NATURE
AND NATURAL RESOURCES
OF THE MURMANSK REGION

Gennady Alexandrov, Irina Zaitseva, Konstantin Kobyakov, Vadim Likhachev

Nature and Natural Resources of the Murmansk Region

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The book about natural treasures of the Murmansk region, focusing not only on its economic value but also its aesthetic, recreational and other properties, depicting the intact nature as the source of human well-being. Large illustrative material reflects peculiarities of natural objects, at the same time helping us understand the key principles of the northern ecosystem existence. The book shows vulnerability of the northern nature, drawing attention to the significance of many phenomena that often remain unnoticed in the everyday life. A separate chapter investigates some aspects of traditional resource management that has been applied on the Kola Peninsula since ancient times.

The book is designed for a wide circle of readers. It can be used as a training appliance during the lessons of geography, biology, local. Recommended for all those interested in the region's nature and environmental issues.

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Dear reader!

You are holding a book about enchanting and diverse nature of the Kola region, its rich resources and amazing landscapes, about the variety of relations between the nature and the man in the North.

The Murmansk region is the land of rough and cold coastal rocks, endless tundra and the northernmost primeval boreal forests in Europe. Rich mineral and marine resources, the planet's oldest rocks, unique flora and fauna are far from the full list of the region's natural heritage. Settlements of the Eastern Saami and the Pomor pathfinders shaped a whole era of our land's culture.

In the 20th century the region's ample mineral resources attracted a flow of geologists, miners, chemists, sailors who did their best to give all those treasures to people. But at the same time the development of land had its side effects: the northern nature is very vulnerable; it cures the wounds inflicted by human activities slowly and with difficulty.

This book as well encourages us to help the nature recover from damage and prevent the possibility of doing new harm. We believe this book will receive wide response and help readers not only to form a closer acquaintance with our region's nature but to love and understand it, and, most importantly, inspire them to preserve its beauty for the new generations.

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The Chairman of the Council of the Kola Biodiversity Conservation Center.

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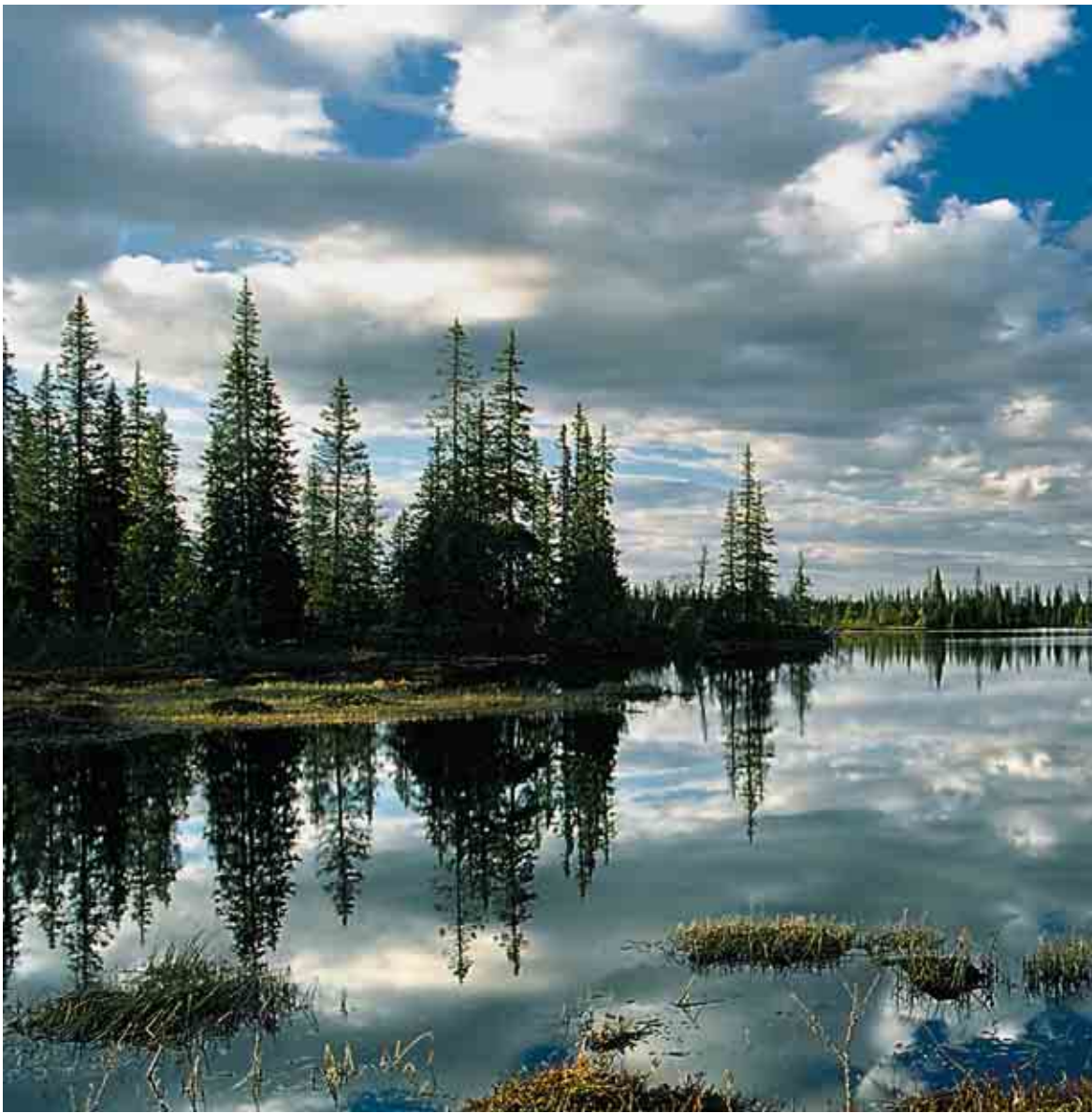
Garden of Eden or Land of Darkness?

When Karl Linney made his first journey through Lapland, he said: “If it weren’t for mosquitoes, this land could’ve been called Heaven on Earth”. Travellers who come to the Murmansk region (the East Lapland) for the first time often repeat his words, not suspecting it.

According to a lot of them, the most impressing thing about this place is infinitely diverse sky. Incredible colors of sunsets and dream-like shapes of clouds, gentle tones of the midnight sun and Aurora Borealis…

Vladimir Kuznetsov



Mikhail Ryzhov

But others think in a different way... Ethnographer Nikolay Kharuzin who visited the Kola Peninsula in 1887 wrote: “Most time of the year Lapland is covered with snow, rivers freeze and the sun, beginning from autumn, hardly shows up above the horizon. And people, doomed to a long existence in the darkness, drag out their monotonous, dull days waiting impatiently for the brief summer… It looks like all the forces of nature have agreed to attack the Lopar, to ruin his already unenviable lot, as though they don’t want a man to settle down here, in this land of gloomy spirits”.

Gennady Alexandrov

Gennady Alexandrov

Weather and Sky

Almost all of the Murmansk region lies north of the Arctic circle. The sun doesn't set for several months in summer, and in winter – doesn't rise. The polar day lasts nine weeks in the north of the region and four weeks in the south, while the polar night lasts five weeks and one and a half week correspondingly.

The polar night isn't impenetrably dark. There is still a sort of "day" – the sunrise turning to the sunset, and when it's cloudy the mid-day twilight can be seen.

Despite the region's northern location the climate here is quite mild thanks to proximity of the warm Nordcap Current – the east-north branch of the Gulf Stream – which keeps the south-west part of the Barents Sea from freezing even in severe winters. At the same time the warm current determines hyper-humidity, frequent and thick fogs, lasting cloudiness and a lot of precipitation.

The mean temperature in February and January doesn't fall below -13°C. The main "disadvantage" of the winter is its length: from the end of October to the beginning of May. The mean temperature of the warmest month, July, is between +10°C and +14°C, though there happen to be "hot" days when the temperature rises above +20°C.

Permafrost, typical for other regions located in these latitudes, doesn't occur here, though there are small areas of perennially frozen ground in marshes and tundra mountain belts.

Gennady Alexandrov

In November and December, as the polar night comes nearer, water reservoirs freeze. Crystal ice-pendants hang beside rivers rapids.

During the low tide, the young ice sinks to the bottom, splitting into countless little fragments of mirror-glasses, new ones emerging after each new ebb.

Later appear standing floes or *ropaks* – clusters of ice blocks where large boulders still break the ice field allowing the sea waters come to the surface. Ropaks grow with every new tide (ebb, flow). With time they will be covered by snow drifts.

Gennady Alexandrov

Gennady Alexandrov

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Crystal ice-pendants will appear on rivers again in spring, though new ones look a bit differently smoothed by the sun.

Icefalls keep growing over the whole winter period. They appear in unexpected, as it may first seem, places, – where in summer moisture just oozes out faintly and no falling water can be seen at all. But by spring the frost manages to create huge icicle curtains or even complete flows of ice from these tiny drops of water.

Gennady Alexandrov

Vladimir Kuznetsov

April is called “the spring of light”. Snowdrifts are still strong and frosts occur sometimes, but it’s already warm in the sun and the day becomes longer than in the Middle Russia.

Igor Ryabkov

On some lakes spring begins only in summer. The end of May and even June is still the time of ice fishing here.

Gennady Alexandrov

Morning frosts cover trees in airy dresses of rime. Snow muffles them up in *kukhta* – snow coats.
Sometimes these coats become so thick that trees bend to the ground and even break.

Igor Ryabkov

Slowly and Quickly

At low temperatures all vital processes take longer. Activity of bacteria decelerates which makes decomposition of dead organic matter rather slow. This slows down ingress of nutrients suitable for plants into the soil. An important conclusion for us, humans, is: recovery of damaged ecosystems requires more time in a cold climate.

The real spring comes only by the end of May. The areas that seemed void of life get full of birds and insects; plants grow and bloom quickly as though trying to catch up with what they have missed during the long winter. However, in spite of such a vigorous vital activity of the summer period, productivity of terrestrial ecosystems is low on the whole.

Patches of snow could be met occasionally in the eastern part of the Kola Peninsula until the end of July. The plants hidden under the snow would have to grow up and give seeds in the short period from the snow melting to the autumn cold.

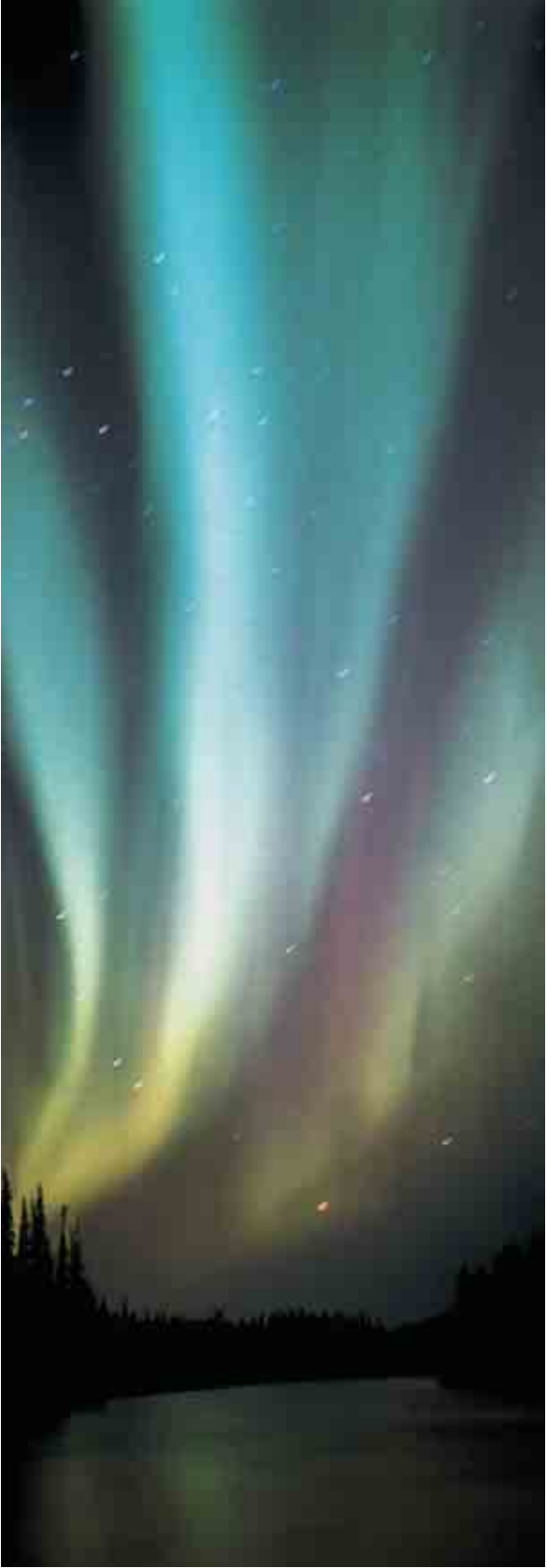
Gennady Alexandrov

False Helleborine *Veratrum lobelianum*

The rushing northern spring moves seasons closer to each other. Phenological signs are unpredictable during this period. “Winter” landscapes with a plenty of snow and ice can bee seen in summer months as well.

Konstantin Kobyakov

Konstantin Kobyakov



Leonid Kornishin

Aurora Borealis

The Murmansk region is a convenient place to watch Aurora Borealis, a miracle of nature. Closeness to the magnetic pole of the Earth allows to observe this phenomenon from August till May. Northern lights are extremely varied in their form and evolution. Here is a description of a most typical Aurora Borealis provided by O. I. Semenov-Tyan-Shanskiy:

"At first a white arc appears above the northern horizon; it gradually rises higher and higher separating itself from the horizon with a dark segment. While it moves towards the zenith, a new arc of light appears in the north, approaching the zenith following the first arc which simultaneously moves towards the southern half of the sky, and then the third arc comes… At some moment arcs break into vertical rays of light in the form of curtains stretching across the sky from the west to the east in several rows. The curtains look as if they are rippled by the playful wind; they seem to be woven from parallel rays of light whose upper ends fade in the height. The light fades, then it flashes again in bright greenish-white flame, its rays pulsate rapidly as if dancing. Sometimes the curtain forms a ring centered on the zenith: this type of northern lights is called "the crown". Sometimes the rays are purple, more seldom they are golden. Flashes of light can also occur during the full moon. The shape of Aurora Borealis is so transparent that stars are clearly visible through it."

Aurora Borealis is produced by the bombardment of the upper strata of the atmosphere by protons and electrons rushing from outer space. These particles excite oxygen and nitrogen molecules and make them emanate quanta of light till they regain their initial state of balance. The bands of northern lights may stretch for thousands kilometers forming a huge curtain several hundred kilometers high and just several hundred meters wide.

The brightness of northern lights varies, the weakest of them can be compared to the Milky Way, the strongest rivals the full moon. Such Aurora Borealis could light the earth on a moonless night. Bright flashes of northern lights are sometimes accompanied by cracking sounds.

According to the Lapps belief, the swift flatter of northern lights betokens wind. In old times the Lapps saw in Aurora Borealis the souls of the dead rising to the sky. And the Russian Pomor legend explains that this glitter is the reflection of shoals of herrings migrating in the Arctic regions. The glitter on the scales of a living herring actually resembles bright flashes of fire. Russian Pomors call Aurora Borealis *spolokhs* and believe that one should not look at it for a long time: it can cause a headache.

Mikhail Borisenko

Aurora Borealis is sometimes called the "solar wind". It could transform the sky as swiftly as the atmospheric wind changes clouds on the threshold of a storm.

Vladimir Kuznetsov

High latitudes are a wonderful place for the observation of other meteorological phenomena, such as vertical pillars of the setting sun, sun and moon halos, mirages raising the line of the horizon.

Gennady Alexandrov

Patchwork of Landscapes

Kola landscapes are very diverse. Over the distance of just several kilometers one may find forests, bogs and rocks, meadows, rivers and lakes. A part of this diversity is the result of human activity. People transformed the land's surface by ploughing up fields, planting or felling trees, building railway lines and highways.

But it's the natural causes that play the key role in the composition of the Kola landscape. The area is located on the boundary of two natural zones – the tundra and the forests of temperate belts (or taiga). There is a dynamical transitional area between the tundra and the forest, the so called forest-tundra.

The area occupies the North-Eastern margin of the Baltic crystalline shield, formed by ancient Archaean and Proterozoic rocks. Elevations and depressions of ancient rocks have been smoothed by the glacier effect and are mostly covered with moraine – a layer of glacial drifts. But outcrops of ledge rocks are common here as well.

A range of mountain massifs – the Lovozero tundras, the Khibiny mountains, Chuna-, Monche-, Salnyje and Wolf tundras – stretches from the east to the west in the central part of the Kola Peninsula. The maximum height of these mountains doesn't exceed 1200 meters. They have convex, smooth slopes, flat, woodless, plateau-like peaks, cut by deep canyons and valleys through which rivers and springs run, in the grip of sheer cliffs. The Saami called such shapes of relief *khibiny* Later this term stuck to one of the massifs as a proper name. Glacier cirques, like gigantic bowls with steep walls, can be seen on the slopes of the Khibiny and Lovozero mountains, and a rocky arctic desert – on their tops. Other elevating forms of relief are called *tunturis* – mountains with woodless peaks and *varaks* – rocky ridges, mostly covered with moraine sediments and overgrown with wood.

But plains and low hills remain most widespread forms of relief on the Kola Peninsula. Bogs, sometimes reaching enormous dimensions, are situated in most depressions. Peculiar "hanging" bogs can be found even on mountain slopes.

Gennady Alexandrov

Konstantin Kobyakov

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Konstantin Kobyakov

Lapponic poppy *Papaver lapponicum*

The Lapponic poppy – a beautiful highland plant – is an endemic species of the Murmansk region and the Northern Norway. Delicate yellow flower-heads are visible from afar on bare and, as it may seem, lifeless stony slopes.

The Lapponic poppy is a "pioneer" species: it is always among the first to settle on new screes and rocks.

Georgy Kasyanov

Georgy Kasyanov

On large mountain massifs rock outcrops and fragmental material predominate. The picture of the flora distribution is subordinated to the law of vertical zonality.

The uppermost of these belts is situated on tops of mountains and slopes and from the first glance looks like a stone desert. But it's a mere illusion. Screes and rock outcrops are all covered with lichen incrustation that takes form of black crusts and greenish-yellow spots. Light-grey mosses fill the space between stones. On a loamy-rubbly surface of grained soil, formed in the process of the nepheline syenites erosion, violet-pink sparks of the purple saxifrage glow.

Konstantin Kobyakov

Purple saxifrage *Saxifraga oppositifolia*

Gennady Alexandrov

Glacier buttercup *Beckwithia glacialis*

The glacier buttercup (*Beckwithia glacialis*) is a delicate but robust plant of alpine Arctic deserts. With time *Beckwithia*'s flowers change their color: first the petals are white and then they turn pink.

Gennady Alexandrov

Glacier buttercup *Beckwithia glacialis*

Another typical scree dweller is the alpine sorrel.
Its leaves taste like those of the common sorrel and are also edible.

Gennady Alexandrov

Alpine sorrel *Oxyria digyna*

The Lake Akademicheskoe is the largest mountain lake in the Khibiny. It's situated in a vast glacier cirque.

Gennady Alexandrov

Why are there no Trees in Tundra?

The tundra zone edges the Kola Peninsula in the North and the East. Woodless spaces also stretch along the southern border of the peninsula, forming a belt that ranges from several meters to 10-30 km. So, why are there no trees in tundra? It's believed that they just can not grow because of a too short vegetation period which lasts about two months here, and also because of strong winds and erosion of the tree bark, resulting from its excision by icy snow.

There is anthropogenic hypothesis of the tundra origin as well. People cut trees for heating and building purposes while the recovery of forests goes slowly in such severe natural conditions anyway. Probably the natural balance was disturbed and thin wood, that once grew here, was never able to recover again.

On the Kola Peninsula tundra is mostly lowland, with many bogs and shallow lakes. When approaching the sea, it is often cut by precipitous cliffs. Rivers break through the rocks, forming steep canyons in which narrow strips of forest hide. Lichens, mosses and dwarf shrubs play the key role in tundra's plant cover. Light patches of cladonia and cetraria lichens cover all the dry spaces and uplands. Lowlands are commonly overgrown by thickets of the dwarf birch (*Betula nana*), or *yernik*, though in a bit more fertile areas bilberry bushes and motley grass can be found. Boggy areas are covered with sphagnum mosses, cloudberry and sedge. In coastal tundras the main role belongs to crowberry *(Empetrum hermaphroditum)*, a dwarf shrub, most resistant to chilly littoral winds.

Gennady Alexandrov

Stony tundras usually look obscure and bleak, but their micro-relief gives shelter to many plants and animals. Biodiversity of these tundras is usually high.

Tundra plants press themselves to the ground, hiding from cold arctic winds. Even stems of the dwarf birch *(Betula nana)* don't grow upwards but creep among mosses and lichens. Surprisingly, in summer the mushrooms appear to be the highest "plants", towering above the tundra vegetation.

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Gennady Alexandrov

In a June tundra you always notice blooming Alpine azalea *(Loiseleuria procumbens)*, even an occasional tiny "flower bed". Sometimes the dwarf shrub blooms in abundance and over this season you ought to walk very carefully not to tread on delicate flowers.

Gennady Alexandrov

In the beginning of July groups of blooming snow-white dryads, or mountain avenses *(Dryas octopetala),* spring here and there, taking the place of melting snowflakes.
Their leaves resemble those of an oak-tree, which is why the plant was called so in Latin. In the Greek mythology "dryads" were forest nymphs inhabiting forests and oak woods.
Another name for the plant in Russian is "ptarmigan grass".

Gennady Alexandrov

Nevertheless, in spite of such an active blossom, colors of the summer tundra are moderate. The burst of colors will come in autumn.

Gennady Alexandrov

The alpine bearberry *(Arctous alpina*), blooming until appearance of leaves, is hardly visible. Its crystal goblet-flowers are exquisite but against the background of withered leaves they give an impression of loneliness and during this period the whole plant looks as if naked.

Gennady Alexandrov

Elegant reticulate leaves spectacularly emphasize large berries. That's when the second name of the berry – a thunder-berry – comes to memory. Unripe berries are reddish; then they become black with a metal shine. It takes them two years to ripen. The Alpine bearberry lives for about 80 years and first blossoms in the 20th year of its life.

Gennady Alexandrov

Although all deciduous dwarf shrubs of the North greatly change their appearance in autumn the alpine bearberry is the one which colors tundra the brightest. Such an intensive crimson can be produced neither by the blueberry *(Vaccinium myrtillulls)* and the great (bog) bilberry *(Vaccinium uliginosum)*, nor by the dwarf cornel (*Chamaepericlymenum suecicum*).

Gennady Alexandrov

Gennady Alexandrov

Lemmings, Geese and Falcons

Life of organisms in the tundra is uneasy. Only in June, when the surface layer of the soil thaws, growth of plants becomes possible and lasts for about 2-4 month. As it finally gets warm, plants begin to develop so quickly that in 2-3 days many of them already start blooming. Annual plants are very rare in the tundra: the summer is so short that they don't have enough time to give seeds. As to perennial plants, they mostly propagate vegetatively, giving young shoots from roots and stems. There are many evergreen plants – wild rosemary, red bilberry, crowberry, juniper.

Animal life in tundra is full of contrasts. White silence of the winter is rarely disturbed by occasional footprints of a polar fox or a lemming's squeak. But in late spring, after rapid snow melting, life unfolds: large flocks of geese, swans, ducks and sandpipers fill the air with the clapping of their wings and mating calls. They too don't have much time: during the period from the end of June, when the snow melts, and the ice breaks up on reservoirs – to the middle of August, the time of departure, – they have to find a partner, build a nest, raise their chicks. But the waterfowl still has to change feathers, so during this season they can not fly and are forced to hide in silent back-waters of numerous rivers, lakes, among marshes.

In the summer time herds of wild and domestic reindeers move to the coastal tundra, escaping mosquitoes. Predators – wolf and glutton – follow them. Birds of prey also migrate here in the search of rich food resources. The most "noble" bird of prey is gyrfalcon which nests in littoral cliffs.

In the Arctic even the rodents, Norwegian and Arctic lemmings, regularly change their habitats. Their seasonal migrations remind that of reindeers' between winter and summer pastures. In winter these little animals prefer areas with thick snow cover hiding rich grass supplies under it. And in summer they move to damp places with plenty of moss, their staple food. There is another similarity between lemmings and reindeers: just as reindeers, if in great numbers, are able to eat up all the lichen cover, lemmings can eat all the moss. In the years of propagation outbreaks which occur approximately once in a thirty years, Norwegian lemmings run hundreds of kilometers, moving in large groups, crossing roads, rivers and not fearing people at all. Sometimes they even come to towns. The last propagation outbreak of the Norwegian lemming on the Kola Peninsula was recorded in 1983-84, since when these creatures have seen more and more seldom, even in their permanent habitats. Shall we ever see them again?

Fledgling of the rough-legged buzzard *(Buteo lagopus)*

Gennady Alexandrov

Wooly willow *Salix lanata*

In order to hide from severe winds and hibernate under the snow, many tundra plants seek lowland areas, creep on the ground, form thick tufts, or “cushions”.

Only in tundra one may find such strange tiny willows, buried in moss. At first sight it isn’t easy to acknowledge their relation to a common pussy-willow or a white willow.

Gennady Alexandrov

Polar willow *Salix polaris*

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Netleaf willow *Salix reticulata*

Gennady Alexandrov

Lonely boulders, signs of activity of an ancient glacier which moved them in the multi-meter ice strata, look majestically on the open tundra spaces.
Sometimes the glacier left stones in unusual sites as if tired of "carrying" them any longer.
Often it arranged them in a strict order, from the north-west to the south-east.
Such was the route of the last Scandinavian glacier.

Konstantin Kobyakov

On polished cliffs – "rams' foreheads" – furrows and ridges of the same south-western orientation, so called "glacier strokes", are often seen.
Seaside rocks, having been treated by the glacier, were additionally flattened by waves.

Ryurik Chernyakin

As the low-tide bares the sea floor, sand cones resembling small volcanoes can be seen.
Sometimes they are so numerous that form a sort of "volcanic landscape".
It's all the lugworm's *(Arenicola marina)* work.
Burrowed deep in the sand it filters marine water together with sand, in the result of which sand hillocks arise near the vent.

Konstantin Kobyakov

Light Taiga

Forests of the Murmansk region, unlike those growing in more southern regions, are full of light due to sparse and low trees. Not only in pinewoods but also in darker spruce forests there is nevertheless enough light for the development of a thick dwarf shrub cover. In untouched areas one may find old spruce forests with lichen-bearded trees, under which lies a carpet of green mosses and bilberry occasionally joined by representatives of other plants. The same sort of carpet, but with a plenty of red bilberry and reindeer moss, covers pine-woods. In the Kola forests berry-fields are very abundant though bilberry, red bilberry and great bilberry bear fruit best of all on open sites.

Grass spruces, usually growing in valleys of rivers and brooks, are distinguished by the highest diversity of vegetation. As a rule they don't occupy large areas. A fir-tree here reaches about 25-30 m and under its canopy 1-1.5 meter-high ferns grow, so that sometimes the scenery reminds of tropics. Other large herbaceous plants, seldom occurring on the rest of the territory, can be also found here.

The most light-demanding and fast-growing of the taiga trees, the birch chooses old glades and fire-sites, forming so called

Konstantin Kobyakov

secondary forests. Soon birch-woods become replaced by coniferous forests. In the Murmansk region there are many boggy forests – both pine and spruce. Like bogs, they are covered with a thick carpet of peat mosses which form the underlying peat layers.

Everyone knows the most common taiga inhabitants: bears, wolves, elks, foxes, hares, wood-grouses, though not everyone had a lucky chance to meet them in the wild. The forest fauna of the region is diverse, though not as dense as in the woods of central Russia: after all in the northern conditions productivity of plants which are eaten by herbivorous animals (which in their turn become prey to predators) is lower.

However, not these widely-known animals but barely visible mouse-like rodents and small passerine birds make up the majority of the vertebrate fauna. Presence of black and three-toed woodpeckers is considered the sign of the taiga's health. Very few of us manage to meet the nicest predators of taiga – lynx and otter. The biggest "red-book" owl, the eagle owl, is also a rarity here. Other rare species of owls can be also met in old mossy fir-woods: the great grey owl and the Ural owl.

Konstantin Kobyakov

Gennady Alexandrov

In the oldest forests common berries (bilberry, red bilberry, great bilberry) are hardly found. More common are gramineous plants, ferns and other herbs.

Gennady Alexandrov

Climatic conditions of the Murmansk region are severe and so fir- and pine-trees usually give yields of cones less than once a year and in boundary forests it happens even once in 50-60 years.

Konstantin Kobyakov

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Fires and Refuges

Fires are one of the main enemies of the region's forests. Though it is known that they used to rage on the Kola Peninsula in prehistoric times, human factor dramatically increases their frequency. According to various figures, from 99 to 95 percent of all fires in the boreal forests are man-induced and occur as the result of breaking fire safety rules. Forests, exposed to industrial waste, burn during practically the whole period of fire risks because there is a lot of dry dead wood.

Research suggests that at least once in 300-400 years most of our present forests passed the after-fire recovery period.

Most often dry lichen pine-forests burn. Ground fire usually leaves most pine-trees uninjured though destroys lichen. This promotes quick growth of young pine-trees for which it was difficult to make their way through a thick cover of lichens and mosses. If fires don't occur for a long time, pine-trees are gradually forced out by fir-trees – less fire-resistant but more shade-tolerant.

There also exist fire refuges or refugiums – intact forest areas. They are often situated in valleys of rivers and brooks, on steep humid slopes. Grassy spruce forests with a plenty of underwood and multiple-aged stands usually grow there. As a rule, such areas are very small, most of them don't exceed one hectare.

Gennady Alexandrov

Gennady Alexandrov

A spade and a bucket are traditional means of suppressing forest fires. Sometimes knapsack sprayers are used. But absence of roads in forests often creates certain difficulties in bringing more complicated equipment to the spot.

But even the most furious fire usually doesn't destroy all the trees in the pine wood and the scorched "old residents" become the source of seeds for the future forest restoration. This 40 year-old burned-out forest is quickly getting overgrown with young pine-trees.

Konstantin Kobyakov

Konstantin Kobyakov

During the fire periods rocks often act as refuges for plants. They give shelter to many herbs rarely found in other areas. Some of them can migrate back from rocks to forests over a certain post-fire period. The larger the cliff, the more species of plants can be found there. A common middle-Russia wild strawberry *(Fragaria vesca)* appears to be a plant of rocks in the Murmansk region.

The wild rosemary, or Labrador tea *(Ledum palustre)* – a peculiar dwarf shrub-"fire-worshipper" – can easily survive not great fires. Several years after the fire accident, areas clarified by flame often get thickly covered with bilberries. But for many plant species fire becomes a real tragedy – they disappear forever.

Konstantin Kobyakov

Why do Trees Decay?

Poor soil and cold climate is the reason why the Kola forests were little affected by slash-and-burn agriculture. Damage inflicted on forests until the end of the 19th century by shelterwood felling was also insignificant. That's why the Murmansk region can still boast of quite large intact woodlands. Patchy, diverse canopy, congregation of different-aged trees (including very old ones) on one spot and a lot of wood debris (dead wood) are the main features of such forests. At the same time timber doesn't disappear "in vain" – it is the most important component of the forest ecosystem. Standing or fallen dead trees become inhabited by bracket fungi, beetles, lichens and mosses. For most of them dead wood is the only source of food or home.

Bracket fungi are one of the key elements of the taiga ecosystems. Most visible are their fruiting bodies, forming large hoof-shaped burls on living and dead trees. But fruiting bodies of the most species are not as big and represent solid porous sponges on the underside of the fallen trunk, sometimes with caps, sometimes without. Mycelium of a fungus lives inside the trunk, gradually decomposing the wood and making it suitable for other organisms. Bracket fungi can vary in size, color and… smell. The shelf fungus is also a bracket fungus but its porous gill develops in the birch bark cracks.

The shelf fungus and very few other bracket fungi grow on living trees, usually on weakened ones. Most of them settle on already fallen trees. Moreover, each species needs a specific tree, diameter of the trunk (thin pole or a branch, medium or large log) and a certain state of wood (fresh, half-decayed, strongly decayed). Some species grow only on dead fruiting bodies of other bracket fungi.

According to estimations, 4-5 taiga species of trees provide home to about 100 species of bracket fungi with up to 1000 species of insects living on them (or on the wood they have decomposed). These insects, in their turn, are eaten by dozens of species of birds. And the birds become food for predators and parasites. All these species become very rare or even extinct in young and "commercial" forests devoid of dead wood. Decaying wood is the best substratum for the growth of young conifers. Completely decomposed by fungi and bacteria, the tree returns into the soil in the form of organic and mineral substances, improving life conditions of soil and terrestrial organisms.

Konstantin Kobyakov

Such bracket fungi as *Phellinus chrizoloma* are quite difficult to notice. Their fruiting bodies hide from precipitations, springing on the underside of the fallen tree, and it is possible to see them only if you peep under it.

Konstantin Kobyakov

A fallen tree creates a spot of light in a thick forest.
A glade is a good chance for young fir-trees to rise quicker and get what they have missed under the shade of big trees.

And this is the most common bracket fungus of our forests – *Fomes fomentarius,* which dwells on dead birches.
Its English name is a hoof fungus.

Konstantin Kobyakov

Forest as Resource

Conditions in which forests of the Murmansk region grow are very severe. Nowhere else in Russia conifer forests stretch so far to the North. As a source of timber they are not so attractive. The forest grows slowly here and only 150-200 year trees reach "technical ripeness", or, in other words, are ready to be cut down. Low, gnarly trees, often with fiber twisted around the core, however, have very solid structure, resistant to external influences. But this quality, highly valued in old times, isn't much in demand on the modern market. And what is important, the timber yield in such forests is very poor: one hectare of the Murmansk forest provides on average 3-4 times less timber than in the Middle Russia.

But the Kola forests have another one, incomparably more vital resource – their protective functions. Presence of a forest provides milder natural conditions, more suitable for the people's living than they would have been in treeless tundra. The forest abates winds, purifies water and regulates the flow of atmospheric precipitations.

However, large forest areas in the Murmansk region were affected by intensive felling that reached its peak in 1960-1970s. At that time millions of cubic meters of wood were annually cut, and what is more, the use of heavy tractors often caused soil erosion. Some of the old clearings are still covered with just sparse bushes of birch and no one knows whether forest will rise here again…

That's why at present most of the region's forests are classified as the forests of the Group I. This means that the main purpose of such forests is to fulfill water-protection, sanitary-hygienic, sanative and other functions, and the industrial timber-felling is prohibited there. Another part of forests belongs to the Group III designated for industrial purposes. Nowadays the scale of wood felling is comparatively small first of all because of poor timber reserves and exhaustion of economically available forests.

Apart from timber felling, there are other forms of forest exploitation connected with direct or indirect use of forest resources. For example, picnics, tourism, fishing, hunting, and gathering berries, mushrooms and lichens as well as reindeer grazing.

Konstantin Kolyakov

Gennady Alexandrov

Konstantin Kobyakov

In our days instead of a woodcutter's hand-work multipurpose machines are used. At one go they manage to saw down a tree, chop off its branches, cut it into parts of the required length and pile them on a truck. Productivity of such a combine is very high – in just one day it can clear the whole hectare of wood from trees...

Konstantin Kobyakov

Konstantin Kobyakov

Gennady Alexandrov

The wood sorrel *(Oxalis acetosella)* is a small gentle plant, sometimes called "hare's cabbage" for its nice sourish taste.
It's rare in the Murmansk region and can be found only in old spruce forests in the south of the region. It's listed in the region's Red Book.

Gennady Alexandrov

Gennady Alexandrov

Driftwood is a priceless gift of the northern rivers to all those who explored woodless banks of the Arctic seas. In the 20th century, when the forests were felled and logs were floated in great quantities, rivers brought especially much driftwood. In order to enable rafting timber down narrow rivers, numerous supporting dams were constructed.

In 1980s stream driving (by separate logs), which led to the most significant losses of wood, was prohibited. Later the floating method has gradually ceased to exist as most of riverside forests were logged. As a result there is now less driftwood on river banks and now its resources are replenished in a natural way

Driftwood buildings are a feature of the northern sea shores.
Huts where fishermen used to live for long periods of time and even to spend the winter were soundly built and called *stanovye*. At some distance more simple huts – *razvolochnye* – were set up.
Fishermen's huts on the White Sea were called *tonyas*.
This name has remained until the present days.

Gennady Alexandrov

Gennady Alexandrov

Gennady Alexandrov

Gryadas, Mochazhinas

The Murmansk region is the land of mountains, forests, lakes and…bogs. Though for most people bogs are rather unpleasant gnat-infested places, only suitable for gathering cloudberry and cranberry, they are a unique biosphere reserve. As peat deposits form, they fix carbonic acid. Excess of this gas in the atmosphere, the product of the fossil fuel incineration, leads to the greenhouse effect. Thus, peat formation in bogs is a natural counterbalance to the human activity. Bogs in the sources of rivers and brooks preserve and purify water; they are a refuge for rare plants and a home for many animals.

There is a great variety of bogs. In terms of hydromineral nutrition they are divided into three main groups: low (eutroph), high (oligotroph) and intermediate (mezotroph). In the Murmansk region all the kinds of bogs can be found.

Low bogs are situated in river valleys, lowlands and on lower parts of relief with the close stand of ground waters. Vegetation of such bogs is mainly represented by high sedges with admixture gramineous plants and motley grass. Green mosses, shrubs and trees (alder, willow, birch etc) can be also found there.

High bogs are mostly situated at watersheds. Unlike low bogs fed by subterranean waters they moisten mainly through atmospheric precipitations. High bogs are characterized by prevalence of sphagnum mosses. Along with green and sphagnum mosses, there also grow cotton-grasses, sedges, and dwarf-birch. Besides, these bogs are rich in cranberry and cloudberry. Dwarf, slow-growing pine trees with picturesque spider-like crown are rather common here. Intermediate bogs take middle position between low and high bogs.

Hummock-ridge and lakelet-ridge bogs are also widespread in the Murmansk region. On relatively dry *gryadas* (rus. for ridges), stretched perpendicular to the surface slope (direction of the flow), plant species typical for high bogs grow, and the space between these ridges – *mochazhinas* (rus. for depressions) – is preferred by low-bog species. But on the most wet (heavily watered) hollows only dark hypnum mosses or liquid peat can be seen. There may be lakelets in some hollows.

In the tundra hilly bogs can be found. Knolls of exposed peat appear in the result of permafrost soil buckling.

In June, which here corresponds to the biological spring, voices of wood sandpipers, green-shanks, whimbrels, golden plovers, bustling around their nests, can be heard on many bogs.

On an old pine-tree, on the edge of a bog, preferably “with a view on the lake” a fish-hawk, or osprey, *(Pandion haliaetus)* nests.
As a rule, the nest is perennial and quite sizeable: from one and a half to two meters high and wide.
The osprey feeds on fish, on which he swoops from above, snatching it from the water with his sharp claws.

Sergey Ganusevich

Gennady Alexandrov

Tussock (hare's-tail) cotton-grass *Eriophorum vaginatum* in blossom

Gennady Alexandrov

Tussock (hare's-tail) cotton-grass *Eriophorum vaginatum* in blossom

Gennady Alexandrov

Many-spikelet cotton-grass *Eriophorum polystachion* with fruit

Sedges, Cotton-grasses, Bulrushes

Most northerners are familiar with the cotton-grass, a peculiar symbol of our bogs and tundras. But not everyone knows how do these plants blossom. Their snow-white pappuses are often mistaken for flowers, but in fact they are the cotton-grass fruits. As to blossoming, it comes very early, often when there is still snow, and so cotton grasses take the role of the northern first spring flowers. In the beginning of blossoming their spikelets are ash-grey due to upper paleas, then, as stigmas peep out, they become silvery and several days later they turn golden, as stamens replace faded stigmas.

In total there are about ten species of the cotton-grasses in the region's flora. The most common among them are the tussock (hare's-tail) cotton-grass *(Eriophorum vaginatum)* and the many-spikelet cotton-grass *(E. polystachion)*. The picture of the former was taken during its blooming season in May, the latter (with fruit) – in July.

The Arctic (Scheuchzer's) cotton-grass *(E. shcheuchzeri)* has very neat ball-shaped heads and the reddish (Russian bog) cotton-grass *(E. russeolum)*, unlike other cotton-grasses, has pappuses of a delicate yellowish-brown tint.

Gennady Alexandrov

Arctic (Scheuchzer's) cotton-grass *Eriophorum scheuchzeri*

Konstantin Kobyakov

Reddish (Russian bog) cotton-grass *Eriophorum russeolum*

Konstantin Kobyakov

Reddish (Russian bog) cotton-grass *Eriophorum russeolum*

Gennady Alexandrov

Deer-grass *Baeothryon caespitosum* in blossom

Gennady Alexandrov

Alpine bulrush *Baeothryon alpinum* with fruit

Bulrushes *(Baeothryon spp.)* are close relatives of cotton-grasses and their neighbors in bogs and tundras. Their pappuses are smaller but no less elegant; they are sensitive to even a faint whiff. There are two species of bulrushes in the region.

Sedges, the richest genus of the northern flora, can be found everywhere – from bogs to cliffs. It counts about seventy species but not many northerners know them by their look.

Sedge flowers are unisexual, gathered into pistillate and staminate, sometimes mixed, spikelets. Usually spikelets are separate, as it is seen on the pictures of blossoming sedges – *Carex caespitosa, C. flava, C. irrigua*. As far as the fruits are set, staminate spikelets quickly wither and fall off.

Pistillate flowers are additionally enclosed in urceolate (jug-like) sacs, developing together with the fruit. In case of the yellow sedge *(Carex flava)* they can be clearly seen in the very beginning of blossom. The sacs are formed with a modified bractal leaf and play an important protective role, hiding ovary and fruit.

Gennady Alexandrov

Sod sedge *Carex caespitosa*

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Yellow sedge *Carex flava*

Gennady Alexandrov

Morass sedge *Carex irrigua* in blossom

Gennady Alexandrov

Morass sedge Carex *irrigua* with fruit

Gennady Alexandrov

Cloudberry *Rubus chamaemorus*, female plant

Gennady Alexandrov

Cloudberry *Rubus chamaemorus*, male plant

Cloudberry's blossom is often exuberant, though a carpet of flowers doesn't necessarily turn into a carpet of berries. But often such a poor harvest is not the weather's fault, as the northerners habitually think. The true reason is that cloudberry is a dioecious plant.

Unlike our other berry dwarf shrubs, its flowers can be either pistillate, only with ovary, or staminate with just stamens. Moreover, male plants producing only staminate flowers are often more numerous, and it's their abundance that creates the illusion of a rich future crop. Male flowers are bigger, usually with four petals, female ones are smaller and pentapetalous.

Gennady Alexandrov

Sergey Konyaev

Gennady Alexandrov

In the Khibiny and other mountains of the Kola Peninsula patches of emerald-green moss, or “hanging bogs”, can be seen on slopes with running water.

Konstantin Kobyakov

Lakes: Cool and a Bit Warmer

There is a great variety of lakes in the Murmansk region – from small forest lakelets (*lambines*) to the vast Imandra indented with bays and Umbozero, up to 115 meters deep.

As a rule, small lakes represent a glacier-dug hole originally filled with the glacier's waters, and the large ones appeared as tectonic rifts in the earth's crust. Some lakes are man-made. Each of hydroelectric power plants located on rivers Paz, Tuloma, Niva, Kovda, Voronja, Teriberka has a water-reservoir for the flow regulation.

Lake water is pure and transparent, so it doesn't need to be boiled before drinking. Because of a cold climate there is almost no organic in the water, that's why most lakes are oligotroph, little nutritious and never "blossom".

Another peculiarity of our lakes is that, apart from pike, perch, purbot, poach, typical for the central regions; there live

Gennady Alexandrov

In June the period of the trees' "anthesis" begins. "Candles" appear on pines and fir-trees while birches put on their catkins.
The pollen is emitted in such an abundance (especially by coniferous trees) that the surface of lakes, river creeks and even sea gets interspersed with a bright yellow powder often mistaken for the traces of industrial pollution.

Gennady Alexandrov

many specific northern species such as white-fish, brown trout, and Arctic char. It is only in the severe northern climatic conditions that they can successfully stand competition with the “southern” fishes – this is why the cool water of our lakes is so vital for them.

In this context there exists such a notion as “thermal pollution”, caused by some industrial objects. For instance, warming-up of the Babinskaya Imandra by the waters of the external coolant circuit of the Kola nuclear power plant for just several degrees leads to ousting of the cold-loving northern fishes by less valuable species in this part of the lake.

Vladimir Kuznetsov

Gennady Alexandrov

Water buttercup *Batrachium peltatum*

Batrachiums, or water buttercups, grow in lakes and rivers. Rising from a depth of several meters, they sometimes frighten boatmen with the illusion of a shoal.

Konstantin Kobyakov

Mikhail Borisenko

Konstantin Kobyakov

Reed *Phragmites communis*

Small lakes – *lambines* – are secluded places where duck broods feel safe and swans are frequent. What makes the lakelets especially charming are growths of reed, the most “emotional plant in the world”, sensitively responding to all changes in the life of the lake. “Listening to the reed means listening to the eternity”.

Ryurik Chernyakin

Red-necked phalarope *Phalaropus lobatus*

Phalaropes differ from other sandpipers by appearance, behavior and lifestyle. First, females are colored brighter than males and more active in courting. Secondly, it's males that hatch eggs. Thirdly, these little sandpipers spend almost all their life on the water, be it a lakelet or puddle in tundra, or even an open ocean, where the birds usually winter.

Ryurik Chernyakin

Grey goose *Anser anser*

Grey geese resemble bean geese but are found more seldom. Only several couples are currently nesting in the region. The species is listed in the region' Red Book.

Rivers

The Murmansk region is also rich in rivers – from torrential mountain streams to the peaceful and majestic plain rivers. The largest are Ponoy, Tuloma, Niva, Paz, Varzuga. For lowland rivers moderate speed of current is typical. Vast lake-like widenings and stretches alternate with rapids where the current becomes stronger. Big falls, or *paduns*, as locals call them, are often attached to such places. The most large and beautiful paduns are situated on rivers Kutsa, Chapoma, Chavanga, Strelna, Pulonga, Shuonijoki, Titovka. Swamp waters very little contribute to the mountain rivers feeding, which is the reason for such an incredible purity of these rivers. The main source of nutrition for rivers of the Kola Peninsula is melted snow.

The rivers of the Kola Peninsula are abundant with fish. One of the most valuable and famous fishes of the North, salmon, swims into them from the sea. It used to be the main wealth of the Kola Peninsula before the discovery of minerals. Livelihoods of the Pomor villages depended on salmon trade. In small rivers a couple of graylings is frisking on every rift. The trout is also common here.

Gennady Alexandrov

Mikhail Borisenko

Gennady Alexandrov

Sergey Konyaev

Water from the northern rivers and lakes can be drunk without preliminary boiling because the low temperatures impede development of pathogenic organisms. The clearest waters are to be found in highland snow-fed lakes and rivers. Despite their reddish tint, swamp waters are also fit for drinking due to bactericidal properties of the sphagnum moss.

Ivan Vdovin

Vincha, a torrential river in the south of the region near the border with Karelia, was formerly a floatable river. Rapids-*paduns* on such rivers used to be a real headache for timber-floaters.

Gennady Alexandrov

Maika is a small river in the northern part of the Rybachy Peninsula. Its width in the mouth doesn't exceed five meters. But the waterfall on it looks quite impressive.

Gennady Alexandrov

Salmon, brown trout and pink salmon, or humpback salmon, are able to ascend rapids and waterfalls on their way to spawning areas. But their passage isn't always successful. Sometimes the fish gets thrown out of the stream and bumps into stones, and the stunned poor thing slides down into the cove under the fall where it comes to its senses before a new try.

The Big Rapid (or Log Rapid) on the Ponoy river. Seagulls' hunt on impetuous rifts is often more successful than on a tranquil water. The great black-backed gull *(Larus marinus)* is looking for its prey.
Seals arrive here from the sea for fishing, and it seems that a 20 kilometer-long way doesn't confuse them at all!

Konstantin Kobyakov

Konstantin Kobyakov

Civilized Tourism in the Wild Nature

Beauty and diversity of an almost untouched nature, many places of interest and proximity to the country's central regions makes the Murmansk region attractive to lots of tourists. It has become especially noticeable in the recent years when many traditional tourist sites became unavailable for the travelers for various reasons. Skiing, mountaineering, hiking and boating are most popular in the region.

Routes in the Khibin and Lovosero mountains are very well known. Each year thousands of skiers travel here to admire the unique polar nature and gain skills of surviving in extreme conditions. More and more visitors are getting engaged in such new forms of sport and relaxation as flying on paraplanes, kiting (sliding after the kite across frozen lakes and snow-clad tundras), freeride (off-track mountain skiing and snowboarding). Sightseeing trips to the tundra (in summer – on jeeps and quadrocycles, in winter – on snowmobiles) also become popular.

The Murmansk region with its rich natural diversity also has good prospects for the educational tourism: bird- and animal- watching, botanical and mineralogical excursions, ethnographic expeditions (acquaintance with the culture of the indigenous peoples).

In those areas where the truly wild nature has remained it would be more reasonable to develop tourist business than to carry out devastating industrial management and thus destroy the unique recreational resource whose value will only increase with the time.

Sergey Konyaev

Sergey Konyaev

But unfortunately the uncontrolled tourism also represents a risk for the environmental sustainability. Large animals are the first to abandon territories disturbed by visitors, then rare plant species extinct in the result of trampling, and so on. That's why the tourist zones should be adjoined by specially protected areas in which the most vulnerable flora and fauna species could find a refuge.

National parks where resorts border with protected areas – that's a wise solution. At the same time, special rules regulating human influence are necessary in such public zones: for example, setting a camp only in specially arranged places, centralized accumulation and transportation of garbage. Tourist companies responsible for this or that territory must exert control over the site. Very often socially active tourists take this responsibility voluntarily upon themselves.

Only appropriate efforts in developing tourism and nature conservation can change the world image of the Murmansk region as the region famous for its large-scale industrial pollution and nuclear submarines. Our land, first of all, deserves attention as a region of the unique wild nature and rich cultural heritage, extremely interesting for travelers and very diverse.

Konstantin Kobyakov

Despite the Khibins' relatively moderate height, there are routes of high complexity classes, so the development of mountaineering has brilliant prospects here.

The Khibins' routes are represented in the general catalogue of Russia's mountaineering routes.

Konstantin Kobyakov

Gennady Alexandrov

Konstantin Kobyakov

Boating is one of the earliest trends in the sports tourism on the Kola Peninsula. Popular river routs for canoes, catamarans and rafts were actively explored as early as in the 60-s of the 20th century.

Sergey Konyaev

Backcountry – climbing mountains on foot and sliding down on skis or a snowboard – is a good way to explore lots of interesting sites.
Those who choose a standard alpine skiing complex miss such an exciting opportunity.

Sergey Konyaev

Flights over the mountains on paraplanes are especially popular in the Khibins.

Kiters (those who slide after a kite) can develop big speeds and perform high jumps. One can follow a kite on skis, snowboard or in special sledges.

Mikhail Ryzhov

Sergey Konyaev

Freeride (off-track descending on skis or snowboards) and ice-climbing are gaining wide popularity in the Murmansk region.

Sergey Konyaev

Nature Reserves, National Parks…

Wildlife conservation is one of the most efficient measures of supporting the environmental sustainability. According to ecologists, the vulnerability of the northern environment demands to limit the industrial activity on 80-90% of the region's territory.

Specially protected natural areas occupy 8,1% of the Murmansk region. At different times three nature reserves – Laplandsky, Kandalakshsky, Pasvik – as well as 10 partial reserves and 47 nature sanctuaries were established.

In the city of Kirovsk there is one of the world's northernmost botanic gardens – the Polar-alpine botanic garden-institute, which has its own small wildlife area in the Khibiny.

The Murmansk region hasn't got a single national park yet. It is planned to establish a national park on river Kutsa, in the South-West of the region where there once used to be the first Finnish reserve. Another national park is supposed to be created in the Khibiny.

Gennady Kataev

Sergey Shestakov

Alex Gilyazov

The Laplandsky nature reserve, the oldest and the largest in the region, was created in 1930 for the preservation of a wild reindeer.
At present not only reindeers but the whole natural complex of the northern taiga is being protected there.

Gennadiy Alexandrov

Sergey Shestakov

Besides, the Laplandsky nature reserve is the homeland of the Russian Father Frost. Incidentally, the Korvatunturi Mountain, where the Finnish Santa Klaus resides, is not so far from here – just 40 kilometers away.

2

Organisms

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Plants - hunters

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Andrey Rogalev

Rock ptarmigan *Lagopus mutus*

How Is It to Live in the North?

The image of the Kola nature, its stability and protective ecological properties are created, first of all, by various organisms – from huge trees to microscopic bacteria.

Cold climatic conditions often make plants and animals change their appearance. The further to the north, the lower are trees; some of them develop creeping shape. Just the same happens to herbaceous plants. The northern representatives of the same biological species are much smaller in size than their southern relatives.

Warm-blooded animals inside some genera and among populations of one and the same species

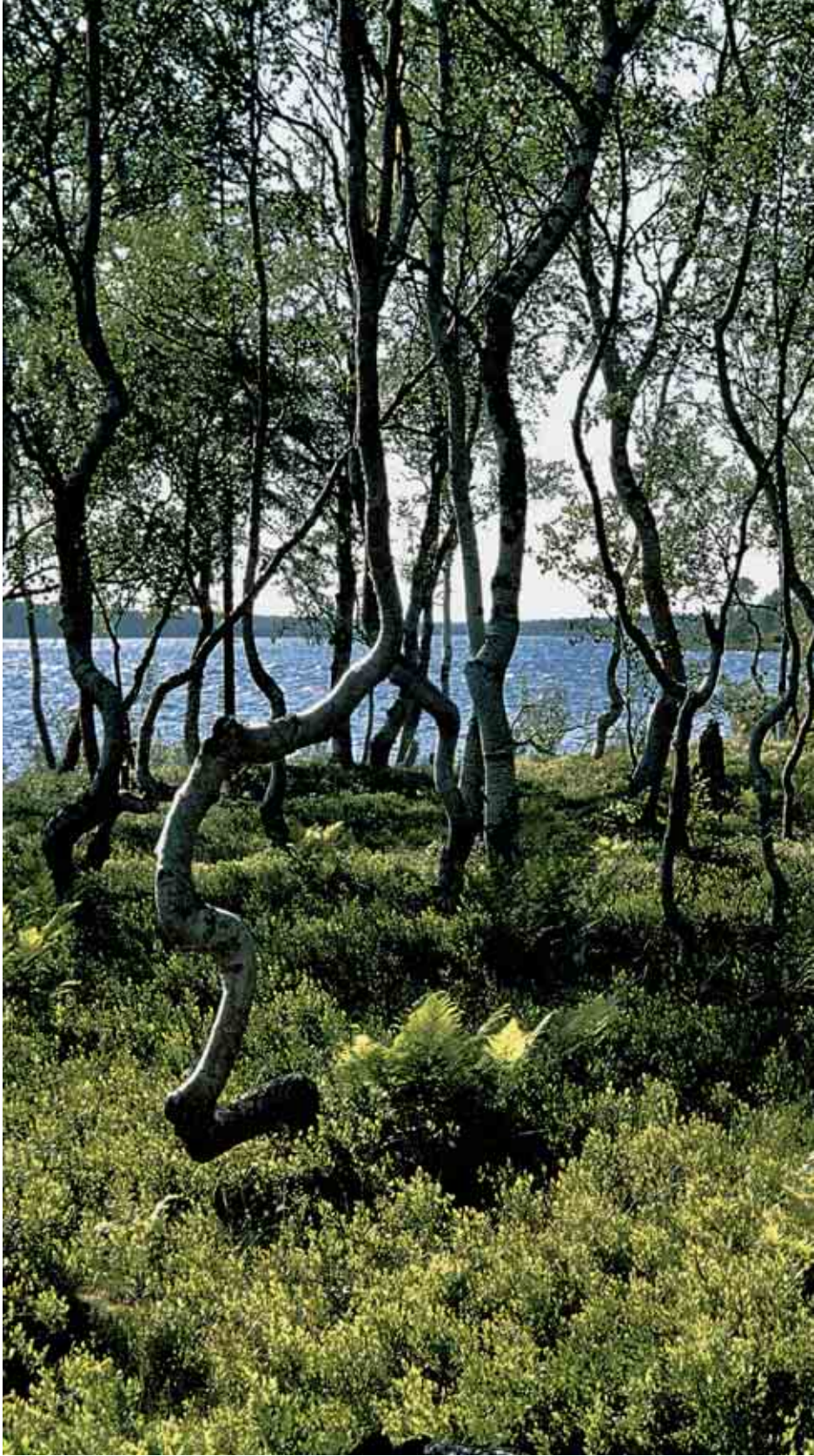
demonstrate inverse dependence: the colder the climate, the larger they are. For example, the polar bear *(Ursus maritimus)* sometimes paying a visit to us from the Arctic ices is the largest of all the bear species. Boreal wolves (so-called tundra or polar wolves) are larger than their wood congeners.

It is explained by the fact that animals with greater mass of body are better adapted to the cold climate: their surface area-to-mass ratio is less than that of smaller animals.

There are some other large warm-blooded animals living in the North and feeling themselves comfortable during the entire polar night period – seals, elks, reindeers, gluttons.

Gennady Alexandrov

Harp seal *Pagophilus groenlandicus*



Gennady Alexandrov

"Dancing birches" is a typical scenery of the Kola forest-tundra.
But what makes these birches dance?
It's because winds and frosts damage their top buds, and so their trunks continue to grow from lateral buds, making curves.

Igor Ryabkov

Who Is the Largest?

In autumn it's difficult not to notice bright yellow spots of round-leaved trees on the mountains. All the trees inside such "group" come from underground sprouts of one and only tree grown from a seed, and, actually, represent a single organism. Aspen-grove is the largest "organism" of the Kola nature.

Soil microorganisms outnumber all other organisms by the quantity of species. A unique role in boreal soils belongs to mushrooms. Various groups of fungi, including microscopic ones, decompose organic substances of soil, fallen leaves, wood, making them available for other organisms again. The "mushrooms" we usually gather are fruiting bodies whose function is only spore discharging. And the main part of a mushroom is mycelium located in the ground.

What Is the Number of Fungi?

About 80 percent of all vascular plants, including, practically, all kinds of trees, exist in symbiosis with this or that kind of fungi, forming a mycorhiza. Filaments of a fungus, mycelium, braid roots of plants, helping the latter to assimilate mineral matter from soil, especially phosphorus.

Some plants can manage without mycorhiza only if they are well supplied with necessary elements. But, as a rule, it has nothing to do with plants growing in the northern conditions characterized by insufficient mineral nutrition. Direct transportation of phosphorus through mycorhiza to the roots of plants is proved experimentally. In their turn, plants supply symbiotic fungi with carbohydrates.

Close relations between plants and fungi determine the species number of the latter in this or that locality. At present, over 500 species of mushrooms are described in the Murmansk region. In areas with moderate climate the number of mushroom species is approximately seven times more than the number of plant species. With about 800 species of vascular plants in the Murmansk region, it can be suggested that the potential number of mushroom species is at least 5,000.

Gennady Alexandrov

Conic morel *Morshella conica*

The fruiting bodies of some fungi have peculiar shape and color. Often it's difficult to explain biological reason for such a bright appearance.

Gennady Alexandrov

Tiger's eye *Coltricia perennis*

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Eyelash fungus *Scutellinia scutellata*

Gennady Alexandrov

Orange peel *Aleuria aurantia*

Konstantin Kobyakov

Strap-shaped coral *Clavariadelphus ligula*

Gennady Alexandrov

Beefsteak mushroom *Gyromitra esculenta*

Gennady Alexandrov

Gem-studded puffball, or devil's snuff-box *Lycoperdon perlatum*

In the Murmansk region, abundant in mushrooms, people often neglect many species which are edible and even popular in other regions. Among them are saddle fungi and morels opening the season of "silent hunting"; puff-balls, champions in weight among mushrooms; honey agarics, the most amicable wood mushrooms. Research on the cultivation of the conic morel *(Morshella conica)* by the example of agaric cultivation is carried out in some countries. In 1983 a mycelium of conic morel was first cultivated.

Konstantin Kobyakov

Sheathed wood-tuft *Kuehneromices mutabilis*

Gennady Alexandrov

Fly agaric *Amanita muscaria*

What Is the Number of Plants?

Unlike fungi, flowering plants, as well as horsetails, earth mosses, ferns and conifers, making up the group of vascular plants on the whole, have been studied quite profoundly in the Murmansk region. Taking no account of adventive and cultivated plants, there exist 882 species.

But if we take into consideration adventitious plants brought in intentionally or accidentally from other areas their number will make up 1,162. This figure can significantly increase with the appearance of new alien species.

Local bryophyte composition (mosses, liverworts) is insufficiently studied yet. About 600 species of bryophytes are found in the region.

Gennady Alexandrov

Flowers of wood-rushes, or field-rushes, *(Luzula spp.)* are pollinated by wind but look no less attractive than flowers of insect-pollinated plants.

Pods of mosses of genus *Splachnum* have wide collarets, which makes them similar to Chinese umbrellas. The collarets are often brightly colored and smell, attracting insects which facilitate distribution of spores. It is interesting that this genus uses as a substrate exclusively excrements of large mammals (elk, bear).

Yellow splachnum *Splachnum luteum*

Gennady Alexandrov

Of all the monocotyledonous flowering plants, the Orchid family *(Orchidaceae)* is considered to be the most developed one; and of all the dicotyledonous plants – the Composite family *(Asteraceae).* In the Murmansk region there are 15 species of the orchids and over 50 species of the composites.

Gennady Alexandrov

Fairy slipper *Calypso bulbosa*

The fairy slipper, or calypso, *(Calypso bulbosa)* is an early June orchid. After blooming its single leaf can be noticed only occasionally.
Like many composites, the sow-thistle *(Sonchus arvensis)* is the plant of the late summer and even autumn. Its inflorescences flash along the sea shores in August-September.

Sow-thistle *Sonchus arvensis*

Gennady Alexandrov

Gennady Alexandrov

Alternate-leaved golden saxifrage *Chrysosplenium alternifolium*

Golden saxifrages (genus *Chrysosplenium*) are amusing plants which have lost corollas but claim for insect pollination.
They are noticeable owing to bractal leaves, which are slightly more yellow than the stem ones.
Besides, avoiding competition with other plants, golden saxifrages often grow separately in uncomfortable places, near peat pits and silted pools, standing out against their dark background like lighthouses.

Gennady Alexandrov

Kemsky meadow-rue *Thalictrum kemense*

There are five meadow-rues of genus *Thalictrum* in the region's flora.
Some species are very similar to each other; the others differ so much that their relationship can hardly be identified.
For instance, the tiny alpine meadow-rue *(Thalictrum alpinum)* is just 10-15 cm high, while the Kemsky meadow-rue *(Th.kemense)* grows up to one meter and even higher.
Artless flowers are common for the entire genus. They lose their perianths very early but preserve their charming simplicity.

Gennady Alexandrov

Heather, ling *Calluna vulgaris*

Flowering of the common heather *(Calluna vulgaris)* is beautiful and sad at the same time because it betokens the quick approach of the northern autumn.
However, this lovely dwarf shrub doesn't hurry. Its amethystine bells sparkle in our forests for almost the whole August.

Our rushes *(Juncus spp.)* and wood-rushes *(Luzula spp.)* of the *Juncaceae* family are “cinderellas” among the plants.
They can cover a moist wasteland, a damp ravine or a shapeless quarry with a delicate carpet, but in our perception they still remain nondescript grass.
Even a rush in blossom might be overlooked, although during this period it changes magically.
The matter is that the flowering period of some wind-pollinated plants is extremely short. Botanists call such a phenomena “explosive” flowering, when suddenly and impetuously, as if with a wave of a magic wand, all plants in the area burst into blossom.
Rushes prepare for blossoming in the evening, exposing stigmata out of their buds, and the next morning all the flowers open simultaneously, dispersing pollen for just two or three hours.

Gennady Alexandrov

Salt-meadow rush, salt-marsh rush, black-grass *Juncus gerardii*

There is something Greek in the strict architecture of flowers of the northern grass of Parnassus, or bog star, *(Parnassia palustris)* and the plant’s Latin name – “parnassia” – derives from a well-known mountain in Greece, where, according to ancient legends, muses and Apollo lived.
Amber “lyres” inside the bog star flower are modified stamens – staminodes – a sort of “theatrical scenery” for insects.
The true stamens have the color of white marble. In a juvenile flower they grow close to each other and hide the ovary.
Each day, strictly in turn, one of the stamens separates from the ovary, and one may tell the flower’s age by the number of deflected stamens.

Gennady Alexandrov

Bog star, northern grass-of-Parnassus *Parnassia palustris*

Konstantin Kobyakov

Quillworts (*Isoetes spp.*) are a very ancient group of the *Lycopodiophyta* division, close relatives of huge lepidodendrons which formed the planet's carboniferous forests in the Paleozoic era. The present-day quillworts are very sensitive to the purity of water in lakes where they live. Probably, this is the reason why they have almost completely disappeared in Europe and middle Russia but are rather common in the Murmansk region.

Lake quillwort *Isoetes lacustris*

The ostrich fern *(Matteuccia struthiopteris)* is the largest fern in the region. Its vegetative leaves, the green ones, can reach one meter and a half in height, and the spore-bearing leaves are much lower and have a brown color. They often remain upstanding in winter and can be easily noticed in spring long before new leaves appear.

Gennady Alexandrov

Ostrich fern *Matteuccia struthiopteris*

Christmas green, northern running pine, ground cedar *Diphasiastrum complanatum*

Gennady Alexandrov

The northern running pine, or Christmas green, or ground cedar, *(Diphasiastrum complanatum)* is another ancient spore plant of *Lycopodiophyta* division. It's usually found in pine forests of the Murmansk region but in many European countries it's included in the Red Books.

Konstantin Kobyakov

The aconite, or wolf's bane, or monk's hood, (*Aconitum septentrionale)* is the largest herbaceous plant of the Murmansk region, very attractive but rather poisonous. People with sensitive skin shouldn't touch its leaves to avoid getting stung.

Plants-hunters

There are a few species of insectivorous plants in the Murmansk region: two species of sundews (genus *Drosera*), three species of butterworts *(Pinguicula*) and three species of bladderworts (*Urticularia*). They all grow in habitats poor in available nitrogen, phosphorus and other biogens, covering their deficit by animal food. But what concerns the basic organic matter, they produce it on their own, through photosynthesis.

Sundews *(Drosera spp.)* catch their prey with special glandules secreting sticky honey-like droplets. When an insect attracted by "honey" sticks to these droplets, the leaf curves in such a manner that the victim gets completely covered with a dissolving fluid.

Feeding process of butterworts *(Pinguicula spp.)* is much simpler. Surface of their leaves is sticky, fully covered with tiny glandules, some of which secrete sugar to attract insects while the others secrete digestive enzymes. For small insects it's just enough to get stuck to the leaves. But in order to digest a larger prey leaves may convolve a little.

Gennady Alexandrov

Alpine butterwort *Pinguicula alpina*

Gennady Alexandrov

Flat-leaved bladderwort *Urticularia intrermedia* (flower)

Gennady Alexandrov

Common butterwort *Pinguicula vulgaris*

Gennady Alexandrov

Round-leaved sundew *Drosera roundiflora*

Bladderworts *(Urticularia spp.)* are aquatic plants. Their leaves are divided into thin filiform segments among which special transparent bladders for catching small invertebrates are hidden. They are hollow, with sensitive bristles, which, if disturbed, give a signal to open the trap. Having been caught on them, a luckless daphnia is pulled into the bubble with a stream of water.

All the insectivorous plants blossom, and their flowers are pollinated by insects. But these visitors are always set free.

Sundews blossom very interestingly: their flowers remain opened strictly until the midday. Why not longer is a mystery.

Bladderworts *(Urticularia spp.)* blossom very seldom as if they don't expect any favor on the part of those whose larvae they hunt under water. They propagate vegetatively, as a rule. In the late summer thick green pellets can be easily noticed on their leaves' ends: they are wintering buds, giving birth to new plants in spring.

Gennady Alexandrov

English sundew *Drosera anglica*

Gennady Alexandrov

Here we see upper floating leaves of *Urticularia intermedia* with wintering buds on their ends. One small bud is enough to cover the whole marsh with emerald strands. Trapping bladders of this species are located on lower leaves, which are vertically standing apart, and can't be noticed from above.

Gennady Alexandrov

Peppered rock-shield *Xanthoparmelia conspersa*

Gennady Alexandrov

Red pixie cup *Cladonia coccifera*

Gennady Alexandrov

White-worm lichen *Tamnolia vermicularis*

Gennady Alexandrov

Elegant sun-burst lichen *Xantoria elegans*

The Most Robust…

Mycelium of a mushroom is one of the two basic parts of the major group of the northern organisms – lichens. In lichen a fungus exists in symbiosis with a unicellular alga, their symbiotic relations last “for life” and don’t depend on such conditions as the presence of the fungus’ spores during mycorhiza formation. Being able to take moisture and mineral matter from the atmosphere and to produce organic matter on their own by photosynthesis, lichens, perhaps, are least of all dependent on substratum. They can grow anywhere – on bare cliffs, poor or mineral soils, branches of dry or alive trees. That is why they thrive in severe northern conditions. To be more exact, in the North lichens do not compete with other plants which grow quicker but need better conditions. Lichens themselves grow very slowly but the time is on their side.

Thus, about 970 lichen species of the world’s 20 000 species of this group have been discovered in the Murmansk region. Five percent of the planet’s lichen flora is not so little. To compare: there are 250 000 vascular plants in the world, while we have less then a thousand of them. In many plant communities such as lichen pineries, lichen and moss-lichen tundras, rocky alpine tundras, lichens are the basic components of the plant cover.

... and the Most Fragile

Lichens are sensitive indicators of the environmental pollution. In the environs of cities and industrial enterprises specific composition of lichens is much poorer – just a few most resistant species can be found there, and even these are not numerous and, as a rule, their state is far from satisfactory.

It is generally known that in the Far North the reindeer moss lichens are used as forage plants for reindeers. Vast forest and tundra territories of the Murmansk region are covered with forage lichens. Interestingly, reindeers prefer multiply-used pastures to “virgin” thick carpets of a reindeer moss. When herds are numerous and natural migrations are hampered, the lichen cover is easily spoiled: reindeers not so much eat it, as trample it down – after all, reindeer moss crumples easily in dry weather.

Reindeer moss grounds in Scandinavia suffer from overgrazing. Fortunately, only small areas in the North-West of the Murmansk region were affected by this phenomenon.

Konstantin Kobyakov

Trees' "Beards"

In pristine forests trunks and branches of trees are covered with "beards" of lichens. Contrary to a common belief, lichens don't damage trees, only using them as a comfortable habitat. They take moisture and a few necessary mineral substances from the atmosphere.

Big "beards" such as greenish-brown *Bryoria fremontii* take a long time to grow until the beginning of propagation – that's why they need old trees and a virgin forest.

Does Fish Really Look for Warmer Waters?

Productivity of the Arctic seas, including seas washing the Kola Peninsula, is higher than productivity of land because the marine environment is more stable and less prone to seasonal fluctuations. Winter life of marine communities is also active. Productivity of the Barents Sea is especially high. Due to a warm current it almost never freezes and the plankton does its work all the year round, being the basic unit for the marine ecosystems' food chains. The more plankton there is, the richer is the sea in fish, the more sea beasts and birds we can find there.

Many sea birds can spend almost all the time in the open sea but always nest on the land. Dozens and hundreds of thousands of kittiwakes, murres, guillemots and other birds gather in rookeries where their eggs nestle side by side on cliff ledges. Most bird rookeries of the Barents Sea are situated on archipelagoes Gavrilovsky and Seven Islands which are part of the Kandalaksha nature reserve.

In spite of sea birds' diversity, the whole number of species decreases to the North. This rule, though, has exceptions. For example, the further North the bigger is the variety of species within some families of sea birds and sandpipers. The same happens to willows. Research suggests that diversity and population density of birds inhabiting upper swamps becomes richer as it gets closer to the North.

Ryurik Chernyakin

Landscapes of the protected Ainovy Islands in the Western Murman are not especially impressive.
Even in summer, the most cheerful season, their leitmotif is monotony and dreamy sadness.
But the birdlife is in full swing during these months.

Ryurik Chemyakin

Atlantic puffin *Fratercula arctica*

In 1980s birds of the Barents Sea suffered food shortage.
At that time resources of herring, capelin, Arctic cod, sand lances were seriously undermined by over-catching.
Restricting quotas and a long-term ban on fishing changed the situation for the better.
Today Atlantic puffins enjoy successful fishing, as a rule.

Positive changes were also noticed in the life of shags during the last two decades. There has become plenty of them in the Murman.

Ryurik Chernyakin

Shag *Phalacrocorax aristotelis*

Atlantic puffins spending almost the whole life in the open sea
and at the same time digging holes in the ground during the nesting period have body shape that meets these controversial demands.
To fly up from a flat surface they have to get to some elevated site and start off against the wind.

Ryurik Chernyakin

Ryurik Chernyakin

Arctic terns *(Sterna paradisae)* are record-breakers in flight distances among birds.
Nesting in the Arctic, wintering in the Antarctic, in spring they return later than others and when it is time to leave they are among the first to go.
Why they don't choose nearer places to winter is a mystery.

Ryurik Chernyakin

According to A.N. Formozov, the drake of the common eider *(Somateria mollissima)* is a very beautiful bird, in whose plumage "all the colors of the faraway North are blended:
whiteness of the tundra's snows... deep blackness of coastal cliffs... greenish tint of ice... rosy-yellow glow of a dawn".
On the opposite, female eiders wear more modest dress which helps them remain unnoticed as they sit tightly on their nests.
But during the breeding season their colorful partners follow them everywhere so persistently that often reveal their secret nesting place.
However, when the last egg is laid, males say good-bye to their "wives", becoming "free men" again. In such periods couples, who haven't nested yet, sometimes literally suffer from flocks of admirers, these new-sprung bachelors.
Imagine feelings of the "legal husband" hourly and daily forced to drive away bothersome contenders.
And sometimes their number reaches ten individuals and even more.

Ryurik Chernyakin

Man-made Changes

The man not only changes his environment, creating an artificial urban world. He also changes the composition of flora and fauna. These changes are often planned, but more usually they are a side effect of the human activity.

For the last hundred years the fauna of the Murmansk region has been supplemented with new species, never registered here before. Among them are American mink, muskrat, Kamchatka crab, or king crab, humpback salmon, or *gorbuscha*, which were specially brought here for further commercial use.

Significant changes also occurred in the fauna of birds. According to Academician Fedor Pleske, in the end of the nineteenth century 166 bird species inhabited our country, 125 of them nested. Now the list of birds includes 270 species, of which 178 nest.

Of course, we can assume that some species just haven't been recorded at that time, but, anyway, changes in the ornitofauna are colossal. Birds which follow the man – swallow, sparrow, starling, pigeon – have become common nowadays. Ortolan bunting *(Emberiza hortulana)*, lapwing *(Vanellus vanellus)*, common rosefinch *(Carpodacus erythrinus)*, never seen before on the Kola Peninsula, appeared.

The status of numerous representatives of the animal world has been changed by the human presence. For example, the eider, almost extinct in the end of 1920s, has become a common species, the elk, rare in the 19th century, is now a commercial object. On the contrary, formerly frequent otter is now included the Red book. The same unfortunately happened to gyrfalcon, peregrine falcon, and wolverine.

Ryurik Chernyakin

The peregrin falcon *(Falco peregrinus)* is a large beautiful falcon with typical "whiskers".
It feeds on birds, catching them exceptionally in the air.
While swooping on the victim, it can develop speed to 100 meters per second.
The peregrin never hunts within its nesting area, enabling other birds to settle nearby and taking them under its unintentional protection.

Ivan Vdovin

Nestlings of a peregrine falcon, growing without any nest on bare cliff ledges, in no way make an impression of harmless creatures. They hiss at uninvited guests and can inflict painful wounds by a sharp beak.

Sergey Ganusevich

Ivan Vdovin

The white-tailed eagle *(Haliaeetus albicilla)* is a very large bird. Every year it builds on its already huge nest which is usually placed on high lonely trees. Sometimes these nests reach the height of two meters and even may collapse under their own weight.

Konstantin Kobyakov

The rough-legged buzzard *(Buteo lagopus)* is the most widespread bird of prey in the Murmansk region. It has received its Russian name "kanyuk" (a moaner) for the typical mournful cry it makes flying above tundra or mountains. Despite their modest size, in comparison to the white-tailed eagle, a pair of buzzards can attack the eagle, chasing it away from the nest. Quite clumsy in the air, the eagle prefers not to get involved and flies off.

Fledgling of a white-tailed eagle looks quite impressive, only a yellow beak reveals its young age.

Ivan Vdovin

Sergey Ganusevich

The young goshawk *(Accipiter gentilis)* still can't fly confidently and so it waits to the last moment until the "threat" comes very close, and only then it moves to the next tree.

Why do Species Disappear?

Name of a brook in the Khibins – Majvaltajok – means "beaver's brook" in Saami language. Images of beaver are found among the petroglyphs of Kanozero. It is also known that in 15-17 centuries beavers were hunted for their pelts. And in the 18th century they completely vanished from the Kola Peninsula because of over-hunting. Later there was an attempt to restore the beavers' population with the help of their southern relatives. But this project failed – most probably the number of "invited" animals was too small for successful reproduction.

Not so many species of animals and plants extinct from direct destruction. More often species suffer from changes of their habitats. Water plant of the Russian Red Book *Lobelia dortmanna* was found in the beginning of the 20th century on the lake Kovdozero. After the water reservoir construction the plant has never been seen again.

Rare biological species possess not only aesthetical value. Even most numerically small species play their own, unique role in the natural interconnections, being essential for the existence of some other organisms and the part of geochemical cycle. Putting them on the verge of extinction we destroy our environment. And the extinct population of rare species is difficult or even impossible to restore.

Alex Gilyazov

The gyrfalcon *(Falco rusticolus)* is a legendary bird of prey and the largest of all the falcons.
Since old times it has been used as a hunting bird. In the Middle Ages the falconry was very popular among the European aristocracy.
A trained gyrfalcon was the "star" in this entertainment, being considered the best hunter and a truly royal present.
In 17-18 centuries the Kola land supplied the Russian Tzar court with gyrfalcons.
Tzars offered them as presents to their neighbors or potential opponents, such as Turkish sultans and Persian shahs, with a view to build friendly relations.
The gyrfalcon has always been a rare bird. It's been established for sure that only a few couples of gyrfalcons are nesting in the Murmansk region nowadays.

Ryurik Chernyakin

The purple sandpiper *(Calidris maritime)* inhabits mountain stony tundras but in the non-breeding period stays at sea shores. Its nest is a “spartan” lining of dry herbs that’s typical for many sandpipers. Eggs are hatched by both parents but it’s always the “father” who looks after the brood.

Ryurik Chernyakin

The oyster-catcher *(Haematopus ostralegus)*. Its Russian name is *kulik-soroka*, or sandpiper-magpie. The bird was called so for having much in common with “magpie-white-sides”, the popular character of Russian folk-tales. It has the same black-white plumage and fidgety character. It’s often oyster-catcher you hear first of all on the sea shores, and not seagulls or terns, though they settle in colonies and also like to make noise with or with no reason. However, very soon you easily get used to all these voices as you do to a tranquil sound of waves.

Ryurik Chernyakin

The long-beaked and long-legged common red-shank *(Tringa totanus)* is a classic sandpiper. It’s quite odd to see it sitting on a high angelica since long legs are meant first of all for wandering around bogs and water reservoirs. But almost all sandpipers of this genus – green-shanks, wood-sandpipers, and common sandpipers – easily seat themselves on trees, shrubs and high grasses.

The pewit *(Vanellus vanellus)* nests exceptionally on meadows, which explains its Russian "nickname" – *loogovka* (from the word *loog* – a meadow).
It bustles noisily and persistently around its nest and chicks.
As there are very few meadows in the North, this bird wasn't mentioned in ornithological records of 19th – early 20th centuries.
It appeared in the Murmansk region not long ago – in 1970s.

Konstantin Kobyakov

In spring males of ruff *(Philomachus pugnax)* adorn themselves with splendid colorful "collars" and "ears" as well as less attractive but bright warts.
In a typical courting pose "admirers" curtsey and, remaining motionless, they direct their beaks to the ground, as if feeding.
But it's rather a "dance" than feeding.
In autumn males devoid of their breeding dress differ from females only by larger sizes.

Ryurik Chernyakin

Golden plovers, or frost-birds, *(Pluvialis apricaria)* are common dwellers of large bogs, mountain and plain tundras.
In summertime they laments pursue the man throughout the tundra, passing on "the baton" from one nesting area to the other.

Gennady Alexandrov

Beasts of the Sea

The most harmful effect of human activity is, perhaps, the condition of cetacean life in our seas. Some time ago the Barents Sea was a major feeding ground of whales in the North Atlantic. By the end of the 16th century whale and walrus oil turned into a profitable commodity. Major expeditions were sent to the Barents Sea to explore its whaling potential. This, by the way, was one of the objectives set before the expedition of Barents himself, whose name was later given to the sea.

By the beginning of the 18th century the cetacean and the walrus populations were already undermined. Nothing but names on the map, such as the Morzhovets (walrus hunting ground) Island in the White Sea, reminds of the former industry. As early as the 17th century Russian Pomors went to Grumant and Matka, contemporary Spitsbergen and Novaya Zemlya islands, to hunt walruses.

Nowadays encounters with large cetaceans are extremely rare in the Barents Sea, but white whales are quite common in both seas washing the peninsula. As for seals, the ringed seal and the bearded seal are often observed here. The gray seal and the harbor seal are less common, they are found only in the Barents Sea.

Gennady Alexandrov

Harp seal *Pagophilus groenlandicus*, young animal *(serka)*

Gennady Alexandrov

Harp seal *Pagophilus groenlandicus*, adult animal *(krylan)*

The harp seal holds a special position among pinnipeds; social behavior is most typical for it. During the molting and parturition periods in February and March these animals gather in major groups on drifting ice in the Gorlo strait of the White Sea – the Pomors' traditional seal hunting site. Formerly hunters tried to catch only large animals for their oil and skins. It was only in 1940s when target hunting of newly born seal cubs, *belyoks*, was started for the sake of a tiny piece of silvery fur. Before that their fur, which is difficult to process, had no commercial value. Today Russia is the only country in the world where the seal cub hunting is still practiced on minor scale. Other countries have banned not only hunting itself, but also the sale of the fur produced by such a barbarian method.

The Pomor names of the harp seal are *lysun* (bald one) or *kozha* (skin), young female seals were called *utelga*. There were also different names for seal cubs that rapidly change their color during the first weeks and months of their life. Snow-white *belyoks*, whose first shedding had just begun, were called *khokhlushas*, and after shedding they became *konzhui*, or *serkas* (grey). Fur of these seals is grey with dark spots.

The attributes of an adult animal are a dark mask on the head and an ornament in the shape of wings on the back. These animals are called *krylani*, or winged.

Nikolay Kotelenets

Spine bones of a dead whale. Large whales are rarely thrown out onto the shore. But if this happens Arctic foxes acquire a "dining room" and a "shelter" for many months.

Ryurik Chernyakin

Mother seals rarely leave their cubs, unlike father seals. The males of the grey seal (*Halichoerus grypus)* are much more cautious than female seals. While some mums would sometimes even defend their cub, fathers would escape to the sea well before a man could get close enough to them.

The breeding season of grey seals starts at the darkest time of the year, November and December.
Their cubs are called *belyoks*, or whities, just as the cubs of harp seals, but their fur is not as white.
Being born absolutely helpless, a few hours later they are able to perceive the world consciously, and in a day or two they can already grumble and snarl.

Ryurik Chernyakin

Andrey Nestruev

Cyanea capillata jellyfish

Andrey Nestruev

Aurelia aurita jellyfish

Andrey Nestruev

Metridium senile sea anemone

Mysteries of the Deep

The two seas washing the Kola land are similar in certain aspects and greatly differ in others. The Barents Sea is clearly an ocean sea with high salinity and water transparency. The White Sea is an inland sea, almost completely surrounded by coasts. Major rivers decrease concentration of salt in it, especially in bays, and reduce transparency of water.

There is a certain affinity in the species structures of both seas, but some species find their optimal biological niche in just one of the seas. There are also species which feel comfortable in any water, for example, *Aurelia*, or eared jellyfish, and the *Cyanea* jellyfish.

Aurelias are bad swimmers, only able to move slowly. Aurelias passively eat all the small plankton they filter. More active cyaneas are armed with thread-cells collated on long filaments. They are predators, and aurelias often become victims of their “colleagues”, cyaneas.

Actiniae are a decoration for any seabed. That’s why they are often called sea anemones or sea flowers. The actinia *Metridium* often forms colonies shaping true underwater flower gardens. Species of various tints settle side by side producing the impression of a flowerbed. Unfortunately, sometimes these remarkable settlements suddenly and totally disappear for no comprehensible reason. It’s a great pity for divers.

However, the sea conceals many mysteries which can not be revealed at once, if ever. In 1990s the Russian public was wrought-up by sensational reports of mass death of starfish in the White Sea. Most mass-media attributed it to some large-scale poisoning of the sea through the leak of missile fuel from a wrecked

Many actiniae are amazing and resemble flowers. There are six species of sea anemones in the White Sea, but only the *Metridium* forms such closely packed colonies, other species are found singly.

Andrey Nestruev

submarine. Commissions of different levels, including a governmental one, were organized to investigate the accident.

Actually, piles of starfish cast out by the storm looked dismal, but, fortunately, there were natural reasons for it. The starfish, found on the seashore appeared to be *Asteias rubens*, fierce destroyers of shellfish and, first and foremost, mussels, the most common bivalves of the coastal waters. Thick and often extensive settlements of mussels were given the name of mussel beds. Yet, despite the considerable quantity of shellfish in such settlements, they are practically inaccessible for the starfish.

Starfish concentrate only at the edges of the colony attacking single mussels or separate sparse groups of shellfish. As a matter of fact, the starfish has to take a special position to open the shell of the mussel, embracing it with all its rays-tentacles. Gradually opening the valves several millimeters wide, the starfish pushes its stomach inside out into the formed slit, and, having digested the mollusk, it draws the stomach back. This method of feeding requires enough space, and on a thick mussel bed starfish fails to open the shell – its tentacles just can not penetrate between the tightly cramped shellfish.

Andrey Yashin

Metridium senile sea anemone

Andrey Yashin

Tealia feline sea anemone

A solid colony of mussels *Mytilus edulis* in the fucus *Fucus spp.* zone

But it's quite another matter when the mussel bed falls into decay, and this process follows a certain cycle of 6-15 years. There are several reasons for it, although some of them are not clear yet. But the fact is that the decay of the mussel bed makes shellfish vulnerable to predators' attacks, and starfish gather at such mussel beds in huge numbers.

This was what happened in the Letniy Bereg (Summer Coast) of the White Sea in 1990. Aging mussel beds attracted tremendous numbers of starfish, but their feast was cut short by a sudden lasting storm. Besides that, the wind-driven wave reduced the salt concentration of coastal waters, decreasing the ability of starfish to find their bearing. As a result, the starfish feast turned into a tragedy.

But the mass death of the *Mya* gaper clam *(Mya arenaria)* remained almost unnoticed by the public; it happened almost everywhere in the White Sea at the turn of 1950-1960s for no obvious reason. Such things did not worry people then, but all the seashore, in the Kandalaksha Bay, at least, was covered with mya shells.

Andrey Yashin

Asterias rubens starfish on the edge of a mussel bed

The same fate soon awaited the threespined stickleback. As a result, the welfare of marine birds – seaswallows, auks – was undermined, as they used to feed their young with it. Yet, the disappearance of the stickleback was also noticed by ordinary people because in the hungry post-war years, stickleback, being an easy catch, was fished in great numbers for "whitebait soup". It was also processed into the fish-flour to feed the domestic fowl.

The death of the eelgrass *(Zostera marina)* was a real disaster for the sea. In the summer of 1960 it suddenly burst into blossom, which usually does not happen on such a massive scale, and started to die away after the blossoming period. As soon as a year later there were no traces of lush submarine eelgrass meadows. The reasons for the disaster are still unknown, although there were plenty of hypotheses. Among them were epiphyotic, a fungus infection, a certain biomass cycle associated with the solar cycle, and many other phenomena.

The existence of the White Sea herring (*Clupea pallasi marisalba)*, which traditionally spawned on eelgrass, appeared to be under threat. Transfer of its spawning to other plants was not always successful. The eggs spawned over fucoids, Coastal Kelp, often went dry during low-tides. On the red algae eggs did not mature due to low water temperature in the areas of the algae habitat. Experts even spoke of creating artificial spawning grounds because the White Sea herring is an important commercial species. The economy of many coastal villages historically depended on its catch. Finally, the eelgrass populations were restored naturally, but it happened only in late 1990s, decades later. The populations of mya and stickleback were restored a bit earlier.

Hardly explainable phenomena were also observed in the Barents Sea, and it sometimes had colossal effect on people's life. Thus, the unexplainable change of the cod migration routes in the late 19th century brought about a total change in the fishing system of the Murman area. This resulted not only in the disappearance of the centuries old spring fish trade, but also put an end to the socio-economic phenomenon of *pokrut*, when Pomors from the White Sea villages went fishing having signed promissory notes. Fishing camps of the Rybachy Peninsula became deserted, the cod fishing moved to the East Murman, was conducted only in summer, and fishermen were hired to work for a wage, as a rule.

Mysterious phenomena observed in such a relatively stable environment as the sea testify to the complex structure of wildlife interrelations and demand for a respectable approach to them.

Andrey Yashin

Threespined stickleback *Gasterosteus aculeatus* and the "house" of *Arenicola marina* logworm

Andrey Yashin

Flustra foliacea moss polyp and *Pagurus pubescens* hermit crab in the shell of *Natica clausa* snail

Andrey Yashin

Polymastia mammilaris sponge

Vitaly Primak

Strongylocentrotus droebachiensis sea-urchins; *Chlamys islandicus* sea scallop; *Styela rustica* ascidium; *Lithotamnion spp.* calcareous algae

Comparing the two seas, the Barents Sea is generally more abundant. Many biological species have industrial value only in this sea.
Take, for instance, the sea scallop and the strongilocentrotus sea-urchin. They are appreciably smaller and less common in the White Sea.

The young of the sea scallop fasten themselves to submarine rocks with special filaments, byssus, and larger animals become mobile.
They are able to escape "from under the nose" of starfish and other predators.
In danger these shellfish quickly shut their valves, and the jet of water propels them away.

The *Henricia* and *Crossaster* starfishes are common in both seas.
Interestingly, *Henricia*'s menu consists exceptionally of sponges, and chemoreception helps it recognize the species it prefers.
Crossaster mainly feeds on its "relatives", other echinodermata, including starfishes of other species.

In both seas one can find rocks of unusual color, pink or lilac, covered with a crust of the calcareous algae of the *Lithothamnium* genus of the red algae division.
Some growths of these algae resemble madrepores' coral structures which form reefs in the southern seas.

Vitaly Primak

Crossaster papposus starfish

Vitaly Primak

Henricia sanguinolenta starfish on the *Lithothamnium spp.*

Andrey Nestruev

Lyre crab *Hyas araneus*, the aboriginal species of the northern seas

Vitaly Priimak

King crab *Paralithodes kamtschatika*

It is not clear at present whether the adaptation of the king crab from the Far East seas is a benefit or a disaster for the Barents Sea where it appeared in 1980s.
Initially set free near Murmansk the crab lived unnoticed for a long time, but recently its population rapidly increased, which lead to serious competition with local biological species.
Having settled in the Barents Sea, it extended its habitat to the West, invading the Norwegian Sea and getting the name of the "Russian crab" from local fishermen.

The echinus sea-urchin *(Echinus esculentus)* is found in the Barents Sea. Young sea-urchins can camouflage themselves with strips of algae, shells and other sea litter.
As for adult sea-urchins such behavior is a sort of a useless habit. A lonely weed looks ridiculous on a bright large echinus.

Vitaly Priimak

Gennady Alexandrov

European swallowtail *Papilio machaon* on *Rhodiola rosea*

The bedstraw hawk is a rare butterfly in the region. Before taking off these heavy hawk-moths warm themselves up for a long time with quick flutter of wings.

Gennady Alexandrov

Bedstraw hawk *Hyles gallii*

Foresters are the calmest among our butterflies. They are poisonous for most birds, that's why they are so slow and leisurely.

Gennady Alexandrov

Forester *Zygaena exulans*

Butterflies, Moths and Others…

As for the large butterflies of the Murmansk region, only the European swallowtail could be regarded as a truly local species. As a rule, it successfully breeds in the North, despite its short summer. Its caterpillars manage to grow up and pupate. In bad years, cold or rainy, swallowtails fly seldom, and their pupae don't survive winter. The butterflies may disappear for a year or two, but later they suddenly appear again migrating from the southern regions.

The lot of other beautiful fliers in the Kola Peninsula, migrating butterflies admirals and painted ladies, is not happy either. In spring they regularly come to the North and breed here. But these species hibernate as adult insects, not as a chrysalis, and, it is believed they can't survive winters to the north from St. Petersburg. So, young butterflies which hatch here only by the end of summer usually have no time to migrate south, to their places of hibernation, before the autumn colds.

As for smaller butterflies, the blues are common here. This family got its name from the blue color on top of the wings of male butterflies of some species. Yet, our blues seldom boast their wings. Mobile butterflies rarely warm their back in the sun, as small tortoise-shells or admirals do it. The sitting blues usually have their wings folded.

Gennady Alexandrov

European swallowtails are caring parents, they lay eggs thoughtfully, one or two for a plant, so that their young – caterpillars with great appetite – would not starve. Yet, if the butterflies are numerous, the young of several parents may find themselves on the same umbelliferous plant. So, to make a good heavy chrysalis, they will have to find a new "umbrella" for themselves.

Gennady Alexandrov

Cranberry blue *Vacciniina optilete* on the *Cladina rangiferina* lichen

Felix Shklyarevich

Red admiral *Vanessa atalanta*

In the middle Russia meadows are the common places where butterflies come together. In the North natural meadows are scarce, and quite often few biological species form them. Seashore provides a happy difference, where lush and varied growth prospers on surf debris.
The rustling of European swallowtail wings is quite perceptible in the growth of cuckoo-flowers *(Coronaria flos-cuculi)* on a quiet day.

The most numerous small moths all look alike for an amateur though there are about four hundred species of them in our region. The larger species are sometimes called butterflies. They don't have Russian names, as a rule. The lower photograph features a moth from the case-bearer genus (*Coleophora*) on the flowers of the bladder silene *(Oberna behen)*.

Gennady Alexandrov

Gennady Alexandrov

Reed beetles from the *Donacia* genus are usually found near water, just like this beetle on the flowers of the shoreline meadow-sweet *(Filipendula ulmaria)*.

Our wild wood cockroach is a close relative of a common home cockroach, or croton-bug, but, no doubt, he is much more elegant. Above all, he's a brilliant flyer. The Murmansk region has its own species of wild cockroach – *Ectobius lapponicus*.

Gennady Alexandrov

The smaller argynnis *(Boloria euphrasinae*) is a modest member of the majestic family of Nymphalidae.
This family includes the peacock-butterfly, admiral, small tortoise-shell and other bright butterflies.

Gennady Alexandrov

Globe-flowers *(Trollius europaeus)* are a small house with a roof for the capricorn beetle *Brachyta interrogationis.*
Usually the beetle is hidden by the dome of sepals, often staying all the night in the flower.

Gennady Alexandrov

The most famous insects of the North, which willy-nilly every person had to encounter, are mosquitoes and midges.
There are three genera of bloodsucking mosquitoes in the Murmansk Region.
The largest of them are mosquitoes from the *Aedes* genus.
One of them rests on the naumburgia *(Naumburgia thyrsiflora)* flowers.
Only “girl”-mosquitoes bite.

Gennady Alexandrov

Sergey Ganusevich

Konstantin Kobyakov

Gennady Alexandrov

In the North, summer may be hot or cool, dry or rainy, but no summer is... moskito-free. Yet, not all summer months are equally bad as far as mosquitoes are concerned.
June is wonderful in its gentle birch mist, when the “mosquito is still asleep”. The August mosquito is not bellicose at all, as the return of dark nights reduces breeding activity of these insects.
So, one has to bear the burden of mosquitoes just for a month or a month and a half, and it does not seem to be much...

Gennady Alexandrov

Gennady Alexandrov

Syrphid flies, or hover flies, with striped abdomens resemble wasps, but, just as other flies, they have two wings, while wasps have four. Syrphid flies are large insects, and for the sundew which trapped this fly of the *Syrphus* genus it is an unusual catch.

Where do Species Hide?

We tend to distinguish beautiful and impressive objects – scenic lakes, cliffs, waterfalls, canyons – as natural "masterpieces" or natural monuments. But there are other "masterpieces" looking maybe less beautiful, but playing a far more significant role.

These are places of concentration of rare species or, in a more scientific language – refuges. Rare species gravitate to such places for various reasons: unique natural conditions, difficult accessibility, absence of human activity.

There are hundreds of rare birds' nests in the Ponoy lowland – the intact land of bogs, lakes and river canals. Flora diversity of ultra-alkaline massifs of the Khibin and Lovozero mountains, cliffs of the Turiy Cape is conditioned by their chemical composition and nutritional richness.

The Puhyakuru Canyon in the South-West of the region is unique by its vegetative composition. Rare plant species are found on some coastal cliffs of the White and the Barents seas.

Gennady Alexandrov

This picture shows very well what does "protective" coloring mean. This ptarmigan can be hardly noticed against a background of the Khibins' gravel-rubble slopes where it lives.

Gennady Alexandrov

Alkaline intrusive rocks containing apatite, calcite and other minerals come out to the surface on the Turiy Cape. That's why cliffs here are characterized by high concentration of nutrients, vital for plants.
Perhaps this explains the uniqueness of the local flora.

Gennady Alexandrov

This dandelion *(Taraxacum leucoglossum*) is the endemic of the Turiy Cape and grows only on its narrow, several dozen meters wide, coastal strip. Botanists can not find out the reason for such a strict preference. The plant refuses to live in botanic gardens: it dies.

Gennady Alexandrov

The Maria's root peony *(Paeonia anomalia)*, on the contrary, is very responsive to the care of gardeners and grows perfectly well in a culture, where it is cultivated by artificial "partition of a shrub". As for wild peonies, they reproduce themselves only by seeds and sprout very slowly.

Biological Species as a Resource

All kinds of organisms without exception constitute a resource for human activity. In a more common sense, they all contribute to supporting the environmental balance. More specifically, some species (commercial species, medicinal and food plants) already have economic use. Others, most likely, can be used potentially because researchers regularly discover new properties and possibilities of use of already known herbs in medicine, food industry and other fields.

But nevertheless the key function of biological diversity is to support the environmental sustainability. There were several dramatic examples showing that the extinction of 20% of biological species in a particular ecosystem can lead to its complete destruction. In our time of natural and man-induced disasters the stabilizing role of biodiversity is extremely important.

Gennady Alexandrov

Curative properties of the *Rhodiola rosea* root attract a lot of people. As a result, in some places this species has completely disappeared.

Gennady Alexandrov

Konstantin Kobyakov

Rare lichen, registered in the Red Book of Russia, – the lungmoss *(Lobaria pulmonaria)* – has grown on the bark of this old rowan-tree.

Konstantin Kobyakov

Sergey Konyaev

Cliffs in the Knibin and Lovozero Mountains, in spite of their seeming lifelessness and severity, are habitats of numerous plants which are rare in other areas. These cliffs are the acknowledged center of the region's biological diversity.

Konstantin Kobyakov

Old spider-like pine-trees are often used by various birds for nesting. Both fish-hawk and golden eagle can build a "house" on such a huge pine-tree. This nest was built by a raven family but in future it may be occupied by someone else, for example, kestrel, which usually doesn't bother about building its own nests.

Konstantin Kobyakov

In old humid forests, inaccessible to small fires, one can find whole growths of a rare fern *Diplazium sibiricum*.

Konstantin Kobyakov

The Key Biotopes

Elements of the environment, most essential for the support of the species richness, are called key biotopes because their existence is a “key” to the ecological sustainability. For example, primeval forests are considered key biotopes as they are home and the only source of life for a whole range of plants, fungi, animals. More common species can also exist in secondary birch woods, forests that underwent selective felling or in suburban and roadside forests.

Other key biotopes are cliffs whose height exceeds two meters. There grow many rare and Red Book species of the Murmansk region such as tiny rock ferns, unusual lichens, saxifrages. These plants find there unique conditions, including… absence of other vegetation, in other words, there are no species to compete with. On high steep rocks small and large falcons nest, the most rare of them are gyrfalcon and peregrine-falcon.

Banks of rivers and brooks with their moist and rich soils give shelter to many various organisms. Besides, they can be also considered the most crucial biotopes. When forest fires occur, many plants, including fir-trees, find their refuge here.

Outcrops of carbonaceous and alkaline rocks, relatively rare in the region, are also important for the biodiversity conservation. There grow many region’s unique plant species which need exactly this kind of soil-forming rocks. Such key biotopes as bogs fed by underground springs, are very rich in nutrients which makes them attractive for many rare plants.

A large old tree in a younger forest is more small-scale but no less important key biotope. Old alive trees can become home to birds of prey, rare lichen species. As for fallen trees, they give shelter to rare species of bracket fungi, beetles. In dead trees woodpeckers gouge out hollows which are later used by dozens of dwellers from owls to martens and bats.

Konstantin Kobyakov

What Threatens Species?

Each biological species needs special conditions of the environment to survive, in other words, has its own ecological niche. Just in the same way factors, threatening survival of this or that species, differ. At the same time numerous threats can be united in a group of just several, most typical ones. They are "universal" risk factors, posing danger to a lot of biological species, especially rare ones. Obviously, their influence concerns more primitive organisms as well, but multiplicity of these organisms diminishes the disastrous effect.

Of course, the most "universal" threatening factor is building, especially in the remote areas where the wild nature is still undisturbed. Apart from flora and fauna already suffering on the building site, indirect factors can be even more destructive: a road constructed to deliver building materials becomes the source of trouble for animals, leads to fires, poaching. Building requires a thorough environmental impact assessment, that is, investigation how the project would affect rare plant, animal species and the whole nature. The same concerns mining works (development of quarries, construction of mines), mass geological prospecting (loading drills, road laying).

Effect from clear cutting is no less destructive: they change microclimate and hydrological regime which can lead to the extinction of some species even at a large distance from the clearing. Large-scale and uncontrolled picnicking and other holiday activities, hunting rare animals or plants for commercial purposes inflict colossal damage to the nature.

However, some species make good use of man-made objects. Here the kestrel (*Falco tinnuculus)* has built a nest on a metal bearer in a forsaken military settlement.

Konstantin Kobyakov

Konstantin Kobyakov

Wasteland near Monchegorsk

Gennady Alexandrov

Abandoned military settlement Ozerki on the Rybachy Peninsula

Vladimir Latka

Konstantin Kobyakov

Timber left on a clearing

Konstantin Kobyakov

Industrial zone of the Kirovsk mine in the Khibiny

The Red Book of the Murmansk Region

Many plants, animals, fungi of the Murmansk region are listed in the Red Book of the International Union for the Nature Conservation and the Red Book of the Russian Federation. Besides, there is a regional list of rare species – the Red Book of the Murmansk region. The Government of the Murmansk region ratified the "Regulations on the Red Book of the Murmansk region", the core idea of which is a need for the rare flora and fauna species habitats conservation. According to the Regulations, "all activities, leading to destruction or disturbance of habitats of animals and plants listed in the Red Book of the Murmansk region, are prohibited". The species' habitat is not just all the spots of the species individuals' location on a certain territory but also on adjoining areas, disturbance of which threatens the existence of individuals.

Gennady Alexandrov

The grapefern *Botrychium multifidum* is registered in the Red Book of the Murmansk region as an endangered species.
Each year grapeferns form just one leaf, and the plant's age can be calculated by the number of leaf scars remaining on their rhizomes.
It was established that despite its modest size this speciec of grapefern can reach the age of several dozen years and even be contemporary to centenary pine-trees under which it lives.
Prothalliums of grapeferns lead a long underground life, feeding with the help of soil fungi at this time.
The period between the beginning of spore sprouting and appearance of a green plant on the ground surface may vary from ten to twenty years.

3

Interior of the Earth

Ancient History of the Earth

Minerals

Mineral Deposits

Silver Island

Lapland Factories

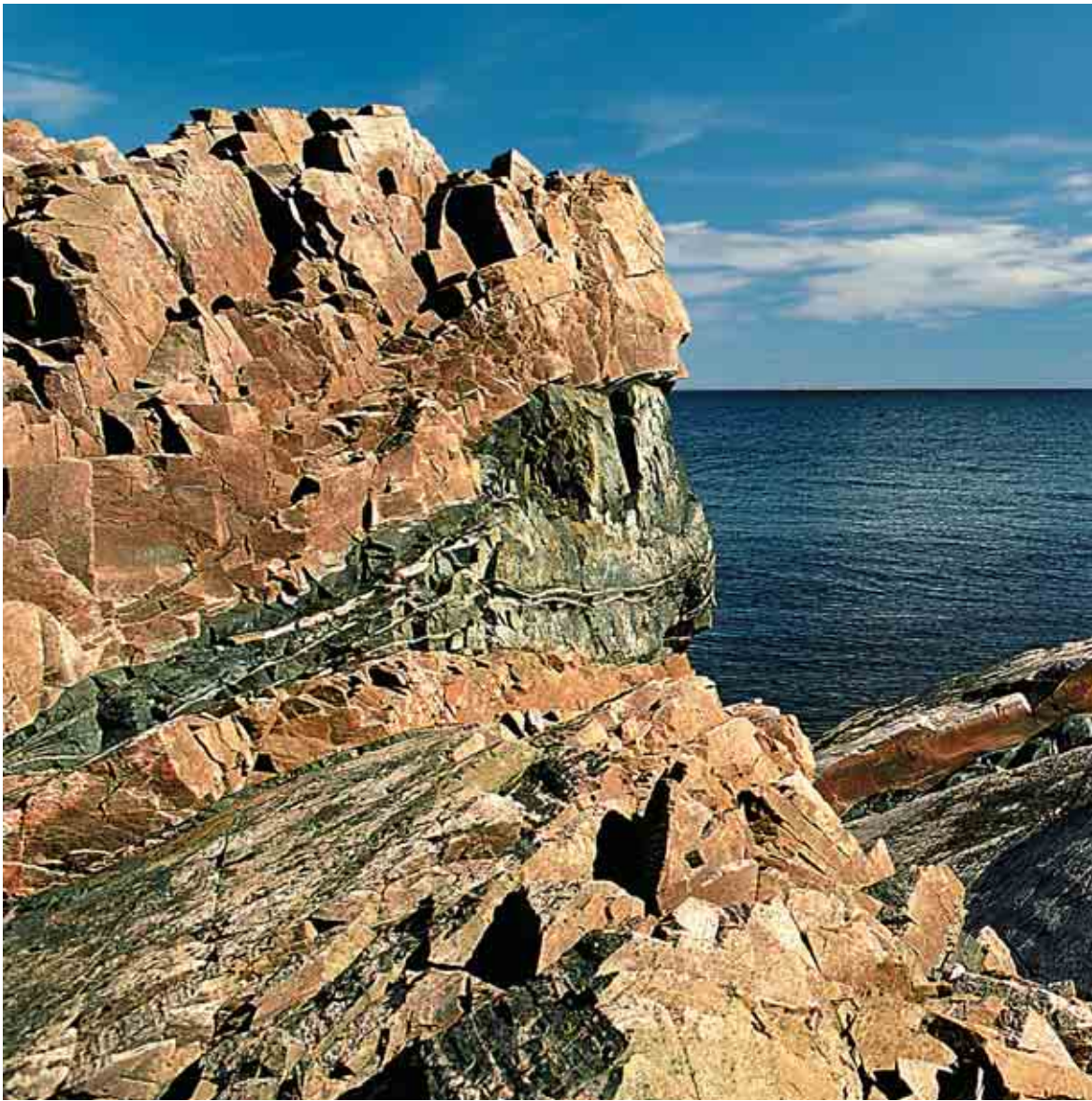
Will the Forest Cover Wasteland?

Ancient History of the Earth

In the Kola North you can find the most ancient rocks of the Earth formed three billions years ago right under your feet. It has been established that the main features of the region's geology have already been formed in the early Proterozoic period (2.6-1.7 billion years ago).

In the course of such a long period of time an intricate complex of gneisses, shales, amphibolites, granulites, granite intrusions, diorites, gabbro, ultrabasic rocks has been formed. All these rocks comprise an extremely complicated fold structure whose basic elements stretch north-west and are broken by numerous faults. Their formation marked the end the most active tectonic life of the Kola Region and for a long time it represented a stable platform.

About a billion years ago a considerable part of the peninsula was a seabed. Marine sediments accumulated on its surface. Later the sea receded, its floor turned into land. Traces of marine sediments have survived along the perimeter of the Kola Peninsula; they are conspicuous on the Sredny and Rybachy Peninsulas, and on the Kildin Island.



During the Paleozoic period, 350-400 million years ago, ancient rocks were broken by the intrusions of alkali-type and alkali-ultrabasic igneous rocks. Due to the oval shape and concentric structure of these intrusions they were called “central type” intrusions. Some time ago they were feeding vents of ancient volcanoes. The most famous of them form the mountain massifs of the Khibins and Lovozerskie tundras, the Kovdor massif.

The contemporary structure of the Kola Peninsula, its relief and water flow system were formed during Neogene Quaternary period of the last million years. At the same period the layer of quicksand sedimentary rocks covering nowadays most of the peninsula was produced due to the activity of glaciers, the sea, rivers, lakes and neotectonic movements. The quicksand layer is usually less than ten meters deep but in the lower parts of the relief, in the river, lake and pediment valleys sediments it can be several dozens or hundreds meters deep. The ancient past of the Earth protrudes through this cover in the form of subsoil openings in the channels cut by rivers and creeks, on steep mountain sides and the seashore.

Gennady Alexandrov

Konstantin Kobyakov

Basalts. At the Orlov-Tersky Cape, as well as along all the north-east coast of the Kola Peninsula, ancient igneous rocks emerge from the sea.

As a result of numerous tectonic movements the territory of the Kola Peninsula underwent vertical shifts.
Granites carved by sea waves in the past are situated 200 meters from the seashore between the Cape Nemetsky and Cape Pekkaniemi, at the height of 50 meters.
Geologists call them “granite waves”.

Dmitry Saburov

Granitoids are widespread along the Murmansk coast from the Motovsky Bay in the north-west to the Gorlo (throat) of the White Sea in the south-east. They form a peculiar lens-like structure called the Murmansk Block by geologists. The age of these rocks is about three billion years.
Impassible landscape with its giant rocks, cliffs, swamps, rivers full of rapids and numerous lakes gives this land wild and ancient look.

Konstantin Kobyakov

Rock gardens, intricate remains of ancient marine sediments chiseled by wind erosion, emerged at the Sredny Peninsula.

Mikhail Borisenko

Ivan Vdovin

Mikhail Borisenko

Grigory Ivanyuk

The wall of the Olenegorsk deposit quarry provides a clear picture of magma rising to the surface through the crack in a thick rock.
This formation is called a dike. Here a dark green dolerite dike breaks through light pink pegmatite veins and a thick layer of biotite gneisses.

Grigory Ivanyuk

Mighty veins of microcline pegmatites cutting through the thick iron ore rock very much complicate ore extraction at the Olenegorsk iron ore deposit.

The canyon in the Dolgaya Shchel (Long Crack) area was formed as a result of washing out the peridotite dike in the mass of granite gneisses by marine water.

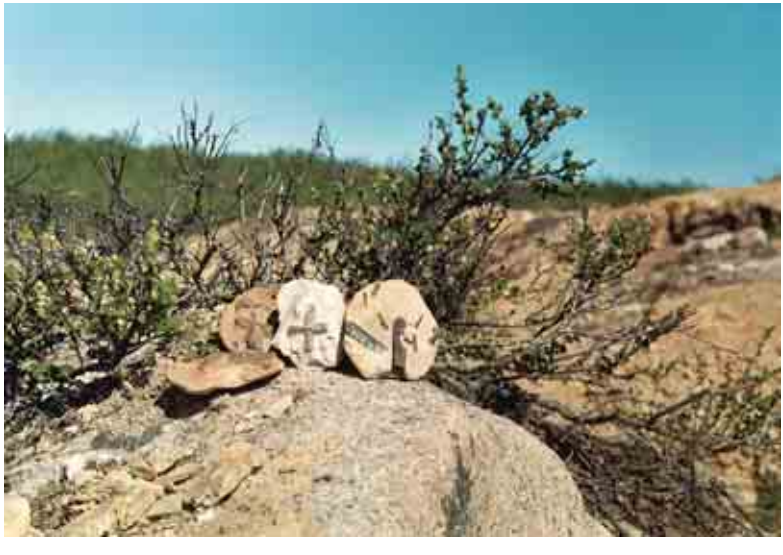
Gennady Alexandrov

Radial rays of the kyanite shale of Keivi from the Novaya Shuururta deposit.
This modest looking mineral forms a considerable part of the Keivi heights.

Gennady Alexandrov

Collectors better know another form of kyanite, crystals of the beautiful blue color.
They are found in quartz veins cutting through grey kyanite shales which turned blue due to the effect of high temperature.
Sometimes even kyanite crystals of a jewellery quality can be found.

Another mineralogical wonder of Keivi is staurolite.
It was named so due to the ability to form cross-shaped crystal clusters (from the Greek word “stauros”, or cross).
It is known that medieval monks used to wear staurolite crosses, worshiping their not of human making origin.



Vadim Likhachev

Vadim Likhachev

The mighty layers of crystalline shales stretch for more than 150 km in the Keivi.

They are mainly formed by tremendous concentrations of three minerals: kyanite, staurolite and garnet. These minerals are not rare, of course, but they are not found in such an enormous quantity anywhere else in the world.

Garnet is a natural abrasive raw material. Its transparent varieties are highly valued by jewelers.

Kyanite contains 63% of alumina, the main source of aluminum.

Silumin, a cilico-aluminum alloy, and high-quality refractory material, can be produced directly from kyanite.

The composition of staurolite is close to that of kyanite.

But we still have a long way to go before the industrial use of these three minerals is possible.

Yet for the moment lumps of huge crystals of blue kyanite with cruciform twins of staurolite and giant garnet crystals are the pride of collectors.

Vadim Likhachev

Gennady Alexandrov

The Kandalaksha and Kolvitsa tundras provide a wonderful opportunity to study extraordinary rocks – the granulites of the Lapland-Kolvitsa belt.

Gennady Alexandrov

It is supposed that granulites were produced by colossal pressure and temperature at the depth of dozens kilometers, and their mineral content and structure prove that. Yet there are hypotheses that a part of granulites are of sedimentary origin, and strips visible in their structure may testify to it.

Vladimir Latka

Grigory Ivanyuk

It is supposed that the Khibins massif is a root part of an ancient volcano whose mouth was located in the area of Tulyilukht Bay of the Umbozero Lake.
It is a concentric zonal intrusion with the diameter of about 40 km going down to the depth of at least 12 kilometers.
Another typical feature of this massif is a circular ijolite-urtite structure with 28 km in diameter and about 2 km wide where all the apatite deposits are focused.
The total amount of apatite-nepheline ore in Khibins makes up 3,650 million tons. The ore is mainly concentrated in 10 deposits: Kukisvumchorr, Yukspor, Apatite Circus, Eveslogchorr, Rasvumchorr Plato, Partomchorr, Kuelpor, Koashva, Deer Brook and Nyorkpahk.

Grigory Ivanyuk

Paleozoic sedimentary rocks of volcanic origin in the area of the Flora Mountain are a reminder of ancient volcanic past of the Lovozero massif.
Even today these rocks baked together more than 370 million years ago seem to have just erupted from the mouth of some submarine volcano.

A section through the Lovozero massif shows that it is shaped like a mushroom with the cap of about 30 km in diameter on the surface and the stalk which narrows and goes down to the depth of more than 15 kilometer. A depression in the "cap" of the massif is filled with the Seidyavr Lake. This massif is one of the major and most unique alkali massifs of the world.

The supergiant deposit of loparite, an ore containing the world's largest resources of tantalum and niobium, has been discovered and is being developed here. A rich and unique mineralogy has won the Lovozero massif the fame it deserves. 340 kinds of minerals were found here, and about a half of them are rare and most rare minerals. All in all 73 new minerals were discovered in the Lovozero area.

Gennady Alexandrov

Shadow migmatite of plagiogranites in amphibole-biotite-plagioclase gneisses from the depth of 10,000 meters.

Microcline brecciated metabasalt from the depth of 5,984 meters.

The deepest borehole in the world was bored in the Pechenga district on the bank of the Vilgiskoddeoaivinyarvi ("Lake under the Wolf Mountain" in the Lapp language).
The boring of the Kola super-deep borehole started in 1970, and in 1990 it reached the depth of 12,262 meters!
The process of boring produced 4,024 linear meters of unique core samples. The research conducted at this borehole provided the first direct data concerning the structure and composition of the deep zones of ancient continental crust and helped to make up its geological, geochemical and geophysical "images".
The material produced during this research substantially altered the old concepts of the continental crust structure and composition, proving the presence of ore mineralization and fluids at the maximum depth, thus changing views upon the nature of geophysical borders.

Dmitry Saburov

Core sample from the depth of 5 kilometers

Dmitry Saburov

Konstantin Kobyakov

Minerals

The varied geology of the Kola Peninsula, its unique geological history and shallow bedding of the root rocks made possible the discovery of rare and new minerals here. Academician Fersman called the Kola Peninsula an outdoors mineralogical museum. Geological research conducted at less than one thousandth of the total land area of the planet helped discover and study more than 700 minerals, or about a quarter of the mineral world of the Earth! More than a hundred of them were discovered here for the first time, and many of them have not been found yet in other areas of the globe.

Most of these minerals – about 500 – were discovered in the subsoil of the picturesque mountain system of the Khibin and Lovozero tundras uniting two massifs of alkali igneous rock of close composition. Lamprophyllite was the first mineral described here more than a hundred years ago by the Finnish expedition headed by Wilhelm Ramsay in 1894. As a matter of fact, one could study the geography, history, culture of this land by the names of minerals discovered here.

Names of people who studied this area made history in the names of minerals, such as ramsayite (lorenzenite), hackmanite, fersmanite, labuntsovite, kupletskite, korobitsinite etc. The names of mountains, lakes, rivers and canyons of Lovozero and Khibins provided the basis for the names of minerals, such as imandrite, umbozerite, khibinskite, lovozerite, seidozerite, karnasurtite, tuliokite, vuonnemite, revdite. The Lapp culture and language are reflected in the names of seidite, penkvilksite, saamite, loparite, laplandite. The names of such minerals as nordite, arktite, murmanite, grumantite, terskite, tundrite speak for themselves. Specific mountain rocks also reflect the exotics of this area: khibinites, lujavrites, urtites. Mineralogists all over the globe are quite familiar with this land due to mineralogical terms. There is no other locality in the world where such a great number of minerals were described.

What is the reason for such mineralogical variety in this area? The fact is that here we see the largest massifs of alkali rocks found on the Earth's surface. Alkali rocks are quite rare formations. And, as for ultrabasic rocks of the types that are found here, the fingers on your hands are enough to count them. Ultrahigh alkali content spells high solubility of rare elements. Having dissolved practically all the

periodic table, the crystallizing alkali magma gave us all its mineral variety.

Many rare minerals would have never been discovered if ore exploration hadn't been conducted here. The surge of mineralogical discoveries in the early 1970s is associated with the mineralogical study of underground pegmatite veins which surfaced during ore extraction. The Yubileinaya pegmatite deposit of the Lovozero tundra is a mineralogical heritage site that has become famous as the place where a record number of new minerals, 13 of them, were discovered. The Shkatulka (Casket), Sirenevaya (Violet), Palitra (Palette) pegmatite veins and other veins of the massif surprise researchers not only with new discoveries, but also with record size of rare mineral samples which are found but in microscopic quantities at other places.

At present all major mineralogical museums of the world have unique collections of the Khibin and Lovozero minerals, and thousands stone connoisseurs come to this area every year to amplify their collections with the samples of extraordinary minerals which are quite rare for the most part. These minerals include famous enough astrophyllite, eudialyte, loparite, lorenzenite which are found in remarkable quantities here, and various mineralogical rarities which are known but in single samples, such as khibinskite, kukisvumite, izolueshite, tuliokite, perlialite, vlasovite.

The study of mineralogical rarities is interesting both from the scientific and from practical points of view. The new minerals may prove to be useful in industrial mineralization, or they could have unique structure and qualities which are technologically important. Take, for instance, lovdarite (its name means "the gift of Lovozero"), a mineral famous for its unique shape selective properties from the Yubileinaya vein of the Lovozero tundras – it was artificially produced by Japanese researchers.

Long-term studies of the Khibins-Lovozero system make it possible to suppose that the number of minerals which exist in reality, but have not been discovered yet, greatly exceeds the number of minerals which were found and described at present in the natural environment.

Gennady Alexandrov

Ivan Vdovin

The Shkatulka (Casket) giant pegmatite vein was exposed in 1990 at the Umbozero mining field.
It was one of the most brilliant mineralogical study milestones of the Lovozero massif which are known today.
The largest body of ussingite pegmatite in the world was given its name for the beauty and variety of rare minerals which often offer record effusions here.
Since this pegmatite vein is located at considerable depth, far from the surface, many rare minerals have survived in it undestroyed, untouched by erosion.
Two new minerals, shkatulkalite and litvinskite, were discovered here.

Ivan Vdovin

Grigory Ivanyuk

Congelations of sodium-containing opal which have appeared on the wall of the underground mine of the Karnasurt deposit in the Lovozero massif near the Yubileinaya pegmatite deposit are the clear evidence that the process of mineral formation is still going on in this ultra-alkali massif.

Striking accumulations of yellow vuonnemite, milk white large grains of chkalovite with pink tugtupite trimming, orange bunches of serandite and black umbozerite stars against the background of violet ussingite contrast with brown lomonosovite and green aegirine.

Grigory Ivanyuk

The zorite (pink) and the raite (gold-brown) in the natrolite from the Yubileinaya vein of the Karnasurt mine are among the most famous minerals discovered in the Lovozero massif.

Grigory Ivanyuk

Recently another unique polymineral pegmatite vein, Palitra (Palette), was discovered during tunneling at the Karnasurt mine.
More than 40 minerals were found in it at present. Many rare minerals have been found here in the form of very large crystals – clusters of natrosilite, for instance, are sometimes half a meter large.
But rare ultra-alkali minerals, such as bariolgite, kapustinite, kazakovite, manaksite etc, are especially interesting here.

Samples of the eudialyte from the Lovozero massif usually look different compared to the Khibins mineral of the same name.
The Lovozero eudialyte is brownish-red, its color resembling gore, while the Khibins mineral of this kind is crimson.

Gennady Alexandrov

Grigory Ivanyuk

Eudialyte (Lappish blood) in the apatite of the Kukisvumchorr deposit.

Samples of the Khibin eudialyte are striking and beautiful. They are used in the production of decorative caskets, brooches, pendants.
Eudialyte also forms one of the components of numerous kinds of rock in the Lovozero tundras. Eudialyte lujavrites are especially reach in this mineral, they contain about 10-15 % of it.
In his book titled *Memoirs about the Stone* Academician Fersman cites a legend about the war of Saami with "Swede" Kuiva: "And they started a real war, going after Swedes, some with shotguns, some with a knife, but the Swede was strong, he had no fear of Lapps.
At first he cunningly trapped our Lapps at Seidyavr and began to slaughter them. He strikes right, and ten our men fall, and drops of blood spluttered all the mountains, tundras and Khibins; he strikes left – and ten our men fall again, and again drops of Lappish blood spluttered tundras."
Saami defeated Kuiva who turned into a cliff standing over Seidozero, only red drops of Lappish blood (eudialyte) remained in tundras after that.

A mineral tour in the Khibins. Connoisseurs of stones come here from every corner of the globe to collect Kola minerals.

Grigory Ivanyuk

Gennady Alexandrov

Graphic granite (Jewish stone). The Rikolatva deposit.

The granite pegmatite resembles ancient Jewish writing in its appearance. Its astounding structure is determined by the fusion of two minerals, quartz and feldspar. Quartz is usually grey or white, rarely black, while feldspar is white, red, pink and green (amazonite).

The Kola Peninsula deposits of jewelry quality amazonite are the main source of this raw material in Russia.

More than a hundred amazonite containing veins have been discovered at the Kola Peninsula, and most of them are concentrated in the area of the Western Keivy. The largest of the discovered veins are on the Ploskaya Mountain and Parusnaya Mountain.

The amazonite vein of the Ploskaya Mountain is the largest amazonite vein in the world.

And the Parusnaya Mountain, famous for excellent samples of crystalline amazonite from its vein, was declared to be a natural heritage site.

The grass-green and blue-green high quality amazonite is used in the production of small decoration items and stone carving products.

The ground amazonite is used as decorative material by the construction industry.

Amazonite rocks in the quarry of the Ploskogorskoye deposit.

Victor Grishin

Konstantin Kobyakov

Deposits of the violet quartz, amethyst, were found in the extensive territory of the Tersky shore, from the Cape Tury to the mouth of the Ponoy River.

Amethyst druses are found in the cracks of red-color sandstones. Amethyst crystals may be of various hues of violet color, and their size may vary from several millimeters to 2 centimeters.
Quarts druses of other colors, such as orange, smoky, black (morion) are also common enough. Besides quartz, accumulations of fluorite, barite and calcite are also found quite often on the walls of cracks of the Tersky sandstones.

The cliff which gave its name to the Mys Korabl (Cape Ship) amethyst deposit. Recently a small bird colony appeared on it, which is not quite common for the White Sea.

Gennady Alexandrov

Konstantin Kobyakov

The breccia of Tersky sandstones.
Some time ago tectonic processes crushed these sandstones, and later empty space between the sandstone fragments was filled with quartz cement of high-temperature solutions circulating in the rock.

Fragments of red Tersky sandstones are common along the coast of the Kola Peninsula among the littoral boulders.

Konstantin Kobyakov

The amethyst from the Mys Korabl (Cape Ship) deposit.

The Kola amethyst is characterized with surprisingly even color of equally developed crystals forming druses on reddish-brown sandstone.
Wide specter of colors, strong base helped amethyst from the quartz veins of the Tersky shore find a worthy place among the decorative stones of Russia. Amethyst is not mined at the Tersky shore at present. A natural heritage site was established at the territory of the Mys Korabl deposit.

Gennady Alexandrov

Mineral Deposits

The Murmansk region is one of the most developed mining areas of Russia. Here, in the area covering less than one per cent of Russian territory, major deposits of crucial mineral raw materials are concentrated, a powerful mining industry was created to meet a considerable portion of the country's demand for phosphate ore, phlogopite, vermiculite, muscovite, nepheline and ceramic ore, iron, baddeleyite, nickel, copper, cobalt, niobium, tantalum, rare-earth metals. The extraction and processing of mineral resources form the base industry of the Murmansk region economy. Other branches of economy, such as power generation, transport, social sphere, are mainly aimed to provide for the activity of the mining and metallurgic industries whose produce comprises 50-70 % of the industrial production of the region.

Major deposits of the apatite ore in Russia are concentrated in Murmansk region. They are mainly focused in the Khibins and around the town of Kovdor. The production of phosphorous fertilizers is based on the Kola apatite concentrate. 10 deposits of apatite ore have been explored in the Khibins, and the extraction of ore is conducted by four mining enterprises at six deposits with the use of both open-cast and underground mines. Since 1930, during all the history of the Khibins mining, 1575 millions tons of ore have been produced. Apatite is extracted together with iron ore at the Kovdor deposit. Today the Kovdor ore-mining and processing enterprise have launched the use of a man-caused deposit, its own waste of previous years rich in apatite.

The Murmansk region comes second in Russia in the deposits and production of sulphide copper and nickel ore. Ten deposits of this kind were registered; all of them are located at the Pechenga area. When the prices of the end produce of the industry are high, it uses local lean ore, when the prices are low, it adds imported shipping ore. The end produce of metal works is nickel, copper, cobalt – the demand for it is high at the internal market and abroad. Concentrates of precious metals, such as gold, silver, and of the platinum group metals, extracted from copper and nickel ore as by-products, are processed by the factories located outside this region.

Eleven deposits are the source of raw iron ore, five of them are exploited now. Two enterprises conduct the extraction of ore at five quarries.

Igor Ryabkov

The OAO Olkon is mining ore at the deposits of the Olenegorsk ore district, the OAO Kovdor GOK works at the Kovdor deposit.

The Lovozero massif of the Murmansk region is the only place in Russia today where such rare metals as tantalum and niobium are mined.

The region holds a leading position in the country in the deposits and production of quartz and feldspar raw material for fine ceramics. The Kola quartz-feldspar raw material is used at the factories of Russia and other CIS countries to produce decorative and household porcelain and faience, and electrical porcelain.

The Kovdor deposit of vermiculite and phlogopite is the largest in the world, containing 85% and 78% of Russia's resources of these minerals respectively. Their deposits will last for several hundred years, and practically all the extraction of this ore in Russia is based here. Mica concentrates are supplied to mica factories, metal and tyre plants of Russia and exported to other countries.

The reserve deposits which are not planned to be used yet include the largest in the world Keivy kyanite deposits, lithium deposits of the spodumene pegmatites of the Kolmozero, eudialyte (zirconium) deposits of the Lovozero tundras.

Recently geologists discovered new kinds of mineral deposits. Geologists study them and prepare for extraction. These deposits include chrome near Monchegorsk, titanum near the Murmashi settlement, platinum and palladium in the Fyodorovo-Panskiye tundras. Intensive exploration of diamonds is under way. Two kimberlite pipes with poor diamond content have already been discovered at the Tersky coast in the middle course of the Yermakovsky Creek.

Murmansk region also has considerable, but hardly explored yet deposits of cap-stone and decorative stone. Besides the famous amethysts of the Mys Korabl at the Tersky coast and amazonite veins of Western Keivy, abundant sources of unique collection quality raw material and decorative stones are found in the Khibins and Lovozero massifs of alkali rock, Western Keivy, Kovdor massif, Pechenga copper and nickel deposits.

The Tsentralny (Central) mine of the Zhdanovsky deposit.
Pechenga mining district.

Gennady Alexandrov

Copper and nickel ore (ore phyllite) of the Kotselvara deposit.

Gennady Alexandrov

A rib of copper and nickel ore in amphibolite.
The Vostok (East) deposit.

Mikhail Borisenko

Slag dumps of the Tsentralny mine.
It is one of the last old pines which survived in the neighborhood of the Pechenganickel works tailing dump.
A new growth of young pines has already appeared. This has become possible after the metal works started to use low-sulfur local ore and cut pollution.

Mikhail Borisenko

Ore transportation in the underground mines at the Severny (Northern) mine of the Pechenga deposit. The underground pit has already gone deeper than 700 meters.

The quarry of the Kovdor iron ore deposit. The quarries of vermiculite and phlogopite deposits are in the background on the left.

Eight minerals of industrial value have been found in the area of Kovdor massif. They include magnetite, baddeleyite, apatite, calcite, dolomite, forsterite, phlogopite, vermiculite.
They are mined at five commercial deposits containing complex baddeleyite-apatite-magnetite, phlogopite-vermiculite, of apatite containing carbonatites, olivinite ore and apatite-staffelite ores.

The kovdorskite is a mineral named after the mountain massif. It has not been found anywhere outside it.

Grigory Ivanyuk

The wall of the Kovdor iron ore deposit quarry. Light veins of dolomite carbonatites in phosphorites are visible. 12 new minerals were discovered in the veins, and 9 of them have not been found anywhere in the world outside the Kovdor massif. More than 180 kinds of minerals were found in the massif all in all.

Due to inconsiderable thickness of loparite ore stratum, mine shafts of the Karnasurt mine are usually less than 80-100 centimeters high. It is impossible to walk here. The shaftman has to crawl on his knees in the working face.

Grigory Ivanyuk

The loparite – a mixture of sodium and titan and niobium, rare earth-elements, – is extracted in the Lovozero Mountains at two mines: Karnasurt and Umbozero.
This mineral forms tiny hemitropal crystals of black color with the sectional view resembling the Star of David.
Thin, up to 30 centimeters, veinlets of malignite also contain loparite in the Lovozero massif.

Grigory Ivanyuk

At the foot of Karnasurt Mountain the mine with the same name is located.
In the Saami language Karnasurt means the Mountain of the Crow Wing.
Industrial exploration of the Lovozero tundras started in this area, and formerly a workers' settlement Ilma named after a picturesque lake was situated near this mine.
Hard climate conditions at the foothills of the Lovozero tundras made first settlers move to the forest zone where the Revda settlement appeared.

Grigory Ivanyuk

The quarry of the Tsentralny mine of OAO Apatite. Rassvumchorr Plateau was here some time ago…
The general height of terrain here went down for more than 500 meters during 40 years of apatite extraction – about 600 million tons of ore were produced here.

Igor Ryabkov

Since the basic deposits of apatite which could be stripped at open casts are gradually going down underground mining covers an increasing portion of ore production.

The blow of striped apatite-nepheline ore on the wall of the Kirovsky mine quarry of the Kukisvumchorr deposit in the Khibins.
The apatite, natural calcium phosphate, is also called the stone of fertility.
The apatite concentrate serves as basic raw material for the production of phosphate fertilizers at the territory of our country and former Soviet republics.
The nepheline, sodium and potassium aluminosilicate, is used in the production of alumina, soda, potash and cement. Industrial demand for it makes up millions of tons, and it can be fully met by the production of the apatite-nepheline ore at the Khibins deposits.

Grigory Ivanyuk

Grigory Ivanyuk

Titanite (brown) in apatite (light green) and in nepheline (deep green).

As a rule, mineral titanite (sphene), a natural calcium and titanium silicate, is present in rock as dispersed grains. It does not form independent deposits anywhere in the world, except the Khibins massif.
A considerable quantity of titanite is also found in the extracted apatite-nepheline ore which can produce a concentrate of it with more than 30 % titanum dioxide.

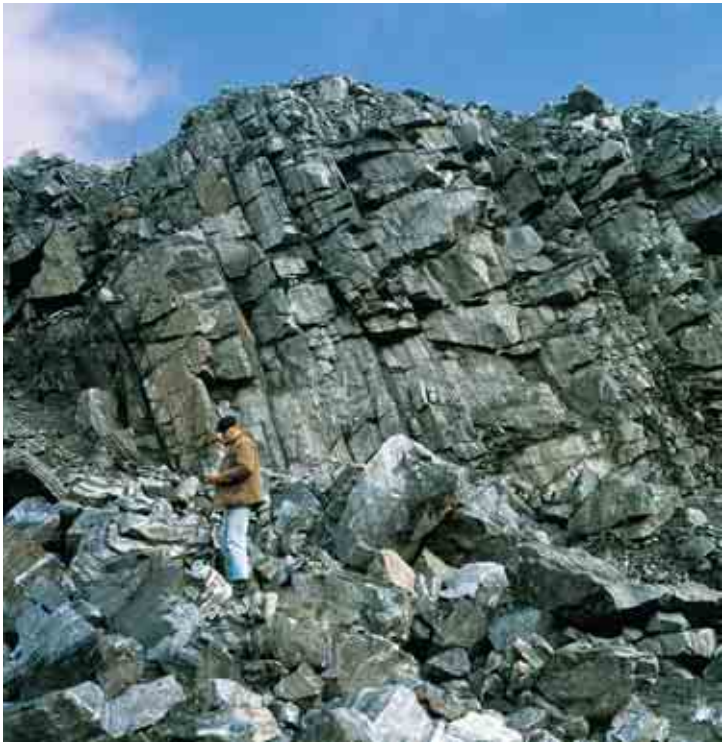
Spotty apatite-nepheline ore of the Kukisvumchorr deposit.
Sugar-like apatite features spots of effusions of pink-brown titanite and brown aegerine diopside.

Gennady Alexandrov

Grigory Ivanyuk

Puckered ferruginous quartzite.
The 15th Anniversary of October deposit.

The outcrop of sulfide-magnetite ferruginous quartzite on the wall of the quarry of the iron ore deposit named after the 15th Anniversary of October.



Grigory Ivanyuk

The quarry of the Olenegorsk iron ore deposit.

Gennady Alexandrov

Silver Island

The Medvezhy Island (Bears' Island) in the White Sea has retained a fame of a silver island.

Local Russian Pomors knew about it long ago. As far back as in the 17th century they secretly sold silver nuggets from the Medvezhy Island to the monks of southern monasteries. Yet, they hid the deposit from the authorities fearing that they would be forced to work at silver mines.

Their fears were justified; it happened so when the government learned after many years where the secret island was located. The "eternal" workers of the Petrovsky plants were permanently attached to mining works, and peasants of local villages, such as Umba, Kandalaksha, Varzuga, had to spend shifts at the silver mines.

The mine with a speaking name of *Give us Luck, our Lord* was the most productive but the working conditions there were the most unbearable and miserable. Workers tried to escape from the island, but they were caught. The silver fever had thrilled Russian Pomorye for eight years. To the Pomors' luck, it ended in 1740, when the land deposit was exhausted and the silver vein escaped into the sea.

All in all 736 kilogram of silver were produced at the Medvezhy Island during the mining period.

Gennady Alexandrov

The cliff on the north-east cape of the island has an unusual for the North name of Grek (Greek). The hopes of people and signs of the epoch were reflected in the names of mine pits: Two-Headed Eagle; Boyarynia (Lady); Hope; Luck; New Luck; Give us Luck, our Lord.

Gennady Alexandrov

Gennady Alexandrov

Lapland Factories

Picturesque area near the mouth of the Rusinga River and Three Islands in the Gorlo of the White Sea was a place of suffering in the past.

It is hard to believe that during the rule of Anna Ioannovna and Yelizaveta Petrovna copper mining plants as large as the Ural plants were constructed here, in this almost unpopulated, even at present time, land.

Hundreds of people were brought into remote tundra from the Arkhangelsk Gubernia, about a thousand people were awaiting their fate in the villages attached to the plants by the tsar's decree. Labor at the mines was unbearably hard, the production of ore was low, the deposit proved to be insufficiently explored.

During ten years of work the ore extracted at the Lapland factories helped produce just 2,016 kilogram of red copper. The remains of mine pits have survived till our time at the coast.

Gennady Alexandrov

Gennady Alexandrov

Rusinga is a modest creek in its upper course. It's the tide that makes it a majestic river in its lower reaches.

Gennady Alexandrov

Will the Forest Cover Wasteland?

The areas damaged by the industrial waste of "Severonickel", "Pechenganickel" enterprises, by the mine dumps of the Apatite mining and processing works arouse grave ecological concern. Devastated by sulfurous anhydride pollution and ravaged by fires and logging, territories around the towns of Monchegorsk and Nickel form bizarre deserts. About 0.2% of the Kola forests were damaged, i. e. transformed into man-caused wasteland, and 2% of forests suffer from pollution to a certain degree. Traces of various chemical elements and compounds resulting from the activity of the above-mentioned and other industrial enterprises can be found practically at all the territory of the western part of the region, and their effect on the ecosystems of the area has not been sufficiently studied yet. To restore vegetation on the damaged and polluted lands is a difficult task, since these lands are located in the area of continuing industrial activity. This task is made even more difficult by the natural and biological complications of the subarctic zone where the restoration of environment is an extremely slow process even in favorable conditions.

Due to the transition to low-sulfur local ore extracted at the Pechenga deposits and to environment protection measures the pollution from the exhaust of metallurgical works have gone down by one third since last five years. The "Severonickel" and "Pechenganickel" works started the modernization of the technological process and the restructuring of productive facilities, and this is going to reduce pollution. Experiments are conducted to plant grass and bushes at the "Monchegorsk wasteland".

Dust generation at the barren rock dumps of OAO "Apatite" pose a serious ecological problem. Summer "dust-storms" have become common in the town of Apatity. Enterprise experts are working to reduce dust generation at tailing dumps and to fix their surface with vegetation. Extensive man-caused deposits are found in the Kovdor area. The Kovdor ore mining and processing enterprise OAO has launched large-scale processing of these deposits to produce apatite and baddeleyite concentrates.

The so-called Kuzomenskiye sands in the mouth of the Varzuga River may serve as an "ecological lesson" to our descendants. They were produced by loggers in the 19th century. The coastal ecological systems haven't managed to survive and restore themselves after logging and fires, sands haven't been covered by vegetation, and now winds blow them in every direction, gradually covering the old village of Kuzomen (which means "fir-tree cap" in Finnish) with a layer of sand.

Andrey Harlov

A cemetery covered by sand near the Kuzomen village

Konstantin Kobyakov

Mosses belong to the plants which are the least sensitive to acidic precipitations. Lichens disappear first, they are sensitive even to low quantity pollution, and then higher plants go.
Mosses can be found in wet places even in the center of wasteland.

Konstantin Kobyakov

4

People and Nature

Life Rested on Nature and Traditions

First People

Who Made Pictures on Rocks?

Mystery of Labyrinths

People Descended from Reindeer

Domestic or Wild?

Land of Spirits

Sacred Lakes

First Slavs

Pomors' Daily Life

Pomor Traditions

Cultural Landscape

Where Pines Don't Grow

Ponoy Is a River and a Village

Sirens, Bugles, Howlers...

These pictures, or "*pisanitsy*", were found in the Rybachy Peninsula. They were painted with mineral ochre on 6-th millennium B.C.

Vladimir Kuznetsov

Life Rested on Nature and Traditions

People have been living in the Kola Peninsula for more than eight thousand years. For a period of this time the relations between a man and nature have been established differently. It is obvious, that people's influence on the environment became evident only last century.

Since the most ancient times, alongside the consumption of resources a man strove to understand the outside world, explain symbolically conformity to natural laws, and necessity of a zealous attitude to nature.

Rock paintings, labyrinths, Sámi seids, Pomor crosses and chapels not only blend in with the landscape, but they are distinctive "meeting points" of human and natural. Here, as in the focus of the lens, the realization of interdependence with nature, characteristic of this or that culture, is refracted.

Thus, rock paintings show hunt scenes and depict dozens of animal species that played the greatest part in the people's life.

Vladimir Kuznetsov

Ivan Vdovin

Reindeer and bear cults, traced historically further to the Sámi, found their reflection in the rock paintings of the Kanozero and Chalmny-Varre. The paintings themselves have a distinctly ritual character and might serve as a place to worship nature forces.

The Sámi, the first historically well-known population of the Kola Peninsula, had a wide-spread tradition of revering seids. Contrary to man-made rock paintings and labyrinths, seids were revered rocks, cliffs, lakes. The cult of the objects not touched with a man's hand raised a particular respect to them and nature, on the whole. Reverence for them goes back to great antiquity. Perhaps, those people who left rock paintings and labyrinths worshipped seids.

The Pomors, the Russian population of the Kola Peninsula that appeared there in the Middle Ages, worked out themselves or adopted from the local residents traditions of careful use of nature and reverence for it. The Pomor crosses, contrary to natural revered seids, sanctified the place by themselves. They were put as a gratitude for a good catch, rescue, they helped to find one's bearing on the ground. The Pomor chapels and crosses are frequent landmarks of ancient worship places.

In what way have the relations of people to nature been built? Why do people's activities of the past or a traditional economy of the present-day Sámi"blend in with the landscape" more harmoniously, than the ways of contemporary resource consumption? Probably, looking closely at the relics and traditions of the past we will find some of the answers to these questions…

Vladimir Kuznetsov

First People

A lot of landscapes in the out-of-the way corners of the Kola Peninsula seem primeval. For a long time there existed a concept that people inhabited our harsh territory a relatively short time ago. The first researchers didn't find any traces of people, living here in ancient times. Thus, Aleksandr Ivanovich Kelsiev, collecting materials for an anthropological exhibition in 1877, wrote: "I traveled from Sosnovka northwards along the bank… Except heaps of rocks and two evident "*chudsky"* holes… the bank doesn't produce any prehistoric artifacts. After all researches I can say with conviction, that there are not any of them here." And only in the second part of the 20-th century were sufficiently complete archeological researches carried out and they gave an idea of what the life of people in ancient times was like.

It became clear, that people followed the retreating glacier. Its catastrophically fast destruction started about 10 000 years ago. The northern coast of the peninsula, that had thawed out earlier, was inhabited first. The main source of life was the sea: seal hunt, marine gathering. The settlements were small and temporary, the tools were quite primitive. In the later part of the Stone Age, 6000-4000 years ago, the character of nature use changed somewhat. The significance of fishing increased. At the time the people began going over to a more settled way of life.

In the early part of the Metal Age, 4000-2000 years ago, the population became more mobile. On large boats people opened not only the coastal area but also inland parts of the peninsula. The life of the people was vividly reflected in the rock paintings, that they left throughout Northern Europe, from Norway to Karelia and the Kola Peninsula. They had perfect equipment for hunting sea animals and fishing and built many-oar boats. Subsequently, the traditions of sea hunting and boat building were lost to a greater extent. There isn't still a definite opinion of reasons for that.

Vladimir Kuznetsov

Rock carvings, the Kanozero lake.

Yury Ivanov

Neolithic tools, the Drozdovka bay.

On the coast of the Kola Peninsula and along its main waterways in its central part there are hundreds of well-known sites dating back to different epochs. Particularly numerous are Neolithic sites and sites of the early part of the Metal Age. Some of the sites on the eastern Murman have been well preserved, and they look as though people have left them only recently.

There are still ashes and coals in the hearths; the fire, however, went out there several thousands years ago. Tools made of quartz or shale can be found on the sites. Tools made of silicon are rarer, they are indicative of an exchange with other tribes, because there are not any outcrops of quality silicon on the Kola Peninsula, so it was imported.

Konstantin Kobyakov

Vladimir Kuznetsov

Who Made Pictures on Rocks?

One of the most reliable evidences of ancient people's life and views is rock paintings or carvings. Pictures engraved at the rocks scientists call petroglyphs. Two large assemblages of such pictures are found on the Kola Peninsula: on the river Ponoy in the village of Chalmny-Varre, on Kanozero lake in the middle part of the river Umba. There are also ancient pictures painted with red ochre in the Rybachy Peninsula, so called *"pissanitsy"*. All these assemblages of paintings are declared to be monuments of culture.

Rock paintings blend in perfectly with their surroundings. In opinion of many researchers it is a landscape together with a complex of the paintings that is the most ancient temple, a place for people to worship nature and make magic ceremonies. The subjects reflected in the Sámi (Lappish) legends: reindeer and people that remind you of the stories about a deity of hunt and Sámi's (Lapps') forefather Myandash who was a reindeer and man, are carved on the rocks of Chalmny-Varre and on the cliffs of Kanozero.

There are pictures of "flying reindeer" (a reindeer in a jump-flight), "shamans" the head adornments, looking like antlers or reindeer's and elk's heads, and also people (? shamans), holding in their hands magic staffs with the tops shaped as an elk head. Sea boats were decorated with an elk head. A bear cult practised by many peoples of the North, probably, found its reflection in the bear hunting scene. Hunter's chasing a bear is shown in the picture with deep knowledge of animal's habits. There are separate large pictures of the animal's tracks. The people often hold various animals and birds in their hands or touch them. Scenes of hunting sea animals (whales and white whales) are frequent.

A lot of paintings of animals were done with great care, this states they had some special symbolic meaning for the people and were, perhaps, totems. These pictures are, as a

rule, on a noticeable spot; they are of large sizes, deep carving and are not intertwined with the subject scenes; a unique figure of the beaver is, for example, of that kind. This animal, by the way, has disappeared from the Kola Peninsula through a man's fault. Importance of some pictures of animals is emphasized with geometric figures and abstract symbols. In addition to the above mentioned animals, there is a fox, squirrel, snake, lizard, crane, duck, goose, partridge, pike, salmon and "sturgeon" in the paintings.

More than 500 paintings of Kanozero have been discovered. The figures differ in their style, ways of doing them, sizes and depths of their carving on the rocks. According to these peculiarities paintings date back to the Stone Age, the early part of the Metal Epoch or the Middle Ages. Analogues of some ancient paintings of Kanozero can be seen in other corners of Northern Europe: from Onega Lake and the White Sea coast in Karelia to the shores of Sweden and Northern Norway. The latest splash of rock creativity was…at the end of the 20th century: inscriptions-"visiting cards" made by sailing tourists, who camped there on their route. Unfortunately, these primitive inscriptions fatally damage the masterpieces of ancient art.

Kanozero rock paintings were discovered during a tourist sailing down the river Umba. By good luck, there was a museum worker in a rafting team, and he managed to see a hand-made piece of work among lichens and cracks. But people, who lived in the neighboring village, didn't have the faintest idea about existence of these paintings, to say nothing of numerous tourists, who had been there before. If we look at the rocks closer when traveling in the wilderness, it may well be, that some more rock paintings will be discovered on the Kola Peninsula.

Vladimir Kuznetsov

Vladimir Kuznetsov

At the beginning of July 1997 a local lore museum in Revda organized rafting down the river Umba. Its participants didn't aim at making any discoveries. On the fifth day of their journey, pulling on Kanozero Lake, the members of the expedition approached a small island, on a steep shore of which a monumental inscription "ТАМБОВЪ" could be seen from afar, and also a lot of other ones, less garish, made by aquatic tourists. Up to that moment nobody supposed, that a few thousand years ago these rocks aroused people's desire to immortalize their art on them...

On the rock paintings of Kanozero you can see many-oar boats, on such boats ancient people opened up the sea shore and rivers of the Kola Peninsula.
They hunted white whales and even bears from the boats.

Vladimir Kuznetsov

To photograph paintings, the archeologists sometimes either draw them with chalk and ash or use an easily washed off paint.
In the distant past the ancient artists, perhaps, also colored their pictures with some natural paints or dyes like ochre to make them noticeable.

Vladimir Kuznetsov

Yury Ivanov

Vladimir Kuznetsov

Under strait beams of sunlight some of the paintings can be seen, if pored with some water.
The relief of the pictures develops not as shadows under slanting beams of light, but as patches of sunlight on the most prominent parts of the paintings.

Rams' foreheads of the cliffs on the Kanozero islands, where the paintings were found, are made up of very soft rocks-porphyry metasamotity and metapyroksenity.
That is why, you can't walk there in shoes and put heavy things on them, and what is more, you can't start a fire on the rocks.
The Kanozero petroglyphs are in an urgent need of competent protection, otherwise this monument of world importance will simply disappear before our very eyes.

Vladimir Kuznetsov

The petroglyphs are considerably damaged by the graffiti written by numerous water tourists sailing on the Umba.
Even today, after placing a special table on granting this area a status of a historical and cultural monument,
the tourists engrave their inscriptions right over the petroglyphs, irretrievably destroying ancient pictures.

Mystery of Labyrinths

Researchers are still discussing, what is the purpose of the labyrinths made up of small rocks and found by the sea all over Northern Europe. The best-known labyrinths of the Kola Peninsula are located in the mouth of the river Ponoy, near Kandalaksha, close by the mouths of the rivers Umba, Varzina, Kharlovka. The labyrinths date back to III-II millenniums B.C. Sometimes "Arctic Neolithic" sites are found nearby. The labyrinths are shaped into a double or, more rarely, ordinary spiral, sometimes with a stone in the middle of it. Their creation is ascribed by folklore in England to the druid priests, in Sweden and Norway to the dwarfs and trolls. In Northern Europe they were also called "fairies' dances", "St. Peter's dance", and on the White Sea – *vavilons* (babylons). The pictures of the labyrinths are widely-known on the artifacts of Crete culture. According to a legend, it was in a labyrinth on Crete, where monster Minotaur lived, and to whom human sacrifices were offered. A ritual purpose of the labyrinths is traced in this myth. May northern labyrinths of the Kola Peninsula have been places of offering sacrifices, gigantic altars built by the ancient people?

Konstantin Kobyakov

There is one more hypothesis. In the mythology of the ancient people the northern labyrinths could have been connected with a funeral cult: following the coils of the spiral souls of the dead went down to the underworld and could not return to the world of the living, because of the intricacy of the babylon's passageways. And an every day hypothesis of the purpose of the labyrinths says that they were models of sea snares for fish.

Vladimir Kuznetsov

The spirals of Umba labyrinth are well observable while other labyrinths are overgrown and lost in the course of time. That happened to a labyrinth in the village of Ponoy. In the 19-th century there was its detailed description in literature, but in the middle of the 20-th century the villagers had dim memories of it. On the lawn of the labyrinth the children played games, suspecting nothing about its existence.

Gennady Alexandrov

Kandalaksha maze is located close to the town and is often visited but once the Pomors, who took their “babylon” zealously, hid it from strangers. There are, all in all, about ten well-known mazes (labyrinths) in the Murmansk region and Karelia. And many more of them, several dozens, were found on the Solovki (the Solovetskie islands).

People Descended from Reindeer

The time, when the Sámi people (the Lapps) came to Kola land, is lost under the cover of centuries. Were they authors of the oldest petroglyphs or did they paint only the latest rock paintings? As regards this, discussions are still taking place among the archeologists. However it may be, the Sámi (the Lapps, Lopari, Laplands) appeared on the Kola Peninsula after the glacier thaw, but earlier than any other people known at present.

The neighboring people and European travelers pictured the life of the Lapps as incredibly hard. Gloomy Pokhela, inhabited by magicians, the land of cold and gloom, is mentioned in the famous Karelian-and Finnish Kalevala epos. According to the works and pictures of the European travelers the Sámi then hunted with a bow and arrows, fished, drove reindeer harnessing them to the sledge looking like a boat *(kerezhi)*. The most important myth of the ancient Lappish culture narrates about the relationship of a person and reindeer. A woman married a deer and a man-reindeer originated from their marriage, it was Myandash – an ancient deity of hunt. The Sámi worshipped Myandash and offered him sacrifices. As historical sources say, the Lapps lived by means of hunting (including reindeer hunt) and fishing in ancient times. Gradually reindeer-breeding began playing a more important part. Whether it was brought in or arose in that area, it is also a mystery. The hunters lay in a wait for reindeer on their migration paths, then they learned to catch young deer, domesticate them and use for sledging loads when moving from place to place. With their own reindeer it was more convenient to follow migrating herds. In the course of time a herd passed into the possession of a separate person who marked their ears with a special brand. Perhaps, it was how a method of partly free pasture appeared. The travelers of the last centuries noted that, most likely, the Sámi followed reindeer and

not vice versa. It was environmentally grounded: semi-wild animals, migrating on their natural paths, would better feed themselves and with less probability they would "overuse a pasture" as the most experienced herdsmen could have done. But the herdsmen guarded the herd against wolves, cared for sick animals, helped fawn. The most placid reindeer were used to take belongings and people from one place to another. On the sites, where people stayed frequently and for a long time, they made a *vezha*, a semi-dugout covered with turf or bark. For brief stays a portable dwelling consisting of poles and skins, *kuvaksa* – a Lappish chum, was used.

The Komi reindeer herders, who together with their reindeer and the Nenets herdsmen crossed the narrow entrance of the White Sea at the end of the 19-th century, influenced greatly the ways and every day life of reindeer-breeding. Under the Soviet power reindeer passed into the possession of the people, the government program of transition from a nomadic to settled lifestyle was implemented. Instead of temporal seasonal *pogosts* villages were founded and every village was a kolkhoz (a collective farm). As a result of the amalgamation of collective farms there were only 3 collective reindeer-breeding farms in 1960-s. Many small settlements and almost all pogosts were deserted. Today the main districts of residence of the Lapps are Lovozersky and Kolsky, the largest settlement and the center of the Sámi culture is the village of Lovozero. Beside the Lapps the Komi, Nenets, Russians work in the deer herding teams. A present day reindeer-breeding is wooden huts and tarpaulin chums with stoves, cross-country vehicles and snow-mobiles to get to a herd, radio or television for leisure. In the summer reindeer graze freely. By the winter they are gathered in deer enclosures, counted, a part of them is slaughtered. Reindeer meat is popular in Scandinavia. But the life of a reindeer-breeder is not easy as in former times.

"From behind of Kamenskoe, from behind of Imandra, out of the inside of a hardened land Myandash is running – a reindeer. Myandash-pyrre is his name... Myandash-pyrre is the beginning of life in the area. From one edge of the earth to its other edge, from the beginning of not our bounds Myandash-pyrre is running. His way is the way of the sun, he is to run hither. Myandash-pyrre is flying, a reindeer with golden antlers! As white as snow he is running from behind of faraway Lymandry, from behind of Norway, is flying straight to Kamenskoe Nizhnee Lake. His hooves got dirty – and he didn't like that land, didn't love that water. He ran to Syivyn. He stood up on a steep rock. It is here!"...

Vladimir Kuznetsov

Vladimir Kuznetsov

There are about 2 million head of domestic reindeer in the world. Almost two thirds of them are in Russia.
In the 20-th century a total of domestic reindeer ranged from 50 to 80 thousand in the Murmansk region and now it is 60 thousand head. Former collective farms, transformed into agricultural production cooperatives "Tundra" and "Reindeer-breeder", are engaged in deer herding. Beside them there were created 10 Sámi communities aimed at reindeer-breeding and other traditional crafts.

Vladimir Kuznetsov

Reindeer existence depends on reindeer moss. This name unites a group of very small light green, grey, yellow lichens that grow very quickly and often produce a dense lichen cover in the forest or tundra – a real "reindeer moss carpets".
First of all they are species of the genus *Cladonia* – the reindeer cladonia *(Cladonia rangiferina),* the alpine and the forest cladonia *(C. alpestris, C. sylvatica),* and some others. In wintertime these species of lichens are the only accessible feed for reindeer, they dig them out with hooves from under the snow. It turns out easier with a group of deer than a single one. Therefore even wild reindeer get together into small herds.
In the summer reindeer nutrition is more various, it feeds both on grass and new leaves in the trees. The Lapps say a reindeer likes mushrooms best.

Reindeer herders are very anxious to preserve pastures. Once the Sámi believed that to strip the earth, remove a layer of the moss or grass was a mortal sin. Even if a reindeer took off a large piece of the moss lichen carpet, they asked the earth for forgiveness.

Vladimir Kuznetsov

Until the end of the 19-th century reindeer-breeding was spread in all of the territory of the region, in the 20-th century, however, with an industrial development it was forced out to the eastern part, mainly to Lovozersky district.
Only small reindeer herds are pastured in Kovdorsky, Kolsky, Pechengsky districts.

Vladimir Kuznetsov

Ivan Vdovin

Ivan Vdovin

Vladimir Kuznetsov

In the 18-19-th centuries a *vezha*, a low semi-dugout with a conic roof covered with turf, was rather a spread dwelling of the Lapps in the places for their long staying. After adopting Russian population's custom to build a log frame of the house, the Sámi kept their traditional construction with a hearth location in the center and an opening for smoke over it. One of the last existing today vezhas was discovered in the district of Nizhne-Kamensky pogost on the Ponoy and now it is in the museum of Revda. And even at present-day it is a *kuvaksa* that is a commonplace dwelling for a short staying in the tundra. But now it is more often called in Komi – a chum, and it is covered not with reindeer skins but with tarpaulin.

The third issue of Arkhangelsk Diocesan Church-Archeological Committee of 1896 says, "5 *verstas* (one *versta* is 3,500 feet) away from Lovozersky pogost there is a decrepit chapel *In the Name of the Birth of Christ*, it is unknown when and by whom it was built." It is amazing but the chapel erected in the out-of-the way place has been preserved till present time. Today it is the only old cult Orthodox building on the territory of Lovozersky district. Due to the brand on the logs it became possible to ascertain the builders of the chapel. As it was found out that was a patrimonial brand of the Lapps by the name Sharshiny whose descendants live in Lovozero and are going to restore the chapel.

The first baptisms of the Kola Sámi took place in the 16-th century and they were prepared by the devoted Christians whose missionary activity can be called a spiritual heroic deed. One of them, for example, was monk Pheodorith (1481-1571) from Solovky. For 12 years he lived as an ascetic among the Lapps, having learned their native tongue and traditions, preparing them gradually to Christianity. Later he founded the monasteries in Kola and Kandalaksha, wrote works on history of Lapland and Karelia, he was a tsar envoy to Constantinople, and brought the Patriarch's blessing to reigning for Ivan the Terrible. The monasteries founded by him were the only ones that didn't have any ancestral lands and didn't profit, the prosperity depended entirely on the brethren's labor.

Ivan Vdovin

Ivan Vdovin

Domestic or Wild?

Deer live not only in the tundra, but it is there that the herds of domestic and small groups of wild reindeer are the most noticeable. If you aren't a specialist, you can't tell a domestic reindeer from a wild one, but wild reindeer are taller and larger. Domestic deer have brands on their ears.

Natural ways of reindeer migration were disturbed after the construction of the railway to Murmansk. Breaking a main line caused extinction of the most population of wild reindeer and, in fact, traditional "wild deer" hunting was destroyed.

Wild reindeer are considered to be concentrated mainly in the Lapland Reserve, it was founded to protect them, and also in Tersky Keivy. The reindeer, you come across in some other places, are, perhaps, domestic ones that had run away. But these animals are grazed other than cows.

In old times the Lapps really followed a natural seasonal reindeer motion: in the summer seawards to the tundra, and in the winter to the forest-tundra. Later on they started an originated in Komi system of pasturing with guarding when the guard dogs helped the herders to direct the movement of the herd. Currently, in summer time traditional free pasturing is practised: it is more profitable, though there is some loss from poaching.

A domestic reindeer is a very wary, in fact, half-wild animal. Roads, even temporal ones, crossing reindeer pastures, people and machinery working in this area can hinder essentially their pasturing, to say nothing about the danger of poaching by the sides of the roads. That is why the native peoples' communities are against any projects that change considerably nature habitat in the deer pastureland area.

Vladimir Kuznetsov

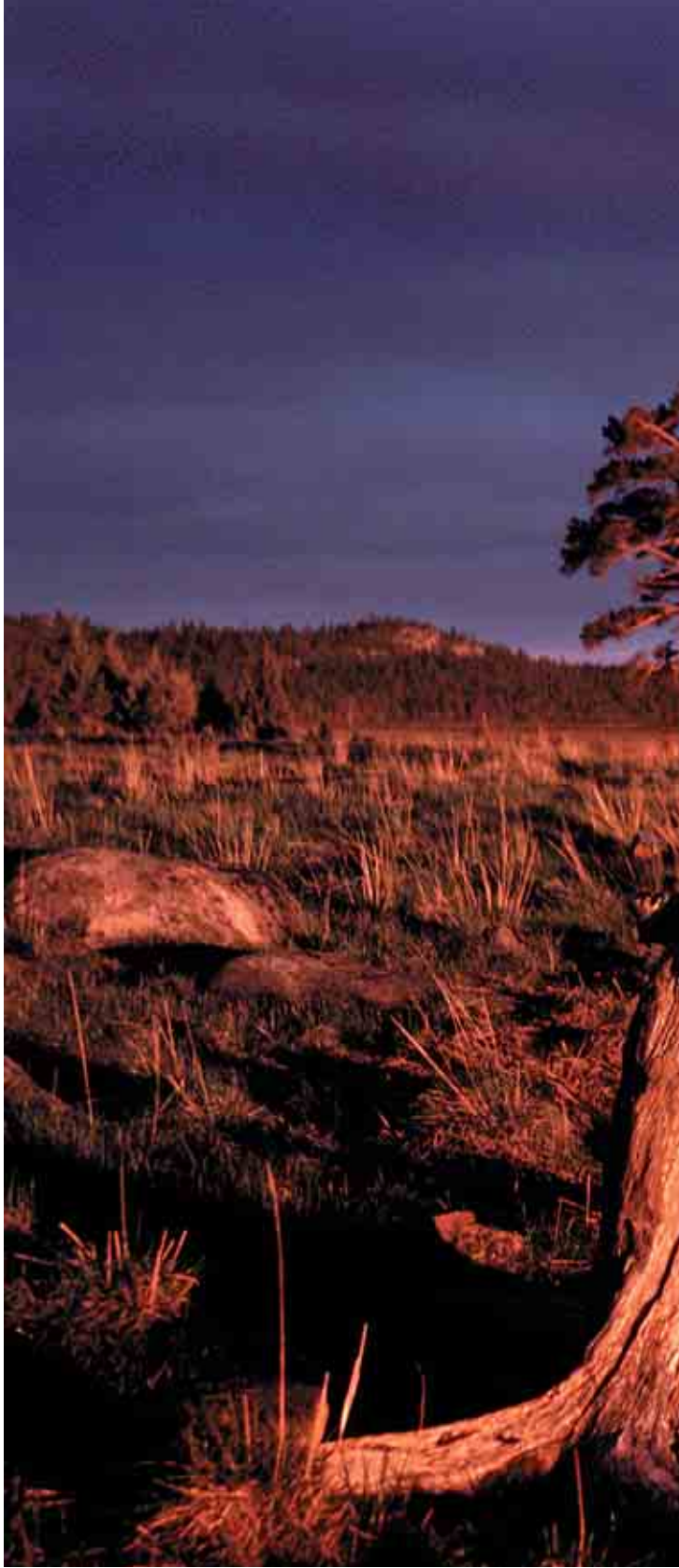
Land of Spirits

Admiration for the beauty of a northern landscape is sometimes accompanied by the feeling that this land… does not belong to people, it hasn't been created for them. A conglomeration of rocks is too wild, the landscapes are too unusual, the feeling that "you are a chance visitor here" often occurs to you. Thousands years ago it was probably the very feeling that could incarnate to an idea about spirits-masters of the land, seids.

These spirits, the Lapps think, decide if a hunter will have a good bag or a fisherman will have a catch. Once upon a time reindeer sacrifices were offered to the seids, and on less important occasions their antlers or strips of colored cloth were offered. Until recently even a normal fishing was preceded with a small sacrifice and a prayer to "the masters of water", seids of this or that lake or river: they were offered some reindeer fat, blood, some food. When building a kuvaksa in a new place, "the water and the ground were paid for" with silver and cooper coins. The people hit the outline of their future dwelling with a twig to drive away evil spirits, "otherwise their sleep will not be good".

The name of a lake, rock, cliff can have the prefix "seid-". You can't doubt people once worshiped the place with such a name, accepting the existence of a particular spirit in this place. But to think of a rock itself as a seid is not right. If people disturb a seid, he can go away, leave his place. According to the legend, this happened to a seid living not far away from Yokostrovsky pogost on the island on Imandra. The legend says that the seid left the place with a great crash and flew over to Vudozero (Vudyavr), where he dwelled in a "stone vezha" on the island.

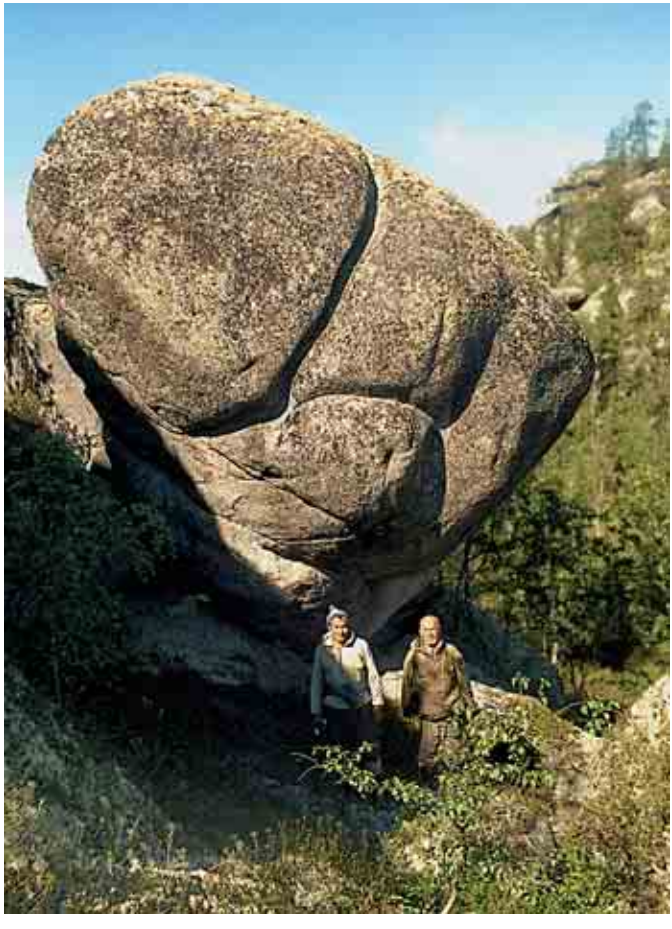
Are there any "live" seids on the Kola Peninsula or have they moved to more distant places, disturbed with the noise of the civilization? However it may be, coins are still put beside some rocks and cliffs held sacred for a long time.



Small in numbers residents of the village Ivanovka, Chalmny-Varre in Lappish, call this dried-up trunk *Sorcerer-Tree*. Despite almost absolute lack of firewood in the vicinity of the village, no one has ever thought of cutting it down.

Cavray seems to be the last man-made seid preserved up to now. It was built to honor Cavray, the eldest brother in gods' family of the Kola Sámi.
The first explores of the Kola Peninsula noted man-made wooden and stone seids in the form of rock heaps.
But later, when Christianity was brought in to the Lapps, practically, all of them were destroyed in the struggle against "idols".

Vladimir Kuznetsov



Vladimir Kuznetsov

According to a legend, it was Cavray who created a wolf to clear out the earth of sick and dying reindeer, and "as a protection from the wolf he gave a man the dog...
That is why the Sámi never shoot wolves. It was Cavray who created a wolf and it was created on purpose."

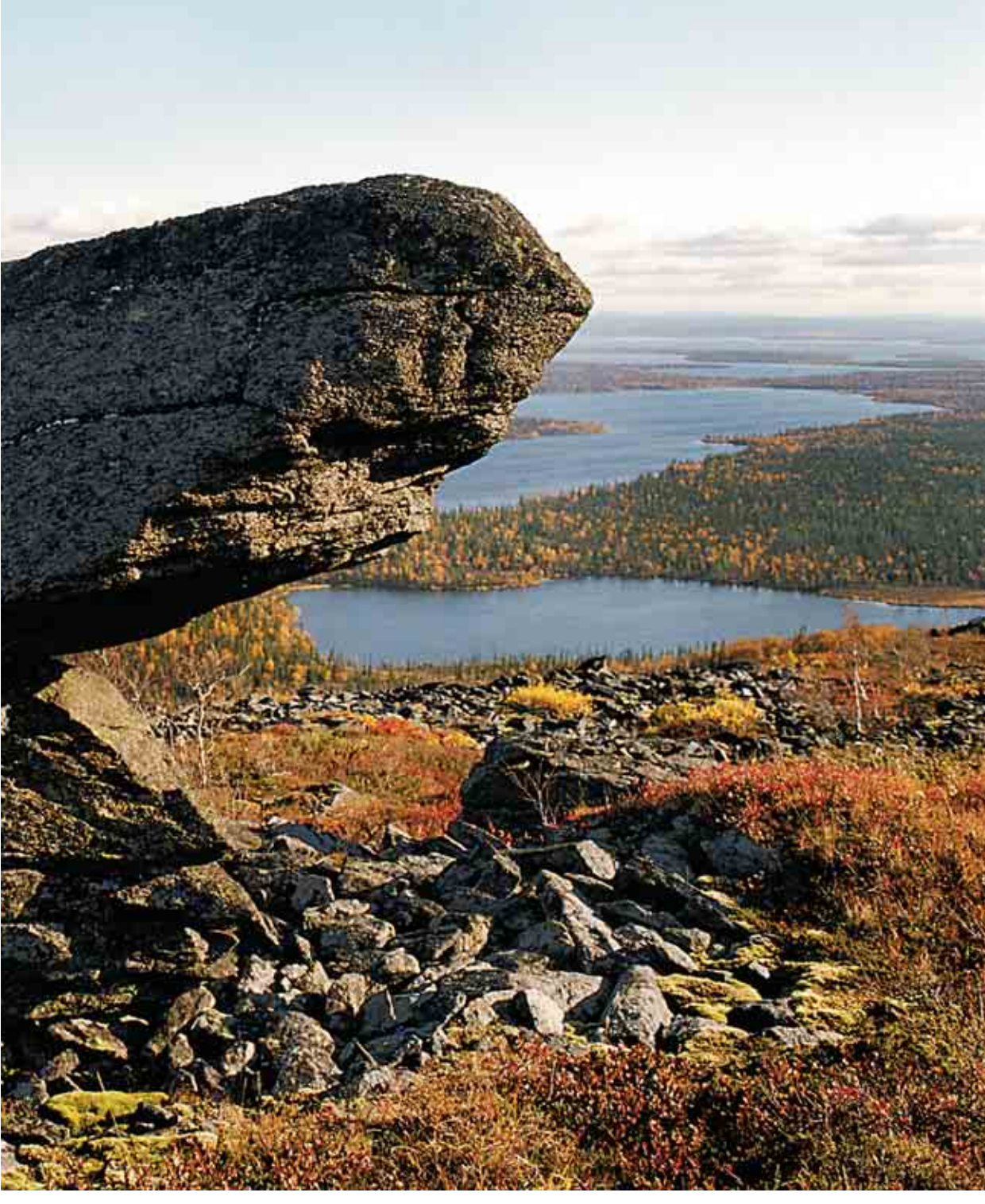
A Lapp asked seids' permission for all great changes in his life. When fishing salmon was finished, the time of moving to a winter pogost in the forest came, he went to the seid.
He offered the seid some tobacco, a head of a fish or deer, decorations made of cloth; he asked for advice and approval for this moving.
On arriving at the forest the Lapp took an offering to a sacred tree where also dwelled a seid.
In the spring there would be a new offering and praying before leaving for the sea where, in its turn, it was necessary to pray to a seid.

Konstantin Kobyakov

Boulders on the "feet", small rocks-supporters, are not rare in the Kola tundra. Nowadays all such constructions are often called seids, indicating with this word, first of all, their natural specificity. But "true" seids, land-owners, are only some of them.

Konstantin Kobyakov

Ethnographer Vladimir Charnolusky, who studied the life of the Sámi in1920-1930s, called Lapland the land of a “flying rock”.
In the North you can often see separate rocks, single boulders in such an unusual position on the ground, that only a slight touch to them seems to be enough for these huge things to take off and…fly away.



Ivan Vdovin

A vast swampy hollow of the Ponoy is surrounded by the cliffs.
In this difficult to access region there are plenty of historical monuments, seids.
Huge cliffs outlined as human faces, “great-granddads”, are located near Vuliyavr Lake. The Sámi talk about them as turned to stone ancestors, who first came to this land.

Ivan Vdovin

The lowland in the middle current of the river Ponoy is also called the “Ponoy depression”. Actually, to move in this area is rather difficult especially at the beginning of the summer when everything is flooded with water.

Ivan Vdovin

At the foot of these cliffs, according to a legend, a lot of the Lapps perished, they were thrown down from the steep slopes by the aliens, the Chud or Normans.
Helpless in the struggle with taller and well-armed enemies, the Sámi began “going down below the earth’s surface”, living secretly in holes, dugouts so that “neither people nor the sky could see the smoke of their hearths”.

Vladimir Kuznetsov

A seid-spirit could leave his place, flying away by himself or together with the rock he dwelled in. But no one could move away a seid from his place against his will.
The legend says that 40 residents of Varzuga led by a priest came to Seidpackh, a sacred rock at Lake Vuliyavr on the Ponoy, to throw down the “idol” from the cliff and make the Lopari accept Christianity.
But, though the work seemed to be easy, their efforts turned out to be futile for the seid was not moved over from his place.

Ivan Vdovin

Vladimir Kuznetsov

On a high shore of Lake Akiyavr, among the fragments of the top of a mountain destroyed by time, there is a cliff-left-over that is called Grandmother.
There is a legend about it: “A wife argued with her husband, she held her own, didn’t want to give in. He was going to hit her, but she grabbed her daughter and broke into a run and ran, ran. She wanted to get to her father in Voronye, on the mountain she sat down to rest and turned to stone”.

Konstantin Kobyakov

Lapland paintbrush *Castillea lapponica*

Sacred Lakes

The most protected lakes are called by the Lapps a “seidyavr” – a “sacred lake” in translation, or a “lake of a spirit”. There are some lakes of that type on the Kola Peninsula. Ethnographer Vladimir Charnolusky wrote about one of them: “In case of need to fill a cauldron with some water, a Lopar (a Lapp) will never draw water with a covered with soot cauldron right out of the lake as it is usual, but he will draw some water with a clean ladle and then pour it into the cauldron.”

One can say that an original “environment protecting zoning” of the territory was current with the Sámi: there were lakes varying in the degree of protection in which fishing was permitted on certain days only with observance of some rules and rituals. Such measures helped to retain the reserves of fish resources and species.

The best-known sacred lake of the Kola Peninsula Sámi – Seidozero in the Lovozersky Mountains – is famous for its unique fish productivity.

Konstantin Kobyakov

Over Seidozero in the Lovozersky tundra one hundred meter silhouette of a “dancing old man” has spread – seid Kuiva. One can notice the old man is in a cap and there are *kangi* (the Lappish shoes) on his feet. There are a lot of legends about him. The most popular says that a chief of alien conquerors was defeated by the Lapps and he turned to stone.

Around Seidozero in the Lovozersky Mountains the largest saxifrage of the region grows – *Saxifraga hieracifolia.* It’s difficult to understand why this area attracts this species, but you can’t meet it anywhere else in the region, only a few individuals of this plant have got over to the neighboring Khibiny.

A botanical symbol of the Lovozersky Mountains can also be *Castillea lapponica* that decorates the feet of the cliffs with its luxuriant inflorescences.

Gennady Alexandrov

Hawk-weed-leaved saxifrage *Saxifraga hieracifolia*

First Slavs

In the mouth of the river Varzuga two Slavic burial grounds of the 12-th century are found. The objects preserved there – arrows heads, a knife, the remnants of a horse harness, a flint used to produce a spark, fragments of clay vessels, iron and ivory decorations – resemble the objects found in Novgorod burial grounds of that time. Then, apparently, there hadn't been any permanent Russian settlements on the Kola Peninsula yet, the people from Great Novgorod came there to hunt or fish and levy a tribute.

The first documents, where the Kola Peninsula is mentioned as the "land of Ter" (the name "Tersky Coast" came from it), date from the 13-th century. The document, that goes back to 1216, says, those who lived on the Tersky Coast were to pay tribute to Novgorod; and in the charter of 1265 Ter Volost (a small rural district) was mentioned among Novgorod volosts. Norwegian sources of the time say the territory that paid tribute to Novgorod was not restricted to the White Sea coast only but covered a considerable part of the Kola Peninsula.

The Russians began populating the territory in the 15-th century. In 1419 a Novgorod chronicle wrote about a "Korela pogost in Arguz", that is in Varzuga. At the end of the 15-th century Pomorye was a member of Moscow State. The document of 1563 points out that in Varzuga there were 126 homesteads with 167 people in them (it's necessary to take into account that only male population was counted at the time). The settlements of Porya Guba and Kandalaksha are known since then. Other Pomor villages appeared even later, many of them were founded by the Pomors from the southern shores of the White Sea.

Gennady Alexandrov

Gennady Alexandrov

Varzuga, the oldest Russian settlement on the Tersky Coast, unlike most of the rest villages doesn't stand by the sea but 20 kilometers up the river.

The left-bank part of the village was often called Nickolskaya side because of standing there Church of St. Nickolai, a Miracle Man, who was very popular in Pomorye, and the right part – Uspenskaya side because of well-known Uspenskaya Church built in 1674 and preserved until nowadays.

Gennady Alexandrov

Gennady Alexandrov

Gennady Alexandrov

Pomors' Daily Life

The Pomors were not the same Novgorod settlers that came there some centuries ago. Life amid severe northern nature made people change their traditions inherited from their ancestors. They had to give up grain farming and retained only market-gardening. Cattle-breeding got acclimatized in the Polar region better: cows (which, by the way, were kept not in every village), sheep, goats, horses were bred. The latter were sometimes replaced by reindeer that well fitted for moving on deep snow. The Pomors took up reindeer-breeding from the Lapps, they, however, kept a few reindeer and used them for transportation only. Today they don't breed reindeer, and in other respects farming is the same.

But fishing was the main occupation for the Pomors. Owing to fishing the Russians survived here. Their trade with other regions was based on it. In the White Sea they caught herring and fish, that was salmon. Only salmon is still called this way – 'fish', the names of the rest are proper nouns: navaga, flounder… The Barents Sea fishing was a tradition for a lot of villages, they caught cod and halibut. They hunted sea animals as well. Everything they managed to get was taken to Arkhangelsk or sold to merchants on the spot. An autumn fair in Kuzomen was very famous. Fish was not only food for people but also feed for livestock. "The sea is our field", said the Pomors.

Gennady Alexandrov

Mikhail Levkin

Swings in the village are children's commonplace good fun. But swings as an attendant construction were often seen near the tonyas – fishermen's log huts – alongside ice-houses and chapels.

Mikhail Levkin

The Tersky Coast, that is monotonously flat in its southern part with the stripes of coastal sand and tundra, changes sharply beyond the bounds of Sosnovka being rocky and precipitous. It becomes difficult to find a convenient place for a fisherman's log hut. Some tonyas cling to the edge of a cliff like a kind of "swallows' nests".

Gennady Alexandrov

Pomor Traditions

Maintenance of ideal cleanness of water, banks and shores characteristic of Pomor culture is not only an "ecological requirement" of fishing. In a similar way, as it has been in the nature of the Sámi culture, environmental appropriateness has found its peculiar comprehension in traditions, customs, legends. Rivers and even brooks were called by the Pomors bread-winners, and when crossing them the people addressed them special thankful and apologetic words. A river is called a bread-winner in Pomor charms. In gratitude for good fishing, for a rescue a "vow cross" was erected on the bank of the river or on the sea shore.

There was a special attitude to fishing areas. Every tonya – a log hut on the river or sea where a family or some families lived and fished in the summer – had its cross for "fishing" so that a catch might be huge. A passer-by prayed necessarily. During summer fishing, when the whole families "sat" in their tonya, any stranger was welcomed by housewives and they fed him to his heart content.

Today Pomor traditions and holidays are being revived. The Summer Folklore Festival is held in Umba. As a souvenir you can buy real Pomor "kozuli" – traditional Christmas cakes. Plenty of villages have become places of summer rest for their former residents, but such large villages as Varzuga, Sosnovka, Chavanga, Chapoma are, as in the old days, keepers of Pomor culture. Pomors' daily life, except for appearance of motorboats and electricity, has not changed greatly.

Gennady Alexandrov

Andrey Harlov

The Pomors keep reminiscences of the time when wooden dolls – *panki* – were put next to the icons.
And once, in pagan times, a small wood-block with solar – sun's signs on the chest, symbols of the rain watering the earth and of a sown field represented a personified goddess of fecundity, the mother-earth and, at the same time, an ordinary woman that gives a birth to the whole human generation.

Andrey Harlov

And famous Varzuga "kozuli" were baked of brown flour at Christmas-tide by the women.
The children played with them keeping sometimes the figures of horned "kozuli", elks, reindeer, horsemen, seals and birds for a long time.

The crosses of the vow were original navigational signs of the Pomors. Today they have become proofs of the Pomors using a compass since old times.
Crossbeams in most Pomor crosses on the coast of the Arctic Ocean were oriented exactly towards the magnetic North. At that time the Pomors didn't know about the variation of the compass and a "mistake" by erecting crosses corresponded exactly to the magnetic variation of the locality.
Huge crosses were noted by the western travelers in the 16-17 centuries who looked for a seaway to Moskovia and India, though a greater part of the crosses was destroyed to execute the tsar's edict "On Prohibition of a Seaway to Mangazea".

St. Nickolai was especially honored in the North as a patron of seafarers.
At storms and sea catastrophes people addressed him their prayers. French doctor Lamartinier who visited the Kola Peninsula in 1653 noted that the local people spoke of that saint as if he might be their brother and countryman.
It was not by chance that there were so many churches in his honor in Pomor villages. One of them is Nickolskaya Church in the village of Kovda built in 1613. It took the place of an older one that was burnt by the Swedes in 1589.
A proverb has been preserved till the present day "From Kholmogory to Kola there are thirty-three Nickoly".

Ivan Vdovin

Cultural Landscape

The Sámi inhabited the Kola Peninsula a very long time ago, and even if their system of land use, which blended in with seasonal cycles of nature, influenced the landscape, then it was interwoven with natural processes to such a degree that it could be regarded a "background factor".

A typical "Sámi cultural landscape" is a reindeer moss pastureland in the tundra and forest tundra, a forest and lake with fishing nets or a fisherman's boat, rare covered with turf huts –*vezhas* or tarpaulin tents – *kuvaksas*. At present, in addition to that, there are tracks of a snow-mobile in the winter and of an all-terrain vehicle in the summer, but the residents even small children mainly go on foot including many days' marshes as in former times.

A traditional Pomor landscape looks differently. The conditions of nature formed a peculiar culture of the Pomors, and the people, in their turn, changed the landscape. The landscapes of the Pomor coasts differ both

Gennady Alexandrov

Mikhail Levkin

from slightly changed settlements of the Sámi and from a more considerably transformed agricultural landscape of Central Russia. There are hardly any fields; ploughed up according to a centralized plan in the 20-th century areas are being overgrown; farming is mostly unprofitable. The farming folk have small vegetable plots and traditional hayfields on the by-river meadows again. As in the old times the community lives by fishing: “The sea is our field”.

A present-day Pomor countryside is maritime tundra and a shore with fishermen’s huts-tonyas. Next to the tonya there is usually a traditional household complex: a winch for pulling boats, a peg for fishing nets, an ice-house (a cellar) for fish. In the villages located in the estuaries there are roomy log houses tanned with the storms, wood-paved roadways, sheep grazing right out of doors or at the edge of the sea.

Gennady Alexandrov

There are a few trees; there aren’t any orchards, and, in general, trees grow too slowly. Besides lest the houses should get rotted, they are built to be fanned by the winds. There are small vegetable gardens and berry bushes, but the main source of berries is a forest and swamp.

Gennady Alexandrov

Gennady Alexandrov

Konstantin Kobyakov

Where Pines Don't Grow

Sosnovka is the remotest from the regional center settlement. But the epithet "dying out" that has become usual for most Russian out-of-the-way places can't be applied to it.

The name of the settlement is strange because there are not any pines in the surrounding tundra, although once someone can have seen the only one or two pines. It has surprised the man, and probably after that event the village got its name. The names of the local collective- and soviet farm with all its renamings are more understandable. They reflected a specific time span and people's way of life: "Way of Reindeer", "Named after Chkalov", "In Memory of Lenin", "Reindeer-breeder".

Walking around a neat village with a continuous green lawn you involuntary recall a popular Russian saying about "grass and firewood" and a proverb about a cart and sledge. By the way, the sledge in Sosnovka is at work both in the winter and summer.

Konstantin Kobyakov

Gennady Alexandrov

Gennady Alexandrov

Gennady Alexandrov

The tides coming in opposite Sosnovka as elsewhere in the White Sea Gorlo (a strait or narrow entrance to the bay) are very high – 4-5 meters in height. Under their force the flow of the rivers in the estuaries is slowed down and even is turned backwards; people's daily life is subjected to their rhythm.

Gennadiy Alexandrov

Gennady Alexandrov

The riverbed of Sosnovka in its lower reaches is an impressive canyon with cascades of powerful rapids and waterfalls.

Gennady Alexandrov

The lotus of the northern rivers is *Nardosmia laevigata,* but its flowers are simpler, and it blooms before coming into leaf.

Gennady Alexandrov

The village was located on a single convenient terrace in a deep river canyon 12 kilometers away from the estuary. During a high tide loaded *karbasses* approached the very village despite its remoteness from the sea.
In the spring a steep slope of the canyon threatened snow-slips, and the houses press close to the river.

Ponoy is a River and a Village

There is one and the same name for the longest river on the Kola Peninsula and an old Pomor village with some century-old history. In 1572 an Orthodox church was build in Ponoy the furnishing for which was given by Ivan the Terrible by himself. And though this area is much severer than that in the west of the peninsula the residents of Ponoy were relatively well-off, as a rule.

In 1875 Vasily Ivanovich Nemirovich-Danchenko, noting that the settlement was populous, wrote about it as the capital of the Tersky Coast. A very rear villager in order to relieve poverty left it then for *"pokrut"* to fish on the Murman. The Ponoy River gave food to everyone. A salmon fence on the Ponoy (a special snare, the river was entirely partitioned with, used for salmon catching) was never leased out; the community itself built and maintained it, and sold the catch to free buyers-up.

A local collective- and soviet farm "The North" didn't have any debts to the state. But in 1973 it was liquidated, and the village of Ponoy as a populated area was officially abolished. On the uninhabited houses there remained the tables with a non-existent mail index. Later on, there were attempts to revive the village, but they failed.

The Ponoy River has not been lost for the region yet. Today it has risen in its value. That's not for the reason of salmon in which the Ponoy is still rich as before but of primeval nature that has been preserved in the region to the present day and that has been valued less before.

Gennady Alexandrov

Gennady Alexandrov

Gennady Alexandrov

The Ponoy riverbed in its lower reaches is a deep canyon. Its tributaries in this area from rivers to small streams are hidden in the canyons. The tundra over the canyons is rather harsh.

V.I. Nemirovich-Danchenko writes emotionally about it: “Through frozen soil the withered grass shoots hard, dry and wispy… the bushes creep low-low… crippled trees raise themselves a little over them directing their thin branches southwards as though saving them from a sharp, embracing with death, northern wind”. The author makes also such observation: in the places sheltered from a deathly breath of the North… the vegetation varies”, but this fact is noted by him more calmly without vivid epithets.

Meanwhile, the canyons of the Ponoy and Rusinga are real oases estimated at their true worth by the botanists. Their southern slopes gave a shelter to plenty of plants that are rare in other areas. For some of

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Lake Huron tansy *Tanacetum bipinnatum*

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Arctic daisy *Arctanthemum hultenii*

Gennady Alexandrov

them, perhaps, they became a kind of refuge where species went through the spans of unfavorable changes in the climate.

So, in the canyon of Ponoy there is the only on the Kola Peninsula habitat of the wood anemone *(Anemonoides nemorosa)*, a commonplace plant for central and southern Russia but in no case for the North. The limits of the natural habitat of the species are far in the south at latitude of Petrozavodsk. How this plant has appeared amidst the tundra, and how it survives in these harsh conditions of the region is a mystery.

Under protection of the cliffs other spectacular plants have found a shelter. Attracting bumble-bees, sweet-vetches stand in dense parterres; aconites raise candles of their inflorescences to a meter and a half in height; the baskets of dwarf tansies shine like small suns; peonies surprise with their southern splendor.

Gennady Alexandrov

Arctic sweet-vetch *Hedysarum arcticum*

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Wood anemone *Anemonoides nemorosa*

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Gennady Alexandrov

Sirens, Bugles, Howlers…

Tersko-Orlovsky lighthouse in the White Sea Gorlo is an elder among the Kola Peninsula lighthouses. It was built in 1841 by Solovetsky monks and became one of the first stone buildings of the peninsula. A log town built as early as 1822 by the expedition of Fedor Litke to Novaya Zemlya preceded it.

The White Sea Gorlo was always famous for its bad weather, fogs, shallows, the strongest currents. Even up-to-date powerful vessels regard the force of the currents taking into consideration their possible late arrival if they move “against the water”. The seafarers of the past were in a more difficult situation.

The White Sea hydrographic expeditions of Mikhail Reyneke lasted six years (1827-1832), and every year Reyneke returned to additional descriptions of those dangerous areas. Only in 1868 according to evidence of V.I. Nemirovich-Danchenko were 86 ships, lodyas, shnyakas, schooners, karbasses wrecked there. “There are a few lighthouses, and there is no one equipped with steam whistles…”, bemoaned the writer. Later lighthouses were equipped not only with whistles but also with signal cannons, foggy bugles, howlers, sirens, autophones. Now having served effectively for decades sound signals are considered to be unnecessary. But the light of lighthouses is long-awaited for the ships sailing by as in former times.

Nowadays people also live on Tersko-Orlovsky lighthouse, keeping up the fire started more than a century and a half ago.

Gennady Alexandrov

5

View from Outer Space

What's Seen from Above?

Rybachy Peninsula

Ponoy River

Sergozero

Ivanovskaya Guba Bay

The Gorlo of the White Sea

Ponoy Depression

Keivy

Nyamozero Area

Khibins Mining Industry Node

What's Seen from Above?

First depictions of the Earth as seen from outer space were simple photo shots made by cosmonauts. Later automatic systems were used to this effect with a camera installed on a satellite shot a film which was later parachuted down to the Earth surface in a special container. Of course, all the first devices to photograph Earth from outer space were to meet military objectives and to gain information about the defense and attack potential of the opponent.

This system of photographing the Earth's surface had a number of drawbacks. First and foremost, the launching of photographic film to the orbit and its descent was a complex and expensive process. The first devices capable of transforming information to the Earth's surface in electronic format appeared only in 1974. Besides that, the pictures produced in visible light were not clear enough, for some mist is practically always present in the atmosphere dispersing the rays of the violet part of the subspectrum.

Practically all contemporary systems of remote sensing of the Earth utilize a scanning matrix which records an area of surface in several parts of the specter at once. The range of scanning may be quite different, from ultraviolet to infrared radiation and radio-waves. The visible light range proved to be the least informative from practical point of view, especially its part from the green to the violet colors, and the near ultraviolet. The recorded information is transferred to the surface receiving station over a radio channel.

Today, besides military satellites, there are a number of space based devices which photograph Earth's surface for peaceful purposes, and their data is available for a fee, or even for free. Data produced by the NOAA, Landsat, SPOT, IRS, RADARSAT, ERS, Aster are used extensively in the world, space photographs from the Russian KVR-1000, TK-350, Resource-O and Resource-F are also used in our country. Today these satellites are one of the main data sources concerning environmental conditions, they provide information used in various spheres ranging from cartography, hydrology, forestry, agriculture and fishing, ecological monitoring, land register etc.

This chapter offers photographs produced by the Landsat satellite equipped with a TM or ETM+ scanner which are extremely popular in environmental monitoring. These photographs are made in 6 spectral channels ranging from the visible green light to the nearest infrared rays with the spatial resolution of 30 meters meaning that objects with an area of about 900 sq m can be discerned on the photograph.

Colored depiction is produced by various combinations of three various channels. It is clear that the depictions produced in this process have nothing in common with regular color photography, and quite often nobody but an expert is able to understand what all that color means on the photograph. Decoding such a depiction is a process close to the search for a key to solve a complicated code; that is why decoding is a common term to denote the process of reading information from a photograph during which the picture on the photograph is compared to real objects on the Earth's surface. Thus, smooth black surface is always water, while forests can be red, green and brown, depending on the age and species of trees, season and the combination of spectral channels used. But it has been noticed that a person familiar with the locality can easily find his bearings using a space photograph without special training.

From outer space the Kola wildlife looks even more varied than during ordinary observation. Soaring mountain massifs, huge swamps with swirling zebra strips of rock ranges, swampy hollows and lakelets, dark areas of virgin forests with bold spots of swamps, spotty tundra crossed with forest covered valleys of rivers… How varied and harmonious is a natural landscape!

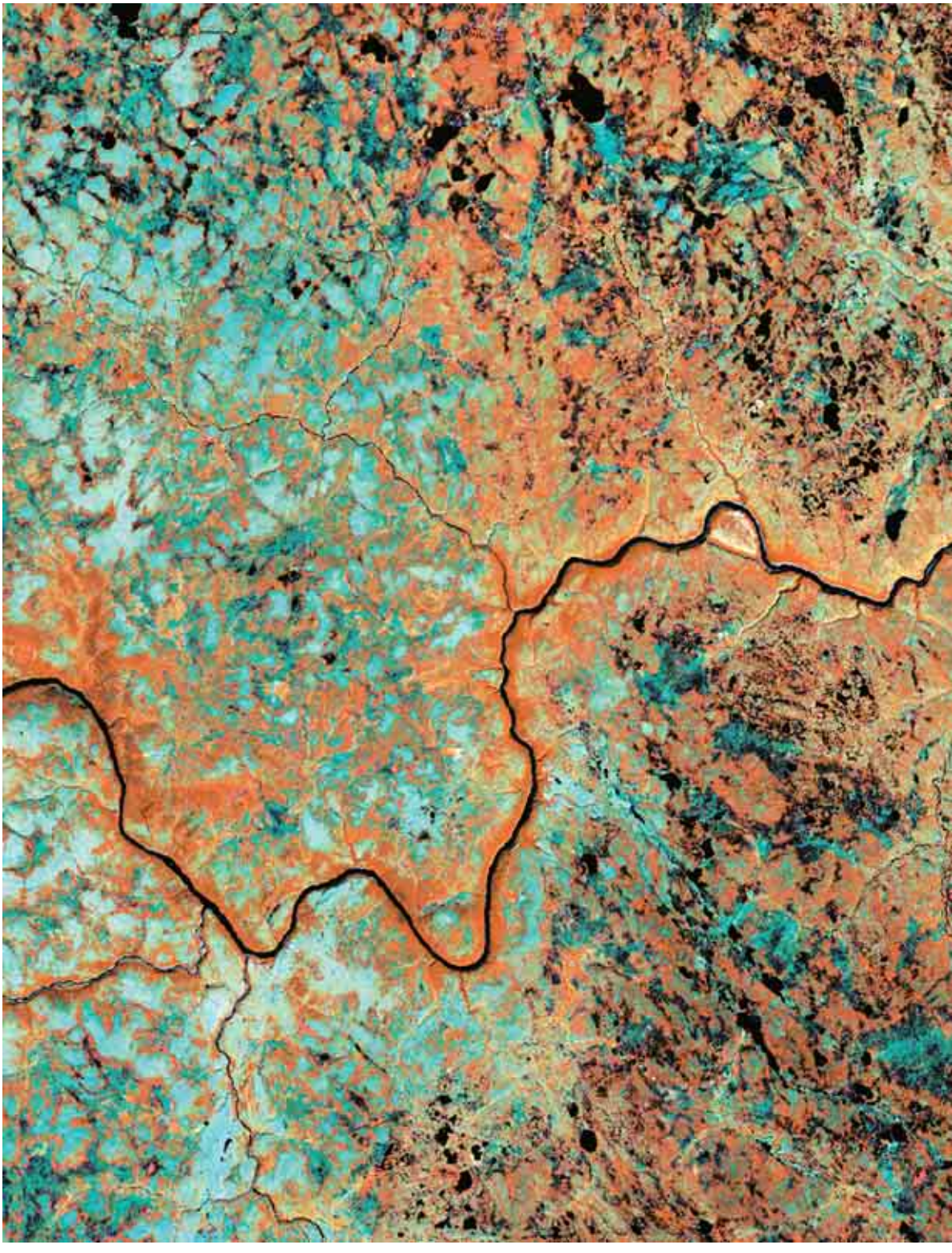
Squares of logging areas, bright monotone urban areas and wastelands, lakes and bays filled with "tails" of pollution look like holes in the skin of the planet. How can we make human activity a more harmonious component of landscapes?

Rybachy Peninsula

The Rybachy Peninsula is the northernmost end of the Murmansk region going far into the sea. A characteristic landscape featuring barren steep cliffs of the Barents Sea coast cut by glacier (green tone) differs dramatically from low hills on the surface of the Rybachy covered by the low-bush tundra (showing pink in the photograph).

Most part of the peninsula territory is woodless, bright red spots of low birch-tree growth are visible only in its south area.

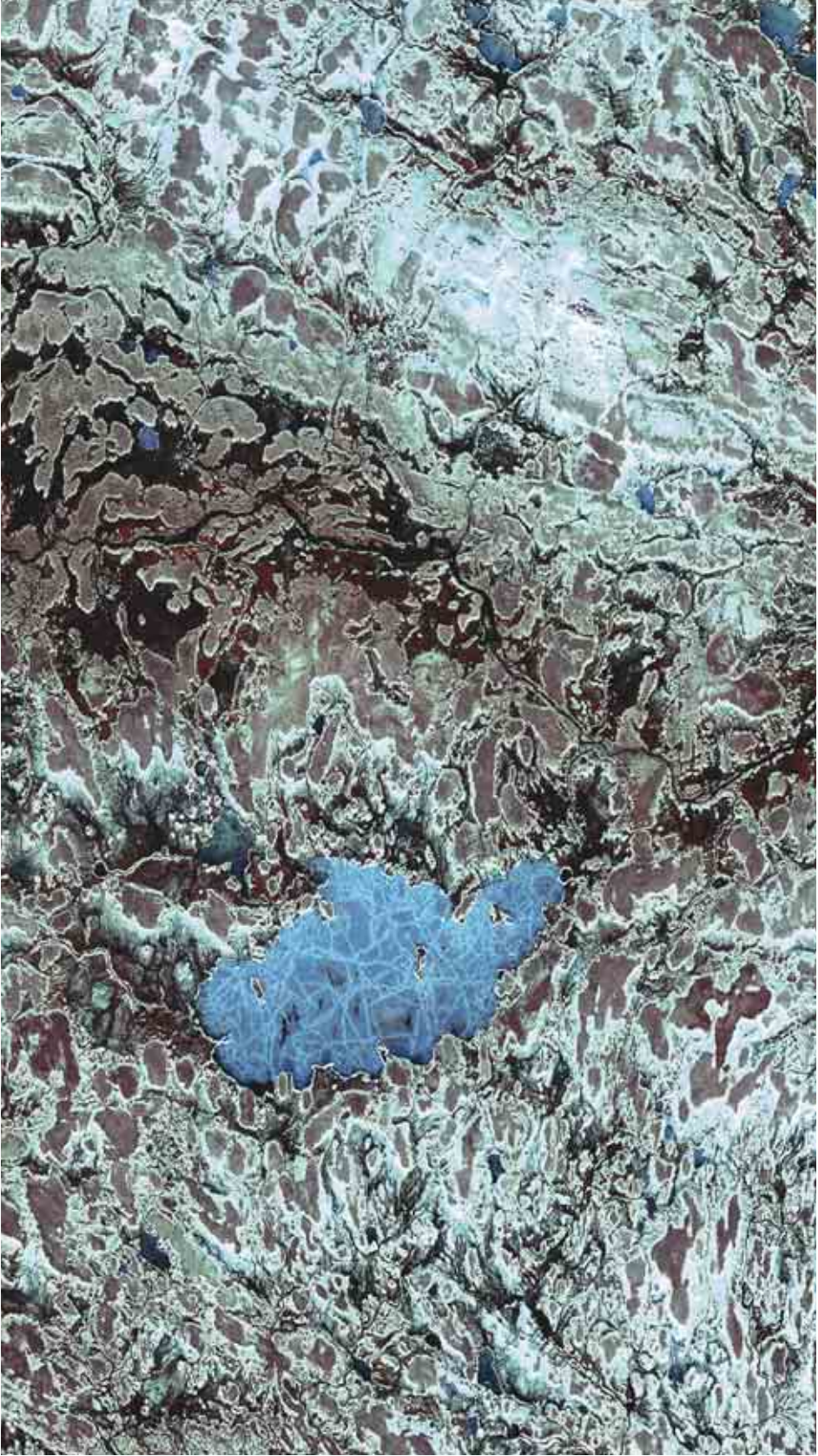
Landsat 7 ETM+, synthesis 4-7-2, September 8, 1999



Ponoy River

A place where the largest river of the Kola Peninsula flows into the White Sea.
Chaotic reddish and bluish spots on the flat plateau of the east part of the peninsula reflect various types of tundras and swamps interspersed with black drops of lakes.
Bluish spots are dry lichen tundras, reddish spots are swampy and grassy tundras and sphagnum swamps.
The crystalline plateau is deeply carved by the river canyon.
Riverbanks and walls of the canyon are overgrown with birch-tree forest protected from tundra winds (bright orange color).
Areas of the old dry channel of the Ponoy River are also visible.

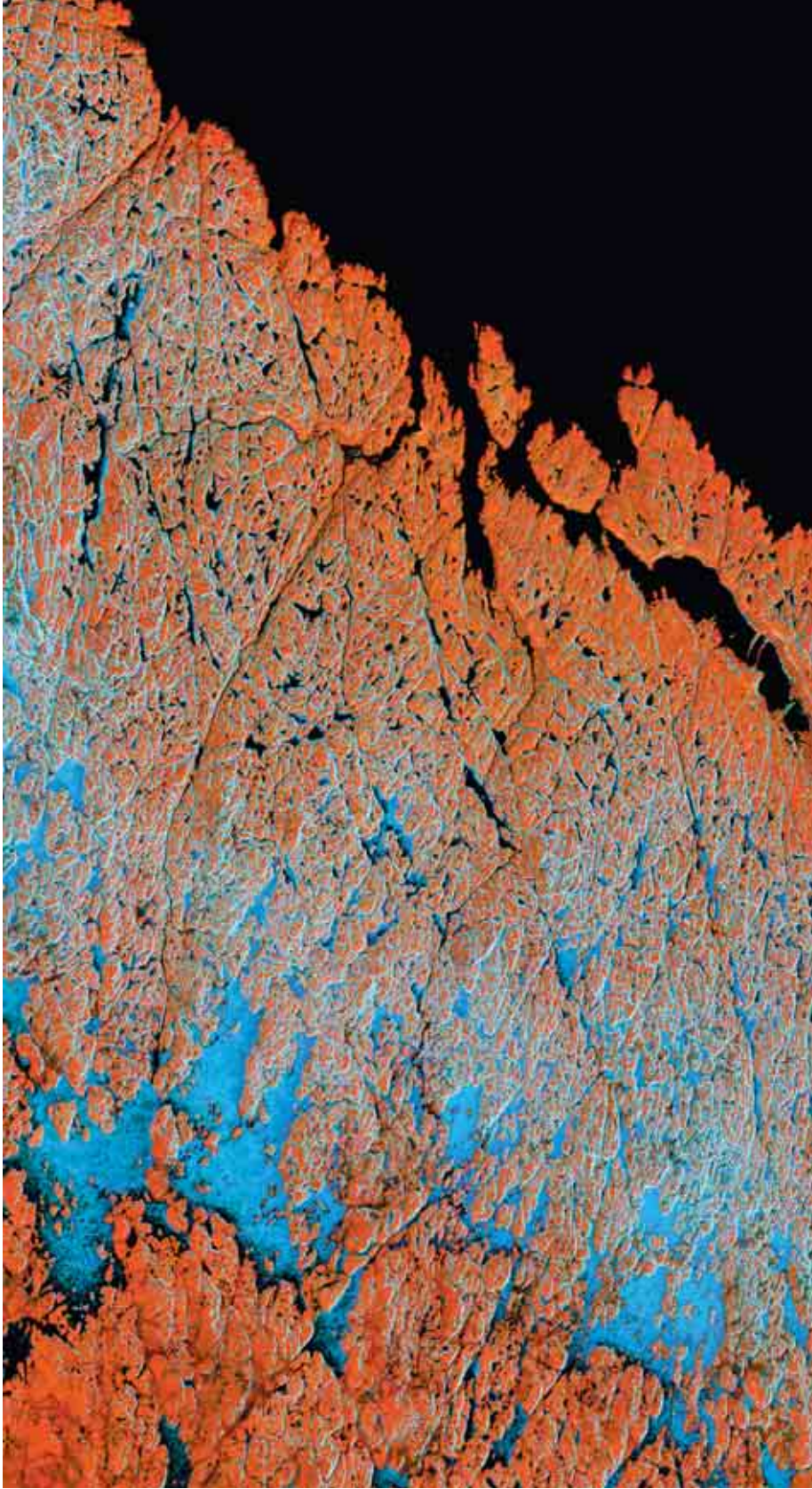
Landsat 7 ETM+, synthesis 4-5-7, July 6, 2002



Sergozero

The winter aspect provides a most typical picture of the landscapes in the east of the region: islands of swampy fir-tree forests in hues ranging from red to black are interspersed with swamps and lakelets of tundra type covered with snow. Cracks in the ice of frozen Sergozero look queer.

Landsat 7 ETM+, synthesis 4-3-2, May 20, 2000



Guba Ivanovskaya Bay

The Murmansk coast of the Kola Peninsula formed by the most ancient Pre-Cambrian metamorphosized rock is cut with numerous cracks and faults which are clearly visible at this spring photograph as strips of unmelted snow. Bays and fiords of the Barents Sea develop along these cracks under the influence of frost and tidal surf.

Landsat 5 TM, synthesis 7-4-2, September 8, 1999

The Gorlo of the White Sea

In the narrow and shallow Gorlo (throat) of the White Sea, ocean tide gains great speed, and the ebb is amplified by the flow off-flow of the Northern Dvina and other rivers.
That is the reason why this area of the White Sea is practically never covered with solid ice crust, except small strips of shore ice near the coast.
When tide races and ebbs, small and large blocks of ice are traveling back and forth, carrying resting areas of seals on them, which, by the way, are not visible in this photograph.

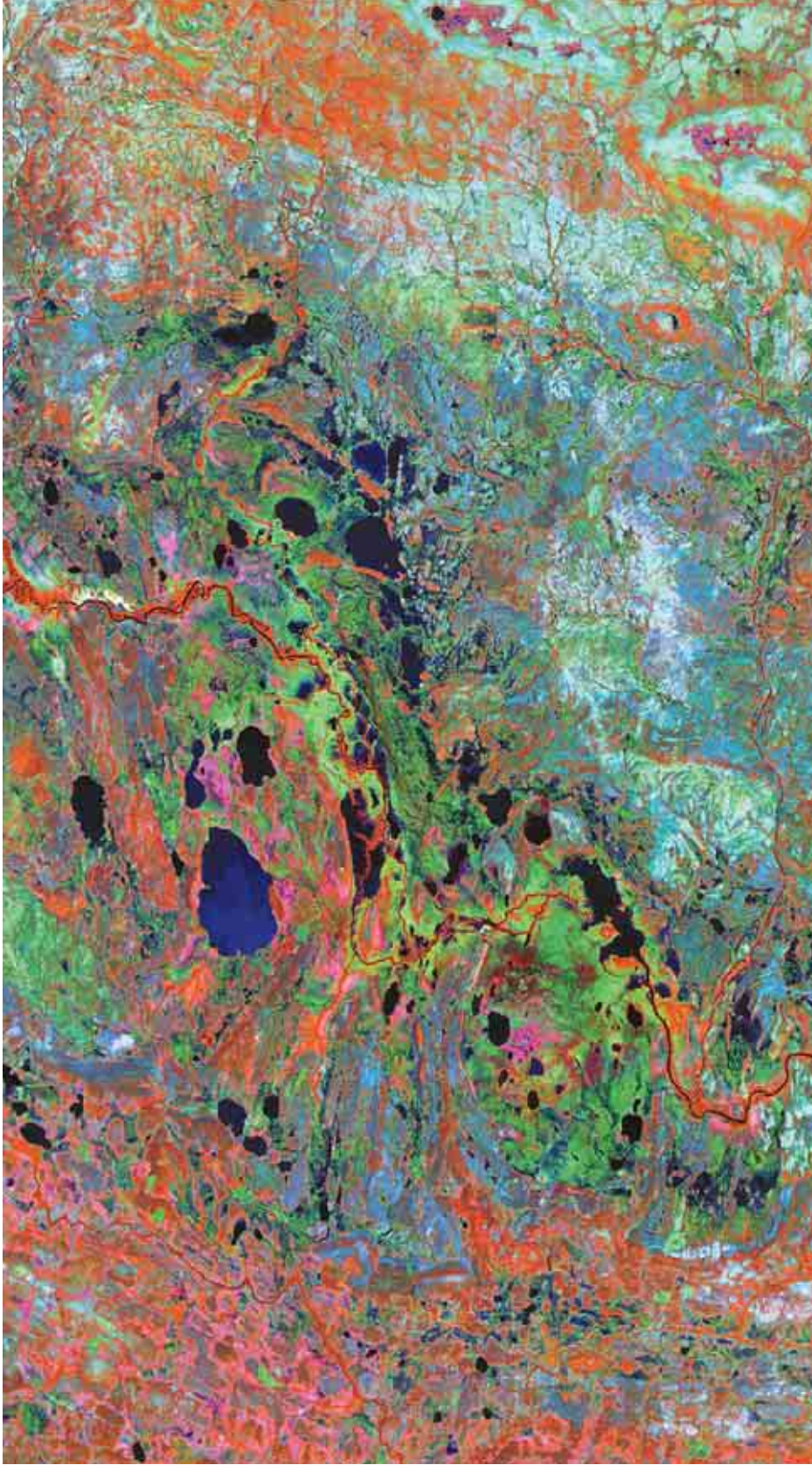
Landsat 7 ETM+, synthesis 4-3-2, April 2, 2002

Ponoy Depression

The largest and the deepest swamps of the region, some of them totally impassible, are located in the swampy lowland in the middle course of the Ponoy River. Numerous small lakes are visible here. Although the swamps look like a flat, brown-green plain, this photograph reveals their tremendous variety reflected in various colors. The swamps differ in vegetation, landscape microrelief, water level, peat sediment components.

It is a wildlife area of the region which was hardly touched by human presence, and it is especially important for the preservation of rare birds of prey and waterfowl species.

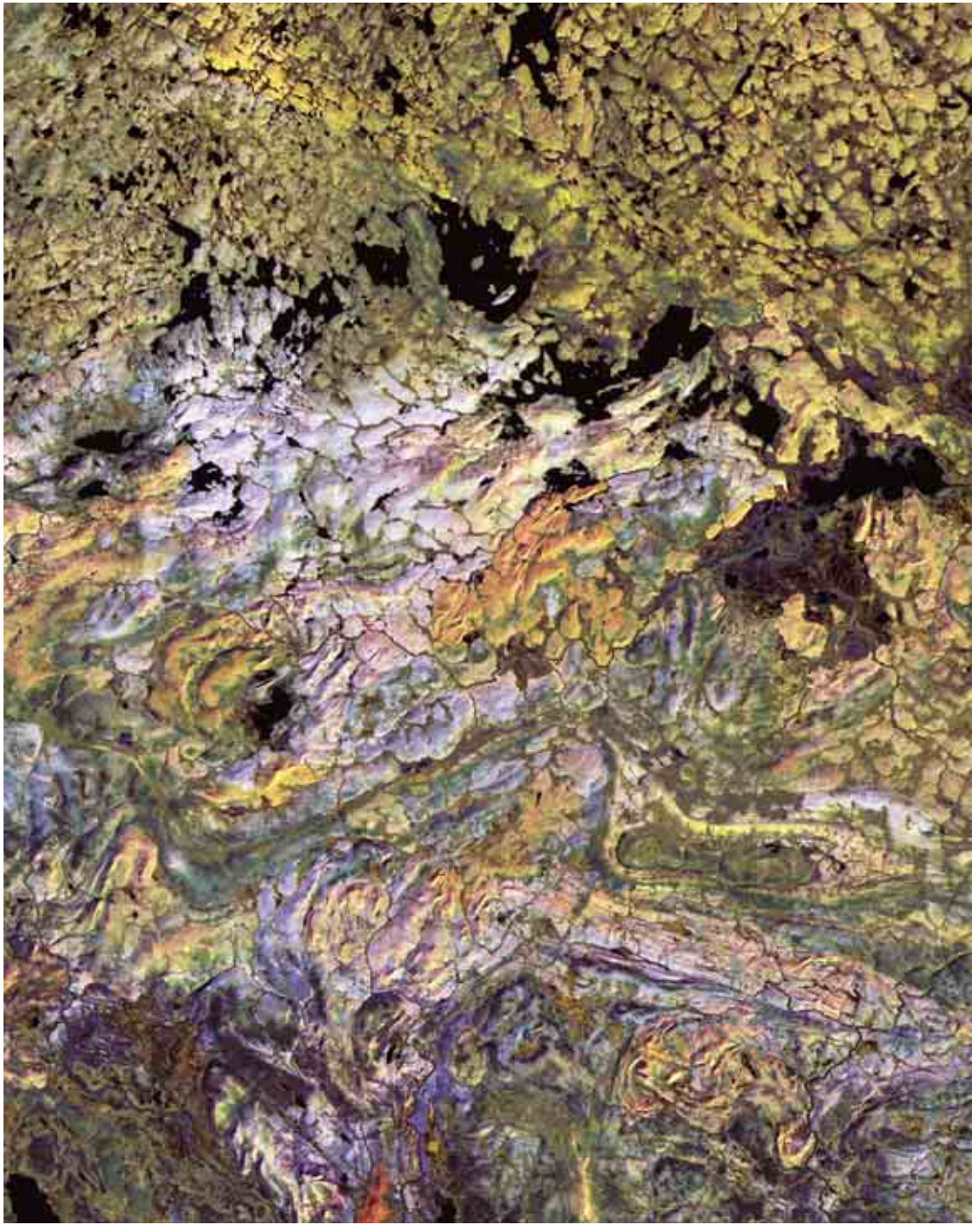
Landsat 7 TM, synthesis 4-7-3, July 19, 1987



Keivy

The Keivy range in the east of the Kola Peninsula is mainly formed by kyanite. It is the largest deposit of silimanite in the world.

Landsat 7 TM, synthesis 7-5-2, September 2, 1995



The Nyamozero Area

Due to more favorable climate conditions the south of the Murmansk region is the area where the growth of forest is most productive, but these forests have been considerably damaged by logging today.
The borderline of the cut down forest in the Murmansk region (reddish hue) separating it from the untouched forests of Karelia (dark hue of pine forests) is clearly visible in the lower left part of the photograph. Bright red hues of the fresh cutover areas and burnt forests (bare mineral rock), are noticeable, bright green rectangular spots are old cutover areas overgrown with birches.

Landsat 7 ETM+, synthesis 5-4-2, June 26, 2000

The Khibiny Mining Industry Node

The Khibiny Mountains are the heart of the Kola Peninsula. Unfortunately, they suffered most from human activity.
This photograph clearly shows all the components of the Khibiny mining industry system.
Cellular bluish structures are the towns of Kirovsk and Apatity, bright blue spots are sedimentation tanks of the plants, and shapeless grey spots are mines. Thick transport network, an airfield and cultivated fields are also visible.
Different hues of red and brown show the vegetation ranging from dark pine forests to bright shrubs of dwarf birches crawling up the grayish massif of mountains cut with broken shadows of circuses.

Landsat 7 ETM+, synthesis 5-7-2, July 28, 2000

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