MACROBENTHOS OF BRACKISH-WATER INTERTIDAL AREAS OF DOLPHIN BAY (SHIKOTAN ISLAND, THE KURIL ISLANDS)

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Brackish-water intertidal macrobenthos communities of Dolphin Bay are of particular scientific interest; they represent typical virgin flora and fauna of South Kuril Islands. Dolphin Bay was studied in detail in 1987. Before that an earthquake happened in 1994 and brought about a lowering of about 0.5-0.7 m. of the island. The data of intertidal surveys carried out in 1997 and 1998 were included in our report too.

Dolphin Bay (Fig. 1) is rather a shallow and enclosed bay; its water in summer warms up to a greater degree than in other bays of the island. In August 1987 the water temperature near shore reached 23 °C in the inward part of Dolphin Bay and 27.9 °C in island lagoon, while in other bays it was only 13.6 °C.

The western shore of Dolphin Bay represents an exposed sand beach, with rich intertidal epi- and infauna and phytobenthos. Before the earthquake the gastropod mollusc *Batillaria cumingii*, typical inhabitant of brackish waters, formed communities with *Hediste japonica*, *Abarenicola pacifica*, *Ruditapes philippinarum* and *Zostera japonica* in the lower and middle intertidal areas. In 1987 were found 28 species of macrobenthos.

Along with a complex of characteristic brackish-water intertidal species, eurytopic sea species were recorded here in 1987. These are *Littorona squalida, Nereis vexillosa*, *Falsicingula kurilensis*, *Littorina sitkana*, *Mysella kurilensis litoralis*, *Cyclocardia isaotakii*, *Schizoplax brandtii*, *Fucus evanescens*, *Ahnfeltia tobuchiensis* and others. In 1997, almost 3 years after the earthquake a belt-forming community of *B. cumingii* reoccupied the mid intertidal zone. The belt of *Zostera japonica* and then a *Zostera marina* occurred at lower horizon. The communities, whose succession was induced by the lowering of the shore as a result of the earthquake, did not reach the state of climax. This was probably connected with the erosion of low-lying shores and redeposition of sediments. In 1997 there were found 20 species of macrobenthos.

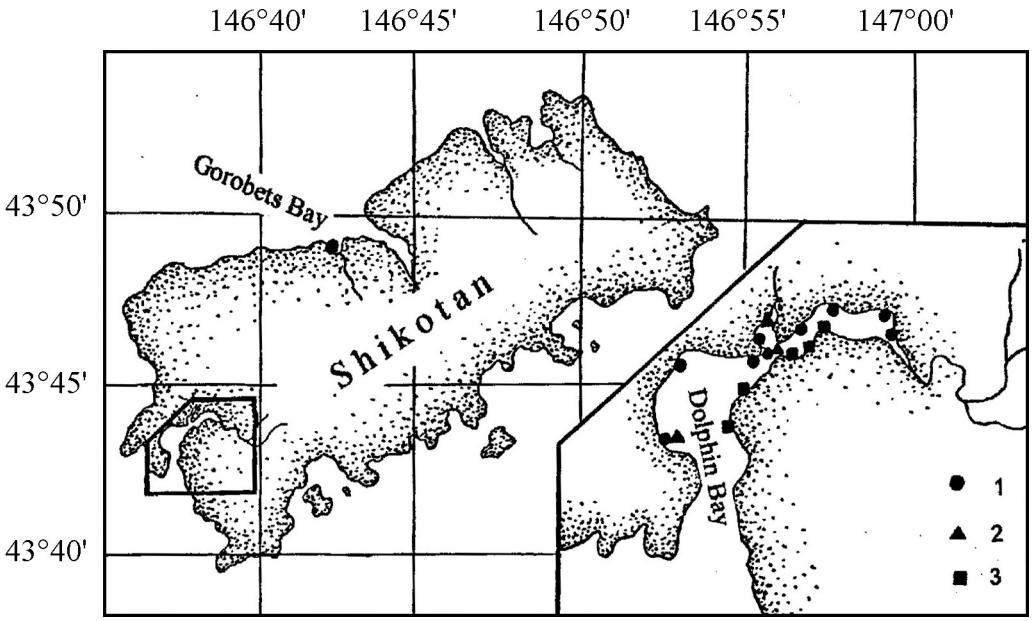

Fig. 1. Shikotan Island and Dolphin Bay. 1-3 – areas of intertidal zone investigated: 1 – in 1987; 2 – in 1997; 3 – 1998

In the inner part of Dolphin Bay, around a rocky reef at the shore line, was meadow of *Zostera marina* and *Laminaria cichorioides*. The rocky reef was covered with *Corallina pilulifera*, *Chondrus pinnulatus* and separate bushes of *Sargassum palidum* and *Cystoseira crassipes*. Above the belt of *C. pilulifera* was a belt of *Mastocarpus pacificus*, and at a mid horizon was a community of *Fucus evanescens.* Among the invertebrate animals, *L. squlida* played the predominant role and it reached the largest size in growths of *L. cichorioides* and on leaves of *Z. marina*. Under *Z. marina* leaves were aggregations of *Ahnfeltia tobuchiensis; M. incongrua*, *Mya japonica*, *Mysella kurilensis litoralis* were encountered in sediment and *Schizoplax brandtii* and other invertebrates occurred on *Zostera* leaves. After the earthquake the reef lowered below zero depth. Despite high diversity of fauna and flora found at this reef (64 species) in 1987, it ranks below reefs in other bays of Shikotan Island, such as Krabovaya Bay (108 and 81 species), Otradnaya Bay (108 species), Dimitrov Bay (100 species), Gorobetz Bay (108 species). Brackish-water reefs at the heads of bays are characterized by the absence of *Phyllospadix iwatensis* which is formed under sea conditions at exposed capes and on protected reefs.

Before the earthquake on pebbles near the reef were rich populations of molluscs (*Neptunea artritica, R. philippinarum, L. squalida, Nucella heyseana var. alabaster* and *Tritia fratercula*) and other invertebrates (*Idotea ochotensis*, *Pagurus middendorffii*, *Ampithoe sp*., *Polychaeta* and others). Three years after the earthquake in 1997 *R. philippinarum* was still numerous here. The composition of *Gastropoda* changed markedly. *Batillaria cumingii* appeared, but *N. artritica, L. squalida, N. heyseana var. alabaster* and *T. fratercula* were not found. Of *Polychaeta Neoamphitrite figulus, Abarenicola pacifica* and others were recorded in 1997. Burrowing forms *Echiurus echiurus* and *Mya japonica* were also encountered.

In 1987 extremely unusual and even unique fauna and flora occurred in the inland lagoon, although the number of species was not high (34). At the high intertidal horizon on shingle-silt substrate was a community of *Salicornia europea + Batillaria cumingii + Haliplanella luciae*. Eurytopic marine species *Littorina sitkana, L. squalida* and *Falsicingula kurilensis* were also found in here. In the mid intertidal horizon the belt-forming bivalve *Ruditapes philippinarum* dwelt. Communities of *Zostera marina* or *Z. japonica* were noted in the lower intertidal horizon of the lagoon. Among *Z. marina* growth invertebrates were scarce but the polychaete *Hediste japonica* characteristic for brackish-waters dominated in terms of biomass *Gastropoda*, *Mysidacea* and *Corophiidae* occurred in large numbers. In 1997 the coastline of lagoon was investigated to the south of a brook. Here, *R. philippinarum*, *Mya japonica, Macoma incongrua, E. echiurus* and other sea and brackish-water invertebrates were found in the community of *Z. marina* on shingle-sand-silt substrate; *Haliplanella luciae, Schizoplax brandtii, Nereis vexillosa, Iravadia nipponica* (altogether 19 species) were found under stones.

In 1987 *Zostera marina* played a leading part in open areas of the estuary of the Ostrovnaya River but at the mouth of the river was a rather extensive belt of *Z. japonica*. A narrow gently sloping shore consisted of shingle, sand and clay. Near the water edge during ebb-tide fry scurried. In the inland part of the estuary the community of *Z. japonica* meet with the tussocks of the *Glaux maritima* and *Triglochin maritimum*. Above these communities *Atriplex patens* and *Puccinella kurilensis* were situated. The invertebrates *Littorina sitkana*, *Gnorimosphaeroma noblei, H. japonica* and others were found on the tussocks and under them. As a result of earthquake water balance was disturbed at the flooded shores of the lagoon and estuary, but eurytopic species typical of brackish-water intertidal areas survived. This is clearly illustrated by a rare species *H. luciae* which survived in the lagoon. In 1998 algae vegetation along the southern shore at the top of estuary was very scarce. On shingle at the mid intertidal horizon separate bushes of *Fucus evanescens* and non-attached *Rizoclonium riparium* grew. Slightly deeper there was *Zostera* marina occurred en masse. Not far from the exit from the ravine growths of *Fragmites australis* on the tussocks extended to the sea. At the upper intertidal horizon *Batillaria cumingii* occurred en masse. Among seagrasses, *Zostera marina* and *Z. japonica* were found; and three species of algae were encountered too. At the exit from the estuary the number of intertidal algae increased to six species. Beyond the exit of estuary nine species of algae were found. At the lower intertidal horizon and upper part of subtidal zone growth of *Z. marina* gave way to *Kjellmaniella gyrata*.

A comparative biogeographical analysis of macrobenthos of brackish-water intertidal areas in Dolphin Bay and that of an exposed seashore in Gorobetz Bay (Shikotan Island) was carried out (Fig. 2). The comparison revealed that widespread boreal species prevailed (namely, amphiboreal species, widespread Pacific boreal and Western Pacific boreal species) in both bays. In Gorobetz Bay these species were more numerous (65) and comprised 60.1% of the total number of species, while in Dolphin

Bay these species were 37.1% (36 species). Low-boreal Eastern Pacific species were numerous too and constituted 25.8% (25 species) of total biota in Dolphin Bay and 17.6% (19 species) in Gorobetz Bay. The number of boreal species inhabiting also the subtropical zone (namely, amphiboreal subtropical and widespread boreal species and Western Pacific subtropical-boreal species) was rather small. In Dolphin Bay these species together were 4.1% (4 species) and 1.9% (2 species) in Gorobetz Bay. There was a more appreciable difference in the number of subtropical-and-low-boreal species: 16.5% (16 species) in Dolphin Bay and only 1.9% (2 species) in Gorobetz Bay. The number of boreal-tropical species in Dolphin Bay was also greater than in Gorobetz Bay. They were 6.2% (6 species) in Dolphin Bay and 1.9% (2 species) in Gorobetz Bay. Arctic-boreal species in Dolphin Bay were two times less than in Gorobetz Bay: 7.2% (7 species) and 13% (14 species) respectively. Cosmopolitan species were 3.1% (3 species) in Dolphin Bay and 3.7% (4 species) in Gorobetz Bay. The peculiarity of the biota of brackish-water intertidal areas in Dolphin Bay is the presence of a considerable number of marine eurytopic and brackish-water species of the subtropical-low boreal group. This corroborates the opinion of some authors (Khlebovich, 1986) that the general biogeographical scheme of brackish-waters should not necessarily coincide with marine biogeographical scheme. Earlier investigated materials and literary data suggest that the transitional zone between the Whole-Arctic and Sino-Indian brackish-water biogeographical regions is situated north of the South Kuril Islands and includes brackish-water intertidal areas of Shantar Islands, Tugursky Bay, Amur Liman, lagoons of North and North-Eastern Sakhalin and the Eastern coast of Sakhalin, extending as far south as the northern part of Terpenie Bay. The species composition of brackish-water areas of the South Kuril Islands, in comparison with northern areas, increases sharply at the expense of warm-water and vicarious species. According to the terminology of Khlebovich (1986), brackish-water intertidal areas of Dolphin Bay can be classified as the Amur-Japanese subregion of the brackish-water Sino-Indian biogeographic region, as opposed to typical seashores of Shikotan Island, which belong to the low boreal of the marine Pacific boreal region (Kussakin, 1990).

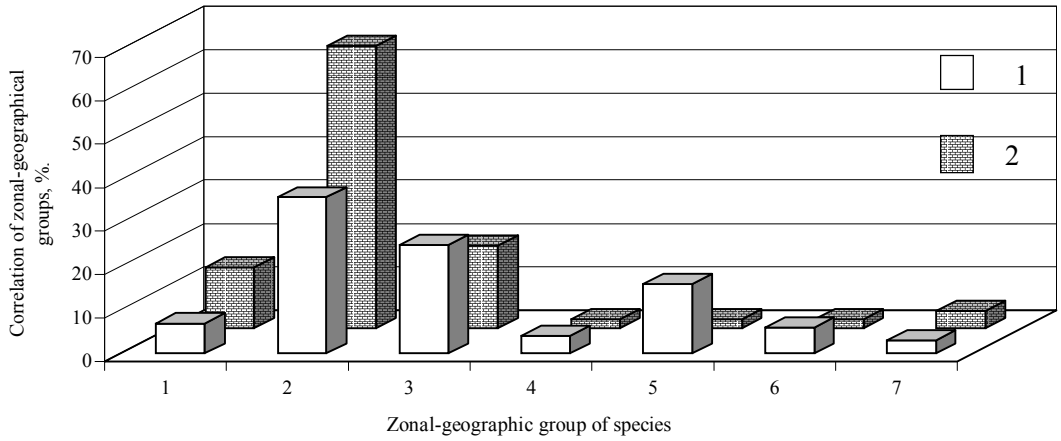

Fig. 2. Percentage of zonal-geographical groups of macrobenthos in Dolphin Bay (1) and in Gorobetz Bay (2). 1-7 – zonal-geographic groups of species: 1 – Arctic-boreal; 2 – widespread amphiboreal; 3 – Western-Pacific low-boreal; 4 – Pacific species inhabiting boreal and subtropical, widespread subtropical-amphiboreal; 5 – amphiboreal subtropical-and-low-boreal, Western-Pacific subtropical-and-low-boreal, subtropical-low-boreal-notal; 6 – boreal-tropical, boreal-tropical-notal; 7 – world-wide distribution

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