

Our sponsors:



TERSKIJ COAST: CONSERVATION OF VIRGIN SUB-ARCTIC LANDSCAPES OF NORTHWEST RUSSIA



REPORT

Stepan Kovalski,
Project "Terskij Coast",
Dpt. of Geobotany,
Biological faculty,
Moscow State University,
Moscow, 119899, Russia

basil@imce.ru

Fax + 7 095 9392777
Tel + 7 095 9393165

Moscow, January 2001

Executive summary

The Project "Terskij Coast: Conservation of Virgin Sub-Arctic Landscapes of the Northwest Russia" was developed by the Research Team at Department of Geobotany, Faculty of Biology, Moscow State University. The aim of the Project was the conservation of an area containing a complex of subarctic landscapes: old growth pine woods, bogs, and open woodland. Interestingly, the area is one of the largest natural landscape systems in Northwest Russia without any anthropogenic disturbance.

The following events can be dangerous for the area: (i) possible felling, (ii) wind erosion due to sheep and reindeer pasture, especially at sand soils and (iii) a possibility of building a circle road around Kola Peninsula.

An integrative zoological, botanical, soil, wood and ecological investigation of the area was done as a part of the Project. Three sub-areas that must be conserved were found and a plan of local reserve included these sub-areas was prepared. At present, the plan of the local reserve is submitted to approval of local authorities.

Many various ecotopes of rare and endangered animals' and plants' species were detected, and some of them were described in the first time for Murmansk region. The stationery investigation of dynamics of vegetation and soil mantle as well as ecological study of some rare and endangered plants and animals was started. Besides, the base for stationery investigations was prepared. Recommendations for forest management were developed, and relations with locals, local authorities and leaders of the fishing co-operative were established.

We have been working constantly contacting with local, regional and federal conservational authorities and NGOs. We also have concluded the Treaty of scientific and technical cooperation with Kandalaksha State Reserve.

Now the main part of the area is not threatened with falling due to Research Team activity.

We plan to continue the conservation activity as follows: (1) to examine the possibility of natural regulation of reindeer population; (2) to continue the stationery investigation of dynamics of vegetation and soil mantle; (3) to continue and to extend the ecological investigation of some endangered plants and animals; (4) to start to conduct an extensive campaign against a circle road around Kola Peninsula in regional and federal mass media.

§1 Project realisation: calendar

01.04 - 01.07 - Pre-field activities (planing, preparing)

05.07 – part of Research Team (S. Kovalski, A. Tupikin, D. Sokoloff, N. Grechanaya, N. Kuksina) departed from Moscow to Kandalaksha.

07.07 - 09.07 – purchase of foodstuffs and (partially) equipment in Kandalaksha.

10.07 – departure from Kandalaksha to Chavanga. Arrival to Chavanga.

11.07 - 13.08 – first step of field researches: initial inspection of territory. Finding and mapping of mature forest areas, habitats of rare and endangered species of animals and plants.

25.07 – arrival of the rest of the Research Team (N. Chist`akova, P. Kvartal`nov, N. Liksakova, M. Pletz)

14.08 – Research Team meeting, discussion of the initial inspection results. Selection of the most important areas for detailed investigation.

15.08 – 20.09 – second step of researches. Detailed investigations in field and in laboratory including at provisional bases at Strelna (16.08 - 20.08) and at Nizhnee Ondomozero Lake (02.09 - 18.09).

26.08 - departure of N. Grechanaya and D. Sokoloff

22.09 – completion of researches, arrival to Chavanga.

23.09 – departure to Moscow (Umba – Kandalaksha - Moscow)

26.09 – arrival to Moscow, preparation of zoological and botanical collections.

Post-field activities:

05.10 - 10.11 Developing of the project of the local reserve

10.11 - 19.11 S. Kovalsky and V. Petrov were sent to co-ordinate the project with the local authorities of Murmansk region. The project was presented to regional administration.

20.11-up to now Work on field collections and preparation of papers for periodicals.

§2 Project realisation: transport

- Moscow – Kandalaksha – train;
- Kandalaksha – Ustje Varzugy (Kuzomen) – lorry;
- crossing of Varzuga – motorboat;
- Ustje Varzugy – Chavanga – track cross-country lorry;
- Chavanga – Tetrino, Chavanga – Ondomozero, Chavanga – Chavangskie keivy, Tetrino – Strelna – Chapoma - cross-country lorry;
- aircraft-survey – helicopter;
- arrival / departure of part-time researchers to / from Umba – aeroplane to Tetrino, then - cross-country lorry;
- departure of field team (except M. Pletz, A. Tupikin, N. Liksakova) to Umba – aeroplane;
- departure to Umba with a luggage – passing fish trawler;
- departure of a whole team from Umba to Kandalaksha – lorry;
- departure of a whole team from Kandalaksha to Moscow – train;
- post-field formal activities - train.

§3 Project realisation: routes

From permanent base in Chavanga:

- routes in Chavanga's neighbourhood;
- radial routes (from Chavanga) to Strelna on east and to izba Gremjacha on west;
- three routes along river Chavanga up-stream to stream Zhilin and four – to waterfall Padun;
- north-eastward route to Beloe Lake;
- aircraft survey by helicopter by route Chavanga – Ondomozero – Strelna – Chavanga.

From temporary base in Strelna (16.08 - 20.08):

- routes in Strelna's neighbourhood;
- radial routes to Chapoma on east and to Tetrino on west
- two routes along river Strelna upstream to Chernoe river
- north-eastward route to mountain 191 (Juginsky Cholm)

From temporary base at izba Zasheek at Nizhnee Odomozero Lake (02.09 - 18.09):

- four eastward routes to river Chapoma on mountains Chavangskye Keivy, Odomozerskiye Keivy
- two southwards routes to waterfall Padun
- inspection of Odomozero Lakes' coasts by kayak (M. Pletz, A. Tupikin)
- route by kayak along river Chavanga until Chavanga

§4 General area description (see also att. 3)

The area investigated is low-disturbed, subarctic landscape on light sandy soils. Along the sea coast, above broad supralitoral zone, extends a belt of *Empetrum* association (*Empetretum*, formation with domination of *Empetrum nigrum* L. resembled to tundra), from 500 m to 6 km in width. Then starts an open woodland belt, 3-8 km in width. After that comes large marsh zone periodically intersected by open woodland belts, 2-3 km in width. Large forests extend along coasts of rivers Chavanga, Strelna, Chapoma as well as along lakes' coasts. The forests are characterised by primeval spruce forests of all ages with some birches (about 20 %). By age of stand and floristic structure these forests regarded as virgin / primeval forest. Area limited from south by Zhilino – Beloe Lakes' line and from north by mountains Keivy is fully coated by forest of this kind. Southern side of mountains Chavangskye and Odomozerskiye Keivy is grown by pine forests. This is a second growth forest appeared on a fire-site of unknown origin (probably, anthropogenic), approximately 20-years old. Upper part and the large part of northern side are covered by mountain tundra.

§5 Results

1 Almost all investigated area is a low-disturbed landscape. Main disturbances are composite destruction, extended around settlements, roads, and the only fire-site at southern side of Keivy. The most interesting for conservation are: (1) southward area from Chavangskye and Odomozerskiye Keivy to (including) Zhilin and Beloe Lakes with adjacent forests; (2) large rivers' valleys; and, in less degree, (3) Odomozero Lakes' waters and adjacent area.

Area (1) is a natural, more or less hydrologically isolated system of forest, marshes and open woodland with natural borders. The area is also important as a habitat of many waterfowls and birds of prey. It has a low value for timber industry but good perspectives for reservations.

Larger part of mature pine forests and significant part of rare and new for Murmansk region plants are concentrated at area (2). The area is important for locals earned their living by fishing of trout and other anadromous fishes. Hydrologically the areas depend on watershed regions. Perspectives of reservation are uncertain. Consultations with municipal and regional administration are conducted.

Area (3) is the largest fresh-water reservoir in neighbourhood, the place of vast gatherings of birds in migration. The area deserves protection according to Ramsar convention. Here it is necessary to conduct monitoring of birds in the passage in autumn and probably to ring them. Perspectives of reservation are uncertain but presumably quite good.

Advisable regime for every area is defined now (see att. 1).

2 We have developed recommendations for forest management as well. At the largest part of the investigated area felling will be not effective because of low wood supply in pine forests (IV growth class) and of high transport costs especially after floating prohibition. If forest managers still are interested in the area, we could recommend pine forests at southern side of Keivy 30-40 years later – they have a low conservation value and significant wood supply (II-III growth class). Provisions will include to build a wood-road and not to use floating.

3 Inclement climate exclude effective long-term field work without permanent base. Our team examined different variants of bases and decided on Chavanga. The place is easy of access and optimal for life. (Here are a shop and a post office, usually works telephone). The most interesting places can be reached from Chavanga by cross-country lorry so there is no need to use an expensive aircraft. A fishing co-operative kindly give us an opportunity to use a house with a stove, where we can live, keep an equipment, dry herbaria and prepare animals. Now we have a permanent post address during our field trips: *Expedition "Terskij Coast", Chavan'ga, Terskij District, Prov. Murmansk, 184014, Russian Federation.* Moreover, we have an agreement about using medical attendant station in Tetrino as a temporary residence.

4 Many rare and endangered bird species mainly nested are found in examined area. The most interesting are from birds of prey: osprey *Pandion haliaeetus*, golden eagle *Aquila chrisaeetus*, white-tailed eagle *Haliaeetus albicilla*, peregrine *Falco peregrinus*, snowy owl *Nyctea scandiaca*, short-eared owl *Asio flammeus*, hawk-owl *Surnia ulula*, boreal owl *Ae-*

golius funereus; from waterfowls: Arctic loon *Gavia arctica*, read-throated loon *Gavia stellata*, whooper swan *Cygnus cygnus*, bean goose *Anser fabalis*, white-fronted goose *Anser albifrons*, Canada goose *Branta canadensis*, eider *Somateria mollissima*, and common crane *Grus grus*, golden plover *Pluvialis apricaria*, long-tailed jaeger *Stercorarius longicaudus*, black guillemot *Cepphus grille*, northern shrike *Lanius excubitor*, red-backed shrike *Lanius collurio*, waxwing *Bombycilla garrulus*. From rare land mammals we found lynx which before were considered for the region as vagrant species.

New habitats for many rare and protected plant species: *Armeria labradorica*, *Actaea spicata*, *Bolboschoenus maritimus*, *Cakile maritima*, *Calypso bulbosa*, *Cotoneaster spp.*, *Cypripedium calceolus*, *Dactylorhiza incarnata*, *Epipogium aphyllum*, *Lactuca tatarica*, *Nuphar spp.*, *Scirpus tabernaemontanii* and some other were discovered. Some of them were found in the region for the first time. Now we are preparing full lists of flora and fauna but some samples in part of herbarium and of zoological collections still need to be defined to species.

5 Zoologists of Research Team have been started a detailed study of biology, ecology and distribution of several endangered species of birds of prey: peregrine *Falco peregrinus*, white-tailed eagle *Haliaeetus albicilla*, and golden eagle *Aquila chrisaetus*. They also are developing the technique of monitoring of birds in the passage. We are intending to develop a schedule of populational studies and monitoring of wild reindeer herds. For investigation of plant dynamics in anthropogenic environment botanists made several permanent sample areas near to Chavanga. We also started to work on ecology of three rare plant species found in Murmansk region for the first time: *Polemonium boreale*, *Epipogium aphyllum*, *Armeria labradorica* and one new species (*Ranunculus x vekhovii* Kovalski et Sokoloff, notosp. nov. ined.).

6 Contacts with locals were highly positive. The locals occupy with traditional fields, mainly with fishery, and are interested in environment conservation. Fishermen and hunters are well acquainted with local fauna and flora and they had given to us a lot of new and valuable information. Studying perspectives of nature management in subarctic Europe we have to pay a rapt attention to an experience of Tersky shore inhabitants. All proposals of our Research Team will be discussed and submitted to local community representatives' approval. In future we think to strengthen and to develop these ties as a basis for further scientific and environmental activity.

7 We established that except possible felling there are some other threats for landscape conservation. For instance, sheep breeding widely distributed among locals, lead to sod de-

struction and because of sandy soils to soil blowing and to desertification. Happily, at the moment sheep livestock is decreased.

Serious threat to conservation is a plan of building a circle road around Kola Peninsula. In case of its realisation there will be a hard disturbance of local environment, a serious soil and hydrological degression and decreasing of a fish resource. At present conservancy organisations and local community are trying to reject the project.

A great problem is feral reindeer herds destroying herbage. Extermination of wolf, a natural predator, in 50-70 years was a result of special state program of fighting with agriculture and hunting vermin conducted by Bolsheviks. Zoologists of Research Team plan to investigate appropriateness of wolf re-introduction in south of Murmansk region.

§6 Financial report

There were several modifications in the budget of the Project that, nethertheless did not change the general scheme.

3280 £ (GBP) was spent in total, including:

Equipment	720 £
1 satellite photograph, maps, 4 tents, 3 field glasses, various field equipment, upgrade of computer at Department of Geobotany, printer cartridge	
Photographic	260 £
Food and accommodation	860 £
Food, living expenses (hostels)	
Internal travel/local vehicle hire	770 £
tickets, including luggage, for train, aeroplane and motor ship, payment of cross-country lorry and motor boats	
Report production & translation	70 £
Administration & overheads	600 £
amortisation of departmental equipment, copying of documents, various fees, paying informational services of forest offices, postage	

The deficit of funds was paid by the members of Research Team from their private money.

§7 Especially interesting facts, recommendation, plans

The information above force to give a special attention to some new conservational problem in region. Some additional investigations are believed to be carried out as soon as possible:

1 detailed investigation of biology, ecology and distribution of endangered animals and plants, such as peregrine, white-tailed eagle, golden eagle, lynx; *Calypso bulbosa*, *Epipogium aphyllum*, *Cypripedium calceolus*, *Nuphar spp.*, *Cotoneaster spp.* et al.

2 special investigation of local rodent fauna, which is forage reserve of birds of prey, for estimation of their conservation perspectives;

3 demographical investigation of reindeer population to develop a way of their population restriction (possibly, wolf re-introduction);

4 (if the project of circle road building will not rejected) investigation of soils and plant associations near to the cost and developing a route of minimal destruction;

5 monitoring of waterfowls in the passage at Ondomozero Lakes and estimation of global and regional significance of Ondomozero Lakes and adjacent lakes for stability of birds' populations;

6 preliminary investigation of eastward territory (to Sosnovka) and a preview of a whole subarctic area of Kola Peninsula;

7 developing a special procedures for rare species conservation on the basis of (1);

8 introducing amendments into a reservation project concerning with territory and protection regime (if needed);

9 improving collaboration with local community for stable developing of local economy and for help in legal realisation of their requirements;

10 attracting an attention of world and Russian community as well as federal and local authorities to problems of conservation at the south of Kola Peninsula.

We are developing a project of field investigation in 2001-2002 years at Tersky shore, which included these investigations.

§8 Changes in Project realisation

There were some changes in Project realisation:

- We have conveyed people and luggage to Chavanga not by aeroplane but by cross-country lorry, because of a sudden increasing of freight charges by carrier. Moreover, runway at Chavanga was closed almost during all season and air traffic passed through Tetrino.

- N. Rogova and A. Khrushchova did not participate in research expedition, Nadezhda Liksakova (SPb, Soil and Biological Faculty of the SPb State University, dpt. of Geobotany, postgrade) and Mikhail Yu. Pletz (Moscow Center for Nature Conservation, ecologist) have taken part in our work.

- the schedule was slightly changed because of meteorological conditions.

§9 Current activity

At present we are still working on field collections and preparing papers for periodicals. We are also making web-site devoted to Project. We are conducting consultations with regional and local state organisations about the reservation project.

Research Team is preparing a project for 2001-2002 years and rising funds.

§10 Special technical recommendations for the further activity in the region investigated

- to have flexible terms because the meteorological conditions can change them up to 2-3 weeks;

- to have a contract with domestic airline in advance (before the navigation starts!) because after the navigation airlines changes their tariffs strongly;

- to have a verbal understanding with owners of caterpillar cross-country lorries in advance so that they have time enough to store fuel for long trips;

- it is advisable to buy written-off cross-country lorry because its low price will be compensated very soon:

local price for using cross-country lorry: 40 km = 5000 rub. = 160 USD

price of workable, written-off cross-country lorry (in closing military units): 22500 rub. = 750 USD

- to have contacts for every organisations conducting field work in the region including geological, anthropological and biological, and ask them for an information required especially for an unpublished one;

- to publish results of the investigation in time and to give collections to herbaria and museums. Unfortunately, a large part of data collected never has published; as a result, various research teams repeated the same studies.

Attachment 1

Extraction from the project of the local reserve "Ondomozerskij"

1.2 The local reserve consists of three isolated parts (...)

1.8 Tersky regional committee of environmental conservation shall control the observance of regime of the reserve.

4.1 Legal activities:

4.1.1 Visiting

4.1.2 Hunting (according to the rules in force)

4.1.3 Scientific researchers

4.1.4 Gathering of mushrooms and berries for personal consumption without using any technical aids

4.1.5 Fishing by residents of Tersky region (according to the rules in force)

4.2 Prohibited activities:

4.2.1 Any falling excepting sanitary ones prescribing according to pathological indices

4.2.2 Building of roads or any other communications

4.2.3 Search, prospecting, exploitation and extraction of minerals including peat

4.2.4 Pasture excepting limited pasture of domestic reindeers during seasonal migrations

4.2.5 Any activity changing the hydrological regime of the area

4.2.6 Change of the status and the regime of soil and forest management

7.1 The territory was suggested for conservation by Moscow State University.

Attachment 2

Extraction from the Treaty of scientific and technical cooperation between Kandalaksha State Reserve and the temporary working collective (TWC) "Tersky bereg"

1 The Reserve is willing to deposit scientific materials collected during the Project realization.

2 The Reserve is committed:

2.1 to accept the materials collected by TWC to the scientific library and the scientific archive of the Reserve and to provide an access of users to them on the understanding that the recommendations of citations (...) shall be kept,

2.2 to permit to TWC members to work in the scientific library and the archive (including an access to unpublished data) with the materials concerning with the topic of the investigation,

2.3 to permit to TWC members to work with herbaria of the Reserve,

2.4 to use the formal official reports of TWC as publications, to exploit unpublished and informal data for official use only and referring to the author; in the other cases to ask the author's permission for exploiting his/her data

2.5 to permit to TWK members to use the Reserve buildings in Kandalaksha for temporary living and storage of the equipment.

3 The TWC "Tersky bereg" is committed:

3.1 to give the reports of investigations for the archive of the Reserve (...) as well as copies of all reports and publications containing the information obtained in the frame of the Project. TWC have no objections against distribution of electronic copies of official reports by the reserve if copyright will be reserved.

3.2 TWC guarantee that unpublished data obtained will not use by another persons or organisations and will not published without an official agreement of the Reserve. These data can be used by the members of TWC for their thesis, graduate works or official reports if copyright will be reserved.

Attachment 3

Geobotanical description of the area

The area investigated was classified as a thin forest of North taiga zone that characterised by low thin coniferous woods with a large proportion of birch.

During the research expedition typical forest associations were described as well as various kinds of bogs, coastal meadows and shrubs, vegetation at Chavangskye Keivy, Ondozerskiye Keivy and at the banks of Onzomozero Lakes.

Coastal associations

The most interesting near to Chavanga were coastal associations. We have distinguished there a littoral zone with such species as *Atriplex littoralis*, *Honkenya peploides*, *Leymus arenarius*, местами *Sonchus humilis*, *Mertensia maritima*, *Tripleurospermum maritimum*, *Lathyrus maritimus* growing singly. A supra-littoral zone was a low sandbank, 3-5 m wide, grown by *Leymus arenarius* with some littoral species. After that were sand drifts, about 8 m wide, with thin vegetation (up to 25%) and with dominance of *Honkenya peploides*, *Erigeron acer*, *Taraxacum*, *Leymus arenarius*, *Achillea millefolium*. Then cereals started to dominate, forming continuous turf – *Agrostis straminea*, *Festuca* sp. At sands crossed by traces of lorries and vehicles near to Chavanga thin cover is formed by *Luzula spicata*, *Armeria labradorica*, *Achillea millefolium* and sometimes by *Spergula arvensis*, *Dianthus superbus*, *Cerastium cespitosum*, *Thymus serpyllum*, *Campanula rotundifolia*, *Leontodon autumnalis* etc. Turf-covered sands changed by more humid and low area. Here and there were streams with banks that were reach with *Carex mackenziei*; there were also *Eleocharis* spp., *Montia fontana*, *Parnassia palustris*, *Comarum palustre*. After this area started a zone with dominance of *Empetrum hermaphroditum*. There were areas with different humidity. Between patches of *Empetrum hermaphroditum* there were little turfs of *Agrostis tenuis*, brushes of *Juncus balticus*, patches of lichens (mainly various species of *Cladonia* and *Cetraria islandica*) and mosses. At small valleys *Carex rariflora* and *Carex aquatilis* were grown. The latter dominated in swamped currents, with some amount of *Carex mackenziei*, *Eriophorum polystachyon*, *Comarum palustre*. At more swamped places were less *Empetrum hermaphroditum* in projective covering, but also occurred *Comarum palustre*, *Agrostis straminea*, *Baeothryon alpinum*, *Salix lapponum*, *Potentilla egedii*. There were *Calamagrostis lapponum*, *Andromeda polifolia*, *Montia fontana*, *Epilobium palustre*,

Triglochin palustre, *Salix myrsinifolia*, *Juncus balticus*, *Calamagrostis deschampsoides* etc found as a single plants. Gradually, the zone with dominance of *Empetrum hermaphroditum* changed by a zone with dominance of juniper. Here were the richest from all associations described. First juniper took about 2-5% in projective covering. The most often occurred *Vaccinium uliginosum*, *Baeothryon alpinum*, *Betula nana*, *Empetrum hermaphroditum*, *Salix lapponum*, *Pedicularis sceptrum-carolinum*, *Salix myrsinites*, *S. glauca*, *Chamaepericlymenum suecicum*, *Sanguisorba officinalis*, *Ligularia sibirica*, *Allium schoenoprasum*, *Carex nigra*, *C. Aquatilis*, *C. Rariflora*, *Primula stricta*, *Pinguicula* sp., *Parnassia palustris*, *Andromeda polifolia*, *Eufrasia* sp., *Rhinanthus minor*, *Juncus balticus*, *Potentilla egedii* could be found as well. Later occurred *Viola epipsila*, *V. palustris*, *V. canina*, *Gentiana linguata*, *Selaginella selaginoides*, *Nardus stricta*, *Arctostaphylos uva-ursi*, *Potentilla crantzii*, *Trientalis europaeus*, *Festuca ovina*, *Carex capitata*, *C. nigra*, *C. dioica* etc. At the beginning of the juniper zone, there was one coastal bank. At its side near to sea occurred many littoral species - *Leymus arenarius*, *Festuca* spp., *Atriplex littoralis*, *Armeria labradorica*, *Luzula spicata*, *Viscaria alpina*, often *Equisetum arvense*, *Festuca ovina*, *Achillea millefolium*. Vegetation at the other side more resembled those of the rest of the juniper zone. Additionally, here could be found *Oxytropis sordida*, *Luzula multiflora*, *Poa pratensis* and lichens *Cetraria islandica*, *C. nivalis*, *Cladonia sylvatica*. After the coastal bank was a zone with thick juniper covering and the richest associations by the number of species. We listed here a total description of vegetation at this zone, where numbers stand for projective covering (%) and plus meant presence (less than 1%): *Juniperus sibirica* 50, *Pleurozium schreberi* 20, *Rubus saxatilis* 15, *Lerchenfeldia flexuosa* 10, *Empetrum hermaphroditum* 10, *Festuca ovina* 5, *Solidago lapponica* 3, *Geranium sylvaticum* 3, *Arctous alpina* 2, *Sanguisorba officinalis* 1, *Vaccinium vitis-idaeus* 1, *Oxytropis sordida* 1, *Poa pratensis* 1, *Salix glauca* 1, *Betula alba* 1, *Vicia sepium* +, *Achillea millefolium* +, *Hieracium* sp. +, *Trientalis europaeus* +, *Viscaria alpina* +, *Rumex thyrsoiflorus* +, *Tanacetum vulgare* +, *Vaccinium myrtillus* +, *Agrostis gigantea* +, *Viola canina* +, *Galium boreale* +, *Rubus arcticus* +, *Cerastium cespitosum* +, *Equisetum arvense* +, *Veratrum lobelianum* +, *Veronica longifolia* +, *Polygonum viviparum* +, *Daphne mezereum* +, *Ribes acidum* +, *Linaria vulgaris* +, *Calamagrostis lapponica* +, *Taraxacum officinale* +, *Campanula rotundifolia* +, *Saussurea alpina* +, *Stellaria palustris* +, *Lathyrus vernus* +, *Nardus stricta* +, *Ranunculus acris* +, *Trollius europaeus* +, *Deschampsia cespitosa* +, *Allium schoenoprasum* +, *Potentilla crantzii* +, *Selaginella selaginoides* +, *Festuca* sp. indet. +, *Gentiana linguata* +, *Parnassia palustris* +, *Filipendula ulmaria* +, *Rhinanthus minor* +, *Luzula multiflora* +, *Orthilia secunda* +, *Pyrola rotundifolia* +, *Carex capitata* +, *Calluna*

vulgaris +, *Salix hastata* +, *Antennaria dioica* +, *Calamagrostis deschampsoides* +, *Euphrasia* sp. +, *Geum urbanum* +, *Chamaepericlymenum suecicum* +, *Carex nigra* +, *Anthoxanthum alpinum* +. Such rich associations occurred as small patches eastward from Chavanga, between them were areas poorer by species amount where *Empetrum hermaphroditum*, *Arctostaphylos uva-ursi*, *Arctous alpina* played the great role. The juniper was changed by low birch woods with willows (*Salix glauca*, *S. lanata*, *S. hastata*, *S. phylicifolia*). Under their canopy often occurred *Filipendula ulmaria*, *Geranium sylvaticum*, *Cirsium heterophyllum* etc. Further, coastal vegetation changed by typical birch and spruce-birch thin woods or by bogs. Westward from Chavanga the junipers alternated with bogs, came to steep slope of river bank, entered into it and changed by poor tundra associations with *Arctous alpina*, *Betula nana*, *Arctostaphylos uva-ursi*, *Vaccinium vitis-idaeus*.

Woods

The dominant kind of the wood was spruce wood (*Picea obovata*) with birch, bilberry or true mosses spruce forest. Density of canopy in such forests was about 0,3-0,4. Spruces were 10-12 m high, birches reached 5-8 m high and grown in groups. In the shrub-and-herb layer the most often occurred plants, except bilberry, were *Empetrum hermaphroditum*, *Lerchenfeldia flexuosa*, *Vaccinium vitis-idaeus*.

The more rich spruce forests were grown at stream banks, up to 20 m high, with density of canopy about 0,4-0,5, with birch in the second layer and with rowan in shrub layer. In the herb layer *Chamaepericlymenum suecicum*, *Equisetum sylvaticum*, *Calamagrostis phragmitoides*, *Rubus chamaemorus*, *Gymnocarpium dryopteris*, *Luzula pilosa*, *Solidago lapponum*, *Veronica longifolia* etc. could be found. The rich spruce forest was described at the left bank of Chavanga River, after emptying of Zhilin stream. Here spruces were about 22-23 m high and 30-40 cm in diameter, with density of canopy about 0,3-0,4. Birches reached about 17 m high, 15 cm in diameter, with density of canopy about 0,1-0,2. Second-growth spruces were thin and differed by age. Sometimes occurred second-growth birches and rowan, as well as single shrubs of juniper. Projective covering (in per cent) in shrub-and-herbs layer was as follows: *Chamaepericlymenum suecicum* 15, *Calamagrostis phragmitoides* 8, *Geranium sylvaticum* 5, *Gymnocarpium dryopteris* 3, *Lerchenfeldia flexuosa* 3, *Equisetum pratensis* 2, *Melica nutans* 2, *Vaccinium vitis-idaeus* 1, *Veratrum lobelianum* 1, *Chamaenerion angustifolium* 1, *Vaccinium myrtillus* 1, *Solidago lapponum* 1, *Rubus arcticus* +, *Carex vaginata* +, *Melampyrum* sp. +, *Orthilia secunda* +, *Milium effusum* +, *Maianthemum bifolium* +, *Luzula pilosa* +, *Linnaea borealis* +,

Equisetum sylvaticum +, *Cirsium heterophyllum* +, *Vaccinium uliginosum* +, *Veronica longifolia* +.

When the humidity was higher, birch and willow woods occurred. They were also rather rich, a rare species, *Epipogium aphyllum*, was found in the birch wood, 3-km eastward to d. Chavanga at the right bank of Vonjuchy stream. This was motley grass birch wood, forming transitional zone between streamside willow wood and spruce forest growing more far from the stream. In shrub-and-herbs layer dominated *Deschampsia cespitosa* 20, *Filipendula ulmaria* 20, *Geranium sylvaticum* 15, *Carex cespitosa* 15, *Geum urbanum* 10, *Crepis paludosa* 5, *Gymnocarpium dryopteris* 5, *Chamaepericlymenum suecicum* 3, *Viola epipsila* 2, *Vicia sepium* 2, *Heracleum sibiricum* 1, *Trollius europaeus* 1, *Orthilia secunda* 1, *Veronica longifolia* 1, *Parnassia palustris* 1, *Vaccinium vitis-idaeus* 1, *Carex acuta* 1, *Equisetum palustris* 1, *E. arvense* 1, *Veratrum lobelianum* 1, *Solidago lapponica* 1, *Rubus chamaemorus* 1, *Anthriscus sylvestris* +, *Agrostis gigantea* +, *Menyanthes trifoliata* +, *Lathyrus pratensis* +, *Pedicularis palustre* +, *Trientalis europaeus* +, *Galium palustre* +, *G. uliginosum* +, *Agrostis tenuis* +, *Pyrola minor* +, *Pedicularis verticillata* +, *Vaccinium myrtillus* +, *Melampyrum* sp. +, *Juncus filiformis* +, *Equisetum sylvaticum* +, *Comarum palustre* +, *Epipogium aphyllum* (2 plants). Among mosses *Mnium cuspidatum* dominated, often occurred *Pleurozium schreberi*, *Dicranum*, *Marchantia*. The soil was humid and peaty.

The vegetation of Chavangskye and Ondomskye Keivy.

Keivy are the range of hills consisting of sand with little stones and covering mainly by lichen pine forests, sometimes with single spruces. Pines were 7-13 m high, 15-40 cm in diameter. In the herb layer the most common were *Cladonia alpestris*, *Cladonia rangiferina*, *Vaccinium vitis-idaea*, also occurred *Empetrum hermaphroditum*, *Calluna vulgaris*, *Arctous alpina*, *Arctostaphylos uva-ursi*, *Festuca ovina*, *Vaccinium myrtillus*, *Cetraria islandica*, *Lycopodium complanatum* etc. Lower in the side the pine forests changed by motley-grass and true-mosses spruce forests with birches, where the most common were *Chamaepericlymenum suecicum*, *Vaccinium myrtillus*, *Lerchenfeldia flexuosa*, *Pleurozium schreberi*, *Polytrichum commune*, *Hylocomium splendens*. Here the upper soil profile (up to 6 cm) was peaty; at the 6-8 cm deep was bright gray sand (probably, due to podsollic soil formation), deeper than 8 cm was pure sand. Under the side slope, near to swamp was low

birch wood (that getting lower approaching to the swamp) with a lot of *Lerchenfeldia flexuosa*, *Vaccinium myrtillus*, *V. uliginosum*, *V. vitis-idaeus*.

Keivy were trampled down by reindeers – their paths looked like areas of bare soil, sometimes deepened as ruts.

At the Keivy's peaks often could be found bare areas with mosaic covering of *Empetrum hermaphroditum*, *Arctous alpina*, *Vaccinium vitis-idaeus*, *Arctostaphylos uva-ursi* and lichens (mainly, *Cladonia*, sometimes with some species of *Cetraria*). Sometimes occurred patches of bare, incuse soil. At the sides of Keivy could be found thin birch woods. At Cavangskye Keivy they occupied significant area. Lichens also dominated in topsoil covering.

Aspen woods sometimes grown at the southern sides. Aspen were 0,5-1 m high, it were crooked shrubs with ascending trunks and with projective covering about 60-80%. Under their canopy often occurred *Arctostaphylos uva-ursi*, *Vaccinium vitis-idaeus*.

Among such, rather poor vegetation, two highs could be distinguished that were grown by rich spruce forest. Here spruces were 22 m high, up to 40 cm in diameter; birches, up to 15 m high formed the second layer. Under its canopy were thin, second-growth spruces, birches and rowans. In herb layer the most common were *Gymnocarpium dryopteris*, *Vaccinium myrtillus*, *Lerchenfeldia flexuosa*, *Milium effusum*, also occurred *Solidago lapponica*, *Calamagrostis phragmitoides*, *Chamaenerion angustifolium*, *Chamaepericlymenum suecicum*, *Luzula pilosa*, *Maianthemum bifolium*, *Dryopteris expansa*, *Trientalis europaeus*, *Linnaea borealis* etc. As on the rest of the Keivy, the soil was sandy, and humus layer was only 1,5 cm. We assumed that this kind of forest was climax for the Keivy, whereas pine forests and bare areas occurred due to fire.

Bogs

Between Chavanga and Ondomozero Lakes were described hillock sphagnum transitory bogs. At the hillocks *Empetrum hermaphroditum*, *Betula nana*, *Rubus chamaemorus* were common, also occurred *Oxycoccus palustris*, *Calluna vulgaris*, sometimes lichens (*Cladonia sylvatica*, *C. rangiferina*) etc. In low places between hillocks *Baeothryon cespitosum*, *Andromeda polifolia*, *Eriophorum vaginatum*, *Drosera rotundifolia*, *Carex pauciflora* were found. In such bogs sometimes occurred gaps and openings characterized

by *Eriophorum polystachyon*, *Andromeda polifolia*, *Drosera anglica*, *Carex rariflora*. We described the bog that had flat surface covering by *Carex rotundata*, *Baeothryon cespitosum*, *Carex pauciflora*, *Andromeda polifolia*, *Eriophorum sheuchzeri* etc., with rare hillocks. Between Chavangskye Keivy and Nizhnee Odomozero Lake was a chain of hillock swamps that differed by the amount of dominant species and by some subdominant species. There also occurred wide gaps, usually with dominance of one of the sedge species (*Carex rotundata*, *C. rariflora*, *C. irrigua*) and with *Eriophorum polystachyon*, *Baeothryon alpinum*. Between the bogs, in current, *Eriophorum russeolum* was found. The vegetation of these bogs was poor with species and rather monotonous.

Southward from the Keivy were wide hummock-ridge bogs. Along the ridge *Betula nana*, *Rubus chamaemorus* were common, but also occurred *Empetrum hermaphroditum*, *Ledum palustre*, *Calluna vulgaris*, *Eriophorum vaginatum*, *Oxycoccus palustris*, *Andromeda polifolia*, *Vaccinium myrtillus*, *V. uliginosum*, *V. vitis-idaeus*, *Drosera rotundifolia*, *Carex pauciflora*, sometimes *Pleurozium schreberi*, *Polytrichum*, *Dicranum*, *Cladonia sylvatica*, *C. rangiferina*. At hummocks *Carex irrigua*, *C. rariflora*, *Andromeda polifolia* were found, and in more humid areas with bare peat *Eriophorum polystachyon*, *Drosera anglica*.

Banks of lakes

Banks of Nizhnee Odomozero Lake were mostly bare and stony, proceeded to typical forest associations (spruce or birch woods). Along the southern bank was a rather long sandy zone with *Polemonium boreale*.

Along the bank of Verchnee Odomozero Lake was a motley grass zone. There occurred *Calamagrostis lapponica*, *Nardus stricta*, *Agrostis borealis*, *Trollius europaeus*, *Solidago lapponum*, *Euphrasia* sp., *Achillea millefolium*, *Parnassia palustris*, *Vaccinium uliginosum*, *Juncus filiformis*, *Veronica longifolia*, *Salix hastata*, *Luzula multiflora*, *Bartsia alpina*, *Phleum alpinum*, *Viola canina*, *Empetrum hermaphroditum*, *Viola epipsila*, *Selaginella selaginoides*, *Pedicularis sceptrum-carolinum*, *Taraxacum*, *Polygonum viviparum*, *Cerastium cespitosum* etc. This zone was comparable with coastal meadows by the amount of species.

The banks of Shunkshinskoye Lake were swamped, with large floatings. Near to the bank was a zone with dominance of *Calamagrostis phragmitoides* and presence of *Carex*

aquatilis, Comarum palustre, Viola palustris, Filipendula ulmaria, Veronica longifolia, Menyanthes trifoliata, Chamaepericlymenum suecicum, Carex cinerea, Equisetum fluviatile, Galium uliginosum, Stellaria palustris, Salix lapponum, Salix phylicifolia. At the more humid places Carex aquatilis dominated. Further was a willow zone, mainly with Salix lapponum. Then stretched a wide floating with dominant Carex vesicaria and presence of Betula nana, Menyanthes trifoliata, Comarum palustre, Carex aquatilis, Andromeda polifolia, Eriophorum polystachyon, Equisetum palustre, Calamagrostis lapponica, Oxycoccus palustris, Baeothryon cespitosum, Carex chordorrhiza, Carex irrigua.

Shrubs

Northwestward from Shukshinskoye Lake was swamped willow wood with Salix lapponum. Under its canopy Comarum palustre, Menyanthes trifoliata, Equisetum fluviatile were common, also occurred Betula nana, Oxycoccus palustre, Pedicularis palustris etc.

Other vegetation

At the banks of Chavanga occurred ribbon grass meadows with Caltha palustris, Ranunculus repens, Juncus filiformis, Lulus multiflora, Veronica longifolia etc. At rocks around waterfall Padun Woodsia ilvensis, Woodsia alpina, Cystopteris fragilis were found; the other rocky species almost were not present.