Ichthyofauna of the Islands of the Taui Bay coastal waters and recreational fishing

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Abstract. The material for research was a collected fish in the littoral and sublittoral zones of the Islands of Nedorazumeniya and Zavyalov coasts (Northern part of the sea of Okhotsk) in June 2018 and August 2019. The authors' research identified 22 and 25 species of fish that live in the summer in the littoral and sublittoral zones of the sea coast of Zavyalov and Nedorazumeniya Islands, respectively. Of these, the most numerous are the Blue rockfish Sebastes glaucus (24.5-49.0%), and White spotted greenling Hexagrammos stelleri (13.5-35.7%). Most species are demersal and benthic ichthyocoen. 41% of the species are characterized by the broad-boreal near-Asian type of range, 28% - mainly boreal, 13% - Arctic-boreal, 9% - high-boreal near-Asian and broad-boreal Pacific. For the development of recreational fishing, 15 species of fish can be promising, for which size and weight indicators are given.

1. Introduction
Recreational fishing is well developed in the world and is one of the most profitable branches of economic activity. A number of authors who study this issue note that this type of fishing provides not only a pleasant leisure time for fishing enthusiasts and pleasure from this activity. The objective of recreational fishing is also aimed at promoting the rational development of aquatic biological resources, both traditional commercial species and those that are poorly developed by industrial fishing [1, 3-11, 13-16, 18].

Recreational fishing in the Northern part of the sea of Okhotsk has more than a 30-year history. It is based on coastal infrastructure, and the objects of fishing are Pacific salmon: Pink salmon Oncorhynchus gorbuscha, Chum salmon Oncorhynchus keta, Coho salmon Oncorhynchus kisutch, Sockeye salmon Oncorhynchus nerka, Dolly varden Salvelinus malma, Whitespotted char Salvelinus leucomaenis, which are caught in rivers and adjacent areas of the sea coast during the anadromous migration of adults to spawn. In recent years, tourist infrastructure has begun developing on the Nedorazumeniya and Zavyalov Islands of the Taui Bay, where citizens of Magadan and other regions of Russia are invited to visit island ecosystems untouched by economic activity on weekends or for a longer time, with sufficient comfort for an urban resident. Sea fishing is one of the leisure options offered by tourist bases.
All the stated above predetermined the purpose of our research to study the species composition of the ichthyofauna of the littoral and sublittoral zones of the Nedorazumeniya and Zavyalov Islands and to identify promising fish species for recreational fishing.

2. Research materials and methods
The material for research was a collected fish in the littoral and sublittoral zones of the Islands of Nedorazumeniya and Zavyalov coasts in June 2018 and August 2019 (figure 1).

Temporary hospitals were organized with a field laboratory to carry out the work, where the species of the caught fish were determined, the collected samples were photographed and labeled, and biological analysis was performed. Fishing was carried out from the water edge (zero mark) to a depth of 50 m using fish traps, set nets with different sizes of mesh, hook and line gear from the board of a small size vessel and a drag seine. Fish that remained under rocks in the tidal zone were caught manually. Species identification of fish was performed using the Chereshnev and coauthors atlas [18] and the Fedorov and coauthors catalog [21]. Common names of fish are taken from the literature [2, 12, 17, 22]. During biological analysis, the length of fish was measured from the beginning of the snout to the end of the middle rays of the caudal fin with an accuracy of 1 mm. The collected materials were supplemented with the data obtained by the authors in the same areas in previous years of research for a better representation of data on fish size and weight indicators.

3. Results and discussions
Zavyalov Island is the largest one of the four Islands of the Taui Bay, located 45 km to the south of Magadan. The island has remained uninhabited for the past 45 years. The island is 21.5 and 7.5 km long and wide, respectively, and has a total area of 116 km². The main part of the coastline is slightly indented and composed of rocks with an abrupt drop in depth. Two bays with a small strip of littoral zone run deep in the shore on the Western side of the island, and construction of a recreation center began on the shore of one of them in 2018.

In general, during the period of research of the Zavyalov Island coastal water area 22 species of fish belonging to 13 families were defined (table 1). The largest number of species in the catches were the
Cottidae (4 species) and Stichaeidae (3 species) families. The Gadidae, Hexagrammidae, Hemitripteridae, and Agonidae families are represented by more than one species. Common species in catches (more than 100 specimens caught) include Hadropareia middendorffii, Sebastes glaucus, Hexagrammos stelleri, Hexagrammos octogrammus. Individual specimens were represented in catches by Bathymaster derjugini, Porocottus minutus, Rhodymenichthys dolichogaster, Hemilepidotus gilberti, Pallasisa barbata, Alectrias electrolophus, Askoldia knipowitschi, Limanda aspera, Eleginus gracilis, Clupea pallasii. Hemilepidotus gilberti was caught in the Taui Bay water area for the first time, Bathymaster derjugini is rare for the Taui Bay and for the whole Northern part of the sea of Okhotsk, other fish species reach a high number [20, 21].

Table 1. Taxonomic list of fish species and their occurrence in the Zavyalov (I) and Nedorazumeniya (II) Islands coastal waters.

| Family               | Species                          | Common Name              | The occurrence in catches |
|----------------------|----------------------------------|--------------------------|---------------------------|
| Clupeidae            | Clupea pallasii                  | Pacific herring          | ++ -                      |
| Osmeridae            | Osmerus mordax dentex            | Pacific rainbow smelt    | - -                       |
| Gadidae              | Gadus macrocephalus              | Pacific cod              | ++ -                      |
| Theragra chalcogramma| Walleye pollock                  | ++ -                     |
| Eleginus gracilis    | Saffron cod                       | + +                      |
| Sebastidae           | Sebastes glaucus                 | Blue rockfish            | ++ +                      |
| Hexagrammidae        | Hexagrammos stelleri             | Whitespotted greenling   | ++ -                      |
| Hexagrammos octogrammus |                          | Masked greenling          | ++ +                      |
| Cottidae             | Myxocephaulus jaok               | Plain sculpin            | ++ +                      |
| Myxocephaulus polyacanthocephalus |          | Great sculpin            | + +                       |
| Myxocephaulus stelleri |                          | Frog sculpin             | ++ +                      |
| Gymnocanthus detrisus| Grayspurple sculpin              | - +                      |
| Porocottus minutus   | Okhotensis sculpin               | + +                      |
| Hemilepidotus gilberti |                          | Japanese irish lord      | + -                      |
| Hemitripteridae      | Hemitripterus villosus           | Shaggy sea raven         | - +                      |
| Blepsias cirrhosus   | Littledragon sculpin             | + -                      |
| Agonidae             | Ocella dodecaedron               | Bering poacher           | - +                      |
| Pallasina barbata    | Tubenose poacher                 | + +                      |
| Bathymasterida       | Bathymaster derjugini            | Blackspot ronguil        | + +                      |
| Zoarcidae            | Zoarcus elongatus                | Nothed-fin eelpout       | - +                      |
| Hadropareia middendorffii |                      | is unknown               | ++ ++                    |
| Stichaeidae          | Alectrias electrolophus          | Northern grin cockshorn  | + +                      |
| Opisthocomus ocellatus |                      | Ocellated blenny         | ++ +                      |
| Askoldia knipowitschi |                          | Mud prickleback         | + -                      |
| Pholydapus dybowskii | Dybowsky's blenni                | - +                      |
| Pholidae             | Rhodymenichthys dolichogaster    | Stippled gunnel          | + +                      |
| Anarchichadidae      | Anarichas orientalis             | Bering wolfish           | - +                      |
| Ammodytiidae         | Ammodytes hexapterus             | Pacific sand lance       | + -                      |
| Pleuronectidae       | Limanda aspera                   | Yellowfin sole           | + +                      |
| Platicthys stellatus | Starry flounder                  | - +                      |
| Myzopsetta proboscidea |                      | Longhead dab             | - +                      |

*The species is not presented in the catches. + The species is presented singularly. ++ The species is presented numerously.

11 species of fish are described by us as promising for recreational fishing with the exception of Clupea pallasii, which amateur fishing is currently banned. These are Sebastes glaucus, Gadus macrocephalus, Eleginus gracilis, Limanda aspera, Hexagrammos stelleri and H. octogrammus, Hemilepidotus gilberti, Myxocephaulus polyacanthocephalus, Myxocephaulus stelleri and
Myoxocephalus jaok (table 2). The most numerous fish of this species group is Sebastes glauces, which occupies more than half of the total number of catches. A significant share of the total catch (26.9%) is formed in approximately equal proportions by Hexagrammos stelleri and Hexagrammos octogrammus.

Such species as Hypoglossus stenolepis and Anarhichas orientalis are also important for sport and amateur fishing. Despite the fact that we were unable to catch a single specimen in 2018, it is known from the literature [20] that these species are an integral part of the ichthyocoen of the Taui Bay, including the coast of the Zavyalov Island, so their absence in the catches may be due to the short duration of our research. Both species reach large sizes, have high gastronomic qualities and are desirable objects of trophy fishing. In this regard, it seems reasonable to include Hypoglossus stenolepis and Anarhichas orientalis in the list of objects that are promising for recreational fishing off the coast of the Zavyalov Island.

Nedorazumeniya Island is 3 km far from the mainland coast and 20 km far from Magadan. The island is 3.5 km long and 2 km wide. On the Eastern and South-Western sides of the island, the coast is rocky, with a sharp slope. In the Northern part of the island, the coast is flat with a well-developed littoral. Here, on the shore of a small bay, a recreation center has been operating for the past few years.

The results of research fishing showed that, in taxonomic terms, most of the identified fish species are members of the same families as in the area of Zavyalov Island (table 1). In comparison with the Zavyalov Island district, a feature of the ichthyofauna of the Nedorazumeniya Island littoral and sublittoral was manifested in the absence of Clupea pallasii and, on the contrary, in the usual catches of Osmerus mordax dentex. This is due to the fact that the first species after spring spawning in the littoral and upper sublittoral immediately migrates to open sea areas, while the second, rolling from the river to the sea after spawning, constantly lives in the coastal zone. It should also be noted that the Pleuronectidae family is more diverse.

13 of 25 species identified in the Nedorazumeniya Island area may be promising as objects of recreational fishing. The total catch is numerically dominated by Hexagrammos stelleri and Sebastes glauces, the total share of which is 60.2%. 3 species of flounder, which are traditional objects of amateur fishing, are of significant importance in the formation of catches (14.2%). Platichthys stellatus reaches large sizes up to 63.0 cm and a mass of 2.8 kg in the Taui Bay [23], and according to these indicators can act as a trophy fishing object.

**Table 2.** Species composition and biological parameters of fish that are promising for recreational fishing in the research area.

| Species                      | The share of the total catch, % | Length, cm (average) | Weight, g (average) |
|------------------------------|---------------------------------|----------------------|---------------------|
|                              | Zavyalov Island | Nedorazumeniya Island |                     |
| Osmerus mordax dentex        | -                 | 1.6                  | 15.5-29.0 (23.7)    | 24-199 (104) |
| Gadus macrocephalus          | 1.3               | 2.1                  | 32.1-61.6 (45.9)    | 69-2565 (995) |
| Theragra chalcogramma        | 3.3               | -                    | 33.9-56.1 (47.2)    | 260-1700 (921) |
| Eleginus gracilis            | 0.7               | 5.5                  | 16.5-23.5 (19.6)    | 45-115 (78) |
| Sebastes glauces             | 49.0              | 24.5                 | 11.2-38.2 (18.2)    | 20-1080 (181) |
| Hexagrammos stelleri         | 13.5              | 35.7                 | 22.1-33.3 (27.3)    | 140-460 (278) |
| H. octogrammus               | 13.4              | 5.3                  | 17.2-20.0 (18.8)    | 90-124 (107) |
| Myxocephaus jaok             | 3.3               | 2.1                  | 42.4-65.9 (54.4)    | 1110-3270 (1959) |
| M. polyacanthcephalus        | 1.7               | 0.5                  | 41.0-68.0 (57.2)    | 870-5430 (3003) |
| M. stellifer                | 13.5              | 7.4                  | 32.7-50.6 (42.1)    | 620-2960 (1556) |
| Hemilepidotus gilberti       | 0.1               | -                    | 22.5               | -a |
| Anarhichas orientalis        | -                 | 1.1                  | -                  | -a |
| Limanda aspera               | 0.3               | 7.6                  | 17.1-43.2 (32.5)    | 57-1138 (393) |
| Platichthys stellatus        | -                 | 6.3                  | 28.2-41.2 (35.1)    | 284-889 (563) |
| Myzopsetta proboscidea       | -                 | 0.3                  | 9.9-36.7 (23.8)     | 7-672 (155) |

a No measurements were made for technical reasons.
4. Conclusion
During the 2018 and 2019 ichthyological studies in the littoral and sublittoral zones of Zavyalov and Nedorazumeniya Islands, 31 species taxons of fish living here in the summer were identified, which are characterized by 5 types of habitats out of 10 known for the Taui Bay of the sea of Okhotsk [20]. Thus for 41% of the species broad-boreal near-Asian type of the habitat is inherent (Northern part of Japan, Okhotsk sea and Bering sea), 28% - mainly boreal (Northern part of the Pacific ocean, the Southern part of the Chukchi sea), 13% - Arctic-boreal (Arctic sea and the North Pacific), and 9% - high-boreal near-Asian (North of the sea of Okhotsk, Northern Kuril Islands, the Western part of the Bering sea) and broad-boreal Pacific (from the Bering Strait to the sea of Japan, Pacific coast of Japan and North America). Most species are inter(poly)zonal and can occur in two or more bathymetric sea horizons. The main part of the species belongs to demersal and benthic fish, with the exception of Pacific herring and Rainbow smelt (living in pelagial), and 5 ichthyocoens out of 15 known for the Taui Bay [20]. About half of the caught species (45.5%) belong to the sublitoelitomesobental ichthyocoen, 32% - littosublitoelitomesobental, 9% - littoral and littosublitoelitomesobental, 4.5% - littoral. Out of the total number of fish species identified by our research in the Zavyalov and Nedorazumeniya Islands coastal zone, 15 species can be recommended for recreational fishing.

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