

**Kamchatka State Technical University (Kamchatka STU)  
Wild Salmon Center, USA**

**MATERIALS ON THE BIODIVERSITY OF THE KOL RIVER BASIN  
(WESTERN KAMCHATKA)**



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In 2006, the first regional salmon refuge in the world was created – the Kol River Refuge – within the boundaries of the watersheds of the Kol and Kekhta Rivers in western Kamchatka. Its creation was the result of successful international cooperation. One of the objectives of the refuge is the study of the biological diversity of protected salmon river ecosystems for monitoring and conservation. At the present, the refuge's management and protection is being conducted by Volcanoes of Kamchatka Nature Park, a publicly funded institution. The book contains materials on the species diversity of plants and animals resident in the Kol River basin. Research took place during the years of 2004-2015. The bulk of the data along the lower reaches of the river was collected between 2010-2015 from the operational base of the Kol River Biological Station, currently owned by Kamchatka State Technical University and along the middle stretch of the river in the refuge's buffer zone, known as Medvezhy Ugol. Teachers, graduate students, and students from the water-based biological resources and fisheries and aquaculture departments of Kamchatka State Technical University participated in the research with support from Wild Salmon Center (USA) and in cooperation with specialists from a number of Kamchatka scientific institutions (Kronotsky State Reserve, Kamchatka branch of the Pacific Institute of Geography (Far Eastern branch, Russian Academy of Sciences), and KamchatNIRO). This is the first comprehensive description of species diversity of aquatic and riparian plants, insects, fish, amphibians, birds, and mammals for a single river on Kamchatka.

This publication is intended for an audience of specialists in the area of ecology and biology, as well as anyone interested in regional ecological issues on Kamchatka and the study of its biodiversity.

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**Cover illustration:** Kol River Biological Station on Kol River. Photography by E.G. Lobkov.

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## INTRODUCTION

The hydrological network is well developed on the Kamchatka Peninsula. According to the Federal Water Cadaster (Surface Water Resources of the USSR, 1973), more than 140,000 large and small rivers with a total length of over 350,000 km and more than 112,000 lakes with a total surface area of approximately 5,880 km<sup>2</sup> are contained within its borders.

Numerous interior water bodies, remarkable for their purity and positive hydrological regimes, represent one of the largest (at the present time, the actual largest) systems of salmon spawning grounds in the entire world.

Kamchatka's water bodies are distinguished the highest levels of salmonid biodiversity, highest level of genetic diversity, diversity of ecological existence strategies, and the highest levels for indicators of fish productivity (Bystritsky et al., 1994; Pavlov et al., 2001, 2007, 2009; Sinyakov, 2006; and many others). Moreover, because of the tremendous biomass brought in from the ocean to rivers, anadromous fish species are an important biological habitat-forming factor for aquatic and riparian ecosystems, significantly influencing many of their components (Lobkov, 2008).

Traditionally the study of biological diversity<sup>1</sup> in Kamchatka's water bodies (even the most studied ones in the region) focuses on the fish themselves, and, best-case scenario, on invertebrate aquatic organisms that play a vital trophic role for fish and on living organisms in parasitic relationships with fish. Other inhabitants of water ecosystems, and their land-based components in particular, remain poorly studied. The accent on the "fish component" of Kamchatka-based research is readily comprehensible. But disproportional knowledge only increases and prevents a transition to the study of all biodiversity of the ecological connections between salmonids and the other main components of their habitat in water and on land. In the end, this inhibits the study of the organization and functioning of water bodies as ecosystems within which water and land-based biota are closely interconnected.

In addition, the importance of the ecosystem-based approach to study salmonid water-bodies is obvious, because only that method is ultimately able to model salmonid river and lake ecosystems and thus develop paths to sustainable management of their productivity (Lobkov, 2008).

Ecosystem research includes a wide range of questions, beginning with inventorying species diversity of not only aquatic but also land-based parts of the ecosystem (plants, invertebrate animals, birds, mammals), identification of the entire diversity of ecological connections between them, study of movements and cycles of nutrients brought in by anadromous salmon species, and other aspects of the structure and functioning of the ecosystem.

This type of work, comprehensive in its breadth and requiring the participation of specialists in a variety of biological disciplines, is innovative in character on Kamchatka. It is on this basis that the Science and Innovation Division at Kamchatka State Technical University (henceforth Kamchatka STU) created a science research laboratory for comprehensive research on water ecosystems within the Department of Water Resources, Fisheries, and Aquaculture in 2011. Within the context of this theme, scientists at Kamchatka STU and other Kamchatka research institutions involved in this collaboration have set a goal of unifying far-ranging research for comprehensive study of species biodiversity in lake

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<sup>1</sup> In accordance with the International Convention on Biological Diversity (UN Convention, 1992), the definition of the term "biodiversity" includes "diversity within the framework of a species and between species and ecosystems". In scientific research practice on the study of microorganisms, fungi, lichens, plants, and animals in specific areas or natural complexes, "biodiversity" presumes first and foremost the species-based (and sub-species-based) diversity of corresponding specific flora and fauna.

and river ecosystems on Kamchatka. This work took place over the course of three field seasons on the Utkholok, Kol, and Opala Rivers and at Azabachye, Nalychevo, and Dalneye Lakes.

The Kol River was chosen as a pioneering site for the purposes of organizing this research. There were solid reasons for making this choice. In its time, the Kol River was identified as a priority area for the development of activities for the study, conservation, and monitoring of anadromous fish biodiversity within the framework of the UNDP/GEF Program “Conservation and Sustainable Use of Wild Salmonid Biological Diversity”. The first scientific baseline studies began here in 2002, led by Lomonosov Moscow State University (MSU) researchers in partnership with the Wild Salmon Center (USA, Portland, Oregon). Full-scale international scientific research began in 2004. Study of aquatic organisms on the Kol River and the adjacent Kekhta River by researchers from MSU and the Severtsov Institute of Ecology and Evolution (Russian Academy of Sciences, Moscow) continued on and off until 2011. On the American side, researchers representing Flathead Lake Biological Station and University of Montana also participated in the research.

Over this period, the biological characteristics of salmonid and associated fish species and fishlike animals as well as the geomorphological and hydrological characteristics of their habitat (Pavlov et al., 2009; Stanford et al., 2005; and others) were studied. The resulting body of information was quite large, and as a result, collaborators from these large research institutions in Russia continue to publish materials on various aspects of fish ecology and their role in salmonid river ecosystems, including the example of the Kol River (see, for example: Kuzishchin et al., 2013; Gruzdeva, Kuzishchin, 2014; Gruzdeva et al., 2014; Pavlov et al., 2014; and many others). Unfortunately, other aquatic biological objects are significantly less studied or even entirely unstudied. Almost zero publications exist about land-based biotic components.

Researchers used the biological research station that was built for that purpose in the Kol River lowlands in 2002-2006 for a field station thanks to collaboration with Wild Fish and Biodiversity Ecological Fund (WF&BEF, Elizovo, Kamchatka Krai) and Wild Salmon Center. Indeed, it was the staff of the community-based Wild Fish and Biodiversity Ecological Fund, Wild Salmon Center (USA) and research ichthyologists from several interested organizations that began discussing in 2001 the idea of building a biological station on the Kol River due to the particular importance of the Kol and Kekhta river watersheds for the conservation of natural biodiversity of salmonids and, most of all, Kamchatka steelhead, including its migratory form – Kamchatka salmon – listed in the Russian Federation Red Book. In 2002, this idea began to come into fruition. Permission for construction and a Forest Fund site were provided to WF&BEF (Elizovo) for this purpose, and the WF&BEF financed the design and construction phases with direct financial support from Wild Salmon Center. Paramushir-Grad Corporation was selected as the general building contractor. November 24, 2005, the Kol River Biological Station commenced operations. Its infrastructure continued to undergo improvements in 2006.

In 2009, with the dissolution of WF&BEF, the biological station was transferred to Kamchatka State Technical University (Fig. 1). In addition to the biological station, the intersection of a branch of the Kol River and the Sobolevo-Petropavlovsk-Kamchatsky Pipeline, to which an unsurfaced road leads from Petropavlovsk-Kamchatsky, is a convenient and accessible place for the study of the Kol River’s key biodiversity components. A conservation enforcement station, Medvezhy Ugol, was established in that location in 2006 and is part of the Kol River Salmon Refuge, the first in the world and in the Russian Federation



*Fig. 1. Kamchatka STU's Kol River Biological Station is situated on the left bank of the Kol River 7 km from the shores of the Sea of Okhotsk. Photography by E.G. Lobkov. 8 September 2008.*

Thus, the Kamchatka STU researchers chose the Kol River for the start of comprehensive research on the biodiversity of salmonid water-bodies for two primary reasons:

Firstly, Russian and American researchers have gotten off to a good start with research on the Kol River. With their results, it has become possible to direct future work not only toward additional studies of fish biology but importantly also toward inventorying the species inventory of the fauna and flora of riparian and land-based biota components.

Secondly, the presence of a well-built, high quality base in the form of the biological station on the Kol River ensures good conditions for fieldwork (Fig. 2).

The materials laid out in this book are the result of research conducted between 2004 and 2015. The main results were achieved by teachers (E.G. Lobkov, V.I. Karpenko, A.A. Bonk, T.L. Vvedenskaya), graduate students (A.L. Lozovoi, D.P. Pogorelova) and students (Yu.E. Shuvaeva, R.S. Klyukina) of the Department of Aquatic Biological Resources, Fisheries, and Aquaculture of Kamchatka STU. L.E. Lobkova (Kronotsky State Nature Biosphere Reserve), O.A. Chernyagina (Kamchatka branch of the Pacific Institute of Geography, Far Eastern branch of the Russian Academy of Sciences), and D.D. Danilin (KamchatNIRO) assisted greatly in work with the collected materials. Moreover, L.E. Lobkova conducted independent additional research in the Kol River basin. Some materials are partially published (Lobkov, 2006; Lobkov et al., 2010; Bonk, Danilin, 2011; Vvedenskaya, Ryzhov, 2011; Lozovoi et al., 2011; Lozovoi, Bonk, 2012; and others), while others formed the basis of dissertations defended in 2011 at Kamchatka STU (Yu.E. Shuvaeva, R.S. Klyukina). Materials regarding mammals (A.S. Valentsev, Kamchatka branch, PIG (FEB RAS) have formed the basis of proposals to establish the Kol River Salmon Refuge. The majority of this information is being published for the first time.

The main research method was comprised of gathering materials to inventory the species composition of flora and fauna in the Kol River in field conditions. The main emphasis was on the lower

and middle parts of its watershed. The watersheds of the nearby small rivers of Kuntovo and Kekhta were surveyed to a lesser extent. Field observations, surveys, collection of plant specimens, sampling aquatic organisms, and their resulting processing took place according to commonly accepted biological methodologies. In addition, information laid out in the Draft Document (Draft..., 2005) for the establishment of the Kol River Salmon Refuge was reviewed and consolidated in the archives of the refuge and in available publications.



*Fig. 2. Conditions at the Kol River Biological station are comfortable for the purposes of conducting lengthy instructional and research expeditions. Visitors and cargo arrive by helicopter. Photography by E.G. Lobkov. 4 August 2010.*

E.G. Lobkov (Kamchatka STU) organized and coordinated the work of the laboratory team and subsequently led authorship of the team's monograph. The results presented in the book are but the start of the inventory of species diversity in key components of the Kol River ecosystem. The comprehensive work on this river is taking place for the first time.

### **KOL RIVER BASIN – FIRST IN THE WORLD EXPERIMENTAL SALMON REFUGE “KOL RIVER”**

The conservation of habitats and conditions for sustainable population dynamics of plants and animals through the creation of protected areas (PAs) and other forms of natural ecosystem conservation has long been recognized by global conservation experience as one of the most effective measures for protecting biological diversity. Salmonids are no exception. Kamchatka is one of the few regions in the world where it is still possible to protect natural populations of Pacific salmon, rainbow trout, and char while accounting for their unique species and intra-species diversity. It is no coincidence that the idea in the Russian Far East for organizing special protected areas and other forms of territorial protection of aquatic ecosystems (for example, commercial fishing conservation zones) aimed at priority protection of salmonid biodiversity has resonated widely among specialists. Over time, international nongovernmental conservation organizations have actively tapped into this idea, including taking the initiative to finance pioneering research. Most notably, the United Nations Development Program (UNDP) together with the

Global Environment Facility (GEF), and Wild Salmon Center (Portland, Oregon, USA) have gotten involved.

In 2006, the State Experimental Biological (Salmon) Regional Refuge “Kol River” was established in Kamchatka in accordance with the goals and objectives of the UNDP-GEF program “Conservation and Sustainable Use of Wild Salmonid Biological Diversity” (RUS/02/g32/A/lg/99 # PIMS: 1288). This was the first attempt at organizing such a protected area on Kamchatka, in the Russian Federation, and worldwide. Its creation was preceded by many years of design studies, the results of which were discussed repeatedly in our nation and abroad. The refuge is the result of unique efforts from productive international cooperation among scientific and conservation organizations, mainly between Russia and the United States under the auspices of UNDP/GEF and WSC. The main parties involved in the salmon refuge are the Wild Fish and Biodiversity Ecological Fund, the Kamchatka branch of the Pacific Institute of Geography (Far Eastern branch, Russian Academy of Sciences), KamchatNIRO, and federal VNIRO. The main burden of financing the project was taken on by Wild Salmon Center (USA). The work was actively supported by the Russian Federation government, which was represented by the Federal Fisheries Agency (FFA).

The boundaries of the Kol River Refuge were identified in Sobolevsky Municipal Region of Kamchatka Krai within the boundaries of the Kol and Kekhta Rivers, with a total area of 220,242 ha. The conservation buffer zone is an additional 78,804 ha. It stretches for 22 km along the seacoast. The catchment basins of the indicated rivers are completely within the protected area (Fig. 3). The refuge existed as an independent legal entity for 10 years. In 2015, the Volcanoes of Kamchatka Nature Park (Kamchatka publicly funded government institution) assumed management and enforcement duties for the refuge.

The watersheds of the Kol and Kekhta Rivers correspond well to the requirements for establishing a protected area aimed at protecting salmonids. These rivers are geomorphologically typical for western Kamchatka, and their hydrological and hydrochemical conditions are optimal for salmonid reproduction. As a result, they possess some of the highest indicators for salmonid biological diversity and population productivity on Kamchatka. Their natural complexes are unaltered or nearly so, with minimal anthropological influence that is not of irreversible character and relatively easily controlled. Economic activity here is typical for Kamchatka; there are no large deposits of subsoil resources, and the territory is relatively inaccessible and unpopulated.

Why was the category of “regional refuge” selected to create the protected area in the Kol and Kekhta river basins? Because, as a form of protected area, regional-level refuges, the activities of which combine conservation while permitting traditional sustainable natural resource use, have long been recognized for their effectiveness on Kamchatka. The goal of creating the Kol River Refuge was and remains (although the refuge has changed its legal status) the conservation of biological diversity of salmonids on the Kol and Kekhta Rivers and creation of conditions for the sustainable long-term use of commercial salmonid fisheries. In order to achieve this goal, the refuge’s planners designed a management mechanism for salmonid populations based on the comprehensive study, monitoring, and conservation not only of the fish but also of the other most important ecosystem components of the protected rivers that form a sustainable habitat for salmonids. Thus, one organizational characteristic that distinguishes the Refuge from other regional refuges on Kamchatka is the combination of the functions of conservation of biological salmonid diversity while at the same time creating conditions for the sustainable use of commercial species based on the watershed principle of creating protected areas and the ecosystem-based approach to monitoring.



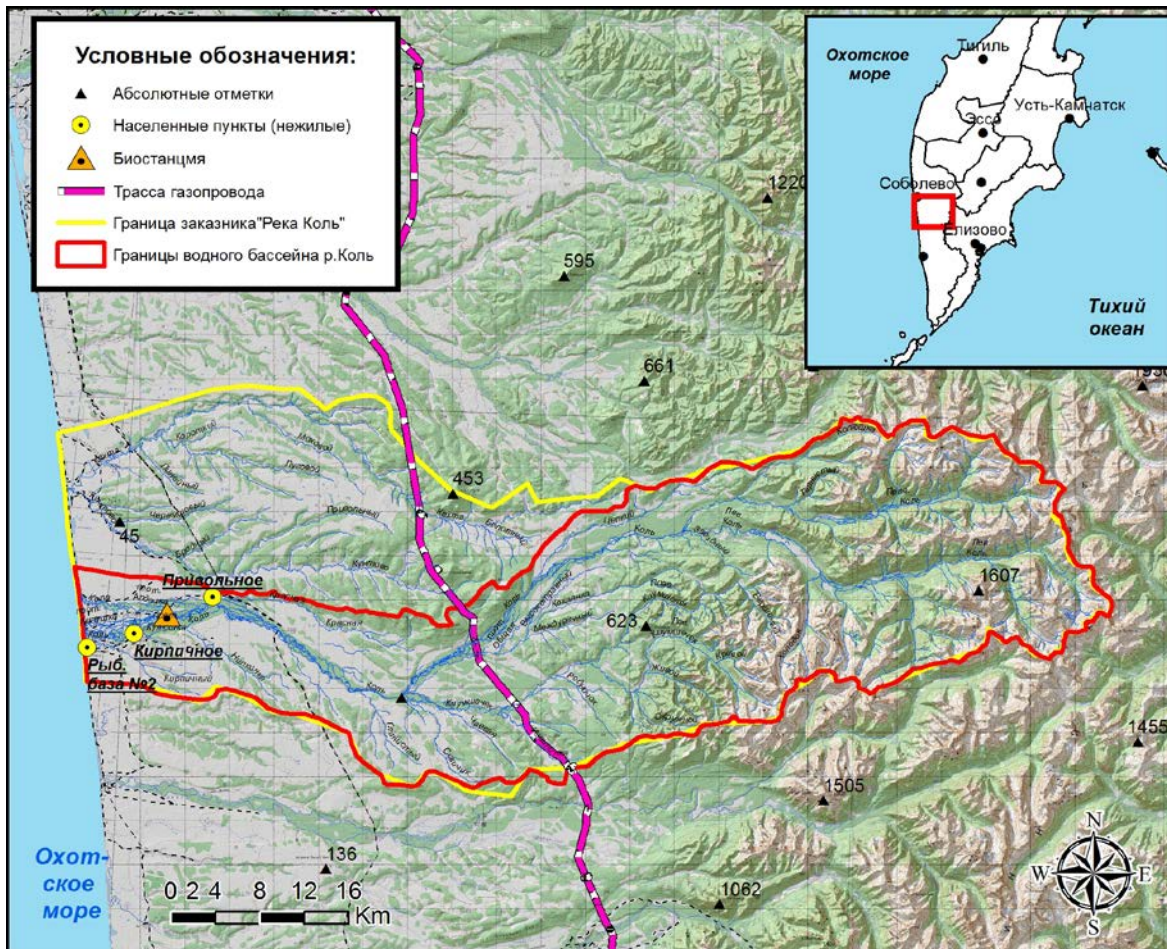


Fig. 3. Geographic location and borders of the Kol River basin.  
Diagram prepared by V.E. Kirichenko (KB PIG RFE RAS)

[Transl. note – Key (top to bottom): Absolute elevation, Settlements (not residential), Biological station, Natural gas pipeline, Kol River Refuge boundaries, Kol River watershed boundaries]

The following objectives were developed for the refuge in accordance with its organizational characteristics:

- Ensure natural conditions for the reproduction of wild populations of salmonids;
- Protect endangered salmon species listed in the Red Book of the Russian Federation and Red Book of Kamchatka: Kamchatka salmon and rainbow trout;
- Organize scientific research and monitoring of salmonid populations, formulate a rationale for their sustainable long-term exploitation;
- Develop commitment to long-term and stable work, sustainable production and use of salmonid resources among the current fishing enterprises operating within the refuge;
- Monitor implementation of the refuge operator’s recommendations by fishing enterprises; and
- Conduct environmental education outreach.

The Kol River Refuge has been termed experimental as it was created in order to gain practical experience and model successful efforts to create conditions for the sustainable use of economically

significant commercial salmonid fisheries with a priority of conservation of the unique natural biological diversity of salmonids. The goal was to be able to then recommend this model's implementation in other regions of Kamchatka. Protected areas on Kamchatka have not yet met these objectives.

Among the primary principles used in creating the refuge which reflect its specific activities, the following examples can be highlighted (Draft... 2005; Lobkov, Zvyagintsev, 2009):

- The Kol River Refuge is a state protected area. It was established in accordance with a Resolution issued by the governor of Kamchatka Oblast dated 25 April 2006 (#206, “On the creation of a state experimental regional biological (salmonid) refuge “Kol River” and the creation of an oblast-level state institution “Administration of the Kol River Salmon Refuge”). Issues regarding state management of the Kol River Regional Refuge were entrusted to the Kamchatka Krai Ministry of Natural Resources and Ecology; at the present, the refuge is within the structure of Volcanoes of Kamchatka Nature Park, a publicly funded state institution.

- Use of the watershed principle for the territory's organization ensures the integrity of salmon river ecosystems and permits monitoring and enforcement of all key components both on land and in water;

- Identification of the watersheds of the Kol and Kekhta Rivers as a regional refuge does not require that the lands, forests and water bodies be withdrawn from the use of land-, forest- and water-users, but nevertheless sets limitations on natural resource users as laid out in the Resolution establishing the refuge;

- The salmon refuge retains legally established structures for traditional natural resource use; organizations and legal entities conducting fishing, hunting, reindeer herding, and tourism as forms of traditional economic activity are required to observe the refuge's conservation regime as well as to assist in achieving the refuge's stated objectives;

- The salmon refuge is not a resource-extracting institution; its main functions are to ensure protection of the natural complexes of the salmonid rivers both on land and in the water, to conduct scientific research and comprehensive monitoring of salmonid river ecosystems to support the natural development of salmon populations and optimize exploitation of commercial species;

- Salmon refuge operations and execution of its assigned tasks are financed by cost-sharing from the budget of Kamchatka Krai and non-budgetary funds; over the years, the main non-budgetary funding source has been funding from the Wild Salmon Center, an international nongovernmental organization, and this was a good example of effective intergovernmental interaction;

- The salmon refuge conducts conservation, monitoring, and other activities on the basis of cooperation, interaction, and consolidation of the efforts of all interested parties. These include: the refuge's administration, local self-governing agencies, state oversight agencies related to environmental protection, conservation and exploitation of animals and aquatic biological resources, as well as all resource users conducting activities within the refuge in accordance with the procedures laid out by law, and indigenous peoples of Kamchatka;

- The refuge is aimed at broadly engaging local residents in achieving its stated objectives and on their active participation in the socio-economic life of the municipal region within which the refuge is located.

The most important organizing characteristic of the Kol River Refuge is its ecosystem approach to the study and monitoring of salmonid fish populations. This is in accordance with the tasks of protecting critical components of salmonid habitat, including both water and land. This includes: conservation of biological diversity and the structure of freshwater communities and ecosystems, a portion of which are salmonid; protection of abiotic conditions in these habitats; conservation of all habitat diversity;

conservation of not only aquatic, but also land-based communities and ecosystems as a single, holistic foundation for the sustainable existence of the entire natural complex of the protected water bodies.

The watershed principle around which the refuge is organized is the guarantor of successful implementation of the ecosystem-based approach to the study and monitoring of the Kol and Kekhta salmon rivers. A scheme developed for the monitoring of salmonids within the experimental Kol River Salmon Refuge focuses on elements of the ecosystem approach for evaluating the status of salmonid biological diversity and salmonid habitat (Pavlov et al., 2009).

Together, the organization, development of potential solutions, and long-time (2006-2015) activities of the Kol River Salmon Refuge comprise an important experience in terms of conservation of salmonid biodiversity as well as in the practice of sustainable natural resource use and nature conservation at the regional, national, and global levels (Lobkov, Zvyagintsev, 2009).