V. V. GLUPOV, YU. N. LITVINOV

Laboratories OF NATURE

By the beginning of the 19th century, naturalists had accumulated a tremendous bulk of data, mainly of a descriptive nature, in manifold fields of biology, such as taxonomy, morphology, and ecology of animals and plants. The great volume of empirical data requiring understanding and in-depth analysis served as a basis for the idea of evolution of living nature and stimulated its further development. All this promoted a quantum leap in research: characteristic of the 19th century was a rapid development in the fields of science that began using experimental methods such as microbiology, immunology, and embryology. Thus, scientists encountered new problems, the solution of which frequently required a combination of experimental activity and systematic field observations. The best way to organize such work was to found biological stations, which could be rightfully regarded as natural laboratories

Viktor V. GLUPOV is a Doctor of Biology, director of the Institute of Systematics and Ecology of Animals, Siberian Branch of the Russian Academy of Sciences (Novosibirsk, Russia), and head of the Laboratory of Insect Pathology with this Institute. He is the author and coauthor of over 80 research papers

Yury N. LITVINOV is a Doctor of Biology, deputy director of the Institute of Systematics and Ecology of Animals, Siberian Branch of the Russian Academy of Sciences (Novosibirsk, Russia), and head of the Laboratory of Ecology of Vertebrate Animal Communities with this Institute. He is the author and coauthor of over 90 research papers

Key words: biological center, research station, biodiversity, ecology, environmental activity, Western Siberia, Gorny Altai

The first permanent biological stations where systematic studies of fauna and flora were performed appeared in the second half of the 19th century. The European naturalists studying sea dwellers pioneered in this area. The first small research laboratories were organized on the French Atlantic coast (in Concarneau in 1859 and in Arcachon in 1867). Note that the studies of marine invertebrates were in many respects inspired by the outstanding discoveries in embryology made by Russian zoologists A. P. Kovalevsky and I. I. Mechnikov, who worked a lot in the Mediterranean region.

It is no wonder that one of the first European marine biological stations was opened in Russia. The decision to organize such a station in Sebastopol, on the shores of the Black Sea, was made in 1869, at the Second Congress of Russian Naturalists, the initiative of N. N. Miklukho-Maklai, a well-known anthropologist, biologist, and traveler. The station was opened in 1871 and acquired an academic status after being assigned to the St. Petersburg Academy of Sciences. This station was headed by Kovalevsky, who considerably expanded and reconstructed it.

Over a relatively short time, marine biological stations were organized in many regions of the world. In particular, naturalists from St. Petersburg University initiated the foundation of a biological station in the Solovetsky Islands, which became a long-standing operational center for collecting and classifying samples of the White Sea living organisms; the station also disseminated methods for artificial fish breeding since fish resources were already becoming exhausted. Along with well-known scientists university students worked there too.

The Institute of Systematics and Ecology of Animals, Siberian Branch of the Russian Academy of Sciences (Novosibirsk) has three biological stations, namely, Karasuk (south of the Novosibirsk oblast near the city of Karasuk), Chany (on Chany Lake), and Teletskoye (Teletskoye Lake, the village of Artybash, the Altai Republic)

In 1884, a rather unusual Russian zoological station was opened in Villa-Franca near Nice. This station, which belonged to St. Vladimir Kiev University, was under the auspices of the Marine Ministry; in fact, the Russian fleet funded it until 1914.

The biological stations involved in studies of freshwater aquatic bodies date back to 1888. In particular, six such research stations had been in operation in the Russian Empire by 1910. The well-known Zvenigorod biological station of Moscow State University was a private laboratory for studying freshwater organisms since 1908; only in 1918 it was assigned to the Institute of Experimental Biology. яIt became a research base for young scientists and graduate students and a site for field practice of Moscow State University students only in 1934.

The first biological station to the east of the Ural Mountains was organized in 1916 in the village of Bol'shie Koty on the shores of Lake Baikal, the largest freshwater lake in Eurasia. The main initiator for founding this station and its organizer was V. Ch. Dorogostaisky, a known Siberian zoologist, who succeeded in attracting considerable funding from the Irkutsk millionaire and philanthropist N. A. Voronov.

Biological stations are research institutions intended for comprehensive permanent studies of plants and animals under natural conditions and for conducting applied activities (acclimation, increase in the biological capacity of natural complexes, and so on). Biological stations are usually organized in the areas with specific natural conditions, famous for rich and unique inhabiting organisms

After the revolution, in 1918, this biological station was assigned to the recently organized Irkutsk University, where Dorogostaisky headed the Chair of Zoology for almost 20 years; he also organized a museum with a scientific repository. The station was involved in the studies of flora and fauna Cis-Baikal and of the lake itself; in addition, biology students were trained there. A farm was organized with the station, where they kept and studied red deer and foxes.

In Soviet Russia, the network of biological stations began to expand rapidly. Biological stations, including those intended for studying terrestrial flora and fauna, were organized under the auspices of the USSR Academy of Sciences, academies of the Soviet republics, and large universities.

In Siberia, a new stage in developing reserves, which functioned as laboratories, began with the organization of the Siberian Branch of the USSR Academy of Sciences. Thus, on vast Siberian territories, a network of biological stations of various specializations was formed as part of the newly founded institutions of the Siberian Branch. Once it happened the other way round: in 1961 the Baikal Limnological Station was reorganized into the Limnological Institute.

Research field stations were also organized with the Biological Institute (today, the Institute of Systematics and Ecology of Animals, Siberian Branch of the Russian Academy of Sciences). Currently, Siberian zoologists have three biological stations at their disposal; they are located in different landscape and geographical zones of western and southern Siberia.

The biological stations of the Institute of Systematics and Ecology of Animals are convenient research bases for both field experimental studies and various scientific meetings. *Photo* shows the participants of the Third All-Russia Conference on Biology of Insectivorous Mammals. *Teletskoye biological station, 2007*

On the shores of Teletskoye Lake

Gorny Altai is among the most unique natural areas in this country. As early as 1932, the Altai State Nature Reserve with an area of 1.3 million hectares was organized there, Teletskoye Lake forming its northwestern boundary. The reserve was closed in 1951; luckily, logging on the reserve failed for technical reasons.

In the late 1950s, the studies, preservation, and rational use of natural resources in this region became more active; in particular, the Altai Reserve was restored. It was at that time when a team of young enthusiasts, forest engineers from the Leningrad Academy of Forestry Engineering, came to the taiga near Teletskoye Lake. Thus began the famous Kedrograd (Cedar City) – a project based on wasteless forest harvesting without the clear-cutting of forest stands. Unfortunately, this idea was not fully realized.

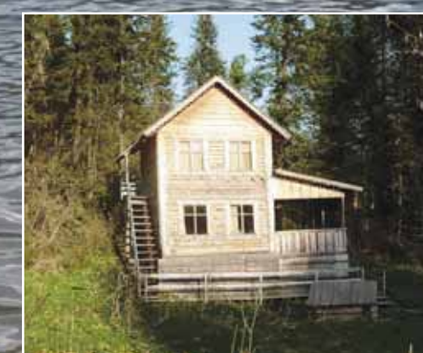
The scientific station of the Biological Institute was organized in 1961 in Yailyu, one of the most picturesque sites on Teletskoye Lake. Three years later, the station moved to its present location, near the village of Artybash on the shore of the lake.

Since the time this biological station was organized, the researchers have been involved in investigating numerous fundamental and applied problems, many of which are still topical. Among these problems are restoration of the Siberian pine, control of forest pests, and study of the natural focus of tick-borne encephalitis. The researchers performed numerous long-term studies into systematics, zoogeography, and ecology of insects, mammals, birds and aquatic fauna of Teletskoye Lake, as well as examination of game resources of the area.

In the 1980s, a cage farm was organized at the Teletskoye biological station aiming to study and breed wild ungulates. In particular, wild sheep argali, which was included in the Endangered Species List (Krasnaya Kniga), successfully reproduced in captivity (later they were transferred to the village of Cherga to the farms of the Institute of Cytology and Genetics, Siberian Branch, USSR Academy of Sciences).

Siberian musk deer were also successfully bred in captivity at this station. Siberian musk deer males are a source of musk gland secretion, used in perfumery and traditional medicine. The researchers developed a method of obtaining this valuable product intravitally, without killing the animals, which is very important for preserving this species with its currently low natural population.

Among the most important research areas of the Teletskoye biological station is the study of biodiversity and dynamics of natural communities in connection with the impact of natural and anthropogenic factors. This includes



Large animals, like this beautiful maral deer *(above)*, are the pride of taiga forests and important game. However, numerous species of small plant-eating mammals – various voles and mice – are more important components of natural ecosystems as well as indicators of environmental state. *Right photo:* Korean field mouse. *Photos by the courtesy of Yu. Litvinov and S. Abramov*

auditing and monitoring of the current population state of several terrestrial and aquatic species, indicators of the overall environmental state.

One of the topical problems is the development of methods for preserving endangered and commercially important wild mammalian species, including ungulates (maral deer and Siberian musk deer), which implies their cage breeding as well as development and improvement of intravital musk sampling.

The researchers hope that the results of their field research will help to create an integrated strategy for

Ants are known to establish close relations with various plant juice- sucking insects: adult individuals eat sweet secretions of insect symbionts and, in turn, provide them with some protection from enemies.

In the Altai, an important source of carbohydrate food for ants is fern sawfly larvae. The uniqueness of this trophic symbiosis is that sawfly larvae are almost all the time hidden from ants in their “apartments,” the frond (leaf) stipes of ferns; therefore, all interactions take place via the holes in fronds, used by larvae for respiration and excretion. *Photo by the courtesy of T. Novgorodova*

Animals living in natural conditions are interconnected via most diverse relations from predatory and parasitic to symbiotic. These relationships form the background of any natural community

The near-Teletskoye taiga is a sort of reserve for parasitic tapeworms: over 50 Cestoda species have been found in the insectivorous mammals and rodents living there. Such diversity of parasites of this poorly studied group has not been found anywhere else in Siberia. Parasitologists of the Institute of Systematics and Ecology of Animals were the first to find larvae of these Cestoda in their intermediate hosts – insects and mollusks. *Photo* shows one of the developmental stages of Cestoda larva in the mollusk intestine. *Photo by the courtesy of V. Gulyaev*

In the evening, dozens of bats fly over small coves and bays of Teletskoye Lake. Chiropterans are the only mammals capable of active flying. These animals, rather rare in our region, have been included in all regional lists of endangered species. *Photo* shows a Daubenton’s bat. *Photo by the courtesy of Yu. Litvinov*

The Karasuk biological station, located on the shores of Krotovaya Lyaga Lake, occupies an area of 412 hectares, including 401 hectares of the area covered with water

rational exploitation of natural resources in this region and increase the efficiency of nature preservation and remediation.

The land of steppes and lakes

The so-called Great Land of Lakes, a unique natural area comprising over 40,000 lakes (!), is located in the south of Western Siberia, in the interfluve of the Ob and Irtysh Rivers. For biomass resources, these shallow lakes stand alone. Sapropel, rich in valuable organic matter and mineral components, and other bottom sediments, aquatic birds, fish, and, last but not least, rich forest-steppe mammalian fauna are the resources that have long attracted the attention of both managers and biologists.

S. S. Folitarek, a well-known Siberian zoologist, wrote about these natural treasures: “They say that seas are treasuries and lakes are jewel boxes. These jewel boxes in Western Siberia are just ajar.” It was Folitarek who proposed to organize a biological station with the Biological Institute to deal with the problems associated

Among the artificial nesting boxes intended for protection from predators, a “jar”-type nesting appeared the most attractive for birds. The reproduction rate in this type of woven “townhouse” is considerably higher as compared with natural conditions. *Photo by the courtesy of A. Mikhant’ev*

Three species of bustards, which are among the largest flying birds inhabiting steppes and deserts, are found in Russia. The males of the houbara or ruffed bustard, especially chic in their spring feathering, trample down real “alien circles” while doing their mating dance. Today this bird is an endangered species. *Photo by the courtesy of V. Shilo*

It won't be an exaggeration to say that the Siberian grouse is a national treasure of Russia. At the planet there exist only three species of these rare and poorly studied birds, and one of them is in this country. An amazing specific behavioral feature of the Siberian grouse is absence of any fear of humans, which, in fact, has led to a significant decrease in its population.
At the Karasuk station, the Siberian grouse is successfully bred in cages. The birds born in captivity are then used as a stock for creating a reserve population of the species in the Novosibirsk oblast, in the taiga forests of the Maslyanino district.
Photos by the courtesy of V. Shilo

with integrated studies, exploitation, and transformation of lakes. Thus, the Karasuk biological station was organized in 1962.

At the station, scientists of three academies, including the Academies of Agricultural and Medical Sciences, as well as specialists from many universities and ministry institutions united their efforts in studying the nature of forest-steppe zone. Experts in various specialties – soil scientists, botanists, zoologists, parasitologists, microbiologists, and virologists – have worked there for nearly half a century.

In the 1960s, an unprecedented experiment on integrated biotechnical activities aimed at an increase in the productivity of the experimental site that comprised four lakes with an area of 1786 hectares was conducted there. The experiment was funded not only by the Academy of Sciences, but also by the State Department of Hunting Industry and Natural Reserves of the Russian Federation (Glavokhota RSFSR). In particular, Titovo Lake was reorganized into a discharged fattening pond for breeding valuable fish species. Six types of artificial nesting boxes for wild ducks were designed and tested under the program for increase in productivity of commercial waterfowl species; these boxes were intended for protecting nests from fires, drastic changes in water level, and predators. As a result, egg loss was completely avoided and the number of younglings was increased.

The experiments demonstrated that the productivity of lake farms could be considerably increased if good investments were made.

Today, an example of successful interagency collaboration is work on preservation of animal biodiversity, which is currently conducted at this biological station in collaboration with Novosibirsk Zoo. Here, in cages, you can see great bustards, little bustards, houbara bustards, golden eagles, and Himalayan snowcocks as well as a "collection" of Tetraonidae birds, including Siberian grouse, ruffed grouse, western capercaillie, and Eurasian black grouse. The new data on avian biology obtained by the researchers are used in developing technologies for their cage breeding.

In spring, from 100 to 300 shaggy voracious caterpillars hatch from a single egg-lay of a gypsy moth. One thousand of such creatures are enough to destroy the leaves (needles) of one tree completely.
Photo by the courtesy of V. Glupov

Currently, joint research projects of Russian, Finnish, and American scientists are aimed at studying the mechanisms underlying population dynamics of the gypsy moth, one of the most widespread phytophagous insect pests of forests. Here they simulate under natural conditions the processes taking place in pest populations at the stage of population growth. In order to study the resistance of this pest to entomophages (viruses and fungi) and various pathogens, they use the gypsy moth caterpillars developing on preinjured trees. The data of this study will help to discover the main reasons causing pest population growth, which will be used for developing forest preservation programs.

Accompanied by bird chatter

Another field station of the Biological Institute is located in a real "bird paradise", on the shores of Chany Lake, the largest natural aquatic body in Western Siberia. It was organized in 1971 to study the main patterns in flyways of migratory birds and their regional and transcontinental connections to prevent dissemination of arboviruses, i. e. the viruses transmitted to humans only via blood-sucking insects.

The part of the Baraba forest-steppe near Chany Lake was chosen purposefully, because this region is of paramount importance for waterfowl and near-aquatic birds of all Siberia, being the main site for their stopover and nesting.

From the very beginning, it was clear to researchers that it made no sense to band thousands of birds and then wait until some banded individuals were recorded. Therefore, each banded bird was intravitally examined, which gave extensive information appropriate for statistical analysis.

One of the main methods used in population studies of birds and their migrations is tagging with metal rings and color marks. Before being released, the banded birds are comprehensively examined; in particular, recently they have been assayed for the presence of avian influenza viruses. *Photos by the courtesy of A. Yurlov*

Although ruffs on Chany Lake are numerous, they mainly just stop there since the majority of these sandpipers nest in tundra. In spring, the males are involved in fierce contests. At this time, they develop magnificent "collars" and "ears" of white, orange, or black-green feathers in various combinations. Their mating feathers are so diverse that it is impossible to find two identically colored birds. *Photos by the courtesy of A. Yurlov*

The banding of over 160,000 individuals helped to see the main patterns in seasonal migrations of over 160 avian species. The main migratory flyways and wintering sites of several populations nesting in forest-steppe were determined along with the nesting and wintering sites of the birds migrating through the Baraba forest-steppe or coming there for molting.

Aquatic bodies of the Baraba forest-steppe were found to be a stopover area during the migration season or as a molting area for the birds inhabiting a vast territory from the Yamal Peninsula to Yakutia. For wintering, birds fly from this area over vast expanses, from the Netherlands in the west to the Korean Peninsula in Southeast Asia. Due to this work of Siberian ornithologists, Chany Lake and the system of lakes near the Bagan River were included into the list of aquatic and wetland areas of international importance subject to special preservation under the Ramsar Convention.

Males of the black-tailed godwit, one of common sandpipers nesting in Baraba, play in the air flying over the site chosen for nesting. Swinging to and fro, and briskly flapping with right and then with the left wing, they utter a characteristic cry sounding like "vereteng."
Photo by the courtesy of A. Yurlov

The great crested grebe is a real aquatic bird, which can hardly move on land. It usually has a floating nest; frequently it is possible to observe how younglings hide themselves on the mother's back, while it dives without fearing that it can lose the offspring. *Photo by the courtesy of A. Yurlov*

The community of pulmonate gastropods, which breathe in both atmospheric air and the air dissolved in water, is very numerous in the basin of Chany Lake. In some years, it is possible to collect over half a kilo of this freshwater "seafood" from one square meter of the bottom. The largest among them is the great pond snail with its shell up to 6 cm high (*right top*).
All mollusks are intermediate hosts for parasitic worms, trematodes. During one day, a great pond snail can hatch, as an incubator, up to 350,000 larvae ready to search for a new host. *Photos by the courtesy of V. Glupov*

These appealing downy creatures will soon become beautiful birds, an adult Pallas's gull, a very large gull nesting on islands (*right*). This species is in the Endangered Species List (Krasnaya Kniga) of the Russian Federation. The colony of Pallas's gulls on Chany Lake reaches 350–400 pairs. As a rule, no more than one youngling survives to flight, although each pair lays two or three eggs.
Photos by the courtesy of A. Yurlov

Currently, ornithologists pay the main attention to studying the natural mechanisms involved in the control of bird populations, including those acting on an intrapopulation level. A large number of banded birds (in some populations the amount reaches 60%) allowed for the collection of unique data on the factors which influence bird mating and breeding performance, age structure of populations, and several other still vague issues in avian population biology. In particular, it has been discovered that the breeding performance and, correspondingly, the number of near-aquatic birds in Western Siberian forest-steppe is determined by climatic factors by 35—75%.

The Chany biological station appeared to be the optimal site for studying interactions between parasitic worms and their hosts: the researchers examined the system mollusks-trematodes (trematodes include the notorious liver flukes which cause a severe human and pet disease so widespread in the Ob basin). Note that the main part of the trematode life cycle is associated with gastropods; as for the basin of Chany Lake, the gastropod community comprises 23 species, where over 50 trematode species can develop.

Among the important activities of biological stations is education. At the biological stations of the Institute of Systematics and Animal Ecology, not only students of biology, but also many schoolchildren, young naturalists from Novosibirsk and other Siberian cities, get their first research experience – unforgettable lessons of love and care for the living world around us

Of great interest to specialists are not only the mechanisms providing for stability of this parasite population, but also the fact that the parasite is absent from biocenosis while all the necessary intermediate and definitive hosts are present. In particular, liver flukes, which are widespread not only in the Ob River, but also in several regions adjacent to Chany Lake, are not found in the lake itself. Specialists hope to understand this phenomenon in the future.

Very soon the Chany biological station became famous with the Asian, European, and American institutions involved in the issues associated with migratory birds and environmental protection. Today, not only Russian projects but also several international programs are being implemented at the station in collaboration with well-known organizations such as the International Council for Bird Preservation and the Center for Northeast Asian Studies (Japan).

The three biological stations of the Institute of Systematics and Ecology of Animals have always played an important role in its research activities: over half of research work in zoology and in adjacent fields is performed there.

Traditionally, biological stations serve as scientific bases for integrated studies in collaboration with researchers from other academic and departmental institutions, and universities. Recently, scientists from Japan, Germany, the Netherlands, Hungary, Lithuania, and other countries have been working there, together with Siberian colleagues. These studies are supported by several Russian and international foundations.

However, the role of biological stations is not confined to purely research problems. Russian and international conferences are traditionally organized there. In addition, students of biology actively work there together with researchers from various institutes, becoming familiar with practical field studies. For example, the Karasuk and Teletskoye stations have been used as summer practice sites in zoology by the students of Novosibirsk State University for many years.

The entire long-term history of biological stations of our Institute demonstrates that they are an important integral part of Siberian biological science. Moreover, their role in investigating many basic and applied problems in ecology, rational wildlife management, and environmental protection as well as their educational potential will only increase with time. This is half the battle for a successful future of Siberian "laboratories of nature."

References

Ecology of Chany Lake. //B. G. Ioganzen, Ed. Novosibirsk: Nauka, 1986 (in Russian).

Game Breeding. Theoretical Foundations and Practice in Siberia (Collection of Papers on the Activities at the Karasuk Station). Novosibirsk: Nauka, 1980 (in Russian).

Insect Pathogens: Structural and Functional Aspects. // Ed. by V. V. Glupov, Moscow, 2001 (in Russian).

Kharitonov A. Yu. Institute of Systematics and Ecology of Animals SB RAS: born in 1944. // Priroda. 2007. No. 12. P. 4–10 (in Russian).

Litvinov Yu. N., Abramov S. A., Krivopalov A. V., et al. Spatiotemporal organization of rodent community in the near-Teletskoye taiga (Gornyi Altai). // Ekologiya. 2007. No. 6. P. 44–449 (in Russian).

Northeastern Altai: Fauna and Environment (Annotated Atlas). Novosibirsk: Izd. SO RAN, 2009 (in Russian).

Sobansky G. G. Animals of the Altai: Large Predators and Undulates. Novosibirsk – Moscow: KMK, 2008 (in Russian).

Sobansky G. G. Animals of the Altai: Small Predators and Rodents. Gorno-Altaisk, 2009 (in Russian).

Tsybulin S. M. Birds of the Altai: Spatiotemporal Differentiation, Structure, and Population Organization. Novosibirsk: Nauka, 2009 (in Russian).

Veen J., Yurlov A. K., Delany S. N., Mihantiev A. I., Selivanova M. A., Boere G. C., 2005. An Atlas of Movements of Southwest Siberian Waterbirds. // Wetlands International, Wageningen, the Netherlands. 60 p.