected at DESMOS caldera last year (2015), including a white smoker and a black smoker. Also, plenty of valuable high definition videos and images were taken, and a total of 3,100 collections of deep-sea macrofauna were sampled. Identification of these collections resulted in 220 different species including 1 new genus and 23 new species. In addition, the in situ observation technique has been well developed and applied in several experiments: in situ detection of hydrothermal vent temperature with the highest temperature 300°C measured; in situ concentration determination of CO_2, H_2O, H_2S and SO_4^{2-} in the hydrothermal vent fluid by Raman spectra analyses; in situ animal moving experiments at the depth of 1,100 meters in the South China Sea; and on-deck vent animal culture experiments.

Studies of bloom-forming toxic diatoms from the northwestern Sea of Japan during 2012–2015

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Herein, we report the results of long-term monitoring studies of diatom species belonging to the genus *Pseudo-nitzschia* (known as producers of the neurotoxin domoic acid (DA) and causative organisms of amnesic shellfish poisoning) from the northwestern Sea of Japan. Amnesic shellfish poisoning in humans, marine mammals, and birds is characterized by a series of clinical symptoms, including brain pathology with cell/tissue injury and memory impairment as a consequence of sporadic or chronic expose to the toxin. Samples of phytoplankton were collected during 2012–2015 in the northwestern Sea of Japan, which is an area of the most developed aquaculture in the Russian marine waters. Seven potentially toxic *Pseudo-nitzschia* species, *P. delicatissima*, *P. pungens*, *P. calliantha*, *P. seriata*, *P.* cf. *pseudodelicatissima*, *P. multistriata*, and *P. fraudulenta*, were found in Peter the Great Bay. The total abundance of *Pseudo-nitzschia* species varied from $3 \cdot 10^2$ to $1.4 \cdot 10^6$ cells L^{-1}. The highest concentrations of toxic *Pseudo-nitzschia* species in Amur and Ussuri bays reached 10^5 cells L^{-1}, well above the threshold value accepted in the European Union and Canada, in four cases ($2.5 \cdot 10^5$ cells L^{-1} in September 2012 in northern Amur Bay, dominated by *P. multistriata*; $1.2–1.4 \cdot 10^6$ cells L^{-1} in November 2012 in Ussuri Bay, dominated by *P. calliantha*; $3 \cdot 10^5$ cells L^{-1} in November 2013 in Ussuri Bay, dominated by *P. calliantha*; $1.7 \cdot 10^5$ cells L^{-1} in October 2015 in Ussuri Bay, dominated by *P. multistriata*). The intensive blooms, caused by *P. calliantha* in November 2012 and 2013 in Ussuri Bay, were preceded by a slight increase in the DA content (up to 0.3 mg kg^{-1}) in *Crenomitylus grayanus* samples, determined using an "ASP direct ELISA" kit. The accumulation of DA in the digestive glands of *C. grayanus* was recorded in autumn or early winter during or after the blooms of *P. calliantha* and *P. multistriata.* Phytoplankton and shellfish toxicity monitoring is required in autumn and winter in these areas, where bivalves are commercially harvested for human consumption.

This study was supported by the Russian Foundation for Basic Research (project no. 15-04-05643a).

Long-term studies of the structure of benthic foraminiferan complexes in the sublittoral zone off Furugelm Island, Peter the Great Bay, Sea of Japan

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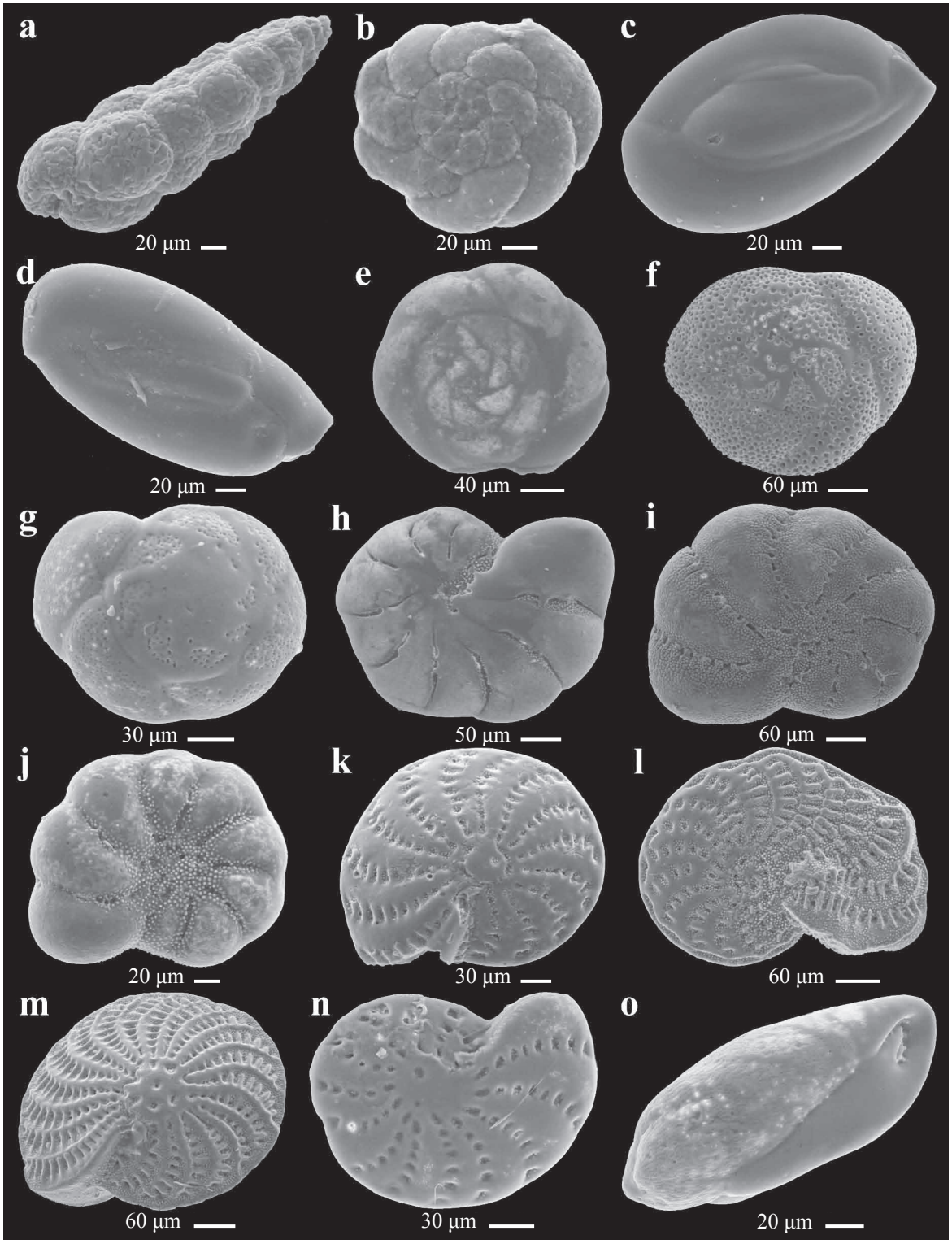
The southern part of the Far Eastern Marine Biosphere Reserve, which includes Furugelm Island, has for a long time served an example of the cleanest water area in the studies of human impact on composition and distribution of various benthic animals in Peter the Great Bay. However, the growth of the population of China and the intensification of economic activities in the Tumen River Basin in recent years have caused an increase in discharge of domestic, industrial, and agricultural sewage waters to the south-western part of the bay. The necessity to preserve the unique nature of the Tumen River became an impetus for the complex ecological research in the 1990s. The foraminiferan fauna of the upper sublittoral zone off Furugelm Island was first studied in August 1999.

The re-studies were conducted in September 2005. A variation in the particle-size distribution of bottom sediments and changes in the structure of foraminiferan complexes were found in three bays of the north-western part of the island (at a total of 6 stations). The species richness of foraminiferans increased from 66 to 70 species, of which 16 ones were common: *Buccella frigida* (Cushman), 1922, *Buliminella elegantissima* (d'Orbigny), 1839, *Canalifera fax* (Nicol), 1944, *Cribroelphidium frigidum* (Cushman), 1933, *Cribroelphidium kusiroense* (Asano), 1938, *Cribrononion incertus* (Williamson), 1858, *Discorbis bradyi* (Cushman), 1915, *Discorbis subaraucana* Cushman, 1931, *Eggerella advena* (Cushman), 1922, *Elphidium advenum depressulum* Cushman, 1933, *Elphidium jenseni* (Cushman), 1924, *Glabratella patelliformis* (Brady), 1884, *Protelphidium asterotuberculatum* (Voorthuysen), 1957, *Quinqueloculina lata* Terquem, 1876, *Quinqueloculina longa* Gudina, 1969, and *Rotaliammina ochracea* (Williamson), 1858 (see Figure). This area was dominated by secretory species; the level of agglutinated foraminiferans was low and averaged at 7%. Values of foraminiferan population density decreased at most stations.

In Zapadnaya Bay, the foraminiferan abundance in the years being compared dropped from 20,000 ind./m^2 to 7,000 ind./m^2 and reached the minimum. Very substantial quantitative variations were recorded from the unnamed bay. The foraminiferan population density decreased from 600,000–800,000 to 20,000–60,000 ind./m^2, respectively. A reduction of the total abundance of foraminiferans, from 2 million to 700,000 ind./m^2, was observed also in Severnaya Bay, at a depth of 19 m. At the same time, in the western and eastern parts of the bay, at depths of 9 and 11 m, the density of foraminiferan population was found to increase from 90,000–140,000 to 400,000–750,000 ind./m^2,



The common species of benthic foraminifera off Furugelm Island: *Eggerella advena* (**a**), *Rotaliammina ochracea* (**b**), *Quinqueloculina lata* (**c**), *Quinqueloculina longa* (**d**), *Buccella frigida* (**e**), *Discorbis bradyi* (**f**), *Discorbis subaraucana* (**g**), *Cribrononion incertum* (**h**), *Cribroelphidium frigidum* (**i**), *Protelphidium asterotuberculatum* (**j**), *Elphidium advenum depressulum* (**k**), *Elphidium jenseni* (**l**), *Canalifera fax* (**m**), *Cribroelphidium kusiroence* (**n**), *Buliminella elegantissima* (**o**).

respectively. The proportion of live individuals in the total foraminiferan complex was high, varying from 28 to 80% in 1999 and from 23 to 70% in 2005. The proportion of agglutinated forms in Zapadnaya and Severnaya bays increased from 4 to 9% within 6 years; in the unnamed bay, it declined on average from 17 to 6%. The species that were found as solitary individuals in 1999 (*R. ochracea*, *Q. longa*, and *C. incertus*), in 2005 increased both their abundance and distribution area, and became common. However, *Quinqueloculina seminula* and *Quinqueloculina* cf. *yezoersis*, registered as common species in 1999, were represented by single individuals in 2005.

Thus, the long-term studies of the structure of foraminiferan complexes have revealed a rich diversity of foraminiferans and a high density of their populations in spite of the decline of quantitative parameters. The high proportion of live individuals and well-developed forms (lack of underdeveloped and abnormal shells) does not give grounds to state that the Tumen River discharge and near-bottom currents have a pronounced impact on benthic foraminiferan communities. The variations in qualitative composition and quantitative characteristics of the foraminiferan complexes at a shallow depth (10–15 m) are apparently caused by movements of sandy soils under the effect of waves and storm surf.

Benthic foraminifera under conditions of gas-hydrothermal activity in the Deryugin Basin, Sea of Okhotsk

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The use of modern underwater vehicles for the deep-sea research allowed identification of the sites of cold barite-methane seeps, or discharges of gas-saturated mineralized solutions, from the surface of bottom sediments. These fluxes of hydrothermal solutions significantly affect the gas and chemical composition of the surrounding sea water, sediments, and benthic communities. Material was obtained during the 61st cruise aboard R/V *Akademik M.A. Lavrentyev* to the Deryugin Basin, Sea of Okhotsk, in May 2013. The studies were carried out in several areas. In this paper, foraminifera were studied in two areas (the northern and southern parts of the basin). Samples of bottom sediment from the methane seep sites were collected using an "Ocean" grab with the cross-section of 0.25 m^2. The material included a diverse foraminifera fauna: 15 species of soft-shelled and 78 species of hard-shelled foraminifera. The most abundant soft-shelled foraminifera, reaching 50 ind./10 cm^2, were *Risigella polaris* Gooday, Kamenskaya, Soltwedel, 2010 and the undescribed species of the genera *Nodellum* and *Micrometula* (Fig. 1). Among hard-shelled foraminifera, the most abundant were *Saccorhiza ramosa* (Brady, 1879), *Reophax curtus* Cushman,1920, *Reophax excentricus* Cushman,1910, *Reophanus oviculus oviculus* (Brady, 1879), *Trochammina globulosa* (Cushman, 1920), *Trochammina voluta* Saidova, 1975, *Buccella inusitata* Andersen, 1952, *Valvulineria sadonica* Asano, 1951, *Uvigerina auberiana* d'Orbigny, 1839, and *Uvigerina* sp. (Fig. 2). The common species constituted on average 44 to 63% of the total foraminiferan abundance. Agglutinated foraminifera dominated the samples; their proportion varied from 63 to 98%. In the northern area, where seeps of methane and other hydrocarbons were found at a depth of 1450 m, the number of recorded foraminifera species was 35, of which agglutinated ones constituted 45%; their population density was not

Fig. 1. The soft-shelled foraminifera: **a** – *Risigella polaris* (300 μm), **b** – *Micrometula* sp. (300 μm), **c** – *Nodellum* sp. (400 μm).

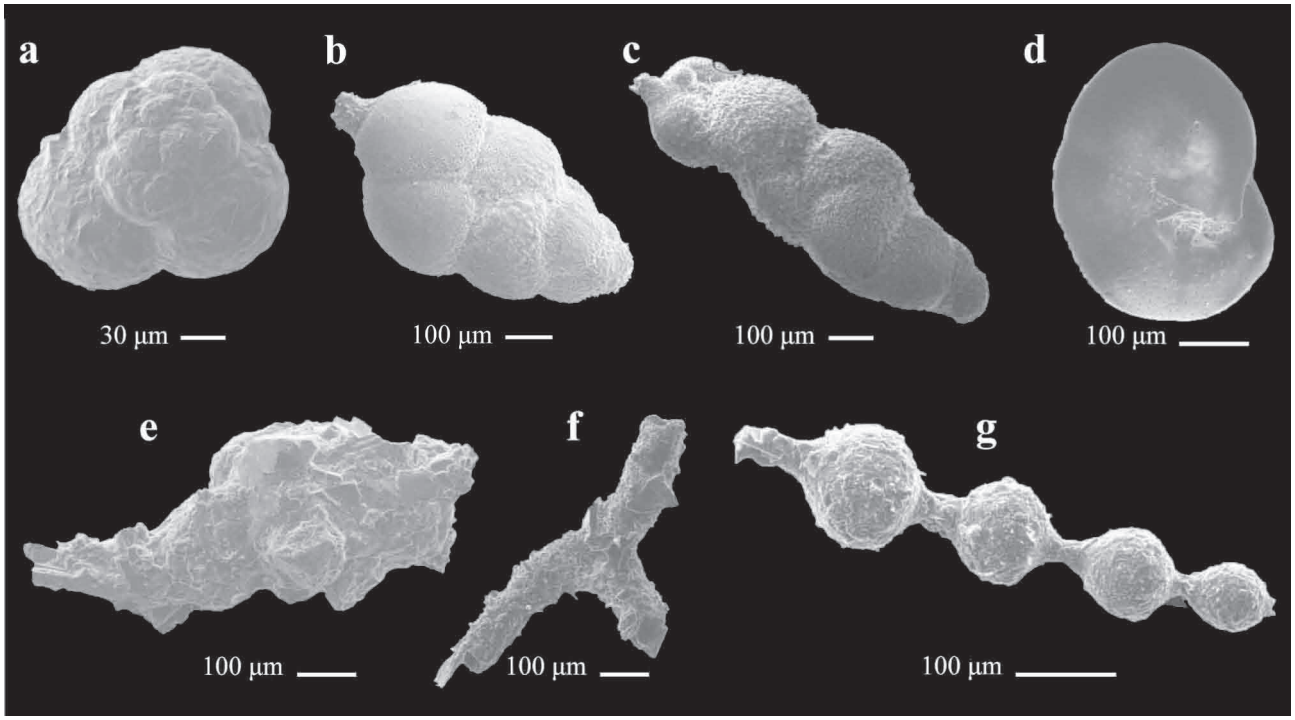

Fig. 2. The hard-shelled foraminifera: **a** – *Trochammina globulosa*, **b** – *Uvigerina* sp., **c** – *Uvigerina auberiana*, **d** – *Valvulineria sadonica*, **e** – *Reophax excentricus*, **f** – *Saccorhiza ramosa*, **g** – *Reophanus oviculus oviculus*.

higher than 50 ind./10 см^2; the proportion of live individuals was 4.6%. The dominant species were *Uvigerina* sp. and *S. ramosa*. Methane seeps were also located at a depth of 1419 m, but the parameters of the structure of the foraminifera complexes there had higher values. The samples were dominated by *S. ramosa*, *R. oviculus oviculus*, and *T. globulosa*. Only single live individuals occurred (5.3%). In the southern part of the basin (the area of barite field), the species diversity (45 species) and the density of foraminifera population were much higher. On the periphery of the barite field, the population density was 320–370 ind./10 cm^2; live animals accounted for 22–28%. The dominant species was *R. oviculus oviculus*. The exception was the station, at which petroleum spots and seeps of H_2S and hydrocarbons were found. Here, the foraminifera abundance was 220 ind./10 cm^2; the proportion of live animals constituted 13% of the total abundance of common species. The samples were dominated by *S. ramosa* and *R. excentricus*. No pronounced dominance of certain species was observed in the study area. The foraminifera complexes, recorded from the sites of cold methane seeps, were small in number and poor in species diversity. On the periphery of the gas hydrate seeps, parameters of species abundance and density of foraminifera population showed higher values.

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Community structure and density distribution of meiofauna and free-living marine nematodes, associated with seagrass species from the intertidal zone in Tien Yen District (Quang Ninh Province, north Vietnam)

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The present study reports on meiofauna from samples collected in April and October 2015, in tropical natural seagrass beds from four localities in Tien Yen Estuary (see Figure). The Tien Yen Estuary is located in the Tien Yen Bay and connects the river with the South Cnina Sea, northeast of Vietnam. The notable feature of the estuary is a strong diurnal tidal regime with a maximum tide range of 4 to 4.5 m. Therefore, the water column of the estuary is dominated mainly by oceanographic factors such as tide waves and near-shore currents. The most important ecosystems in the estuary include mangroves, seagrass and intertidal mud flats. The selection of these four sampling sites (Ha Dong, Con Mat, Cua Song and Xom Giao) was based on the distribution of different seagrass species. Bottom sediments were represented by fine silty sands, water depths varied from 0.5 to 0.8 m. During the sampling period in April the temperature of the bottom water layer ranged from 20.1 to 20.5°C, in October – 23.4–24.5°C; salinity in April 17.6–24.2‰, in October 12–24.5‰. Benthic meiofauna was sampled using cores of 3.6 cm inner diameter (surface of 10 cm^2). The samples were washed through 1 mm and 40 μm sieves, fixed in 4% formaldehyde solution and then stained with Rose Bengal. Meiofauna was sorted and enumerated at higher taxon level using a binocular microscope. Total meiofauna densities in April 2015 ranged from 547±208 to 1148±270 ind./10 cm^2. Highest density and diversity levels were reported for the Ha Dong site, at tide pools and puddles with high diversity of seagrasses (6 species: *Halophila ovalis*, *H. beccarii*, *Halodule pinifolia*, *H. uninervis*, *Zostera japonica*, *Ruppia maritima).* The taxonomic composition consisted of 6 groups, nematodes were the dominant group accounting for 76.8% of the total meiobenthos density. Twenty nine species of nematodes were found, the most abundant were species, belonging to families Xyalidae, Sphaerolaimidae и Tripyloididae. The lowest density was marked at station Cua Song in estuary (3 species of seagrasses: *Z. japonica*, *H. ovalis*, *H. pinifolia*). The taxonomic composition of meiobenthos consisted of 5 groups, nematodes dominated – 49.2%. Twenty seven species of nematodes were identified, representatives of Xyalidae, Sphaerolaimidae и Comesomatidae were most important. In October there was a decrease of meiobenthos and nematodes densities,

Sampling sites in Tien Yen Estuary (Tien Yen Bay, South Cnina Sea).

as well as changes in the species composition of nematodes in comparision to April. Taxonomic composition of meiobenthos consisted of 3–4 groups. Highest density was marked at station HD – density was on average 798±127 ind./10 cm^2. Nematodes were the dominant group (56.2%), 21 species of nematodes were detected. The lowest density of meiobenthos (245±112 ind./10 cm^2) was found at station Con Mat (1 species *H. ovalis*). Nematodes were the dominant group (75.6%), 23 species were found here, dominated by representatives of Comesomatidae and Linhomoeidae families. It is known that in the intertidal zone of northern Vietnam there is a well defined change of dry and rainy seasons, therefore, observed differences can also be due to the fact that we collected samples in different seasons. Autumn assemblage was apparently greatly influenced by continental runoff and precipitation, such as strong torrential rains that have a damaging effect on marine organisms living in regime of visible difference between low and high tide, leading to a population density decrease and changes of species composition.

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Coral reefs in the South China Sea: updated understanding and regional efforts for management

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Coral reefs distribute widely in the South China Sea with the records of nearly one million square kilometers in the coastal waters and huge area in the offshore islands and submersed banks. Reefs stretch from the north (Taiwan and south China shoreline) to the south (Natuna Islands, Indonesia) and from the east (western coast of the Philippines) to the west (Vietnam, Cambodia, Thailand and Malaysia shorelines) as well as in Spratly and Paracel archipelagos, Dongsha Islands and other banks. The recent reviews indicate the extraordinary diversity of reef corals in the South China Sea, comparative to the Coral Triangle. However, as indicated in the regional assessment, major threats including *inter alia* over-fishing, destructive fishing and sedimentation have caused in serious degradation of many reefs areas. More frequent increased surface temperature has threatened coral reefs in many areas with obvious evidences of coral bleaching observed in 1998, 2010 and 2016. Recently, dredging and filling activities for building islands have become more extensive, leading to considerable losses of, and perhaps irreversible damages to, unique coral reef ecosystems in the South China Sea. There have been a number of efforts in last couple decades for enhancing regional cooperation for coral reef and other habitat management. The UNEP/GEF project namely "Reversing degradation trends in the South China Sea and Gulf of Thailand" was implemented during 2002–2008. In this project framework, the Strategic Action Program was developed for enhancement of the coordination among countries. A series of National Action Plans for management of coral reefs and other habitats was developed too. Many activities have been carried out following the completion of the project in 2008. The efforts for improvement of management of MPAs and development of *fisheries refugia* system have been considered at many states. Thailand can be seen as a leading in using coral reefs for marine tourism which had been developed quickly in others. Coral reed rehabilitation has been considered in national policy of some countries (the Philippines, Thailand, Vietnam, etc.) with some results achieved. Regional organizations (IOC/WESTPAC, UNEP) have conducted supports to consider emerging issues related to coral reef future such as ocean acidification and resilience to changes. Recently, new GEF/UNEP Project entitled "Implementing the Strategic Action Programme for the South China Sea" has just approved with the participation of Cambodia, China, Indonesia, Philippines, Thailand, and Vietnam under execution of COBSEA in the timeframe between Sept. 2016 and 2021. The supports of the project will include: Capacity building for activities at the national and local levels; Provision of opportunities in exchange of experiences and good practices among countries in the region; Common guidelines and other tools used by countries in management planning and practices; and for standardization in regional synthesis and comparison; Provision of sound scientific information for management; and Encourage governments at all levels in developing policy related to environment management. Given that there exist many challenges in coral reef management, the truthful and responsible cooperation at the regional level are critical in order to maintain healthy coral reefs in the South China Sea.

Species divergence and genetic differentiation of sand lances (Trachiniformes: Ammodytes) from the northwestern Pacific

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The sand lances constitute a group of small schooling fishes, distributed in the marine shallow waters of the Northern Hemisphere. Being a forage fish, sand lances largely affect the biomass of the coastal marine and terrestrial vertebrate taxa in the northwestern Pacific. The strict environmental specificity of sand lances (preference of clean sandy habitats, pronounced stenothermy) coupled with limited migration activity resulted in restricted gene flow among their local populations and contributed to the origin of cryptic taxonomic diversity with the lack of discrete morphological characters while retaining clear genetic divergence. The latter represents a big challenge for taxonomy and triggers the thorough investigation of molecular genetic patterns underlying the contemporary population genetic and phylogenetic species structure of sand lances.

In the study proposed, we examined the taxonomic composition and relative genetic divergence on mitochondrial DNA level of several sand lances populations from the northwestern Pacific – Sea of Japan/East Sea, Sea of Okhotsk and Bering Sea. The analysis revealed deep genetic divergence (above 6% of *K2P*-corrected genetic distances) on the level of COI gene that forms four clear phylogroups. They occurred both in the presence of isolation by distance (allopatry) as well as in sympatry within the temperature gradient. Only the latter factor was found to be responsible for the origin of clear taxonomic differences while the allopatric sand lances populations exhibit the lack of distinctive features and prone to form cryptic species-level diversity.

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Deep-sea scientific survey by ROV *Hemire*

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Deep-sea bottom of the East Sea (Sea of Japan) and hydrothermal vents in Mariana Basin were surveyed by ROV *Hemire* (see Figure) with mother ship of R/V *Onnuri*. The *Hemire* is a remotely operated vehicle, which was built in 2006 by the Korea Institute of Ocean Science and Technology (KIOST). The maximum diving depth of *Hemire*, which was tested at the western Pacific, is 6000 m. The size of the ROV is 3.3 m in length, 1.8 m in width, and 2.2 m in height. Its weight is 4200 kg in air, and 1.1 kg in water. The maximum speed is 1.5 knot forward, 1.0 knot lateral, and 1.5 knot vertical. It has 6 motor-driven thrusters with 5 HP, respectively. It is equipped with three HD cameras, two 7-DOF hydraulic manipulators, and various equipment such as CTD, CO_2 sensor, magnetometer and pyrometer etc. For the scientific survey, many tools such as Niskin bottles to collect sea water, sediment traps to capture sinking particles, push corer and scoop to collect sediment, plankton net to catch zooplankton, hand net to catch benthic animals are also put in the tool sled of ROV. Field survey in the East Sea was done for 15 days from 12 June to 26 June 2015, and at the Mariana Basin for 14 days from 23 March to 5 April 2016, respectively. At the bottom of the East sea, photos and videos were taken to monitor various deep-sea animals such as sea anemone, snow crab, gastropods, squid, starfish, and fish. Bait traps were used to collect deep-sea benthic animals and fish. During the Mariana Basin survey, many hot water seeping sites at the seamount Forecast and black smoker at Archean site were observed, and benthic animals were collected with bait traps. The most dominant species of the hydrothermal communities at two survey sites was gastropod *Alviniconcha hessleri*, followed by crabs *Austinograea*, *Munidopdsis galatheid* and shrimp *Chorocaris.*

ROV *Hemire*.

Long term changes of Jiaozhou Bay ecosystem, China

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Based on the long term observing data of Jiaozhou Bay, the long term changes of Jiaozhou Bay ecosystem influenced by climate change and human activities were analyzed. Results indicated an increasing trend of temperature and rainfall after 1980s. For the phytoplankton community, the abundance and proportion of dinoflagellate, warm water species and nitrophilous species increased. The biomass of zooplankton showed a dramatic increasing trend in the past 30 years, especially in spring. The average biomass of zooplankton after 2000 reached 0.361 g/m^3, about 3.54 times of the average biomass before 2000. The seasonal pattern of zooplankton biomass and abundance was also changed. In the 1990's, the biomass and abundance were highest in summer, while the peak changed to spring after 2000. The composition of zooplankton species changed at the same time. Both the species number and the abundance of gelatinous zooplankton increased in the past 20 years, especially the jellyfish. The zooplankton biodiversity index after 2000 was 30% higher than that of before 2000. The average abundance of medusa and appendicularia after 2000 were 5 times of those in 1990's. The abundance of copepod, chaetognath and other zooplankton groups were fluctuant during this period. It is important to implement ecosystem based management for Jiaozhou Bay ecosystem.

New species of macrobenthic Thoracostomopsidae (Nematoda: Enoplida) from the deep northwest Pacific

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Species of Thoracostomopsidae have been found in the deep-sea benthic community. Examination of material recently collected by the Russian-German deep-sea expedition SokhoBio (Sea of Okhotsk Biodiversity Studies) to the Kurile Basin of the Sea of Okhotsk on board of the R/V *Akademik M.A. Lavrentyev*, conducted in summer 2015, has revealed new macrobenthic species of the genus *Paramesacanthion* Wieser, 1953. Species *Paramesacanthion* are broadly distributed and have been found in various habitats. Within the genus we consider 16 species as valid and 2 species (*Paramesacanthion brevilabiatum* Schuurmans Stekhoven, 1946 and *Paramesacanthion microsetosum* (Allgén, 1932)) descripted only from females, as species inquirendae. Of valid species, 4 ones were described from the deep sea. Here three new *Paramesacanthion* species are described and illustrated with the aid of LM, SEM and LSM pictures. The sequences of 18S and D2-D3 region of the 28S rDNA are provided for identification based on the DNA analysis.

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Study on the population genetics and demography of *Saccharina japonica* (Laminariales: Phaeophyta) in the northwestern Pacific Ocean

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Saccharina japonica (Areschoug) C.E. Lane, C. Mayes, Druehl et G.W. Saunders is an economically important algal in the northwestern Pacific Ocean. We incorporated two mitochondrial cytochrome oxidase subunit-1 (COI) and tRNA gene (*TrnW-ORF41-TrnI-TrnQ-TrnL*) sequences to investigate the genetic diversity, genetic structure and demographic history of *S. japonica* across its distribution. Genetic diversity indices showed that populations in Hokkaido had highest diversity among the whole populations. In addition, the haplotype network, numerous private haplotypes and shared haplotypes all indicated that Hokkaido might be the genetic honor to the *S. japonica* in the northwestern Pacific Ocean. Bayesian Analysis of Population Structure (BAPS) examined four clusters, but Analysis of Molecular Variance (AMOVA) showed F_{ST} was moderate. According to star-shaped haplotype network, we inferred that there was a shallow population structure of *S. japonica* along the northwestern Pacific Ocean, which was supported by the results of pairwise differences between populations (F_{ST}). *S. japonica* has experienced expansion beginning 5.22 Ka BP according to the neutrality test and Bayesian skyline plots analyses. The observed lack of population differentiation can be explained by this past population expansion and present-day gene flow. High present-day gene flow of *S. japonica* could be influenced by complex factors, like anthropogenic means, currents, aquaculture and drifting fronds. Based on the present data, it seems likely that the shallow phylogeographic pattern of *S. japonica* exhibited high gene flow, low population differentiation, shallow genetic structure and recent population expansion. Our study elucidates that shallow phylogeographic patterns of *S. japonica* could be resulted from present-day gene flow and past population expansion.

Increasing threats of harmful algal blooms in the coastal waters of China

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The frequency, intensity and potential impacts of harmful algal blooms (HABs) increased significantly over the last four decades in the China seas. The high-biomass blooms, such as those formed by the dinoflagellate *Prorocentrum donghaiense*, pelagophyte *Aureococcus anophagefferens*, and haptophyte *Phaeocystis globosa*, have been reported in the East China Sea, Bohai Sea and South China Sea, respectively, since the late 1990s. Blooms of macroalgae, such as the green tides formed by *Ulva prolifera*, appeared every year in the southern Yellow Sea from the year 2007. An increasing trend of toxic blooms was also noticed and the concerns on potential risks associated with seafood contamination by phycotoxins have been raised. The extensive occurrence of HABs posed significant threats to the mariculture industry, natural ecosystems, and the health of human-beings. Studies over the last 10 years found that coastal eutrophication and alternation of natural habitat were important reasons accounting for the apparent increase of HABs in the China seas. To prevent and mitigate the potential impacts of HABs, effective monitoring methods targeted on the bloom-forming species using new methods like qPCR and fluorescence *in situ* hybridization (FISH), as well as analytical methods for phycotoxins based on HPLC and LC-MS, have been developed and applied in HAB studies for a better understanding and effective monitoring of HABs.

Natural and synthesized sorption materials for oil-water purification

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The problem of environmental protection is particularly acute in relation to water pollution by oil and oil products. Most significantly, these effects are manifested in the extraction processing and transportation of oil, as only 1 liter of oil pollutes up to 1000 m^3 of seawater, forming oil-in-water emulsion. Indeed, at the stages of production and transportation are lost each year to the sea up to 7 million tons of oil, and the total number of incoming petroleum hydrocarbons in the marine environment is 2–8 million tons per year.

At the same time as oil and oil products, which are in aquatic ecosystems, detrimental effect on all parts of the ecological chain, from microscopic algae to mammals. Therefore the search for promising methods of treatment and rehabilitation of marine pollution by oil and oil products is of great importance.

Unfortunately, chemical (use of coagulation, sorption, extraction, electrolysis, ultrafiltration, osmosis) and biological (microorganisms use special hydrocarbon) methods are not only reliable, but also the most expensive methods. Therefore, to clean up the marine environment is more promising combination of physico-chemical and mechanical method based on filtration and separation of the insoluble impurities and suspended particles in the water.

In our paper, a search of promising carbon nanoparticles and mesoporous materials to clean the marine environment from oil and oil products, such as: (1) activated carbons obtained by pulsed electron beam initiation of ligno-cellulosic materials with high density with irregular structure; (2) "Taunit" – hydrogen tubes constituting the hollow nanostructures with an inner diameter of 2 nm; (3) carbon of detonation synthesis nanodiamond formed during disposal of explosives and having an inner surface exceeding 5000 m^2/g; (4) graphene oxide; (5) the new sorbents high hydrophobicity and controlled porosity produced by template synthesis using colloidal stable emulsions metylsilicates. In contrast to the above nanostructured materials, said porous calcium silicate (pore volume of 6.2 cm^3/g) can not only convert toxic hydrophobic pollutants in the cement matrix due to the active reaction of silicate component with the hardening of the cement stone, but implement reversible desorption of hydrocarbons.

In preliminary experiments, it was proved that the above materials can be advantageously used as sorbents, carriers and collectors in the treatment of liquid radioactive waste, having a high mechanical, chemical and radiation resistance. The report will present the main results for the use of said sorption materials and methods of their application for the treatment of seawater from oil and oil products.

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Taxonomy on some chitons (Mollusca: Polyplacophora) from China based on valves, radula morphology and gene sequences

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Polyplacophora also called chitons, is one of the primitive clade in Mollusca phylum. They are believed to have diverged relatively early form other molluscan lineage, and play important roles in the evolution. Chitons of five species belonging to eight genera and three families were used in this study. Valves and radulae were obtained and handled in 10% NaOH solution for scanning electron microscope and optical microscopic observation. The mitochondrial COI gene, 16SrRNA gene, 12SrRNA gene and nuclear 28SrRNA gene fragments of 43 individuals these five species were sequenced in this study. Phylogenetic relationships among the species were conducted by Maximum Likelihood (ML) and Neighbour-Joining (NJ) methods based on the combination of COI, 16SrRNA, 12SrRNA and 28SrRNA genes.

Species of Ischnochitonidae sculptured with prominent radial ribs in valves. Chitonids have commarginal lines on head valve and transverse lines on middle and tail valves. Members of Acanthochitonidae have longitudinal ribs and granulates on shell surface. Radulae among species in same genus are almost identical. It is impossible for radula to be used for species identification, but useful for genera discrimination. The major lateral tooth of *Acanthopleura* is with a unicuspid cap, of *Lepidozona* with a bidentate cusp, *Acanthochiton* a with tricuspid cap, and *Onithochiton* with a quadricuspid cap. There is a petaloid process at the inner side of major lateral tooth in the *Acanthopleura* and *Onithochiton* of family Chitonidae. While this structure is absent in *Lepidozona* and *Acanthochiton.* The presence of the petaloid process has been used as a defining character of the families Ischnochitonidae and Chitonidae.

The genetic results showed that the intra- and inter-specific distances ranged from 0.000 to 0.050 and from 0.142 to 0.297, respectively. The intra-specific distances are much greater than those inter-specific distances. All species in informative trees are monophyletic, with high node support values. *Acanthopleura japonica*, *A. loochooane* and *Onithochiton hirasei* are closely related in phylogenetic analysis that conforms their assignation to Chitonidae by morphological classification. This clade clustered with *Lepidozona coreanica* of family Ischnochitonidae, and finally with distantly related *Acanthochiton rubrolineatus* of Acanthochitonidae. It is noteworthy that the different populations of same specie formed a clade first. Specimens of *A. japonica* from Chinese waters and Korea formed separate subclades. The genetic analysis also showed two populations in *A. rubrolineatus* exist in North and South China coast. Morphologic differences in valves were also found among these two groups. *A. japonica* used to be ascribed to *Liolophura* should belong to *Acanthopleura* with close relationship with *A. loochooane*.

Jellyfish blooms around Chinese coast

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Since the beginning of the 21st century, the Chinese coastal sea has suffered from jellyfish blooms, which are considered to be among the most serious ecological disasters, together with the harmful algae blooms (HABs), impacting the marine ecosystem, environmental safety, and the development of the maritime economy. To better understand the mechanisms for such a prominent increase of jellyfish blooms and to assess their ecological and economic impacts on the marine ecosystem, Chinese marine scientists participated in two large national level research projects on jellyfish. The first and the largest one was a National Basic Research Program of China project "The Key Processes, Mechanisms and Ecological Consequences of Jellyfish Blooms in China Coastal Waters" which was conducted from 2011 to 2015 by the Ministry of Science and Technology, China. Some detailed scientific contributions from this project have been published elsewhere (e.g., Oceanologia et Limnologia Sinica, Vol. 43, 2012; Hydrobiologia, Vol. 754, 2015).The second one was the Public Science and Technology Research Fund Project of Ocean, conducted by scientists of the National Bureau of Oceanography, China, from 2010 to 2014. The main objectives of this project were to develop monitoring technique of jellyfish and prediction methods for jellyfish blooms. This presentation provides a brief overview of the major progress on jellyfish study conducted in the Bohai Sea, Yellow Sea, East China Sea, and Jiaozhou Bay.

Distribution of pico-phytoplankton along a transect in tropical Western Pacific

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Picoplankton distribution was investigated along a transect in tropical Western Pacific in December, 2015. Picoplankton composition was resolved into three groups by flow cytometry, namely *Synechococcus*, *Prochlorococcus* and picoeukaryotes. The average abundances of *Synechococcus*, *Prochlorococcus* and picoeukaryotes were $(0.12\pm0.21)\times10^3$, $(0.35\pm0.79)\times10^3$ and $(0.22\pm0.36)\times10^3$ cells/mL, respectively. The average abundances of *Synechococcus*, *Prochlorococcus* and picoeukaryotes in the subsurface chlorophyll maximum (SSCM) (a. 100 m) were the highest, $(0.20\pm0.19)\times10^3$, $(1.57\pm1.13)\times10^3$ and $(1.16\pm0.31)\times10^3$ cells/mL, respectively. *Synechococcus*, *Prochlorococcus* and picoeukaryotes mainly distributed in the upper 200 m. In addition, the abundance of *Synechococcus* in the deep layers (2000 m) at station DY10 was high (0.60×10^3 cells/mL). Correlation analysis showed that relationships between picoplankton abundances and environmental factors (temperature, salinity, and chlorophyll *a*) differed, suggesting that water masses have different effects on picoplankton distribution.

Fatty acid components and trophic relationships in the intertidal and upper tidal community of the shallow-water hydrothermal ecosystem of the Kraternaya Bay (Yankich Island, Kuril Islands)

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Shallow-water hydrothermal ecosystems combine features of both common coastal ecosystems, based on phytoplankton production, and deep-sea ecosystems formed around hydrothermal vents. This combination becomes most pronounced in the intertidal and upper tidal zones. These zones are characterized by an abundance of gas-hydrothermal vents and volcanic water seeps; chemosynthetic processes are also active here. At the same time, they comprise the active photic zone with an intensive proliferation of phytoplankton and a belt of brown macroalgae.

A fatty acid analysis of invertebrates collected from the intertidal and upper tidal zones (up to 5 m) in the Kraternaya Bay (Yankich Island, Kuril Islands) was performed to obtain additional information on the trophic relationships in the shallow-water hydrothermal ecosystem. Lipid biomarkers were used as a helpful tool for studying the trophic ecology and determination of trophic relationships between species in the aquatic communities.

Benthic organisms of common species from various taxa such as Polychaeta, Crustacea, Gastropoda, Bivalvia, Asteroidea, and Echinodidae were collected near the sites of volcanic activity and beyond the area of their effect (inside and outside the gas-hydrothermal vent areas). The fatty acid composition of the specimens was analyzed. Planktonic and benthic microalgae, bacterial and algo-bacterial mats, as well as macrophytes, which can potentially be food sources for animals in the bay, were also subjected to the fatty acid analysis. It was shown that the fatty acid composition of invertebrates is influenced by fatty acids of the dietary origin. The 16:1n-7 and 20:5n-3 acids, which are typical for diatoms, were detected in the polychaete *Polydora volcanica* and the barnacle *Balanus crenatus* at a high level, thus indicating diatoms as a prey item in the diet of these animals. The presence of odd and branched fatty acids, typical for bacteria, in larger amounts suggested an additional input of detritus into polychaetes' diet. The fact that 22:6n-3 and 18:1n-9 acids, characteristic for the carnivorous type of feeding, were dominant in barnacles indicates ingestion of zooplankton by this species. The C18 and C20 polyunsaturated fatty acids, such as 18:3n-6, 18:4n-3 and 20:4n-6 acids, specific for brown algae, were dominant both in the gastropod *Littorina kurila* and its predator *Nucella freycinettii*, suggesting close trophic relationships between *Fucus evanescens*, *L. kurila*, and *N. freycinetty*. It was found that the main food for *Strongylocentrotus droebachiensis* in the zone of gas-hydrotherms is algo-bacterial mats; outside the zone of their effect, these are benthic microalgae and, to a lesser extent, macrophytes and bacteria.

Thus, feeding habits and the trophic structure of the benthic invertebrate communities of the intertidal and upper tidal zones (up to 5 m) in the Kraternaya Bay has been analyzed using fatty acid markers. It has been found that the diet of animals is determined mostly by availability of food in the ecosystem. Some species such as, first of all, sea urchin show a dietary flexibility by reaching high biomass values on a non-traditional food source. The utilization of a wide range of food sources by *S. droebachiensis*, as well as the consumption of brown algae by *N. freycinettii*, suggests that these animals are well adapted to the complex food environments typical for coastal gas-hydrothermal ecosystems.

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Biodiversity of the marine fungi in Russian waters of the Sea of Japan

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The mycobiota of Peter the Great Bay (Sea of Japan) is characterized by a high biodiversity, a different degree of salinity tolerance, substrate specificity, and various modes of feeding.

The investigation of the fungi of Peter the Great Bay revealed obligate marine micromycetes represented mostly by species of the families Halosphaeriaceae, Lulworthiaceae and facultative marine fungi, chiefly of the anamorphic stages of the ascomycetes widespread in terrestrial habitats.

Based on the diversity of habitats and trophic relationships, the following ecological groups of fungi of Peter the Great Bay are distinguished: lignicolous group or wood-inhabiting fungi, arenicolous group, phycophylous group, herbophylous group, geofungi and assemblages of the filamentous fungi associated with bivalve mollusks.

The lignicolous group of marine fungi includes species found on drift and intertidal wood and test-blocks that had been exposed in the bay for a period from a few weeks to a year and then incubated under wet conditions to obtain ascocarps and conidia. The lignicolous group of marine fungi includes species of the genera *Amylocarpus*, *Ceriosporopsis*, *Corollospora*, *Halosphaeria*, *Lulworthia*, *Nais*, *Remispora*, etc. (Ascomycota), *Cirrenalia*, *Humicola*, *Monodictys*, *Trichocladium*, *Zalerion*, etc. (anamorphic fungi).

The arenicolous group of marine fungi consists of ascomycetes, whose fruiting bodies become attached to sand grains and anamorphic fungi degrading organic material in the interstitial habitats. Arenicolous group consists of species of the genera *Arenariomyces*, *Carbosphaerella*, *Corollospora*, *Paradendryphiella*, and others.

Ascospores and conidia of the lignicolous and arenicolous marine fungi were found in the sea foam, collected along the shoreline of Peter the Great Bay (see Figure).

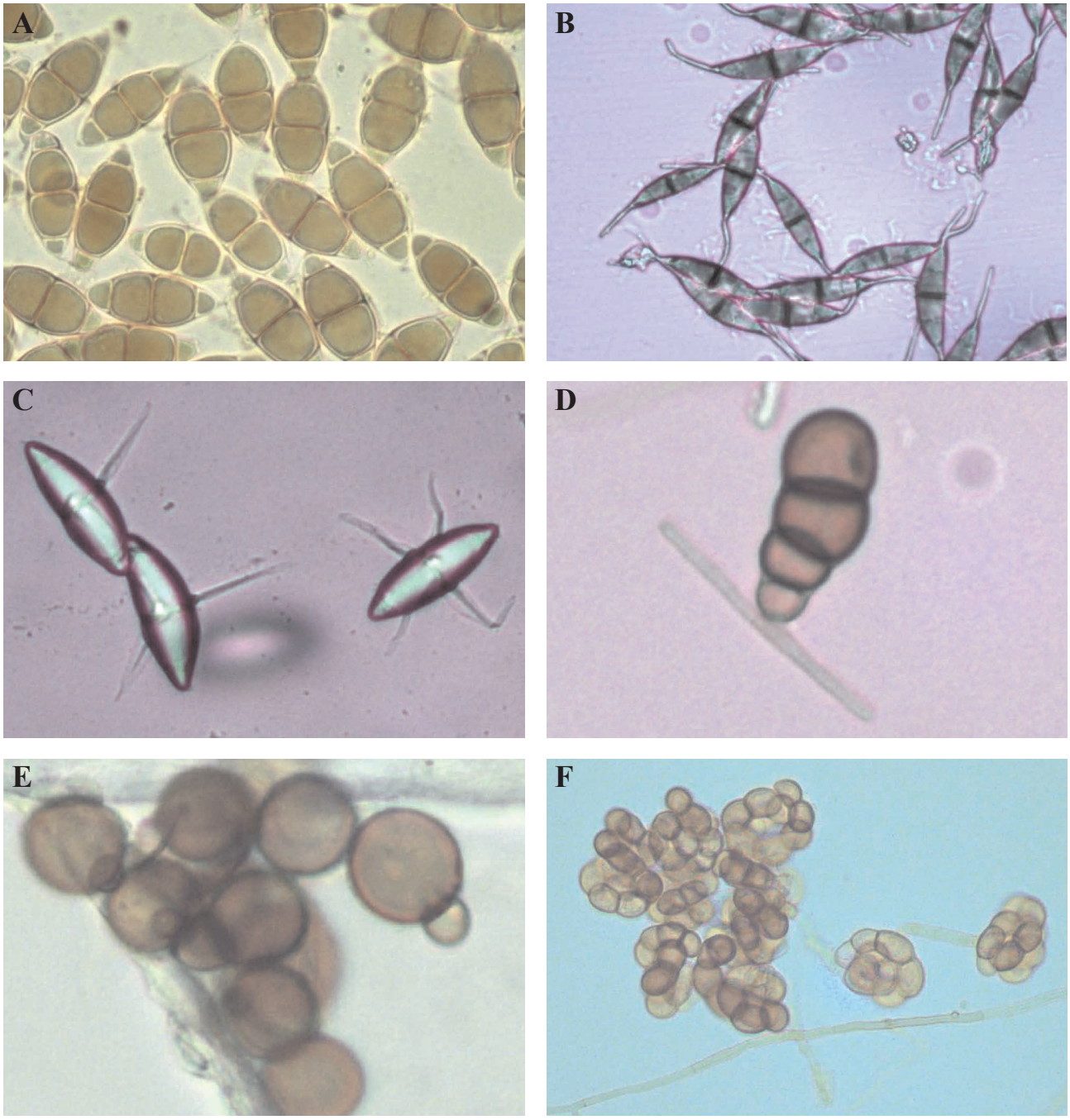
The phycophylous group comprises saprotrophs which were isolated from brown algae and consists species of the genera *Alternaria*, *Acremonium*, *Aspergillus*, *Cladosporium*, *Corollospora*, *Lulworthia*, *Pleospora*, *Paradendryphiella*, *Penicillium*, *Stachybotrys*, *Phoma*, and others.

The ascomycete *Chadefaudia corallinarum* was found on the thalli of red coralline algae of the genera *Bossiella*, *Clathromorphum* and *Lithothamnion*.

The herbophylous group is made up of ascomycetes *Lindra thalassiae*, *Lulworthia fucicola*, and others and anamorphic fungi isolated from seagrass *Zostera* leaves.

Numerous facultative marine fungi of the genera *Alternaria*, *Aureobasidium*, *Cladosporium*, *Geotrichum*, *Aspergillus*, *Penicillium*, *Mucor*, etc. were isolated from sea sediments.

Filamentous fungi associated with bivalve mollusks *Mizuhopecten yessoensis*, *Mytilus trossulus*, *Crassostrea gigas*, *Anadara broughtoni*, and others have been investigated. Fungi were found on the shell surface and in internal organs of mollusks: mantle, gills, digestive gland, kidneys and



The marine fungi from Peter the Great Bay (Sea of Japan). Ascospores: **A** – *Corollospora cristata* (Kohlm.) Kohlm.; **B** – *Corollospora* sp.; **C** – *Halosphaeria mediosetigera* Cribb et J.W. Cribb; Conidia: **D** – *Trichocladium achrasporum* (Meyers et R.T. Moore) M. Dixon ex Shearer et J.L. Crane; **E** – *Humicola alopallonella* Meyers et R.T. Moore; **F** – *Zalerion maritima* (Linder) Anastasiou.

gonads. The taxonomic composition of the fungi associated with bivalve mollusks includes species of the genera *Aspergillus*, *Penicillium*, *Cladosporium*, *Botrytis*, *Fusarium*, *Trichoderma*, and others.

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Microbiological biodiversity of surface seawater with different anthropogenic stress

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Coastal waters of the sea is a place preferred concentration of human activity and receiving a large amount of waste water and waste, which requires constant monitoring of pollutants and changes in the main parameters of the environment which caused by anthropogenic influence. For coastal waters which is actively used in the economic activity of the population of the coastal areas is characterized by the highest pollution at the same time by different pollutants (oil hydrocarbons, phenols, heavy metals, etc.).

Active use of coastal areas for recreational purposes causes in the marine environment a large number of sanitary-indicative microorganisms which have an impact not only on marine microbial communities, but also pose a risk to human health. Conducting microbiological monitoring in environmentally disadvantaged areas was promise for assessing the state of the environment and ecological mapping coastal pollution.

In the last decade this ecological phenomenon as "marine pollution" has become a subject of intense study. Due to the increasing anthropogenic load was necessary to assess the potential risk of anthropogenic interference in the seas of the Far East region for microbial community and, as a consequence, to inhabit the waters of the sea aquatic organisms. First of all, it is important to find out whether pollution pollutants affect the species composition of marine microorganisms and their biological properties.

In the study, 60 isolates of bacteria from sea water has been allocated: in the Golden Horn Bay was isolated 30 isolates, in the Round Bay – 30 isolates. To determine the taxonomic affiliation derived microorganisms was conducted to study their cultural, physiological and biochemical properties by classical microbiological methods.

In the Round Bay was isolated such microorganisms as *Micrococcus*, *Bacillus*, *Arthrobacter*, *Flavobacterium*, *Vibrio*, *Acinetobacter*, *Pseudomonas*, *Actinomyces*, *Corynebacterium*, *Sarcina*.

In the Golden Horn Bay was isolated 30 isolates which identified as *Escherichia*, *Micrococcus*, *Actinomyces*, *Bacillus*, *Vibrio*, *Acinetobacter*, *Listeria*, *Sarcina*, *Enterococcus*.

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