PRISM
ПРИСМ

PECHORA RIVERBASIN
INTEGRATED SYSTEM MANAGEMENT

Slim
2004

# PRISM / NWO PROGRESS REPORT 2003
# II - Expedition Vel'yu & upper Pechora

IB-KSC / RIZA / ALTERRA / DHV

*Report of a fieldwork mission*

24 June - 17 July 2003

# PRISM / NWO PROGRESS REPORT 2003
# II - Expedition Vel'yu & upper Pechora

in the framework of the
Pechora River Basin Integrated System Management (PRISM)
initiative

IB-KSC / RIZA / ALTERRA / DHV

*Report of a fieldwork mission*

24 June - 17 July 2003

Moscow / Syktyvkar, February 2004
H. Leummens, V. Ponomarev, T. van der Sluis (Eds.)

**TABLE OF CONTENTS**

# 1 INTRODUCTION

## 1.1 Project background

The underlying document reports on the field work expedition of Dutch and Russian ecological specialists to the upstream section of the Pechora River basin in the Komi Republic, Russian Federation. The report serves to present a short overview of scientific activities executed in the different thematic directions, as well as some preliminary results of data processing. A comprehensive overview of disciplinary and interdisciplinary scientific results will be presented in separate specialist reports.

The field work expedition is part of the implementation phase of the "Pechora River basin Integrated System Management" project (PRISM), implemented by a consortium of Dutch and Russian organisations, under the overall management guidance of the Dutch Institute for Inland Water Management & Waste Water Treatment (RIZA) and the Institute of Biology, Komi Science Centre, Ural Branch, Russian Academy of Sciences (IB-KSC). The PRISM project is financed by the Partners for Water programme of the Dutch Government.

One major goal of the PRISM project is to integrate scientific knowledge to determine the acceptable boundary conditions for balanced ecosystem functioning in an unique and sensitive boreal and tundra environment. Knowledge on boundary conditions – what are the most vulnerable parts, and what anthropogenic impacts are acceptable without changing irreversibly the ecosystem – is necessary to establish appropriate norms and standards for socio-economic activities in the river basin. Especially industrial activities – wood processing, oil & gas exploration and exploitation, coal & mineral resources mining and transportation (roads & pipelines) – are expected to expand in future. The aim and the specific goals of the PRISM project were described in the PRISM05 document.

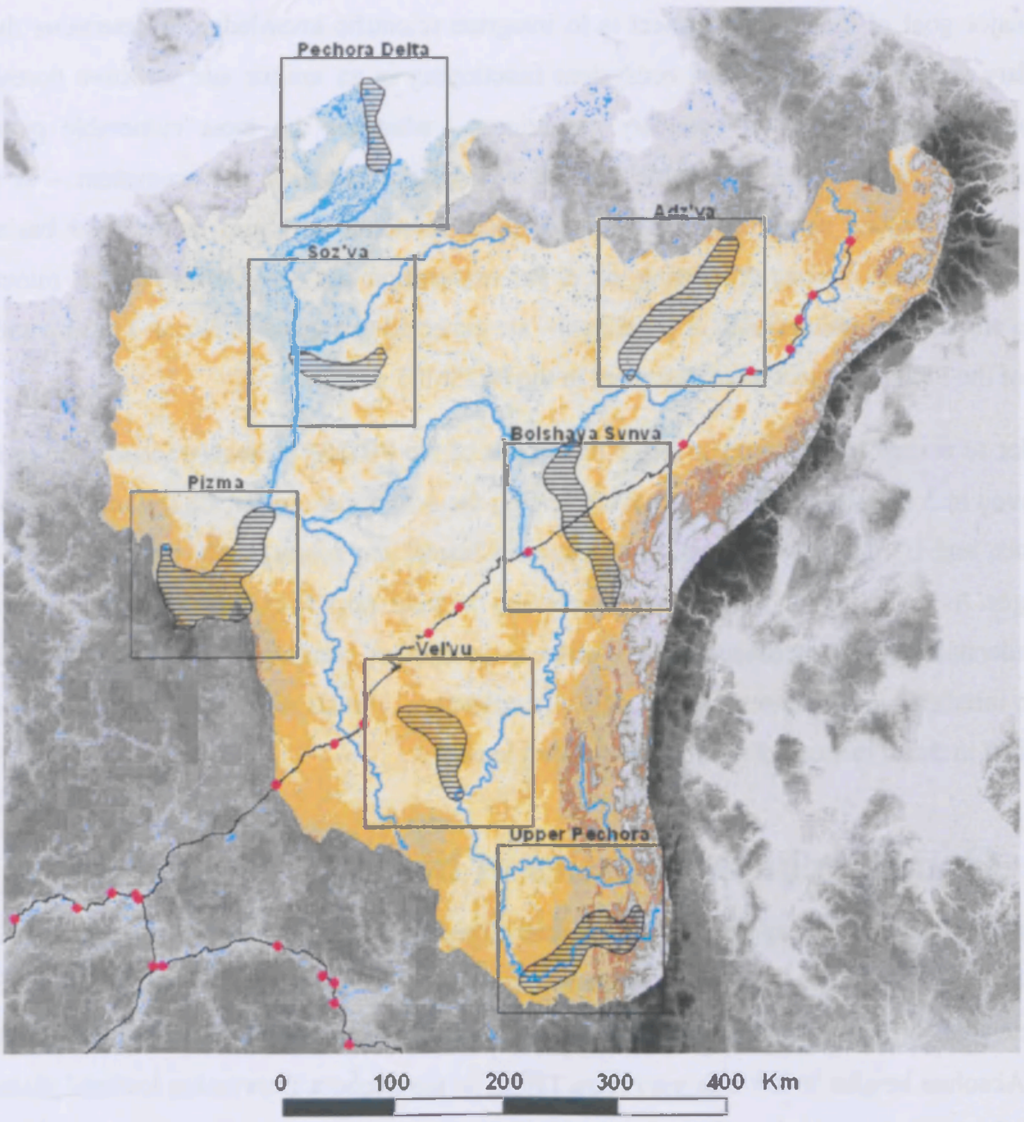
In order to realize the aim and strategic objectives of the PRISM project, implementation activities are structured in 5 clusters: A) the physical cluster; B) the ecological cluster; C) the socio-economic cluster; D) tools; and E) public awareness & education. Clusters are subsequently divided into thematic work packages. Activities within the B-cluster, including the field work activities reported on, aim at increasing the understanding of interdependencies between ecosystem components, as well as consequences of human interferences for terrestrial and aquatic ecosystems. For all work packages, planned activities are described in detail in work plan implementation plans.

## 1.2 General characteristics of the upstream Pechora basin

The areas of interest during the 2003 fieldwork expedition were the Vel'yu river basin and the Upper Pechora, both located in the south-eastern part of the Pechora basin (figure 1.2.1). The region is characterised by three main landscape zones – the lowland plain, the sub-mountain zone and the mountain zone. Absolute heights in the area vary from 150 m in the Pechora Depression lowland plain to 850 m in the northern Ural mountains. The vegetation of the lowland plain is characterised by dark coniferous forests and sphagnum swamps, characteristic for the central taiga zone. Spruce forests are dominant, intermixed and interchanging with Pine, Birch and Fir species and forests. The forest undergrowth is rich in mosses, lichens, mushrooms and herbaceous plants, including berries and medicinal plant species.

The general climate is typical continental, characterised by a long cold snow-rich winter and a short cool moist summer with a limited number of warm days. The average yearly air temperature is -1°C in the lowland plain. The Ural mountains are sufficiently high to affect atmospheric cyclonic activity, and climate parameters show an increase in precipitation and a decrease in average air temperatures from the West to the East, subsequently affecting soil forming processes and vegetation development.

The areas of interest are located in the Sosnogorsk and the Troitsk-Pechorsk administrative regions of the Komi Republic. The Vel'yu river basin study area is located in the eastern part of the Sosnogorsk rayon, established in 1989 during the split-up of the Ukhta rayon. The rayon borders the city of Ukhta, and the regions of Pechora, Vuktyl, Troitsk-Pechorsk and Ust-Kulomsk. The total surface area is 16,500 km$^2$, inhabited by a population of 58,300 people (data 1 January 2000), mainly consisting of ethnic Russians (65%), Komi (16%) and Ukrainians (10%).




General map of the Pechora basin and PRISM areas of interest.

The Upper Pechora area of interest, comprising the upstream section of the Pechora river, is located in the Troitsk-Pechorsk administrative rayon. The rayon has boundaries with the Ust-Kulomsk rayon and the territories of the cities of Sosnogorsk and Vuktyl in the Komi Republic, as well as with several administrative regions of the Russian Federation – the Khanty-Mansysk Autonomous Region, the Tyumen Oblast, the Sverdlovsk Oblast and the Perm Oblast. The rayon was established in 1931. Its total surface area is 40,700 $km^2$, inhabited by a total population of 20,200 (1 January 2000). The administrative centre is the village of Troitsk-Pechorsk, established in 1674. A substantial part of the rayon is located in the Pechora Depression, bordered in the West by the Timan hills and in the East by the northern Ural mountain chain.


Oil exploitation in the Vel'yu river basin.


Traditional resin extraction from *Pinus sylvestris.*


Drying of fish in Ust-Unya


Yaksha, Administration of the Pechora-Ilych Nature Reserve


Livestock grazing in Kurya.

The Sosnogorsk rayon is rich in valuable fossil fuels – oil, gas, bitumen, asphaltite and peat – as well as other valuable natural resources – gypsum, limestone, sand, gravels, phosphorites and mineral waters. The Sosnogorsk rayon is characterised by a relatively high living standard, according to income and services. The rayon is considered to have favourable perspectives for sustainable industrial development due to the diversity in natural resources and the presence of a local processing industry, mainly in the gas sector. Main labour provider is industry, followed by transport, construction and social infrastructure. A potential factor of instability is the current economic dependence of the rayon on the oil & gas sectors, the developments of which depends on the world conjuncture.

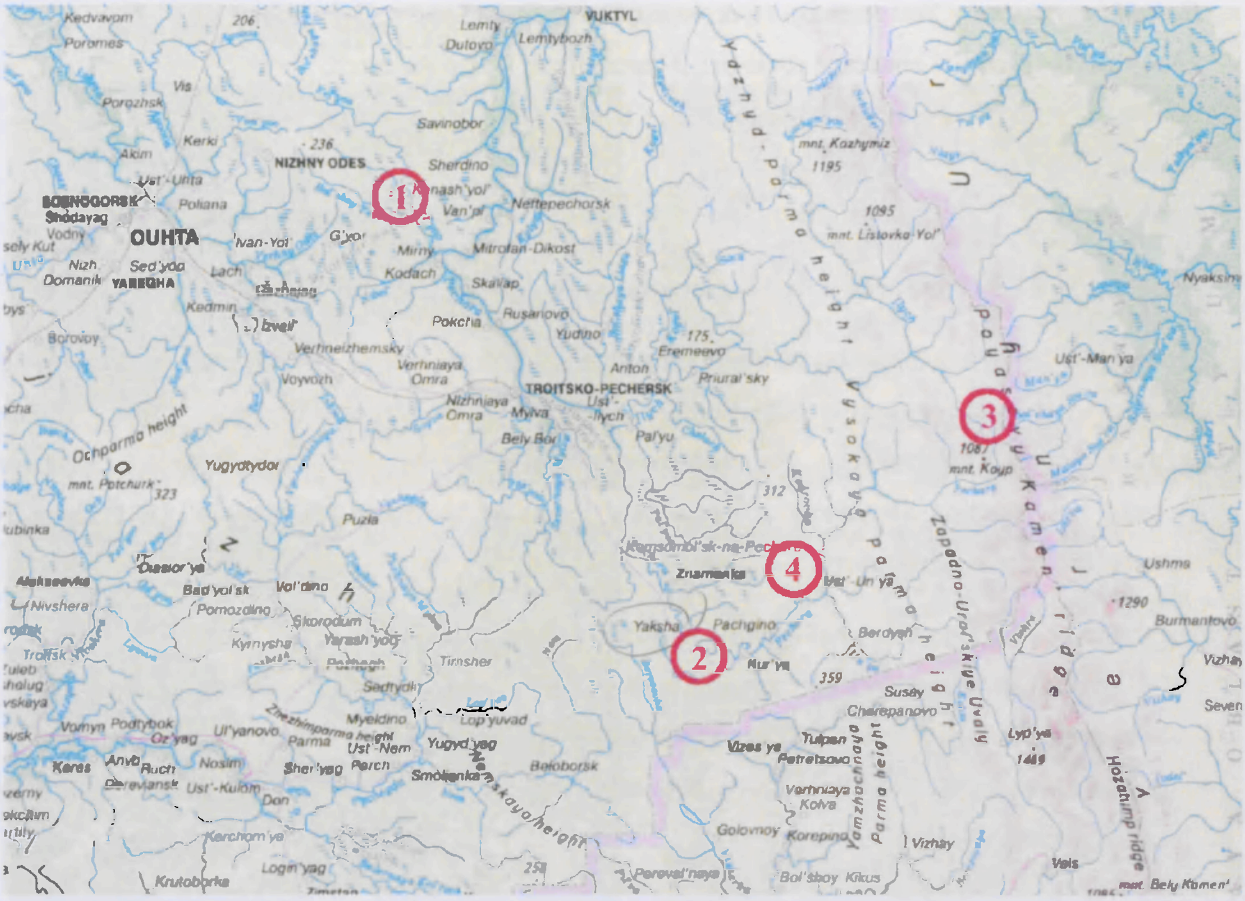
The Troitsk-Pechorsk rayon also is rich in natural resources – potassium salts, semi-precious stones, oil, gold, clays as well as gas. The rayon is characterised by rich forest resources, serving as the main industrial employer for the regional population (92% of the industrial production). Other industrial activities include the production of building materials, polygraphics, light industry and food processing industry.

Nature conservation is implemented in the largest strictly protected Nature Reserve in Europe, the Pechora-Ilych Nature Reserve, covering a total area of 721,300 ha. The Nature Reserve provides protection to a number of valuable hunting species – Sable, Otter, Muskrat, Mink and others. Other wildlife, in the Nature Reserve as well as outside, includes Elk, Reindeer, Brown Bear, Wolf, Fox, Ermine, Lupus and Otter. The area is rich in birdlife. The Pechora river is inhabited by 34 fish species, 8 of which are endemic. Both the Pechora main stream and its tributaries serve as spawning grounds for valuable and protected Salmon species. Commercial fisheries focuses on Salmon and White-fish species.

## 1.3 Field work organisation and participants

The research activities in the south-eastern part of the Pechora basin focussed on aquatic and terrestrial landscapes of both the upstream section of the Pechora main stream basin as well as the basin of a 1st order tributary, the Vel'yu river. In the areas of interest in total 4 main study areas were selected, in accordance with differences in landscape structure and anthropogenic pressure (figure 1.3.1):

- The central Vel'yu basin, near the village of Lenavozh. Intensive oil and gas exploitation, transversing oil & gas pipelines, intensive forestry;
- The upper Pechora, near the village of Yaksha, upstream lowland section. Intensive forestry and protected area;
- The upper Pechora, Ural mountain section. Undisturbed landscapes, altitude landscape belts, protected area;
- The upper Pechora, near the village of Ust-Unya, upstream sub-mountainous section. Intensive forestry.




Locations of the selected field work study areas in the south-eastern Pechora basin.

In addition to these main study areas, aquatic and terrestrial fauna specialists investigated a additional study area in the sub-mountain zone near the Nature Reserve settlement of Zheshym-Pechorskiy, as well as the Pechora river stretch between Zheshym-Pechorskiy and Ust-Unya.

The main mode of terrestrial transportation during the 2003 field work expedition was by car, using the extended network of paved and unpaved roads laid down for oil & gas exploration and forestry activities. A helicopter was only used to reach the study area in the Ural mountains. Additionally use was made of transportation by outboard-engined rubber boat.

In the field work expedition 2003, 8 Russian and 5 Dutch ecological specialists participated:

| | |
|---|---|
| ***Vasili Ponomarev*** | Senior Ichthyologist, Russian Team Leader, Institute of Biology, Komi Science Centre, Ural Division, Russian Academy of Sciences (IB-KSC); |
| ***Svetlana Degteva*** | Senior Vegetation specialist, IB-KSC; |
| ***Sergey Kochanov*** | Senior Ornithologist, IB-KSC; |
| ***Tatiana Pystina*** | Specialist Lichens & mosses, IB-KSC; |
| ***Alla Kolesnikova*** | Specialist Terrestrial invertebrates, IB-KSC; |
| ***Gennady Vtyurin*** | Senior Soil scientist, IB-KSC; |
| ***Evgeni Schramm*** | PhD student, Ichthyologist, Syktyvkar State University; |

***Harald Leummens*** Soil scientist, Hydrologist, Dutch Team Leader, DHV Water BV;

***Theo van der Sluis*** Landscape ecologist, Alterra Green World Research;

***Mervyn Roos*** Ornithologist-ecologist, RIZA;

***Stef van Rijn*** Ecologist, RIZA;

***Pieter Slim*** Senior Forestry specialist, Alterra Green World Research.

Additionally the field expedition members were accompanied by Gennady Shulepov – cook.

Besides the field work activities and preliminary results, the current report also includes some baseline information on hydrology and hydrochemistry characteristics of the areas of interest, provided by relevant specialists of IB-KSC based on literature sources. Translations of draft Russian expert reports were executed by Anastasia Shuyskaya. An additional report on biological resources of the Pechora-Ilych Nature Reserve is in preparation.

The support of the following organisations is gratefully acknowledged:

- the Ukhta Fish Protection Inspectorate, Komirybvod, for their support in transportation logistics;
- Tebukneft, for their permission to visit their territory in the Vel'yu river basin;
- the Administration of the Pechora-Ilych Nature Reserve, for their support in transportation logistics and personnel assistance.

## 1.4 Field work impressions








© V. Ponomarev


© T. van der Sluis


© V. Ponomarev


© V. Ponomarev

# 2 FIELD WORK – ACTIVITIES & RESULTS

## 2.1 Terrestrial ecosystems

### 2.1.1 Soils

Gennady Vtyurin

*Introduction*

During the field expedition, the soil scientist was involved in morphological descriptions and classification of soils types occurring in the study areas. Much attention was paid to observations on differences in soil and vegetation characteristics resulting from different types of natural and anthropogenic impacts, as well as to the restoration rate of these components after disturbances. Soil classifications were completed in accordance with the Russian Soil Classification and World Reference Base of Soil Resources (WRB, table 2.1.1.). Sampling for physical-chemical research was not provided for.

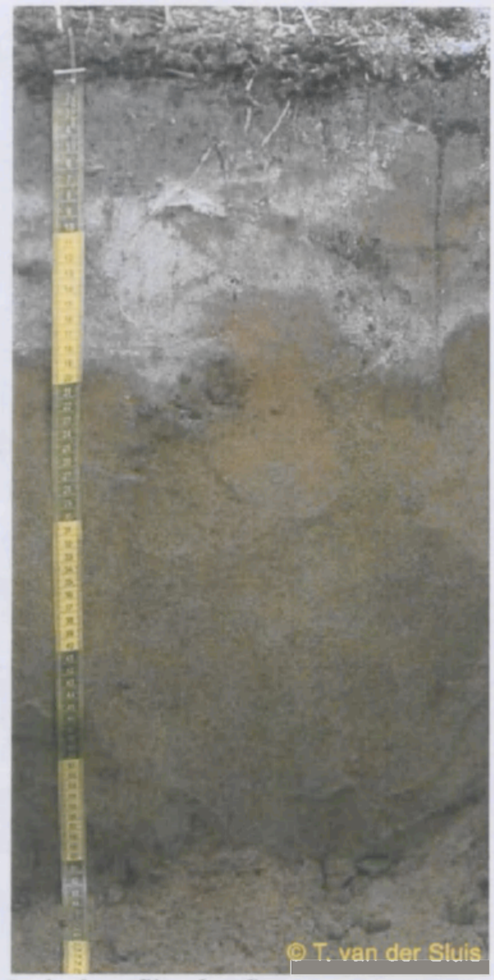
Field studies were carried out by foot and by car from the four base camps in the middle stream section of the Vel'yu river and the upstream section of the Pechora river. Routes and research sites along them were located using satellite images printed at the scale of 1:50,000. Research sites for soil-botanic descriptions were chosen by the geobotanists Svetlana Degteva and Pieter Slim.

*Results*

During the field work, soil types were characterised on 120 sites, based on soil profile descriptions from sections and half-pits. On two sites, soils with characteristic humus-accumulative (sod) horizons were sampled to determine chemical analytical characteristics. In addition, also samples of rock material occurring in soils of the Ural mountains were collected. Soils of the Ural mountains region are of special interest, as hardly any information on these soils is available in literature.

On the lowland plain of the Pechora basin, all soil profiles include an organic-accumulative (peat and peaty) horizon, but not all soils have a humus-accumulative (sod) horizon. On well-drained sites, acidic soils with unsaturated base saturation of the cation exchange complex occur, characterised by topsoil horizons whitened by Fe and clay eluviation. Their properties are extensively discussed in literature. According to the Russian soil classification these soils with an O-E-$B_t$-C profile classify as Podzolic soils, while soils with O-E-$B_{h,fe}$-C profile classify as Podzols. In the WRB these soils are referred to as Albeluvisols and Podzols correspondingly. The lightened stratum is relatively enriched in silicon oxide and depleted of sesquioxides, oxides of alkaline and alkaline-earth elements. Clay and Fe eluviation from the topsoil horizons is mainly explained by the processes of destruction and removal of mineral as a result of podzol-forming processes. Podzol-forming processes result in a low cation absorption capacity, the dominance of Al on the exchange complex, and a low supply of nutrients and nitrogen.


Soil profile in the Pechora mountainous landscape zone (Koyp mountain)




Podzol profile after fire

On poorly drained sites, peat-podzolic and peat soils predominate. The dominant soil forming processes in peat-podzolic soils include peat development, podzolisation and gleyisation, in peat soils – peat development and gleyisation. According to the WRB, these soils form sil complexes of Histi-Gleyic Albeluvisols, Histic Gleysols and Histosols. The central sections of the Pechora and Vel'yu rivers floodplains are characterised by well-drained alluvial-sod soils (A-C soil profiles), while in poorly drained depressions sod-gleyic soils and peat soils occur. Due to the slow decomposition rate of vegetation litter, equal to the low rate of the biological cycle, the alluvial soils include almost everywhere a peaty horizon.

In the mountainous part of the Pechora-Ilych Nature Reserve, besides podzolic soils also often soils with humus-accumulative (A1, A) horizons without podzolic features occur. These soils develop on slopes, on loamy eluvial-deluvium parent material of grey, green and brown schists under large-grass-Spruce forests. The soil horizon structure of these soils varies, including profiles of A-C, $A\text{-}B_{h,fe}\text{-}C$ and $A\text{-}B_t\text{-}C$. The position of these soils in the soil classification is not well understood. Soils with an A-C profile type were classified as Cambisols, soils with other profile types as Luvisols.

Below a moss-lichen cover in the bare mountain zone, as well as on steep slopes under forest, dry peat soils without fine earth fraction occurred. The thickness of the dry peat in crevices between rock outcrops reached 20-40 cm. In accordance with the WRB classification these soils were referred to as Lepti-Folic Histosols.

Along the boundary of oligotrophic peat massifs in the northern and middle taiga zone natural waterlogging was observed. This feature is conditioned by the vertical and lateral expansion of the peatlands, resulting in the rise of groundwater levels in adjacent territories. The vegetation reveals a change from a Haircap moss-Greenmoss cover towards Bogmoss. Soil profiles reflect this process in the formation of small complexes of illuvial-peat podzols or podzol-gleyic soils with sod-gleyic soils.

No qualitative changes could be observed in well-drained sandy and loamy soils as a result of forestry activities and forest fires. Almost on all research sites Histi-Gleyic Albeluvisols occurred in complexes with Gleyic Albeluvisol or Histic Gleysols, which testifies to the potentially low resistance of these soils under conditions of climate changes or disturbances of the vegetation cover. A transformation of a soil complex dominated by Gleyic Albeluvisols into homogeneous Histic Gleysols was observed on research sites 119 (a winter road) and 141 (a gas pipe line).

In general, the restoration of a natural soil profile after anthropogenic disturbances occurs at a much lower intensity than the restoration of the vegetation cover. Rather common are 20-40 year-old regrowing Pine-Spruce stands on primitive undifferentiated soils (Regosols), characterised by vague features of humus or podzol horizons. It is noted that describing rather unknown soils, especially in hard-to-reach regions, without the opportunity for laboratory examinations is very unproductive, adding nothing to the project nor to science. Not being able to determine the analytical characteristics means that the exact soil type can not be determined, and that flora biodiversity can only be limitedly linked to and explained by differences in soil characteristics. To eliminate these contradictions only small amounts of financing are necessary for laboratory research.

Soil erosion following pipeline construction, Central Vel'yu basin

**Table 2.1.1.1** Preliminary soil-correlation table for the soil types identified during the 2003 field expedition.

| World Reference Base (1998) | | Russian Soil Classification (1997) | |
|---|---|---|---|
| **Soil group** | **Soil subunits** | **Soil type** | **Soil subtype** |
| Albeluvisols | Abruptic | Podzolic soils | |
| Albeluvisols | Histi-Gleyic | Peat gleyic podzolic soils | |
| Albeluvisols | Gleyic+Histi-Gleyic | Peat-gleyic podzolic soils | |
| Albeluvisols | Histic | Podzolic soils | |
| Albeluvisols | Anthric | | |
| Anthrosols | Hortic | | |
| Cambisols | | | |
| Cambisols | Arenic | Podzols | Illuvial-Fe |
| Cambisols | Dystric | Podzols | Illuvial-Fe |
| Fluvisols | Umbric | Light-humus (sod) alluvial soils | |
| Fluvisols | Umbri-Gleyic | Alluvial sod-gleyic soils | |
| Fluvisols | Arenic | Light-humus (sod) alluvial soils | |
| Gleysols | Histic | Peat Gleyzems | |
| Gleysols | Plintic | Peat eutric Gleyzems | |
| Gleysols | Eutri-Histic | Peat eutric Gleyzems | |
| Histosols | Dystri-Fibric | Peat oligotrophic soils | |
| Histosols | Lepti-folic | Dry peat soils | |
| Histosols | Eutric | Peat eutric soils | |
| Luvisols | Dystric | Light-humus (sod) alluvial soils | |
| Regosols | | Weakly developed soils | |
| Regosols | Anthropic | Weakly developed soils | |
| Regosols | Fluvic | Weakly developed soils | |
| Regosols | Endogleyic | Alluvial weakly developed soils | |
| Regosols | Arenic | Weakly developed soils | |
| Regosols | Haplic | Weakly developed soils | |
| Podzols | Haplic + Gleyic | Podzols | Illuvial-Fe + Gleyic |
| Podzols | Haplic | Podzols | Illuvial-Fe |
| Podzols | Histi-Gleyic | Gleyic Peat Podzol | |
| Podzols | Anthric | | |
| Podzols | Entic | Podburs | |
| Umbrisols | Lepti-Dystric | Light-humus (sod) soils | |
| Umbrisols | Haplic | Light-humus (sod) soils | |
| Umbrisols | Haplic | Light-humus (sod) soils | |

Notes: typical soil profiles: Umbrisols & Fluvisols - A-C; Cambisols - A(E) & B (weakly developed); Luvisols - A-B-C; Podzols - O-$A_2$(E)-$B_{f,h}$-C; Albeluvisols - O-$A_2$(E)-$B_t$-C; Gleysols - H-$C_{gl}$.

### 2.1.2 Vegetation

Svetlana Degteva

*Introduction*

During the PRISM field season of 2003, geobotanic and floristic investigations were carried out in selected study areas, located in the lowland plain, sub-mountain and mountain landscape zones in the Vel'yu river basin (middle and upper sections) and the upstream section of the Pechora river. In total four ecological profiles were laid out, their length varying up to 5 km from the river bed through the floodplain into the watershed.

The floodplain meadows of the Pechora river provide a rich environment for flora biodiversity.

At selected sites along the transects, detailed information was collected on the main vegetation communities and the biological diversity of ecosystems up to the level of communities and vascular plant species, while bryophytes were sampled for further determination. Parallel, on the same sites also information on soil types, lichens and soil invertebrates, as well as forest productivity, was collected by other specialists.

The structure of vegetation communities was described according to the different layers identified – tree stock, shrub & tree undergrowth, grass-dwarf shrub and moss cover. In forest communities a number of taxation parameters were described – composition, crown density, height, trunk diameter, age, restoration. The species composition and abundance of the ground cover – vascular plants, lichens and bryophytes – were noted.

Special attention was paid to the dynamics of forest ecosystems, in particular the transformation of their biological diversity due to forest harvesting operations, mining, construction of line structures (roads, power transmission lines, oil & gas pipelines) and forest fires. A special set of sampling sites was selected in forestry zones, in secondary and primary stands of three forest types with different ages – Greenmoss-Spruce forest, Lichen-Pine forest and Greenmoss-Pine forest.

Additionally, also attention was paid to studying the weed-ruderal vegetation communities in the small villages of Lenavozh and Ust-Unya.

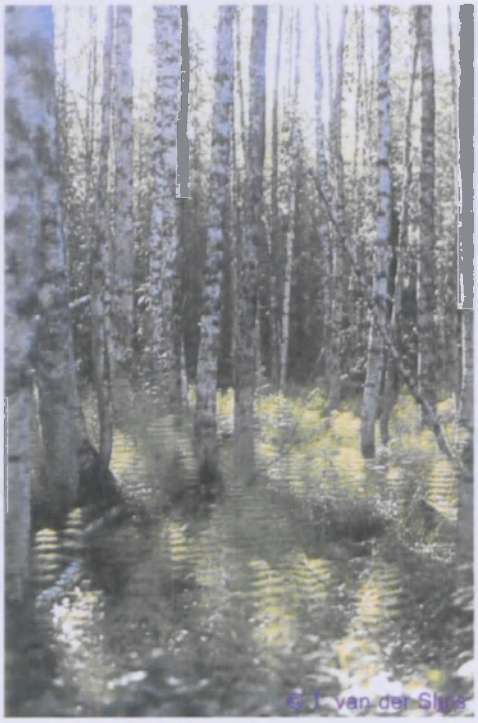
*Results*

In total 129 geobotanic descriptions were made during the period of the field expedition, while 200 samples of leafy mosses were collected for the herbarium.

The main vegetation types in the lowland plain and sub-mountain landscape zones include forests, bushes, meadows and wetlands. In the Urals mountains, the altitude gradient provides an additional factor causing a higher diversity of the vegetation cover, mainly due to the occurrence of mountain tundra.

The overall appearance of the vegetation cover is dominated by forest and wetland communities. Within the forest vegetation community, five formations – Spruce forests, Fir forests, Pine forests, Birch forests and Aspen forests – and five forest type groups – Lichen, Greenmoss, Haircap moss, grass and Bogmoss – can be distinguished. Wetlands typically are classified as transitional, with thin peat deposits, pine afforestations along the edges and treeless in the central part.

Pine forst with lichen undergrowth.



Birch forest with fern undergrowth.

In the middle stream section of the Vel'yu river, near the confluence with the Lenavozh river, the undulating moraine plain landscapes alternate with landscapes of sandy terraces, frontal and lacustrine plains, dominated by Pine forest. On places where the moraine plain is dissected by streams, floodplains are well-defined. Closer to the riverbed, the floodplain typically is covered by thickets of *Carex aquatilis* and *Equisetum limosum*, while the central part is dominated by gramineous-forb meadows. When meadows are no longer used, or irregularly used, the gramineous-forb vegetation becomes overgrown with bushes (*Salix dasyclados*, *S. phylicifolia*, *Rosa acicularis*, *Sorbus aucuparia*) and deciduous trees (*Betula pendula*, *Populus tremula*). Gradually, primary Birch and Aspen forests with a grass undergrowth develop, in the course of time changing into large-grass Spruce forests. A typical feature of floodplain Spruce forests is an admixture of Fir and Larch in the tree stands. In general, floodplain communities are characterized by the highest level of vascular plant diversity.

On the undulating moraine plain watershed, communities of the Bilberry-Greenmoss Spruce forests association occur the most frequent. Mature Spruce stands (VII-VIII age class) are characterized by a low crown density (0.5-0.6). Although spruce is clearly dominant, an admixture of Birch and Pine occurs everywhere. The trunk height of *Picea obovata* does not exceed 16-18 m, with the trunk diameter reaches 20-24 cm. Disturbed stands are heterogenous, while a sufficient amount of Spruce regrowth up to 3 m high can be found. Regrowth is absent or limited, consisting of individual specimens of *Sorbus aucuparia*, *Rosa acicularis* and *Salix phylicifolia*. Dwarf shrubs prevail in the well-defined grass-dwarf shrub layer, with a total projective cover of 40-60 %. In this layer, *Vaccinium myrtillus* is the most abundant species, everywhere intermixed with the less abundant *V. vitis-idaea*, *V. uliginosum* and *Empetrum hermaphroditum*. Herbaceous plants are of less importance. Other species with a high occurrence frequency include *Equisetum sylvaticum*, *Carex globularis*, *Avenella flexuosa* and *Melampyrum sylvaticum*. The moss cover is dominated by Greenmosses, among which *Pleurozium schreberi* and *Hylocomium splendens* are the most frequent and abundant. Rather common is an admixture of *Polytrichum commune* and the Bogmosses *Sphagnum girgensohnii*, *S. cuspidatum*, *S. angustifolium* and *S. warnstorfii*.


Peat bog in Spruce forest.

Undergrowth in undisturbed forests of the upper Pechora basin.

Large areas of primary Greenmoss Spruce forests are disturbed by human activities, first of all by forestry. In areas where forest harvesting has taken place, secondary stands of *Betula pubescens* and *B. pendula* develop. As deciduous trees modify habitat conditions differently than coniferous trees, under the canopy of the secondary forests new floristic complexes develop. The increase of illumination results in a strengthening of the coenotic positions of marginal-glade species (*Chamaenerion angustifolium*, *Avenella flexuosa*, *Melampyrum pratense*, *Solidago virgaurea* etc.). In general secondary deciduous forests are characterized by an increase in vascular plant species diversity and saturation of the floristic complex. The analysis of restoration processes allows to conclude that the regrowth of coniferous species is sufficient to ultimately result in a restoration of conditionally primary coniferous stands.

Stands of *Pinus sylvestris* are confined to terraces with sandy soils. On well-drained sites Lichen- and Greenmoss-Pine forests dominate, along water-logged depressions mainly Bogmoss-Pine forests occur. Many Pine stands suffered from forestry activities and fires more than once. The type of forest regrowth


Ruderal plant communities in Kurya village.

of disturbance: in harvested areas regrowth is dominated by Pine, in forest fire-affected areas usually secondary Birch forests develop.

The most intensive human impact on the vegetation cover can be seen on the locations of hydrocarbon mining. Visits to the Turchaninovskiy oil field showed that on production grounds and surroundings of line structures depends on the type and drilling pits the vegetation cover and soil is completely destroyed. The speed of restoration of the vegetation cover is very slow, and hampered by renewed human clearing. Preliminary analyses allows to conclude that vegetation group developing on disturbed territories consist mainly of apophytes, and that the initial stages of vegetation restoration do not always follow the normal zonal succession.

The floristic complexes occurring in the village of Lenavozh are very diverse. The share of anthropophytes such as *Erysimum cheirantoides*, *Chenopodium album*, *Artemisia vulgaris*, *Capsella bursa-pastoris*, *Amoria repens*, *Plantago major* etc. sharply increases, while also species cultivars appear.

According to relief features, the study area near the village of Yaksha is still part of the Pechora Depression lowland plain. The surface is predominantly covered by thick strata of fluvioglacial sands, covering loamy moraine. Locally sands are eroded and moraines surface. Sedimentary bed rocks of the Permian age (sandstones, clay, limestone, marl) occur mainly at great depths, and only occasionally occur as outcrops along the river banks. The area is characterised by steep slopes and terraces of Pine forests along the Pechora river, a result of territorial uplift and river incision, while the floodplain zone is feebly expressed and occupy small areas.

The peculiarities of the river valley structure are clearly reflected in distribution and type of vegetation cover. Floodplain meadows hardly occur, while floodplain forests occupying a narrow discontinuous zone are weakly expressed. The ancient terraces and the fluvioglacial plain are dominated by Pine forests and wetlands of different types. Lichen- and Greenmoss-Pine forests occur on well-drained sites, while Bogmoss-Pine forests cover flat depressions of the watershed and the outward boundary zone of wetlands. Large forested areas on the left bank of the Pechora river were intensively disturbed by forestry activities, forest fires and recreation. The forests on the right bank of the river are part of the Pechora-Ilych Nature Reserve, and as such were not subjected to anthropogenic impact. In the Nature Reserve, the main factor determining natural forest dynamics is fire. In disturbed Pine forests a decrease in height and projective covering of lichens is observed, while the coenotic role of species changes – *Cladina* *arbuscula*, *C. rangiferina* and *C. stellaris* gives way to species like *Polytrichum piliferum*, *Cladonia turbinata*, *C. deformis*, *C. sulphurina* and *C. botrites*.

In the mountainous zone of the upstream Pechora river, the vegetation cover was studied at a key site in the Pechora-Ilych Nature Reserve, near the mound of the Yurginskaya river. In this area the Pechora river valley follows a meridian direction, separating the Poysovoy ridge and the mountain Yanyvondersyahal, from the Yany-Pupu-Ner mountain ridge and the mountain Koyp. The relief is predominantly low-mountain flat-topped with frost erosion features. The topographical height of the mountain peaks varies between 700 and to 930 m above sea level. The mountain massifs consist of metamorphosed crystal rocks of Cambrian and, partly, Precambrian age. The highest peak in the study area is the mountain Koyp, separated from the Yana-Pupu-Ner mountain ridge by a deep cross-saddle, consisting of epidotizated diabases and epidote-amphibolite schists. The Pechora valley is cut into the plain surface of the third level, its absolute height decreasing from 400 to 340 m above sea level. The river is characterised by numerous meanders, a low current velocity, a limited width and depth, and a pebble bottom. Quite often primary rocks are located directly near the river. The first (floodplain) terrace usually occupies only narrow, small areas, and rarely occurs simultaneously on both river banks. With increasing distance form the source, the meanders deepen, and herbaceous vegetation (communities of foreshores, floodplain meadows), Willow stands and Birch forests are formed. As a rule, the second terrace is expressed more clearly, characterised by Spruce and Spruce-Fir forests and oligotrophic peat bogs. In some cases bed rock exposures of quartzitic-sericitic schists crouch up almost to the bank line, they represent the third floodplain terrace. To the East they are replaced by greenschists typical for the Poyasovoy mountain ridge. Dark coniferous forests dominate, as on the 2nd terrace and primary rocks.

The mountain zone is characterised by a height zonality in the vegetation cover. The belt of dark coniferous forests stretches up to 550 m above sea level. Higher they are replaced by large-grass Birch forests, alternating with areas of mountain large-grass meadows. The tree boundary is located at a height of 650-730 m above sea level and is formed by Fir, sometimes by Spruce and Birch. Above the treeline a shrub belt occurs, changing into mountain moss and lichen tundra. On the tops of the ridges, in the tundra zone, combe rocks occur. No bare mountain zone occurs in this region.

The fourth study area is located in the sub-mountain landscape zone, near the confluence of the Unya river and the Pechora river. The floodplains near the river bank as well as islands in the river bed are characterised by tree-like Willow stands dominated by *Salix dasyclados*. The undergrowth is dominated by large grasses (*Filipendula ulmaria*, *Urtica sondenii*) or gramineous plants (*Calamagrostis purpurea*, *Bromopsis inermis*, *Phalaroides arundinaceae*). The meadows in the central part of the floodplain are used by man for haymaking, while in the vicinity of the village Ust-Unya they also are used for grazing. Floodplain dark coniferous forests are characterized by the predominance of *Picea obovata*, while also *Abies sibirica* plays an important role in the formation of stands. The undergrowth layer is dominated by herbaceous plants (*Oxalis acetosella*) and ferns (*Diplasium sibiricum*, *Dryopteris expansa*, *Matteuccia struthiopteris*). Where dark coniferous stands were destroyed by fires, regrowth is dominated by herbaceous Birch and Aspen stands. The gentle middle and upper slopes of mounds are dominated by dark coniferous forests. Greenmoss-Spruce forests prevail, along drainage depressions and streams valleys replaced by herbaceous-Spruce forests, with ferns or *Aconitum septentrionale* dominating the undergrowth. Sites damaged by forest fire and windfall show a regrowth succession stage of secondary stands dominated by herbaceous-Greenmoss *Populus tremula* and *Betula pubescens*. Between the villages of Ust-Unya and Yaksha, the predominantly sandy deposits create large areas of Lichen-Pine forests, often affected by forestry activities and forest fires.

Vegetation data collected on selected sites in the study areas were inserted into to the data base created with the use of Turboveg. The data base on species diversity will be enlarged after completion of the determination of mosses and lichens.

The results of the field work data collection allow to:

- complete the preliminary classification of landscapes and vegetation communities;
- provide additional data on diversity of the vegetation cover in the Pechora river basin on the coenotic and species levels;
- reveal new habitats of rare plant species, such as *Calypso bulbosa* and *Cinna latifolia*;
- provide a basis to assess the degree of anthropogenic transformation of landscapes.

Preliminary results show that:

- valley landscapes are characterized by the highest level of vascular plants species diversity;
- industrial activities expose the greatest impact on the diversity and structure of natural complexes;
- the natural restoration of the vegetation cover on technogenically disturbed sites does not always follow the zonal succession series;
- human impact on forests ecosystems results in a change of biotopic conditions and, as a consequence, to the change of biological diversity and the coenotic role of species;
- the degree of human impact on ecosystems in the study areas has not reached its highest point;
- the landscapes of the Pechora-Ilych Nature Reserve can be considered as model of undisturbed natural complexes of the Pechora Depression lowland plain, foothills and the Ural mountains. At present, ecosystem dynamics in the main part of the Nature Reserve is determined only by natural factors.

### 2.1.3 Forestry

Pieter Slim

*Introduction*

During the PRISM 2003 field expedition also a survey to collect input data for the forest model FORGRA (Jorritsma et al. 1999) has been carried out, being part of the B4 work package. Information was gathered about the dimensions of individual trees. The field survey was carried out by Pieter Slim, assisted by Theo van der Sluis, Svetlana Degteva, Harald Leummens, Stef van Rijn and Tatiana Pystina. The weather conditions during the field expedition were excellent for the type of research, as was the phenological state of vegetation.

*Data collection*


Old-growth boreal forest in the Upper Pechora.

In order to run the forest model, there is a need for data from the tree layer, the shrub layer, and the herb layer. Data about the herb layer are collected during the standard vegetation survey executed as part of the B1 work package. Sites for forest model data collection were chosen in the direct vicinity of sites where vegetation was investigated, using a so-called phytosociological or vegetation relevé (describing the presence and abundance of trees, vascular plants, bryophytes and lichens). Additionally, at the same sites, data on entomofauna and soils were collected, using similar plot numbering. Only in about half of all phytosociological relevés (n=131) it was possible to collect forest ecological data (n=57), as the vegetation did not always consist of forests, but also of peat bog, waterbody, sandbank, gravel bank, shoreline vegetation, ruderal vegetation, arable land or meadow. In some cases, a lack of time appeared a limiting factor, as collecting forest ecological data was time consuming and required two persons.

A standard set of input data was collected for every individual tree in a standard-sized plot (preferably 400 $m^2$): age (yrs), height (m), crown base (m), diameter at breast height (cm) (DBH at 1.35 m) and diameter root collar (cm) (if height was <1.35 m: in particular for so called Bonsai-shaped trees). Parameters collected of seedlings (trees <1.35 m in height) included: age class (yrs), number of individuals per species per age class, and mean height per cohort (m).

**Plot size & coordinates**

The plot size used for the phytosociological relevé was 20×20 $m^2$. Because of time limitations, the size of the forest ecological plot within the phytosociological plot was 10×10 $m^2$. The plot was laid out and controlled by measuring by foot, with an accuracy of 0.5 m, after which corners were temporarily marked. Based on field characteristics, plots were marked on printed satellite images as good as possible.

**Representativeness**

Care was taken that the forest plots and relevés were representative for the encountered local situation (trees, forest floor). The locations of the forest ecological plots depended on the choice for the phytosociological relevés, which was based on the forest type. The leading principle was to assure a representative assessment of all distinguishable units on the false colour satellite image prints. Within the phytosociological relevé, the choice of the forest ecological plot was based on the representativeness of the tree layer. It was not possible to distribute the sampling of the forest plots over *ca.* 10 forest types with 3-10 plots/type.

**Measurements**

Tree diameters were measured with an accuracy of 0.1 mm. Height and crown base of trees were estimated by the skilled forestry fieldworkers Slim and Degteva with an accuracy of *ca.* 0.1 m in the lower region and of *ca.* 1 m in the higher ones. In every plot estimates were calibrated with a Carl Zeiss tree measurement device. The height of seedlings was measured with an accuracy of *ca.* 0.01 m in the lower regions and of *ca.* 0.1 in the higher ones. Age of trees and seedlings was estimated by Slim and Degteva, often calibrated by counting the every year growth marks, or counting tree-rings destructively (seedlings). In every plot some mature trees were cored by an increment borer (drilling equipment), and tree-rings could be counted in the field with a lens (loupe) to calibrate the estimations of tree age. Counting was not easy due to the insects, light conditions, rottened heart of the tree, and handling the core under difficult terrain circumstances. Tree-rings of coniferous tree species were easy to count, but especially *Betula* and *Populus* species appeared to be difficult or impossible to count (Schweingruber 1989). More information about age in relation to height and diameter has to be derived from relevant tables in Russian literature.

Nomenclature of trees was copied from a special phytosociological database, resembling the opinion of Russian taxonomists. Sometimes the difference between the tree species *Betula pubescens* and *B. pendula* was difficult, but based on the experience and best professional judgement, a choice always could be made. The shrub species *Juniperus communis* L. is not measured or counted because this species will never grow out as a (little) tree.

Data were collected in a logbook, and afterwards put in a FORGRA format database; partly in the field on a laptop, and partly in the institute. There was not yet time for a rigid control of the input.

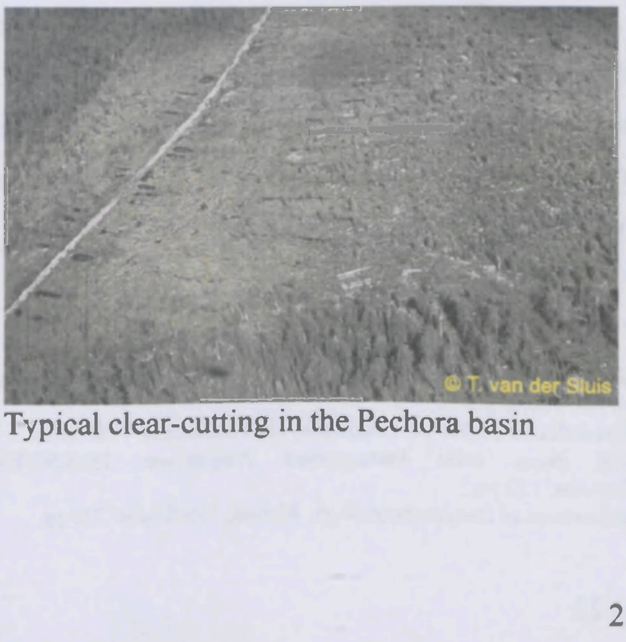
*Preliminary results*

The main tree species encountered in the forest plots included *Pinus sylvestris* L., *P. sibirica* Du Tour, *Picea obovata* Ledeb., *Larix sibirica* Ledeb., *Abies sibirica* Ledeb., *Betula pendula* Roth, *B. pubescens* Ehrh., *B. tortuosa* Ledeb., *Populus tremula* L., *Sorbus aucuparia* L., *Padus avium* Mill., *Salix caprea* L., *S. myrsinifolia* Salisb., *S. phylicifolia* L., *S. dasyclados* Wimm. and *Duschekia fruticosa* (Rupr.) Pouzar.

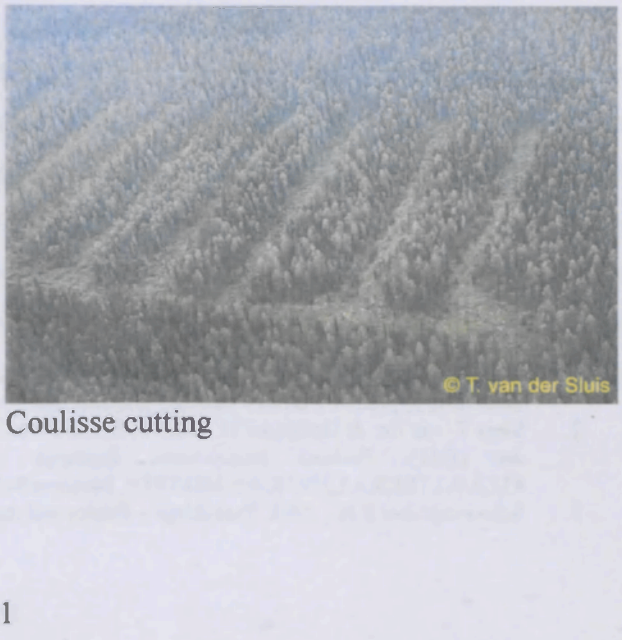
In 57 forest ecological plots of 100 m² each, a total of 2,059 trees (36 individuals/plot) and 3,157 seedlings (sometimes suckers) were measured (67 individuals/plot). Currently data analysis is in progress. Table 2.1.3.1 shows a detailed example of data collected at two forest ecological plots, while table 2.1.3.2 shows an overview of the collected data according to forest type, forest management (clear cut, selective cutting, coulisse cutting, not harvested/not managed), other disturbances (fire, storm, grazing).

**Table 2.1.3.1** Example of two different forest ecological plots (100 m²): Birch forest (clear-cut, original Spruce forest) and Pine forest (pristine, evidence of fire).

| Species | Birch forest, haircap moss type, upland area (running number 2003121) | | | | Pine forest, greenmoss type, floodplain area (running number 2003226) | | | |
|---|---|---|---|---|---|---|---|---|
| | Trees (n) | Average height (m) | Average DBH (cm) | Seedlings (n) | Trees (n) | Average height (m) | Average DBH (cm) | Seedlings (n) |
| *Betula pubescens* | 136 | 2.23 | 1.06 | 12 | 1 | 5.00 | 4.90 | |
| *Picea obovata* | 5 | 1.96 | 1.54 | 7 | 45 | 2.73 | 2.72 | 48 |
| *Pinus sylvestris* | 3 | 1.83 | 1.60 | 1 | 2 | 26.50 | 43.90 | |
| *Betula pendula* | | | | | 18 | 6.24 | 3.96 | 1 |
| *Abies sibirica* | | | | | 7 | 1.98 | 1.60 | 9 |
| *Sorbus aucuparia* | | | | | 1 | 1.60 | 0.30 | |



Typical clear-cutting in the Pechora basin



Coulisse cutting

**Table 2.1.3.2** Preliminary overview of forest ecological plots sampled in different landscape and forest types, and in different forest management types.

| Landscape classification | | | Forest management type | | | Natural disturbance (fire, storm, grazing) |
|---|---|---|---|---|---|---|
| **Landscape type** | **Forest unit** | **Forest type** | **Clear-cut** | **Selective cutting** | **No use** | |
| Upland area (Watershed) | Spruce forest | Spruce, Greenmoss type | | 3 | 3 | |
| | | Spruce, Haircap moss type | | | | |
| | | Spruce, Sphagnum type | | | 2 | |
| | | Spruce, Herb type | | | 2 | |
| | | Spruce, Tall herb type | | | 1 | |
| | Pine forest | Pine, Lichen type | 2 | 1 | 2 | |
| | | Spruce, Haircap moss type | 1 | | | 1 |
| | | Pine, Sphagnum type | | | 2 | 1 |
| | Aspen forest | Aspen, Greenmoss type | 2 | | | 1 |
| | | Spruce, Haircap moss type | 1 | | | |
| | | Aspen, Herb type | | | | 1 |
| | Birch forest | Birch, Greenmoss type | | 1 | | |
| | | Spruce, Haircap moss type | 1 | | | 2 |
| | | Birch, Sphagnum type | 1 | | | |
| | | Birch, Herb type | | | | 1 |
| | Mixed Spruce, Pine, Fir, Birch | mixed, Greenmoss type | | 2 | 3 | 2 |
| | | mixed, Greenmoss type, mountain | | | 1 | |
| | | Spruce, Haircap moss type | | | | |
| | | mixed, Sphagnum type | 1 | | | |
| | | mixed, Herb type | | | 5 | |
| | | mixed, Tall herb type | | 1 | 2 | |
| | Shrub vegetation, Fir, Aspen | mountain tundra | | | 1 | |
| Floodplain area | Mixed forest | | 1 | | | |
| | Spruce forest | | | 1 | | |
| | Aspen forest | | | | | |
| | Willow forest | willow, Tall herb type | | | 2 | |
| | Pine forest | Pine, Greenmoss type | | | 1 | |
| | Birch forest | Birch, Herb type | | | 2 | |
| | Spruce forest | Spruce, Greenmoss type | | 3 | 3 | |

*Recommendations*

In future, phytosociological and forest ecological data should be collected in a better stratified way with a rigorous protocol, based on Land Units obtained by satellite image classification (Van der Sluis & Den Hollander 2002). This stratification could include detailed Russian forestry maps, as most forestry units on the forestry maps could be distinguished on the satellite images. Standard forms need to be developed, and more eye-catching corner markers taken. For monitoring circular plots should be considered.

*References*

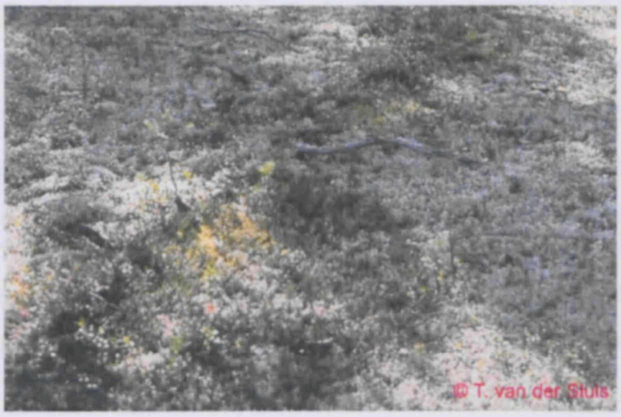

1. Jorritsma I.T.M., Hees A.F.M. van & Mohren G.M.J., 1999. Forest development in relation to ungulate grazing: a modelling approach. Forestry Ecology and Management No. 120, p. 23-34;
2. Sluis T. van der & Hollander H. den, 2002. Land Units at different scales. In: Leummens H., Ponomarev V. & Sluis T. van der (Eds.). Pechora Ecosystems; Research and Basin wide Management Programme. IB-KSC/RWS-RIZA/ALTERRA/LNV/ RWS-MD/DHV, Moscow/Syktyvkar, 122 pp.;
3. Schweingruber F.H., 1989. Tree Rings – Basics and Applications of Dendrochronology. Kluwer, Dordrecht. 276 pp.

### 2.1.4 Lichens

Tatiana Pystina

*Introduction*

During the PRISM field work in 2003, in four areas in the Vel'yu river basin and the upstream section of the Pechora river, the current state of biological lichen diversity was characterised. Samples mainly were collected along ecological profiles with a length up to 5 km, located from the river bed through the floodplain into the watershed. In addition, a number of studies focussed on analysing the impact of different disturbance factors of natural and anthropogenic origin (fires, windfalls, forest harvesting operations, line structures, petroleum production) on vegetation communities, including the lichen component. Lichens were studied in all main types of vegetation communities occurring on the sites: forests, wetlands, meadows, bushes. In the mountainous part of the Urals in addition to the above-mentioned vegetation types also mountain tundra was studied.




Natural lichen undergrowth on dry, sandy soils.

Lichen samples were taken from different types of substratum – bark of trees and bushes, stumps, fallen trees, dead trees, soil, stones, treated timber – in accordance with generally accepted methods in lichenology. Species which could not be determined under field conditions, mainly cructose and sterile lichens, were sampled for determination in the laboratory. Species names of common and easily defined lichens were entered into special lichen cover description forms. The total number of collected herbarium lichen samples is about 1,450. In forest ecotopes, on each sampling location a 7-score scale was used to assess the abundance of the model lichen species *Hypogymnia physodes* on the dominating tree species in the forest layer.

*Results*

The field work in 2003 provided new data on the taxonomic richness of the Upper Pechora basin (table 2.1.4.1). This especially relates to the mountainous part of the Urals, because available data on lichen species composition in mountain forests and tundra were very scanty due to the inaccessibility of the region. Preliminary results show that the lichen biota of the study area at the confluence of the Yurginskaya and Pechora rivers is characterized by the highest biodiversity parameters of all study areas visited. New habitats of protected and rare species of the Komi Republic were revealed there, the most valuable of which are *Usnea longissima*, *Cladonia luteoalba*, *Evernia divaricata*, *Sclerophora coniophaea*, *Pseudevernia furfuracea*.

**Table 2.1.4.1** Preliminary list of protected lichen species of the upper Pechora basin.

| Species | Protection status | Vel'yu basin | Yaksha | Yurginskaya | Ust-Unya |
|---|---|---|---|---|---|
| *Bryoria fremontii* | 3(R) | + | + | | + |
| *Cladonia luteoalba* | 1(E) | | | + | |
| *Collema furfuraceum* | 5(Cd) | | | | + |
| *Collema nigrescens* | 4(I) | | | | + |
| *Cybebe gracilenta* | 2(V) | | | | + |
| *Evernia divaricata* | 2(V) | + | + | + | + |
| *Heterodermia speciosa* | 1(E) | | | | + |
| *Hypogymnia bitteri* | 3(R) | + | + | + | + |
| *Hypogymnia vittata* | 5(Cd) | | + | + | |
| *Leptogium cyanescens* | 5(Cd) | | | | + |
| *Lobaria pulmonaria* | 5(Cd) | + | + | + | + |
| *Lobaria scrobiculata* | 5(Cd) | | | | + |
| *Nephromopsis laureri* | 5(Cd) | | + | + | |
| *Pannaria conoplea* | 2(V) | | | | + |
| *Pertusaria hemisphaerica* | 3(R) | | | | + |
| *Physconia detersa* | 3(R) | | | | + |
| *Pseudevernia furfuracea* | 4(I) | | | + | |
| *Ramalina roesleri* | 4(I) | | | | + |
| *Ramalina thrausta* | 5(Cd) | + | + | + | + |
| *Sclerophora coniophaea* | 3(R) | | | + | |
| *Sticta nylanderiana* | 1(E) | | | | + |
| *Usnea longissima* | 1(E) | | | + | |
| Total | 22 | 5 | 7 | 10 | 16 |

The highest number of rare taxa was registered in floodplain Spruce forests and in mixed Spruce-Fir forests in the upper part of the mountain-forest belt. From the point of view of lichen floristics, the study area situated in the sub-mountain landscape zone (the mouth of the Unya river) is undoubtly of interest. In spite of the considerable degree of human development in this region, on the gentle slopes of Andyuga Parma ridge old-growth dark coniferous and mixed Spruce-Aspen forests have been preserved. In these forests rare lichen species like *Sticta nulanderiana*, *Cetrelia olivetorum*, *Heterodermia speciosa*, *Cybebe gracilenta* were observed. Evidently, the list of key habitats for lichens which was defined after the research in the Middle Pechora (the Bolshaya Synya river basin, 2002) will be extended with mountain dark coniferous forests and old-growth coniferous and mixed forests occupying slopes of small hills in the sub-mountain landscape zone.


*Cladina rangiferina*, typically occurring on wood detritus during the last stage of decay.


The lichen species *Lobaria pulmonaria*, included in the Red Data Book of the Russian Federation is widespread in the Pechora basin.

The analysis of lichen communities on sites with different types of disturbances, including anthropogenic disturbances, is a rather difficult aspect in lichenology. In the Komi Republic very scanty data are available on this subject. Analysing the data collected, preliminary it can be concluded that disturbed sites often show not only a sharp decrease of the species number, also very often the species composition changes radically, compared to undisturbed sites. As such, the obtained data will not only allow to reveal the set of disturbed ecotypes but also to assess the damage on lichen biodiversity of primary forests inflicted by forestry activities, mining and forest fires. In the Vel'yu river basin and in the surroundings of the Yaksha study area also a lot of data were collected which allow to analyse the ground cover restoration dynamics of Lichen-Pine forests after forestry and fires. Additionally, interesting results are expected to be obtained from analysing the lichens collected in the villages of Ust-Unya andLenavozh, because the lichen biota of small settlements show a peculiar species composition, and little information is available in the Komi Republic.

Further analyses will include the assessment of lichen species diversity in different vegetation types, as was also done after the 2002 field expedition. The ecological profiles will reveal the changes in lichen species composition and abundance in ecotopes from the floodplain to the watershed. All results obtained are planned to be included in the data base developed with the use of the Turboveg software programme. A final report with the analysis of the obtained material will be ready by January 1, 2004.

### 2.1.5 Mammals

Sergey Kochanov, Stef van Rijn, Mervyn Roos

*Methods*

In all study areas, direct observations of mammals, their tracks and droppings were recorded to obtain an impression on mammal species composition and distribution in different habitats. Mammal presences were studied along terrestrial routes (by foot and by car) and water routes (by rubber boat and motor boat). Because of the difficulties to notice mammals during the summer period, additionally information from individual hunters (the Vel'yu river) as well as survey data from the hunting service of the Pechora-Ilych Nature Reserve were obtained to expand the list of mammals of the region under study. In this connection, more data on this group of terrestrial vertebrates are required. In addition to other field observations, mice were trapped with special life traps in different forest types in the study areas.

*Preliminary results*

Elks in the Pechora basin require special conservation measures.

During the field work in the upper Pechora region, in total 27 mammals species belonging to 4 orders were registered (table 2.1.5.1). Most species are widely spread on the territory of the Komi Republic, but occur in low densities.

**Table 2.1.5.1** Mammal species occurring in the study areas.

| English name | Scientific name |
|---|---|
| European Mole | *Talpa europaea* Linnaeus, 1758 |
| Eurasian Pygmy Shrew | *Sorex minutus* Linnaeus, 1766 |
| Eurasian common Shrew | *Sorex araneus* Linnaeus, 1758 |
| Blue Hare | *Lepus timidus* Linnaeus, 1758 |
| Russian Flying Squirrel* | *Pteromys volans* Linnaeus, 1758 |
| Red Squirrel | *Sciurus vulgaris* Linnaeus, 1758 |
| Siberian Chipmunk | *Tamius sibiricus* Laxmann,1769 |
| Eurasian Beaver | *Castor fiber* Linnaeus, 1758 |
| Muskrat* | *Ondatra zibethica* Linnaeus, 1766 |
| Bank Vole | *Clethrionomys glareolus* Schreber, 1780 |
| Northern Red-backed Vole | *Clethrionomys rutilus* Pallas, 1779 |
| Grey Red-backed Vole | *Clethrionomys rufocanus* Sundevall, 1846 |
| Wolf* | *Canis lupus* Linnaeus, 1758 |
| Common Fox* | *Vulpes vulpes* Linnaeus, 1758 |
| European Brown Bear | *Ursus arctos* Linnaeus, 1758 |
| Sable* | *Martes zibellina* Linnaeus, 1758 |
| Pine Marten* | *Martes martes* Linnaeus, 1758 |
| Wolverine* | *Gulo gulo* Linnaeus, 1758 |
| Ermine | *Mustela erminea* Linnaeus, 1758 |
| Weasel | *Mustela nivalis* Linnaeus, 1758 |
| European Mink* | *Mustela lutreola* Linnaeus, 1761 |
| American Mink* | *Mustela vison* Schreber, 1777 |
| Common Otter | *Lutra lutra* Linnaeus, 1758 |
| Lynx* | *Lynx lynx* Linnaeus, 1758 |
| Wild Boar | *Sus scrofa* Linnaeus, 1758 |
| Elk | *Alces alces* Linnaeus, 1758 |
| Reindeer | *Rangifer tarandus* Linnaeus, 1758 |

Note: * – according to survey data of the staff of the Pechora-Ilych Nature Reserve

### 2.1.6 Birds

Stef van Rijn, Sergey Kochanov

*Introduction*

Bird communities in the upper Pechora region are, in addition to forest type & age, vegetation structure and human influence, also affected by the geographical location.


Common Cuckoo *Cuculus canorus*


Arctic Warbler *Phylloscopus borealis*


Bullfinch *Pyrrhula pyrrhula*

The Pechora river originates in the Ural mountains and follows a rather strong gradient of landscapes, related to geomorphologic structures. River dynamics, such as flooding frequency and duration, affect soil forming processes, soil characteristics as well as vegetation type, which jointly cause differences in the availability and scale of habitats for birds. As such, the altitude of the river stretch will be a factor to explain the presence and the densities of bird species.

Another important factor is the latitude of the area. The Pechora river first flows through more southern-situated, heavily forested areas before turning North, reaching the tree-line before entering the Barents sea. The river system traverses a huge area with strong differences in climate, and several bird species occur on the edge of their distribution zones on the continent. Due to typical climate conditions, an increasing latitudinal location causes a decrease in the presence and density of birds, from the centre of the distribution area to its boundaries in the North. To obtain an overall assessment of bird biodiversity in the Pechora basin, a correction for the effect of climate and geo-location on species composition and density needs to be defined.

Additional important factors for the presence of bird communities are anthropogenic influences on habitats. In the upper Pechora basin a number of human settlements occur.

Through haymaking and grazing, farmers and cattle influence the presence and structure of grassland and meadows. Large areas in the region were affected by intensive forestry activities, mainly in the past. Besides selective cuttings, clear-cutting was widely practiced. The region is also characterised by the widespread extraction of oil & gas, while a number of important pipelines cross the region. The joint effect of human disturbances creates an infrastructure of deforested and disturbed areas, which effects the type and structure of the forests and other vegetation types. In turn, this resulted in a change in the availability of bird habitats and, with that, in bird communities. Figure 2.1.6.1 depicts the supposed relationships schematically.

*Methods*

The bird species composition, quantity and biotope distribution were studied in 5 study areas located in two areas of interest – the Vel'yu river basin and the upstream section of the Pechora river. Use was made of the so-called "territory mapping method" to make a best estimate of the local breeding bird population, in accordance with generally accepted methods in zoogeographical research (Kuzyakin, Rogacheva, Ermolova, 1958; Ravkin, 1967).

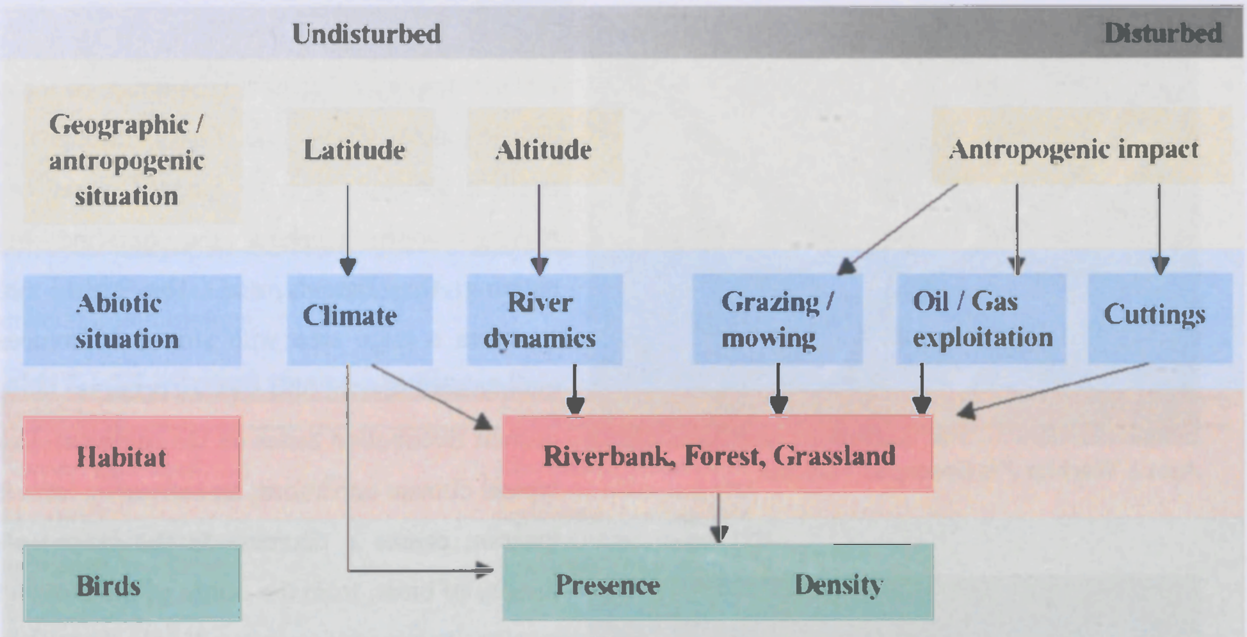



**Fig. 2.1.6.1** The dependence of bird communities on latitude, altitude and human influence in the Pechora region.

The survey routes were executed overland (by foot and by car) and water (by rubber boat and motor boat). Main guidance was provided by printed false colour Landsat satellite images, also use for drawing followed routes. Bird assessments additionally included a description of vegetation types (mainly forests, including their age) and any assessable human influences (cuttings). During surveys, singing males, spotted birds (mainly territory holders), and families were counted. The work was done by 2-3 people (Stef van Rijn, Sergey Kochanov and Mervyn Roos). Due to the selected period of research (24 June-16 July 2003), the pre-breeding activities of the birds were already over their top, and a lot of species had already nestlings or fledged young at that time. The sequence of study areas was related to the phenology of the vegetation. This was done to minimize the effect of the difference in the timing of breeding birds.

Four different methods were used to describe bird communities:

| | |
|---|---|
| River stretches | Water birds and birds living along river banks. Territories were counted by walking along a river stretch or floating on rubber boats (>2 km). For these species the number of territories per kilometre river stretch could be calculated. For other species an indication was given about local densities. |
| Transects | For all bird species, mainly forest birds, territories were counted along transects traversing different vegetation/forest types (length 500-1500 m). The maximum distance at which a certain species can be heard or observed is used to calculate the number of territories per 100 ha. |
| Point observations | At all places visited by occasion, the observations of birds are described. These give an indication of the local presence and densities of the species. Like in the transect, the maximum distance within a certain species can be heard or observed is used to calculate the number of territories per 100 ha. |
| Occasional observations | Birds outside a certain census or with a non breeding status. |

*Preliminary results*

The 5 study areas visited in 2003 are characterised by a different geographic position, varying from the most upstream section of the Pechora river in the Ural mountains (altitude of the river 335,5 m) to the most downstream area in the Vel'yu river basin (river altitude 94,0 m). The study sites also were characterised by differences in human influences (table 2.1.6.1).

**Table 2.1.6.1** General characteristics of study areas in the upper Pechora in 2003.

| Period of observation | Study site | Latitude (degr.) | Altitude (meters) | Human influence |
|---|---|---|---|---|
| 24/6 – 01/7 | Vel'yu river basin | 63.30 | 94,0 | Forestry, oil-gas |
| 02/7 – 07/7 | Surroundings of Yaksha | 61.50 | 126,0 | Forestry |
| 08/7 – 11/7 | Ural mountains | 62.05 | 335,5 | Undisturbed |
| 12/7 – 14/7 | Zheshym-Pechorskiy | 62.05 | 175,5 | Undisturbed |
| 14/7 – 15/7 | Boat trip | 62.00 | 144,9-175,5 | Undisturbed |
| 16/7 | Surroundings of Ust-Unya | 61.50 | 144,9 | Forestry |

During the field work period, in total 120 bird species were observed, corresponding with 3,513 territories (table 2.1.6.2, table 2.1.6.4). Although the total number of species is relatively high, the number of species per study area is small, indicating that every study area has a slightly different species composition with partly own characteristic species. The low number of territories in the Ural muntains and in the surrounding of Ust-Unya is a consequence of the shorter period of visit. According to Russian classification methodology, in 20 different habitats 47 variants of bird communities were observed. In total, bird species representing 12 orders were registered (table 2.1.6.3).

**Table 2.1.6.2** Number of species and territories observed.

| Study site | Number of species observed | Number of territories |
|---|---|---|
| Vel'yu river basin | 80 | 669 |
| Surroundings of Yaksha | 84 | 935 |
| Ural mountains | 58 | 435 |
| Zheshym-Pechorskiy | 53 | 317 |
| Boat trip | 58 | 968 |
| Surroundings of Ust-Unya | 47 | 189 |
| Total: | 120 | 3,513 |

**Table 2.1.6.3** Observed bird species in accordance with their classification order.

| Order | Number of species |
|---|---|
| Anseriformes | 12 |
| Falconiformes | 12 |
| Galliformes | 4 |
| Gruiformes | 2 |
| Charadriiformes | 15 |
| Columbiformes | 4 |
| Culiformes | 2 |
| Strigiformes | 3 |
| Caprimulgiformes | 1 |
| Cypseliformes | 1 |
| Piciformes | 3 |
| Passeriformes | 61 |
| Total: | 120 |

**Table 2.1.6.4** Total list of bird species observed in different study areas.

| Common name | Scientific name | Vel'yu basin | Yaksha | Upper Pechora |
|---|---|---|---|---|
| Black-throated Diver | *Gavia arctica* | + | | |
| White-fronted Goose | *Anser albifrons* | | | + |
| Domestic goose | *Anser domesticus* | | + | |
| Mallard | *Anas platyrhynchos* | + | + | + |
| Pintail | *Anas acuta* | + | | + |
| Teal | *Anas crecca* | + | + | + |
| Wigeon | *Anas penelope* | + | + | + |
| Shoveler | *Anas clypeata* | + | + | + |
| Goldeneye | *Bucephala clangula* | + | + | + |
| Red-breasted Merganser | *Mergus serrator* | + | | + |
| Goosander | *Mergus merganser* | + | | + |
| Tufted Duck | *Aythya fuligula* | + | | |
| Osprey | *Pandion haliaetus* | | | + |
| Honey-buzzard | *Pernis apivorus* | + | + | + |
| Black Kite | *Milvus migrans* | + | + | + |
| Goshawk | *Accipiter gentilis* | + | | + |
| Eurasian Sparrowhawk | *Accipiter nisus* | | + | + |
| Common Buzzard | *Buteo buteo* | + | + | + |
| Rough-legged Buzzard | *Buteo lagopus* | | | + |
| Golden Eagle | *Aquila chrysaetos* | + | | |
| White-tailed Eagle | *Haliaeetus albicilla* | | | + |
| Hobby | *Falco subbuteo* | + | + | + |
| Common Kestrel | *Falco tinnunculus* | + | | |
| Merlin | *Falco columbarius* | | | + |
| Willow Grouse | *Lagopus lagopus* | + | + | + |
| Black Grouse | *Tetrao tetrix* | + | + | + |
| Capercaillie | *Tetrao urogallus* | + | + | + |
| Hazel Grouse | *Bonasia bonasia* | + | + | + |

| | | | | |
|---|---|---|---|---|
| Spotted Crake | *Porzana porzana* | | | + |
| Common Crane | *Grus grus* | | | + |
| Oystercatcher | *Haematopus ostralegus* | | + | |
| Northern Lapwing | *Vanellus vanellus* | | | + |
| Green Sandpiper | *Tringa ochropus* | + | + | + |
| Wood Sandpiper | *Tringa glareola* | + | + | + |
| Common Greenshank | *Tringa nebularia* | + | + | + |
| Common Sandpiper | *Tringa hypoleucos* | + | + | + |
| Ruff | *Philomachus pugnax* | | + | |
| Great Snipe | *Gallinago media* | + | | |
| Woodcock | *Scolopax rusticola* | + | + | + |
| Eurasian Curlew | *Numenius arquata* | + | + | + |
| Whimbrel | *Numenius phaeopus* | + | | |
| Little Gull | *Larus minutus* | + | | |
| Common Gull | *Larus canus* | + | + | + |
| Lesser Black-backed Gull | *Larus fuscus* | + | | |
| Common Tern | *Sterna hirundo* | + | + | + |
| Wood Pigeon | *Columba palumbus* | | + | + |
| Rock Dove | *Columba livia* | | + | |
| Domestic Dove | *Columba domesticus* | | + | |
| Turtle Dove | *Streptopelia turtur* | | + | |
| Common Cuckoo | *Cuculus canorus* | + | + | + |
| Oriental Cuckoo | *Cuculus saturatus* | + | + | + |
| Eagle Owl | *Bubo bubo* | | | + |
| Hawk Owl | *Surnia ulula* | + | | |
| Ural Owl | *Strix uralensis* | | + | |
| European Nightjar | *Caprimulgus europaeus* | | + | |
| Common Swift | *Apus apus* | + | + | + |
| Black Woodpecker | *Dryocopus martius* | + | + | + |
| Great Spotted Woodpecker | *Dendrocopos major* | + | + | + |
| Three-toed Woodpecker | *Picoides tridactylus* | | | + |
| Sand Martin | *Riparia riparia* | | + | + |
| Barn Swallow | *Hirundo rustica* | | + | + |
| Tree Pipit | *Anthus trivialis* | + | + | + |
| Olive-backed Pipit | *Anthus hodgsoni* | + | + | + |
| Meadow Pipit | *Anthus pratensis* | | | + |
| Yellow Wagtail | *Motacilla flava* | + | + | + |
| Grey Wagtail | *Motacilla cinerea* | + | + | + |
| White Wagtail | *Motacilla alba* | + | + | + |
| Siberian Jay | *Perisoreus infaustus* | + | + | |
| Magpie | *Pica pica* | + | + | + |
| Nutcracker | *Nucifraga caryocatactes* | + | + | + |
| Hooded Crow | *Corvus cornix* | + | + | + |
| Raven | *Corvus corax* | + | + | + |
| Bohemian Waxwing | *Bombycilla garrulus* | + | + | + |
| Dipper | *Cinclus cinclus* | | | + |
| Wren | *Troglodytes troglodytes* | + | + | + |
| Dunnock | *Prunella modularis* | | + | + |
| Lanceolated Warbler | *Locustella lanceolata* | | | + |
| Blyth's Reed Warbler | *Acrocephalus dumetorum* | + | + | + |
| Garden Warbler | *Sylvia borin* | + | + | + |
| Lesser Whitethroat | *Sylvia curruca* | + | + | |

| | | | | |
|---|---|---|---|---|
| Common Whitethroat | *Sylvia communis* | | | + |
| Grasshopper Warbler | *Locustella naevia* | | | + |
| Willow Warbler | *Phylloscopus trochilus* | + | + | + |
| Chiffchaff | *Phylloscopus collybita* | + | + | + |
| Arctic Warbler | *Phylloscopus borealis* | + | + | + |
| Greenish Warbler | *Phylloscopus trochiloides* | + | + | + |
| Yellow-browd Warbler | *Phylloscopus inornatus* | | | + |
| Goldcrest | *Regulus regulus* | + | + | + |
| Pied Flycatcher | *Fidecula hypoleuca* | | + | + |
| Red-breasted Flycatcher | *Fidecula parva* | | | + |
| Spotted Flycatcher | *Muscicapa striata* | | + | + |
| Common Stonechat | *Saxicola torquata maura* | | + | + |
| Wheatear | *Oenanthe oenanthe* | + | + | + |
| Common Redstart | *Phoenicurus phoenicurus* | + | + | + |
| Robin | *Erithacus rubecula* | | + | + |
| Dark-throated Thrush | *Turdus ruficollis atrogularis* | | | + |
| Fieldfare | *Turdus pilaris* | + | + | + |
| Redwing | *Turdus iliacus* | + | + | + |
| Song Thrush | *Turdus philomelos* | + | + | + |
| Mistle Thrush | *Turdus viscivorus* | + | + | + |
| White's Thrush | *Zoothera dauma* | | | + |
| Willow Tit | *Parus montanus* | + | + | + |
| Siberian tit | *Parus cinctus* | + | + | + |
| Great Tit | *Parus major* | | + | + |
| Coal Tit | *Parus ater* | | | + |
| Long-tailed Tit | *Aegithalos caudatus* | | | + |
| Wood Nuthatch | *Sitta europaea asiatica* | | | + |
| House Sparrow | *Passer domesticus* | + | + | |
| Chaffinch | *Fringilla coelebs* | + | + | + |
| Brambling | *Fringilla montifringilla* | + | + | + |
| Siskin | *Carduelis spinus* | + | + | + |
| Redpoll | *Carduelis flammea* | + | + | + |
| Common Rosefinch | *Carpodacus erythrinus* | + | + | + |
| Common Crossbill | *Loxia curvirostra* | + | + | + |
| Two-barred Crossbill | *Loxia leucoptera* | + | | + |
| Bullfinch | *Pyrrhula pyrrhula* | + | + | + |
| Yellowhammer | *Emberiza citrinella* | | + | |
| Reed Bunting | *Emberiza schoeniclus* | + | + | + |
| Rustic Bunting | *Emberiza rustica* | + | + | + |
| Little Bunting | *Emberiza pusilla* | + | + | + |
| Total number of species: | | 80 | 84 | 99 |

The largest diversity was recorded in the united upstream section of the Pechora river – 99 species, with 80 and 84 species registered in the Vel'yu river basin and the surroundings of Yaksha, respectively. The larger bird diversity in the upstream section of the Pechora river is explained by the presence of Siberian, as well as rare and protected species. In most terrestrial biotopes the bird diversity is dominated by representatives of the Passeriformes order, while along rivers representatives of the Charadriiformes order occur more often.

The observed number of many common bird species was rather low compared to long-term averages, a fact which can be explained by bad weather conditions in spring 2002, when snowfall during the last decade of May caused mass death of representatives of the Fringillidae, Emberizidae and Turdidae families. The amount and diversity of birds of prey (Miophages) was low due to the low number of Muridae in the study area. The distribution analysis of birds of prey shows the highest species diversity and number of birds registered in the Pechora-Ilych Nature Reserve. The distribution of synanthropic species changed compared to previous years: House and Tree Sparrows, Rock Dove and Starling were no longer met in small settlements, which is explained by a social factor – the complete absence of additional feeding during winter.

### 2.1.7 Amphibians & reptiles
Theo van der Sluis

*Introduction*

This chapter presents the results for the amphibian and reptile survey in the upper part of the Pechora River basin. It is a reconnaissance survey, its main aim being to establish the diversity of amphibian and reptile species, and their habitat preferences in this environment.

In the Komi Republic and the Nenets Autonomous Region, 10 species are known to occur (table 2.1.7.1; [1] [5]), of which 4 species are included in the Red Data Book of the Komi Republic. In 2002, species such as Common Frog, Moor Frog, Common Toad and Common Lizard were observed. In 2003, additionally the Siberian Newt and Common Toad were registered, and as such all species known to occur were encountered. All species are rather common, except for Siberian Newt, which has a protected status in the Red List of the Komi Republic (table 2.1.7.1) despite being one of the widest distributed amphibian species, occurring as far as Mongolia and China. Relict populations are found in Komi, the western part of its distribution area. Its most typical habitat is the lower taiga [5].

**Table 2.1.7.1** Amphibian and reptile species in the Komi Republic and the Nenets Autonomous Region.

| Common name | Scientific name | Status | Occurrence | Distribution |
|---|---|---|---|---|
| Common Frog | *Rana temporaria* | | Present | |
| Moor Frog | *Rana arvalis* | | Present | |
| Common Toad | *Bufo bufo* | | Present | |
| Siberian Newt | *Salamandrella keyserlingii* | Red List 3 (R) | Present | Limited, south-east |
| Common Newt | *Triturus vulgaris* | | -- | Limited, south-east |
| Sand lizard | *Lacerta agilis* | | -- | Limited, south-east |
| Common Lizard | *Lacerta vivipara* | | Present | |
| Slow Worm | *Anguis fragilis* | Red List 3 (R) | -- | South Komi |
| Smooth Snake | *Natrix natrix* | Red List 3 (R) | -- | South Komi |
| ~~Viper~~ Adder | *Vipera berus* | Red List 3 (R) | -- | South Komi |

Common Lizard *(Lacerta vivipara)*

Common Frog *(Rana temporaria)*

*Methods*

During the field work, observations of amphibian and reptile species were recorded in potential reproduction sites, as well as in areas with a high likelihood of presence of species, e.g. meadows and peat bogs. For the survey of aquatic habitats use was made of a professional hand net for amphibian sampling (EFE-design, UK).

Data were collected on the approximate location where the observation was done, including the number of specimen observed, development stage (adult, subadult, juvenile and larvae), habitat type, and height of the vegetation. Observations of larvae were included as well, in which the number of larvae was used to estimate the number of egg clumps (spawn).

The survey took place from the 25th of June till the 16th of July 2003, i.e. slightly earlier then in 2002. Field conditions were favourable, with sunny, rather warm weather with temperatures ranging from 20-34 degrees Celsius. Due to the better weather conditions and earlier survey period, a higher incidence of reproduction could be encountered in comparison with the 2002 season.

*Amphibians and reptiles of the upper Pechora river basin*

In total 120 observations were done of all species, where tadpoles are not included (only estimated number of spawn). One reptile species, the Common Lizard, was observed as well.

Figure 2.1.7.1 presents the observations in different study areas, the Vel'yu river basin, a 1st order tributary of the Pechora River and the upstream section of the Pechora main stream. Most observed are the Moor Frog and Common Frog. The Common Toad occurs at the border of its distribution area, and was only observed around Yaksha. At this study area, 5 of the total of 6 amphibian species present in the Pechora basin were observed. Figure 2.1.7.2 presents the number of observations in accordance with life stage. Most observations were from adults and sub-adults, and to lesser extent tadpoles. Some juveniles could not be determined to species, and might either have been Moor Frog or Common Frog.

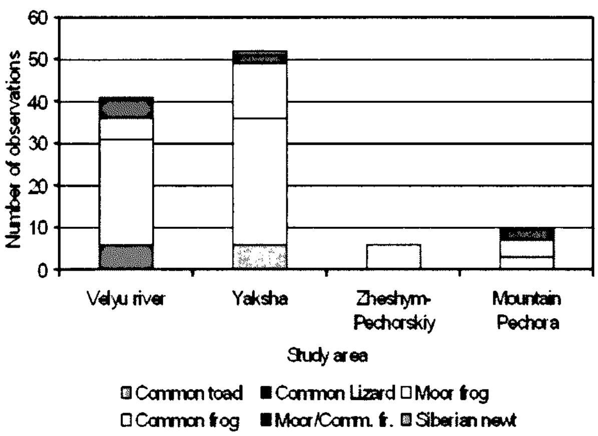



**Fig. 2.1.7.1** Number of observations per study area.

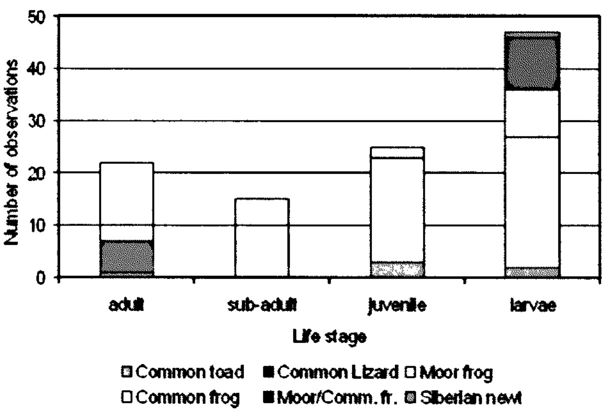



**Fig. 2.1.7.2** Different stages of species.

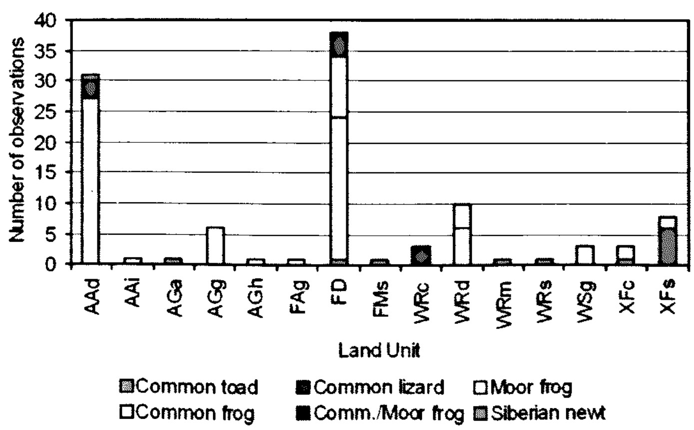



**Fig. 2.1.7.3** Observations on amphibian & reptile species in habitats of the Upper Pechora.

*Habitat preferences of species*

Figure 2.1.7.3 shows observations in relation to the Land Unit. Obviously, there is a preference for AAd, i.e. ditches in anthropogenic areas (drainages along roads and forest tracks). Also in disturbed forests (FD) many observations were done, mainly a large number of tadpoles.

The Common Frog occurs in a variety of habitat types: forests, meadows, river banks, etc. Most observations were done in river meadows and disturbed forests, i.e. open vegetation. The Moor Frog is observed in AAd, i.e. ditches in anthropogenic areas, and disturbed forests (FD). The Common Lizard was occasionally observed on peat bogs, and once in a burnt pine forest.

*Reproduction sites*

In Table 2.1.7.2 the characteristics of reproduction sites (n=48) are given. No egg clumps (spawn) were observed but only tadpoles. Most common reproduction sites were drainage sites along roads, i.e. ditches along the road. In disturbed forests these were often tracks filled with water, caused by heavy forestry equipment. Many reproduction sites were located in the floodplain area near the river, often isolated from the main stream, water was therefore hardly flowing. Only larvae of Common Toad were observed in the main stream of the river.

**Table 2.1.7.2** Characteristics of reproduction sites.

| Species | Number of observations | Habitat |
|---|---|---|
| Common Toad | 3 | River (WR) |
| Moor Frog | 25 | Drainage (Aad), Disturbed forest FD, River (WR) |
| Common Frog | 9 | Disturbed forest (FD) |
| Moor/Common Frog | 10 | Drainage (Aad), Disturbed forest (FD) |
| Siberian Newt | 1 | Water storage along road, (Aad) |

*Conclusions*

All amphibian species present in the Pechora Basin were encountered during the field expedition in 2003. Most amphibian species seemed rather common. The Red List species Siberian Newt (*Salamandrella keyserlingii*) was observed only once during field work. Only one reptile species, Common Lizard (*Lacerta vivipara*), was found.

Most species-rich are disturbed forests, and drainage associated with roads (i.e. ditches along roads, or sometimes ponds or puddles in road tracks). Here also most frequently larvae were found, and those land units are important for reproduction.

It seems that forestry in some cases might increase biodiversity for amphibian species, since diversity of habitat increases, and in particular the number of reproduction sites. Amphibian and reptile species also favour open vegetation.

*References*

1. Anufriev V.M. & Bobretsov A.V., 1996. Amphibians and reptiles (In Russian). In: Anonymous, 1996. Fauna of the European North-East of Russia, Nauka Publishing House, St. Petersburg, Volume IV, 130 pp.;
2. Arnold E.N. & Burton J.A., 1978. A field guide to the reptiles and amphibians of Britain and Europe. William Collins Sons., London.;

3. Gasc J.P., Cabela A., Crnobrnja-Isailovic J. et al. (Eds.), 1997. Atlas of amphibians and reptiles in Europe. Societas Europaea Herpetologica & Muséum National d'Histoire Naturelle, Paris, 496 pp.;
4. Günther R., 1996. Die Amphibien und Reptilien Deutschlands, Fischer, Jena.;
5. Kuzmin S.L., 1995. Die Amphibien Rußlands und angrenzender Gebiete. Westarp Wissenschaften. Neue Brehm Bücherei, Spektrum Akademischer Verlag, Magdeburg.

### 2.1.8 Soil invertebrates & insects

Alla Kolesnikova, Mervyn Roos

*Introduction*

Insects belong to the most numerous and richest group of organisms on Earth. Estimations state more than 1 million species, which is higher than all other animals and plant species groups together. However, the fauna and ecology of insects of the Pechora basin are poorly studied. Within the basin, regions can be found where entomofauna studies have not been conducted, while in other parts, at best, scanty fauna data are available.

Therefore, in June-July 2003, entomofauna research was conducted in three typical landscape zones of the Pechora basin: 1) the lowland plain – the Vel'yu river basin near the village of Lenavozh, the Yaksha section of the upstream Pechora river; 2) the sub-mountain zone – the mound of the Unya river, near the village of Ust-Unya; 3) the mountain zone – the mound of the Yurginskaya river. The selected regions included zones with an intensive anthropogenic load (oil & gas pipelines, former and recent forestry) as well as undisturbed zones (the Pechora-Ilych Nature Reserve, the Ust-Unya reserve).

The information obtained during the field work is of great value: first of all, employees of the Protected Areas have always pointed out the deficiency in data on invertebrates, including insects; secondly, the collected baseline information will in future allow the analysis of changes in insects community structures due to environmental changes; and thirdly, due to the close cooperation with geobotanists and soil scientists there is a possibility to describe the differences in soil insects communities between different soils and vegetation associations.

In accordance with the aims of the project, more specifically the following goals were completed during the field work:

- To collect information on the taxonomic composition of insects and their distribution in different parts of the Pechora basin;
- To study the distribution of insects over different biotopes;
- To relate changes in soil insects species composition and population structure with soil and vegetation types;
- To reveal changes in insects community structure due to human disturbances.

Insects were collected using generally accepted quantitative and qualitative methods of recording: excavations and manual sorting of soil samples with a volume of 0.0625 $m^2$, catching by Barber's soil traps and window traps, and entomological cutting. In total, 150 trap sites were installed along landscape transects from the river to the watershed. Additionally 1,500 soil-litter samples were collected (ten samples in each area), while eight window traps were installed.

In addition to detailed insect investigations on selected plots for detailed vegetation and soil descriptions, data on insects in different habitats were collected during routes on foot as well as by car and rubber boat, in addition to the ornithological and mammal research. No special techniques or traps for catching were used, in most cases determination was possible without catching the insect at all. For fast flying insects or cases when an insect could not be identified immediately, a black diptera-net was used to catch the insect. For detailed determination, only a limited number of specimen were sampled and stored in pots with conservation material (naphthalene or ethanol).

For Bumblebees and Wasps, in addition to habitat type, the caste and behaviour were noted, with additionally observations being made on the plant species when a specimen was found foraging on vegetation. More or less equal amounts of time were spent in all recognizable habitats, to allow for an objective comparison. Due to the good weather conditions, a large number of Butterflies could be seen in all study areas. Species determinations were executed in the field, no samples were collected. Like Bumblebees and Wasps, data collected included species diversity and community composition in different habitats, as well as their preferences in visiting flowering plant species. No distinction between sexes was made. For Dragonflies only the species present in each study area were noted. A first attempt has been made to investigate the group of Horseflies as possible indicator for water quality. Small numbers were sampled for determination.

*Papilio machaon*, a common species in the Pechora basin, included in the Red Data Book of the Russian Federation.

*Pollination by insects*

In addition to the data collection on the above-mentioned insect groups, also a first attempt has been made to collect data of pollinating insects from the viewpoint of plant species. In different habitats first the flowering plant species were identified and afterwards the visiting insects, mainly by group, were noted. A serious start has made in the upstream sections only. It is expected that this approach will provide information on the dominant pollinating insect group in different habitats. The identification was limited to the group level, because the extreme diversity of insect species does not allow fast complete identification.

*Preliminary results*

Collected samples showed the occurrence of representatives of large orders like Coleoptera, Hymenoptera, Orthoptera and Hemiptera. Species from the different orders can be divided in accordance with their preferred habitat: species inhabiting herbage, caught using window traps and cutting, and species inhabiting litter and soil, caught using soil-litter samples and soil traps.

On herbaceous vegetation a great number of Tettigonidae and Acrididae were registered. Bugs in grass are widely represented by families of Miridae, Pentatomidae, Lygaeidae. The common species on herb meadows are *Hippodamia septemmaculata* (Coccinelidae). Small beetles with soft weakly chitinous wing cases which sometimes do not cover the top of their abdomen are also often met on herbaceous vegetation, including soft-winged flower beetles (Melyridae). The Goldenrod beetle (Chrysomelidae) is very common in the herb layer, characterised by a diversity in size and life forms. Although the Capricorn beetle (Cerambicidae) belongs to the group of stem pests, it is a species occurring on flowers and grass. Larvae of *Brachyta interrogationis* develop on roots of herbaceous plants, which explains why these beetles are often met on flowers in great numbers. In the study area the family of lamellicorn beetles (Scarabaeidae) is very diverse. On flowers a lot of *Trichius fasciatus* are frequently met. A rather common beetle is *Potosia metallica*: its larvae develop in ant hills, dust wood, hollows and soil. Beetles eat around flowers or feed on wood sap. In tree cutting areas with light sandy soils and secondary pine trees, favourable conditions exist for the occurrence of the May beetle (*Melolontha hippocastani*). Its larvae develop in soil, gnawing the underground parts of plants. Beetles damage the leaves of trees and bushes but do not feed on them.

The fertile soil layer in which plant roots occur is inhabited by a great number of animals. Among insects the most numerous soil inhabitants of the taiga biocenoses are ground beetles (Carabidae), rove beetles (Staphylinidae), larvae of snapping beetles (Elateridae), weevils (Curculionidae) and darkling beetles (Tenebrionidae).

During the field work, insect communities were studied in undisturbed herb floodplains and upland meadows, wetlands, Pine and Spruce forests with Greenmoss and Sphagnum undergrowth, mixed coniferous forests, deciduous forests, riverside Willow communities, as well human impacted variants of these vegetation types. Relative abundances of insect communities show that due to the specific hydrological regime wetlands are less inhabited by insects. In Pine forests, Spruce and deciduous forests the relative abundance is slightly higher, while herb meadows are characterized by relatively high abundances. Human impact can result either in a decrease or an increase in species diversity, depending on the type and degree of anthropogenic load and its effect on vegetation and soil parameters.

In general, insect fauna in the Pechora basin is represented mainly by species typical for the Palearctic and Holarctic zones. From the zonal point of view species with a polyzonal, arctic-boreal and boreal distribution prevail. Observed insect species mainly belong to the trophic groups of saprophages, zoophages and phytophages.

*Further activities*

The research allowed to increase the data on fauna species and the structure of animal population in natural communities of the Pechora basin. Currently the determination of collected insects is ongoing. The complete taxonomic species list of entomofauna is expected to be ready in January 2004. Subsequently, the biotopic distribution of insects will be analysed, as well as the differences between the 3 main landscape zones.

The following structural parameters are preliminary selected to assess entomofauna diversity of the study area: species diversity, characterizing the degree of mosaicism of soil-plant conditions in each vegetation type (species diversity will be determined using Shannon's diversity index); relative abundance, related with soil richness and biocenoses productivity (the number and catchability of soil insects has already been analysed); spectre of life forms and trophic groups, reflecting the range of ecological niches and development of layers; degree of relative biotopic confinement of species (determined by the ratio of the difference between the share of species in this of that ecosystem and its share in all studied habitats compared to the sum of these shares); degree of ecological similarity of the biocenoses under study and insects communities.

The collected data – taxonomic species composition of flora and fauna, their geographical distribution etc. – will be stored in a unified PRISM data base. As such, an integrated inventory of fauna and flora of the Pechora basin will be possible, as well as analyses of the relationships between animals, plants and soils, and the effect of human impact on communities.

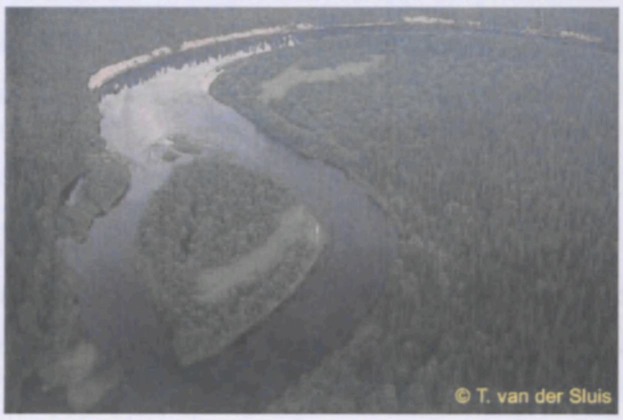
# 2.2 Aquatic ecosystems

### 2.2.1 Hydrology & hydrochemistry

Alexander Kokovkin, Ludmila Khokhlova, Vasili Ponomarev

*Hydrology*

The Pechora river is the largest river of northern Europe. The length of the river is 1,809 km, discharging water from a total water catchment area of 322,000 km², resulting in an average density of river net 0.48 km/km² [1]. The Pechora river originates on the western slopes of the Ural mountains, traverses the north-eastern part of the Russian plain, and flows into the Barents Sea through the Pechora Bay. The basin is characterized by widespread permafrost in the subsoil, mainly in the northern part of the Komi Republic, the Bolshezemelskaya tundra and the Ural mountains, as well as upland bogs (5-15 % of the total basin surface area) [2].





Meander and river island in the Pechora river.

The Pechora river near Yaksha.

The source of the river Pechora is located at the foot of the mountain Pecheray-Talayhual, at a absolute height of about 680 m. In the upstream section of the Pechora basin, the river traverses two landscape zones, the mountain and sub-mountain zones, before entering the lowland plain. In the mountain zone, the width of the Pechora river valley is 4-6 km, widening to 8-10 km at the boundary with the lowland plain.

The hydrological conditions of the upstream section of the Pechora main stream are relatively well-studied, hydrological monitoring started as early as 1916 (table 2.2.1.1).

The main channel of the Pechora river in the mountain and sub-mountain landscape zones is sinuously and stony. Downstream of the mouth of the Manskaya Volosentsain river, the main channel bifurcates regularly – many islands and branches occur, the size of which strongly increase as the river enters the lowland plain. Measurings registered flow velocities of 1.5-2.0 m/s during the spring flooding period and 0.3-0.6 m/s in summer low water period. Between the source and the mouth of the Bolshaya Shedjam river slope angles decrease from 25.1 ‰ up to 1.0 ‰, further decreasing to 0.6 ‰ in Yaksha (table 2.2.1.2).

In the mountain landscape zone, floodplain areas are mainly absent, and where present they cover only small areas with a maximum width of 200-300 m, often either only on the left or right bank of the river. Floodplains occur more often in the lowland plain landscape zone, their width increases to a maximum of 1-2 km. During the spring flooding period, floodplains are covered with an average water layer of 0.5 to 1.0 m. Locally, the flooding level is strongly influenced by the occurrence of ice dams in the river.

**Table 2.2.1.1** Characteristics of hydrological monitoring stations in the upstream section of the Pechora main stream [3].

| River | Station | Watershed, $km^2$ | Distance from mouth, km | Start of observation period | |
|---|---|---|---|---|---|
| | | | | Discharge monitoring | Water level monitoring |
| Pechora | Ust-Unya | 4,430 | 1,643 | Since 1975 | Since 1944 |
| Pechora | Yaksha | 9,620 | 1,506 | Since 1913 | Since 1913 |
| Unay | Ust-Berdysh | 2,370 | 39 | Since 1959 | Since 1931 |

**Table 2.2.1.2** River slope angles during the summer low water period in the upstream section of the Pechora main stream.

| Distance from mouth (km) | Absolute height (m BSL) | Length of river stretch (km) | Slope angle (‰) |
|---|---|---|---|
| 1,809 | 680.0 | 0 | n.a. |
| 1,801 | 479.0 | 8 | 25.1 |
| 1,791 | 384.0 | 10 | 9.5 |
| 1,780 | 335.5 | 11 | 4.4 |
| 1,768 | 292.7 | 12 | 3.6 |
| 1,756 | 248.5 | 12 | 3.7 |
| 1,753 | 239.7 | 3 | 2.9 |
| 1,740 | 214.0 | 13 | 2.0 |
| 1,725 | 189.1 | 1 | 1.7 |
| 1,714 | 175.5 | 11 | 1.2 |
| 1,689 | 163.0 | 25 | 0.5 |
| 1,643 (Ust-Unya) | 144.2 | 46 | 0.4 |
| 1,506 (Yaksha) | 121.5 | 137 | 0.2 |

Hydrological features in the upstream section of the Pechora river and its tributaries are mainly determined by climatic and orographic conditions. The hydrological regime of some small tributaries is additionally influenced by karst features. The climate in the mountain and sub-mountain zones is characterised by low winter air temperatures; on average –17.5°C, maximum -52°C. In summer the average air temperature is +15.7°C, maximum +35°C. Precipitation amounts to a long-term maximum of 720 mm on the western slopes of the Ural mountains, mainly concentrated in the period April-October (500 mm). The maximal daily precipitation may reach 60-70 mm.

The hydrography of the Pechora river is dominated by a spring high water period following snow melt. Long-term monitoring data show the start of the high water period on 25 April (varying between 8 April and 25 May) while maximum water levels are being reached on 21 May (varying between 21 April and 20 June). In general, the high water period is characterised by one flood peak. During the decrease of the water level, minor peaks often are observed, the results of rain showers. The high water period ends in the last decade of June (varying between 26 May and 24 July). The average duration of the flooding period is 63 days, varying between 39 and 96 days. During the spring high water period, on average 57 % (maximum 75 %) of the annual volume is discharged, with average volumes in this period amounting to

1,470 $m^3/s$ (maximum 2,630 $m^3/s$). The summer low water period lasts on average from early July until early October, a total of 70 days. The water level during this period is characterised by a instabilities, on average 2 to 4 times per year rainfall causes minor flooding lasting on average 16 days. The winter low water period lasts for about 200 days, during which the river is covered by ice. The average ice thickness observed at Yaksha was 67 cm, with a maximum of 112 cm. Some data on the average, minimum and maximum discharge at Yaksha are presented in table 2.2.1.3.

The Vel'yu river is a 1st order left tributary of the Pechora river, entering the Pechora river in the lowland plain landscape zone at 1,288 km from its mouth. The length of the Vel'yu river is 173 km, its total watershed 4,110 $km^2$. The main 2nd order side rivers of the Vel'yu river include the Bolshoy Tebuk river – a right tributary at 25 km from a mouth of the Vel'yu river, with a length of 92 km and watershed area of 686 $km^2$ – and the Nibel river – a right tributary entering the Vel'yu at 6 km from its mouth, with a length of 137 km and a watershed area of 1050 $km^2$. The Vel'yu river basin is mainly (93 %) covered by forests, with 4 % of the watershed area occupied by bogs, the largest of which is Djernur, located in the downstream section of the Vel'yu river basin. The average river slope angle of the Vel'yu river is 0.68 %, the average topographic height of the watershed area 168 m BSL, the density of the stream network 0,46 $km/km^2$.

The main channel of the Vel'yu river is tortuous and strongly incised in the lowland plain – river banks reach relative heights above the water of 8-12 m, floodplains in general are poorly expressed. The river is characterised by sandy-stony bottoms. In the downstream section the width reaches 50-80 m, with typical flow velocities of 0.3-0.5 m/s during the low water period, increasing to 1.5-2.0 m/s during the flooding period.

Since 1958, a hydrological monitoring station is located near the Konosh-El village, 36 km from the river mouth. As in other rivers of the Pechora basin, the main phase of the hydrological regime is the spring high water period. On the Vel'yu river, on average the flooding period starts on 30 April, maximum water levels and discharges are reached on 14 May, and the flooding period ends on 11 June. Depending on yearly variations, these dates can shift 20-25 days. On average 57 % of the total annual water volume is discharged by the river during this period. The summer low water period on the Vel'yu river is relatively stable; its average duration is 93 days, maximum 127 days. In general, the low water period is interrupted by 1-3 rainfall floods, their discharges and levels never exceed those of the spring maximum. On average, 30 % of a total annual water volume is discharged during the summer-autumn period (July – November). The winter low water period is stable and characterised by low water levels and discharge, with 12-14 % of the total annual water volume being discharged between December and March. Some data on discharge characteristics of the Vel'yu river near the station Konosh-El are presented in tables 2.2.1.4 and 2.2.1.5.


Downstream section of the Vel'yu river.

The Lelim, a forest tributary in the upper Pechora.

**Table 2.2.1.3** Discharge characteristics of the Pechora river at Yaksha.

| Parameter | Month | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII |
| Mean ($m^3/s$) | 32,3 | 28,2 | 26,9 | 86,0 | 615,0 | 392,0 | 131,0 | 109,0 | 129,0 | 150,0 | 86,0 | 46,3 |
| Maximum ($m^3/s$) | 46,5 | 36,0 | 36,0 | 420,0 | 1020,0 | 881,0 | 304,0 | 329,0 | 247,0 | 386,0 | 203,0 | 203,0 |
| Minimum ($m^3/s$) | 18,9 | 20,1 | 18,8 | 19,3 | 193,0 | 119,0 | 49,9 | 31,7 | 38,1 | 43,6 | 42,3 | 42,3 |

**Table 2.2.1.4** Discharge characteristics of the Vel'yu river at Konosh-El.

| Parameter | Month | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII |
| Mean ($m^3/s$) | 9,7 | 9,0 | 9,3 | 18,2 | 95,5 | 38,4 | 17,1 | 15,8 | 21,4 | 22,8 | 15,0 | 10,6 |
| Maximum | 11,1 | 11,4 | 11,9 | 55,8 | 129,0 | 90,8 | 42,6 | 40,7 | 43,8 | 41,9 | 25,1 | 12,0 |
| Minimum | 4,7 | 2,8 | 5,3 | 9,8 | 35,1 | 18,3 | 10,4 | 8,7 | 11,0 | 14,6 | 9,5 | 9,1 |

**Table 2.2.1.5** Discharge characteristics of the Vel'yu river at Konosh-El (continued).

| Parameter | Average annual discharge | Annual flow modulus | Annual flow layer | Annual flow volume | maximum | | Winter flow | | Minimum open channel | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $m^3/s$ | $l/s/km^2$ | mm | $km^3$ | $m^3/s$ | date | $m^3/s$ | date | $m^3/s$ | date |
| Mean ($m^3/s$) | 23,6 | 11,5 | 363 | 0,745 | 296 | | 8,1 | | 11,5 | |
| Maximum | 29,3 | 14,6 | 460 | 0,924 | 521 | 09.05.79 | 9,3 | 04.04.63 | 17,7 | 25.07.69 |
| Minimum | 18,1 | 8,8 | 278 | 0,571 | 156 | 12.05.80 | 2,4 | 28.02.79 | 7,3 | 16.08.60 |

*Hydrochemistry*

*General aspects*

Literature data characterizing the chemical water composition of the Vel'yu river are not available. Until 1992, the chemical water composition of the upstream section of the Pechora main stream was monitored by the Centre for Hydrometeorology & Monitoring of the Environment of the Komi Republic (Syktyvkar). The most upstream monitoring site was located near the village of Yaksha. Targeted hydrochemical studies of the Pechora river between the Unya tributary and Yaksha were carried out by Vlasova [4], [5].

The upstream Pechora river cuts through the mountain and hill ridges of the western slopes of the Ural mountain chain, stretched in meridian direction. The river is characterised by high flow velocities and a great amount of rapids. Tributaries of the upper part of the Pechora river are relatively small and numerous, the majority having a typical mountain character. The Unya river is the largest of the tributaries of this part of the Pechora. Water mainly originates from snow-melt in the Ural mountains and the lowland plain wetlands.

Near Yaksha the water of the Pechora river has mainly a hydrocarbonate-calcium composition and a low mineralization, 56.8-131.5 mg/dm$^3$. Major biogenic compounds in the river water of the Pechora basin are ammonia nitrogen, mineral phosphorus and total iron. Nitrites and nitrates are in general absent. During winter, ammonia nitrogen contents are very low or absent, due to the reduced biochemical processes and the absence of contaminated sewage water. In spring and autumn increased ammonia nitrogen concentrations (up to 0.72 mg/dm$^3$) are observed, caused by the outwash of biogenic matter from the watershed during regular flooding and incidental rain high discharge periods. However, at the Yaksha monitoring site, actual concentrations rarely exceeded the maximum permissible concentrations (MPC) for fishery water bodies. The Fe-concentration in the river water is closely related with hydrometeorological conditions, explaining its wide range in concentrations between 0.01 and 0.89 mg/dm$^3$. The highest concentrations were recorded during autumn and spring. Mineral phosphorus content in the water of the Pechora river near Yaksha varied between 0.022 and 0.025 mg/dm$^3$.

In northern surface waters organic matter is mainly in solution, although occasionally the amount of suspended organic matter in river and lake waters can increase. The presence of humus materials originating from soils and peat is evidenced first of all by the yellow-brown colour of the water. The organic matter content was determined by indirect measures: colour (6-110°), permanganate (5-11 mg/dm$^3$) and bichromatic oxidation capacity (5.9-68.8 mg/dm$^3$). Between Ust-Unya and Yaksha, minimum parameters of colour, permanganate oxidizability and bichromatic oxidation capacity were observed in winter and during the summer low water period. During spring flooding and autumn rain discharge peak, maximum values of all parameters were observed.

The upstream section of the Pechora main stream has a favourable oxygen regime (up to 124%). At pH's between 7.1-7.7, carbon dioxide content varied between 4.4 and 8.8 mg/dm$^3$. During the winter low water period, the concentration of dissolved oxygen is constant (59-76%). Hydrochemical studies revealed that changes in pH and gas regime of the Pechora river are conditioned by hydrometeorological conditions during the year, the level of photosynthesis of lower and higher plants, the influence of tributaries, current velocity and process of intermixing of water layers.

Data on pollutant concentrations in water courses are very scarce [6]. The upper stream section of the Pechora river shows very low contents of oil in all seasons. The most widespread pollutants are phenols, increasing the MPC for fishery water bodies 2-22 times. Also heavy metals exceeding the MPC were observed, with maximum copper concentrations exceeded the MPC – 90, Zinc – 32 times [7, 8]. It is known that pollutant contents slightly vary with the changes in water discharge [9], however, their absorption by bottom sediments is possible, which later causes secondary contamination of the water environment. It was proved that at pH's between 6-8, insoluble complexes of copper with suspended matter, fulvic and humic acids are formed, causing their accumulation in soils and sediments [10, 11]. As suspended particles, Fe-oxide and humus organic matter occur in large quantities in the water of the Pechora river, and the pH is between 6-8, it is not excluded that the process of copper absorption is very active. Zinc precipitation is also observed, a result of bond-forming with iron oxide and manganese [12].

*Field work*

The hydrochemical studies of the Vel'yu river and the mountain and sub-mountain stretches of the Pechora river executed within the PRISM project provide rather unique new information.

During the 2003 fieldwork expedition, 30 water samples were collected and conserved (with respectively sulphuric acid, nitric acid, orthophosphoric acid, chloroform and hexane) from six river cross sections in the Vel'yu and Pechora main streams. Additionally, the type of the water body, location, geographical coordinates, river bank typification, water depth, bottom type, current velocity, degree of vegetation development, presence of fouling, colour and smell of water, presence of economic activities, pH, water temperature, conductivity, oxygen concentration, oxidation-reduction potential and water turbidity were noted (Table 2.2.1.6). Currently chemical analyses of the samples are ongoing.

**Table 2.2.1.6** Some basic field parameters values of sample sites in the Vel'yu and Pechora main stream in June-July 2003.

| Basin | Location | Bottom | Colour | Smell | pH | T, °C | EC, µS/cm | $O_2$, gr/l | Redox, mV | Turbid | Speed, m/s | Ecomic activity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ve | B.Tebuka | | Ye | No | 6,97 | 14,4 | 34 | 8,99 | 134 | 3,08 | 0.9 | fo,oil,ag |
| Ve | Lenavozh | St-Sa | Ye | No | 7,09 | 13,8 | 37 | 9,25 | 128 | 3,80 | 0.6 | fo,oil,ag |
| Ve | Vadyavozh | St-Sa | Ye | Ma | 7,25 | 14,6 | 57 | 9,44 | 68 | 1,98 | 0.5 | oil,tr,fi |
| Ve | gas-oil pipeline | | Ye | No | 7,43 | 14,8 | 61 | 9,03 | 105 | 2,52 | 0.6 | fo,oil,tr |
| Pe | Yurginskaya | St | Col | No | 7,58 | 11,9 | 41 | 10,30 | 21 | 0,50 | 0.7 | no |
| Pe | B.Shezhim | St | Col | No | 7,88 | 24,0 | 78 | 9,71 | 21 | 0,81 | 0.4 | ec,fi |

Legend:
Basin: Ve – Vel'yu; Pe – Pechora
Bottom: St – stones; Sa – sand
Colour: Ye – yellowish; Col – colourless
Smell: No – no smell; Ma – marshy
Economic activity: fo – forestry; oil – oil&gas exploitation; ag – agriculture; tr – transport; fi – fishing; ec – ecotourism; no – no activities / reserve

Collected data show that upstream of the confluence with the Unya river the Pechora main stream has a temperature varying between 11.9-24°C, a weakly alkaline pH (7.58-7.88), a good oxygen saturation (9.71-10.3 mg/$dm^3$). The conductivity, which indirectly characterizes water mineralization, near the Bolshoy Shezhim tributary was higher (78 µSm) than near the Yurginskaya tributary (41 µSm).

The water in the Vel'yu river was characterized by a favourable oxygen saturation (8.99-9.44 mg/dm3), a neutral pH (6.97-7.43), while according to conductivity measurements (34-61 µS/cm) it is possible to conclude that the mineralization does not exceed 100 mg/$dm^3$. The yellowish watercolour testifies to the contribution of peat waters in the formation of the discharge, as it indicated at the presence of humus organic matter in the water.

A more detailed chemical characterisation of the Pechora and Vel'yu rivers will be presented in mid-December 2003, after the completion of chemical analyses.

*References*


1. Anonymous, 1965. State of Hydrological knowledge. Vol. 3, Northern Area. Leningrad, 610p.;
2. Anonymous, 1972. Resources of surface waters of the USSR. Vol. 3, Northern Area. Leningrad, 662p.;
3. Anonymous, 1985. Long-term data of regime and resources of surface waters. Vol. 1, Issue 9, The Pechora basin. Leningrad, 150 p.;
4. Vlasova T., 1966. Hydrochemistry of the Pechora and Vychegda rivers on the territory of the anticipated reservoirs. Syktyvkar, 26 pp.;
5. Vlasova T., 1988. Hydrochemistry of the main rivers of the Komi ÀSSR. Syktyvkar, 150 pp.;
6. Anonymous, 1984-1992. State Water Cadastre – Annual data on quality of land surface waters. Arkhangelsk, V. 1(28);
7. Anonymous, 2000. State Report on Environmental Conditions of the Komi Republic in 1999. Syktyvkar, 260 pp.;
8. Anonymous, 2001. State Report on Environmental Conditions of the Komi Republic in 2000. Syktyvkar, 190 pp.;
9. Imhoff K.R., Koppe P.& Dietz F., 1980. Heavy metals in the Ruhrand, their budget in the catchment area. Progress in Water Technology 12, p. 735-749;
10. Nriagu G.O.& Coker R.D., 1980. Trace metals in humic and fulviacids from lake Ontario sediments. Environmental Science & Technology 4;
11. Schnitzer M. & Kerndorf H., 1981. Reactions of fulvic acid with metals ions. Water, Air & Soil pollution 15, p. 97-108;
12. Tessier A., Campbell P.G.C. & Bisson M., 1980. Trace metal speciation in the Yamaska and St.Francois rivers (Quebec). Canadian Journal of Earth Sciences 17, p. 90-105.

## 2.2.2 Fish

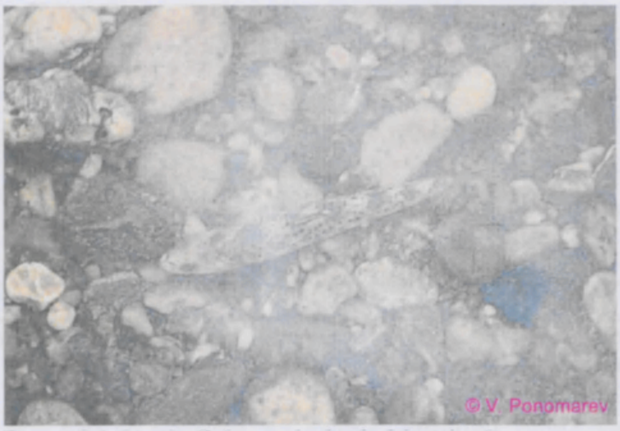
Vasili Ponomarev, Evgeni Schram

*Introduction*

During the field work in 2003, data were collected to characterize fish species diversity and population structures in the Vel'yu river and the upstream section of the Pechora main stream, as well as in a number of (semi)isolated water bodies. The river sections represent three main landscape zones – the North Urals mountains, the sub-mountain zone and the lowland plain.


The first-ever observation of Atlantic salmon *(Salmo salar)* near the source of the Pechora river occurred during the PRISM 2003 field expedition.


European grayling *(Thymallus thymallus)*, one of the most widespread European fish species.




Parr of Atlantic Salmon in its habitat in the upper Pechora.

Except its mountainous stretches, the ichthyofauna of the upstream section of the Pechora river was studied and described before (Ponomarev & Sidorov, 2002). Literature research does not provide any evidence of previous studies on the fish population of the Vel'yu river. However, archive data show that the first basic ichthyological studies in the Vel'yu river were executed by employees of Komirybvod (Kudryan, 1974; Demischenko, 1989).

*Methods*

In general, data on size-age ratios, sex composition, spatial distribution and density characteristics of some fish species were collected. Of 6 fish species, in total 290 specimen were sampled for biological analyses, while 169 fish specimen of two species were put to intravitam mass. In total 30 samples of adipose fins of young salmon fish were sampled for DNA analysis in the upstream section of the Pechora river.

For fish catches, a standard set of 6 Finnish gillnets with a length of 30 m, a height of 1.8 m and a mesh size of 10, 20, 30, 40, 50 and 60 mm were used. Additionally fry nets (length 16 m, mesh size 5 mm) and drag nets (length 70 and 150 m, mesh size 24 mm) were used, as well as an electric fishing rod "BIOWAVE II" (Biokon, Sweden) and fish-hook rods.

The relative fish density was characterized by calculating the average number of individuals per time unit or per catching efforts per conventional hours. Fish accumulations in lakes were located with the help of an echo locator "Wide 3D View" (Techsonic industries INC., USA). Fish age was determined using their scales. For assessing species diversity, indices were used: $PIE=1-\Sigma p^2(i)$, $S=\Sigma[p^2(i)]^{-1}$, $S_g=[\Sigma\sqrt{p(i)}]^2$, $H=-\Sigma p(i)\log p(i)$, $SH=\exp(H)$.

*Preliminary results*

Due to the limited amount of time spent in each study area and the unusual high water levels, unfavourable for fisheries investigations, the data collected do not justify far-reaching conclusions. Besides the limited time spent in study areas, possible contradictions between fish species diversity as observed in 2003 and the data presented in literature and archives can be explained not are connected not only with the duration of field studies can be related to the period of investigation, which did not cover the migration periods of anadromous and semi-anadromous fish species. However, some general conclusions can be formulated.

The highest species diversity was observed in the Pechora river stretches dissecting the sub-mountain and lowland plain. The lowest species diversity occurred in the Vel'yu river and the mountain reaches of the Pechora river (table 2.2.2.1). The largest amount of fish families also was observed in the sub-mountain and lowland plain stretches of the Pechora river (8, while literature data present 10). In the Vel'yu river species of five families occurred (nine based on literature data) while species of the Pechora mountain stretch belong to five fish families.

**Table 2.2.2.1** Fish species composition in water bodies of the Pechora river basin in July-August 2003.

| Common name | Scientific name | Vel'yu river basin | Upstream Pechora river | | |
|---|---|---|---|---|---|
| | | | Mountain | Sub-mountain | Lowland plain |
| Siberian lamprey | *Lenthenteron kessleri* (Anikin, 1905) | (+) ? | | (+) | + |
| Atlantic salmon | *Salmo salar* (Linnaeus, 1758) | | + | + | (+) |
| Siberian whitefish | *Coregonus lavaretus pidschian* (Gmelin, 1758) | (+) | | + | |
| Broad whitefish | *Coregonus nasus* (Pallas, 1776) | | | | (+) |
| European grayling | *Thymallus thymallus* (Linnaeus, 1758) | + | + | + | + |
| Pike | *Esox lucius* (Linnaeus, 1758) | (+) | | + | + |
| Crucian carp | *Carassius carassius* (Linnaeus, 1758) | | | | (+) |
| Gudgeon | *Gobio gobio* (Linnaeus, 1758) | | | | (+) |
| Ide | *Leuciscus idus* (Linnaeus, 1758) | (+) | | | + |
| Minnow | *Phoxinus phoxinus* (Linnaeus, 1758) | + | + | + | + |
| Roach | *Rutilus rutilus* (Linnaeus, 1758) | (+) | | + | + |
| Groundling | *Barbatula barbatula* (Linnaeus, 1758) | + | + | + | + |
| Burbot | *Lota lota* (Linnaeus, 1758) | (+) | | (+) | + |
| Ruff | *Gimnocephalus cernuus* (Linnaeus, 1758) | + | | + | + |
| River perch | *Perca fluviatilis* (Linnaeus, 1758) | (+) | | + | + |
| Bullhead | *Cottus gobio* (Linnaeus, 1758) | + | + | + | + |
| Total | | 5 (12) | 5 | 10 (12) | 11 (15) |

Note: "+" – the species was present in catches in 2003; "(+)" – the species is present according to literature and archive data; "(+)?" – the status of the species requires thorough analysis.

The Vel'yu river basin, subjected to intensive economic activities, shows the absence of fish species common for first order lowland plain tributaries of the Pechora river: White-fish, Burbot, Pike, Ide, Roach and Perch, although these species were recorded in the past (Kudryan, 1974; Demischenko, 1989). During the 2003 field expedition, only species were registered that find their necessary living conditions not only in the main river bed, but also in tributaries of the Vel'yu river: Grayling, Minnow, Char and freshwater Sculpin.

Both faunistic analyses of the catch data as well as literature testify to a consistent increase of faunistic complexes and species diversity from the mountain zone (two faunistic complexes – arctic fresh water and boreal sub-mountain) to the lowland plain (four faunistic complexes – fresh water arctic, boreal sub-mountain, boreal plain and riverine East Asian), related to the change in hydrological habitat conditions and the appearance of different subordinate water bodies. Compared to the lowland plain zone, the sub-mountain zone shows the absence of only the East Asian complex. A similar faunistic complex was typical for the Vel'yu river 20-30 years ago.

On a number of occasions rather low diversity parameters were observed in fish catches. Besides pointing at an impact due to industrial exploitations, as in the Vel'yu river basin, this can also be the result of overcatching, a typical phenomena for the Pechora basin as a whole.

The data collected will allow a broader view on the biological diversity of aquatic communities, the population structure of fish species and abiotic habitat conditions in the upstream section of the Pechora river. Further analyses will support to reveal regularities in the spatial pattern and genetic structure of fish populations and their adaptive potential.

*References*


1. Demischenko T., 1989. Report on ichthyological observations of the Vel'yu river. Central State Archive of the Komi Republic, Ukhta;
2. Kudryan N., 1974. Report on observations of the Vel'yu river. Central State Archive of the Komi Republic, Ukhta;
3. Ponomarev V.I. & Sidorov G.P., 2002. An overview of ichthyologic and fisheries investigations executed in the Pechora river basin. In: Aquatic organisms in natural and altered ecosystems in the European North-East. Works of the Komi Science Centre, UrD, RASciences, Syktyvkar, No. 170, p. 5-33.

### 2.2.3 Aquatic macrofauna

Olga Loskutova, Violetta Shubina, Vasili Ponomarev

*Introduction*

Parallel to investigations on fish species composition and aquatic chemistry, also population diversity of aquatic invertebrates and the structure of benthic communities was studied. Hydrobiological studies were executed in the main river bed of the Vel'yu river from the mouth of the Volchanvozh river to the mouth of the Ediael river, as well as in three of its tributaries, a lake and a former river-bed situated in the watershed. In the main stream of the Pechora river, hydrobiological investigations were executed between the mouth of the Yurginskaya river and the village of Ust-Unya, as well as in the surroundings of Yaksha.

In the upper Pechora, amphibiotic invertebrates were for the first time studied during the PRISM 2003 field expedition.

The upstream section of the Pechora main stream crosses mountain and hills on the western slopes of the Northern Urals, and enters into the Pechora Depression lowland plain. Accordingly, the geological structure of the river valley and the channel structure of the main stream and tributaries change. Rivers are characterised by pebble-boulder bottoms including gravel and sand, with some admixture of silty materials near the river bank. Algae and moss overgrowth are typical features, as are thickets of emergent aquatic vegetation, dominated by *Nardosmiya.* In deltas of local tributaries, so-called kurya's, the pebble-boulder bottom is intermixed with deposits of sand, silt and organic matter. In the non-flowing sections the abundant aquatic vegetation is dominated by pondweeds, sedges, horse-tails and mosses, in the streambed replaced by *Nardosmiya.* The river in this region traverses a formally protected Nature Reserve, which causes human impact to be minimal, confined to ecotourism and fishing. In the sub-mountain zones, near the villages of Ust-Unya and Kurya forestry activities occur.

*Methods*

Parameters investigated included the type of the water body, the river bank structure, geographical coordinates, water depth, bottom type, flow velocity, degree of vegetation development, evidence of pollution, colour and smell of water, evidence of economical activity, pH, water temperature, conductivity, oxygen concentration, oxidation-reduction potential, and suspended materials concentration. For biodiversity characterisation, amphibious insects were caught in all study areas. The sampling and treatment of benthos was conducted in accordance with the procedure, developed and accepted in the laboratory of aquatic organisms of the Institute of Biology Komi SC UrD RAS (Shubina, 1986). Sample pre-processing and species identification of caddis flies were executed by Shubina in the laboratory.

*Preliminary results*

Some general parameters of investigated water bodies are presented in table 2.2.3.1.

In the last decade of June 2003, 32 samples of zoobenthos were collected in the Vel'yu river: 27 quantitative samples, 5 qualitative samples. These samples added will add knowledge to previous studies conducted only in the 12 km-long estuary part of the Vel'yu river and in one of its tributaries – the Nibel river (Zvereva, 1971). The present investigation covered about 100 km of the main river bed and three tributaries never studied before.

**Table 2.2.3.1** Selected parameters of water bodies in the Vel'yu river basin and the upstream section of the Pechora river, June-July 2003.

| Basin | Water body | Bottom | Colour | Smell | pH | T | EC | $O_2$ | Redox | Turb | Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ve | B.Pilyael stream | Sa | Br | No | 6,64 | 12,2 | 29 | 8,95 | 130 | 2,33 | 0,8 |
| Ve | Ediael stream | Sa-St | Ye | No | 6,75 | 12,4 | 32 | 8,78 | 109 | 1,69 | 0,9 |
| Ve | former river-bed | Si-So | Br | HS | 6,36 | 16,7 | 17 | 5,76 | 161 | 2,89 | |
| Ve | Lake Van | Si | Ye | Ma | 6,47 | 22,0 | 18 | 8,67 | 83 | 4,94 | |
| Ve | Vel'yu river | Sa-St | Ye | Ma | 7,32 | 14,5 | 62 | 9,03 | 104 | 2,07 | 0,6 |
| Ve | B.Lenavozh river | Sa | Br | Ma | 7,20 | 14,3 | 48 | 8,69 | 48 | 1,98 | 0,6 |
| Ve | Vel'yu river | | Ye | No | 7,43 | 14,8 | 61 | 9,03 | 105 | 2,52 | 0,6 |
| Ve | Vel'yu river | St | Ye | Ma | 7,46 | 16,3 | 62 | 9,99 | 113 | 2,28 | 0,5 |
| Pe | Kurya | Si | Gr | Ma | 7,23 | 26,5 | 55 | 7,88 | 85 | 5,93 | |
| Pe | Pechora river | St | Col | No | 7,61 | 21,8 | 89 | 8,68 | 107 | 2,40 | 0,8 |
| Pe | Pechora river | Sa | Col | No | 7,59 | 21,5 | 89 | 8,58 | 120 | 2,36 | 0,4 |
| Pe | Pechora river | Sa-St | Col | Ma | 6,94 | 18,6 | 86 | 8,12 | 124 | 3,28 | 0,3 |
| Pe | Kurya (village) | Si | Br | Ma | 7,06 | 18,5 | 56 | 8,65 | 94 | 11,60 | 0,1 |
| Pe | Lelim river | Sa | Br | Ma | 7,11 | 15,9 | 70 | 8,47 | 90 | 4,99 | 0,6 |
| Pe | Kurya | Si | Ye | Pu | 6,42 | 15,2 | 45 | 5,93 | 54 | 39,10 | |
| Pe | B.Chernava stream | | Br | Ma | 5,56 | 17,0 | 23 | 7,83 | 180 | 4,86 | 0,3 |
| Pe | Volosnitsa river | | Br | Ma | 6,45 | 20,1 | 39 | 7,19 | 145 | 4,69 | 0,5 |
| Pe | Pechora river | Sa-St | Col | No | 7,55 | 22,6 | 96 | 8,47 | 96 | 2,47 | 0,4 |
| Pe | B.Hroshevka stream | Sa-St | Br | No | 7,12 | 18,6 | 50 | 9,17 | 65 | 2,98 | 0,4 |
| Pe | Pechora river | St | Col | No | 7,58 | 11,9 | 41 | 10,3 | 21 | 0,50 | 0,7 |
| Pe | Yurginskaya river | St | Col | No | 7,69 | 10,4 | 61 | 10,6 | 49 | 0,96 | 0,9 |
| Pe | nameless stream | St | Col | No | 7,47 | 13,2 | 23 | 9,8 | 126 | 1,36 | 0,5 |
| Pe | Kurya | Si | Col | No | 7,28 | 15,6 | 42 | 8,68 | 69 | 1,08 | 0,0 |
| Pe | Kurya | St-Si | Col | No | 7,16 | 11,1 | 33 | 9,84 | 65 | 3,23 | 0,1 |
| Pe | Kurya Umanskaya | Si-St | Ye | No | 7,07 | 16,3 | 71 | 9,79 | 23 | 2,63 | 0,0 |
| Pe | Pechora river | St | Col | No | 7,81 | 18,9 | 56 | 8,42 | 45 | 0,75 | 0,6 |
| Pe | Pechora river | St | Col | No | 7,67 | 16,6 | 84 | 9,53 | 30 | 0,76 | 0,6 |
| Pe | Lugovaya river | St | Col | No | 8,23 | 13,2 | 159 | 9,66 | 49 | 1,08 | 0,4 |
| Pe | Serapiona kurya | Si | Br | No | 7,20 | 18,0 | 79 | 7,7 | 63 | 4,44 | 0,0 |
| Pe | Puhtovka stream | Sa-Si | Gr | No | 8,35 | 8,9 | 250 | 8,94 | 43 | 3,05 | 0,3 |
| Pe | Pechora river | St | Col | No | 8,10 | 15,5 | 130 | 7,97 | 33 | 1,01 | 0,5 |
| Pe | Dolgiy stream | St | Re | Ma | 6,17 | 9,7 | 33 | 5,29 | 58 | 5,05 | 0,4 |
| Pe | Utlan river | St-Sa | Gr | No | 8,04 | 9,7 | 233 | 8,09 | 6 | 1,75 | 0,4 |
| Pe | Pechora river | St | Col | No | 7,83 | 14,7 | 128 | 8,33 | 32 | 1,16 | 0,4 |

Legend: Basin: Ve – Vel'yu; Pe – Pechora
Bottom: St – stones; Sa – sand; Si – silt; So – organic
Colour: Ye – yellowish; Col – colourless; Br – brownish; Gr – greenish; Re – reddish
Smell: No – no smell; Ma – marshy; HS – hydrosulphite; Pu – putrid

River benthos communities upstream the Volchanvozh tributary consist of 11 groups of hydrobionts, while in rapids 16 groups were observed. Previously, integrated studies of all 5 left tributaries of the Pechora river recorded in total 23 groups of benthos. The PRISM field work identified 19 groups for the Vel'yu river, not found were the rare Bryozoa, Tardigrada, bugs (Hemiptera), dragon-flies (Odonata), and alder flies (Megaloptera). However, in rapids upstream of the Volchanvozh tributary the field work identified spiders never recorded before in any of the left tributaries. On the predominantly sandy bottoms Chironomids dominated in number and biomass, composing more than 80% of the total benthos community. Zvereva (1971) describes the occurrence of a very high number of lower crustaceous in the late 1960s – Cladocers and Copepods – however, nowadays the number of these organisms in the river bed is not high. In rapids Chironomids (57.8 %), larvae of Mayflies (9.4 %) and Buffalo Gnats (6.3%) prevail in number, while larvae of Caddis Flies (25.8 %) and Chironomids (25.4 %) dominate in biomass. Observed quantitative parameters of benthos development are lower than those observed in the 1970s: 3400-9200 individuals/$m^2$ (compared to 4700-45000 in the past), biomass weight of 1.3–3.4 g/$m^2$ (compared to 1.4 – 5 g/$m^2$ in the past). Benthos diversity was the lowest downstream of gas & oil pipe lines transversing the rivers (biomass amounts of 1.1 g/$m^2$).

In the upstream section of the Pechora main stream, 104 benthos samples were collected, of which about half (51 samples) originating from tributaries of the Pechora main stream in the mountain zone which were never studied before. The benthos information base on the Pechora main stream was also significantly enlarged.

In the 2003 samples from the Pechora main stream in the mountain zone 15 groups of aquatic invertebrates were identified, compared to 13 groups during past research (Shubina & Shubin, 2002). In upper Pechora tributaries 14 groups were found, while in the kurya 15 groups occurred. The zoobenthos composition of the kurya added Hydras, Leeches, Molluscs and Harparcticids to the benthos composition of water courses in this region. In total 19 groups of benthos were registered in the water bodies of the upstream Pechora river basin (the mountain zone): Hydrae, Nematoda, Oligochaeta, Hirudinea, Mollusca, Cladocera, Ostracoda, Harpacticoida, Copepoda, Hydracarina, Collembola, Ephemeroptera, Plecoptera, Coleoptera, Trichoptera, Simuliidae, Ceratopogonidae, Chironomidae, Diptera. Based on the fauna composition, the Pechora river in the mountain zone can be characterized as clean, and its state be regarded as ecologically safe.

Emergence of *Odonata* spp. in summer.

*Ephemeroptera* spp., a typical inhabitant of the mountain and sub-mountain landscape zones.

In benthos communities of the Pechora main stream, larvae of chironomids are always present, dominated by representatives of the sub-family of Orthocladiinae. An abundance of 80-90% was observed for Water Mites, Oligochaets, Caddis Flies (*Rhyacophila nubila*, *Arctopsyche ladogensis*, fry of genus Apatania, *Notidobia ciliaris*, a lot of empty houses of *Potamophylax latipennis*) and Water Beetles (dominated by the species *Elmis maugetii*). During the period of investigations, in the river bed of rapids the average benthos number varied between 5,900 and 23,600 individuals/m², and the average biomass between 1.95 to 11.48 g/m², while in calmer flowing stretches the numbers varied between 2,300 and 17,900 individuals/m², the biomass between 0.46 and 29.62 g/m². The considerable spread in the number of individuals and biomass is related to the type of river substratum, the degree of vegetation development on stable pebble-boulder bottoms and the degree of mobility of silt.

In sandy and silty bottoms of the kurya the number of benthos was not high, up to 5,000 individuals/m². The value increases significantly (20,900 individuals/m²) in the presence of a great amount of organic matter. Chironomids, Oligochaets and Ostracods dominate the benthos number in the kurya. The average benthos biomass varies between 0.2 g/m² (on sands) and 25.3 g/m² (peddle-boulder bottom with organic matter), dominated by Two-winged Flies and Oligachaets.

In the zoobenthos communities of Pechora tributaries in the mountain zone Chironomids (100%-occurance), May Flies (90%-occurance) and Oligachaets (78%) are often met. As in benthos communities of the main stream bed, larvae of chironomids dominate in number, but a large percentage (up to 50%) of the total quantity includes Oligachaets, Ostracods and larvae of May Flies. The average number of sediment invertebrates is not high, varying between 1,000 and 3,100 individuals/$m^2$, their biomass varying between 1.00 and 7.45 g/$m^2$.

Sample processing is expected to be completed in January 2004.

*References*


1. Shubina V.N, 1986. Hydrobiology of the Salmon rivers of the northern Urals. Nauka Publishing House, Leningrad, 157 pp.;
2. Shubina V.N. & Shubin Yu.P., 2002. Benthos of the upstream Pechora river and their role in fish feeding. In: Aquatic organisms in natural and transformed ecosystems of the European North-East. Works of the Komi Science Centre, UrD RAS, No. 170, p. 34-50;
3. Zvereva O.S., 1971. General characteristics of benthos of the Middle Pechora and its left tributaries in relation to hydrology. In: Biology of northern rivers in ancient lake lowlands. Works of the Komi Branch of the AS USSR, No 22, p. 44-58.

# 3.

## 3.1 Land observations

Harald Leummens, Theo van der Sluis

*Introduction*

Combining the knowledge of different scientific disciplines – soil science, geology & geomorphology, earth observation, forestry, vegetation science, hydrology, ichthyology, and biology – into an integrated land assessment for the Pechora basin requires the elaboration of a consistent, hierarchical Land Unit classification, taking the different temporal and spatial scales of data and data collection into account. A hierarchical Land Unit classification is vital for upscaling of the collected data to the basin level, as well as to analyze impacts resulting from land use planning and natural resources management.

*Land Unit Classification*

In the report on the field expedition 2002 (Leummens et al., 2002), a first draft Land Unit (LU) classification was presented. The preliminary classification, elaborated for the Bolshaya Synya river basin, was defined based on:

- observed surface characteristics (vegetation, geomorphology)
- earth observation information (satellite image spectral information; Landsat TM)
- scale used for classification (1:50,000)
- purpose or aim of classification

As the Pechora basin is not covered by one Landsat image, it was decided to apply another technique – to purchase and merge available MODIS remote sensing data into an integrated image for the whole Pechora basin. At the RWS-Survey Department, Delft, the groundtruth information collected in 2002 was combined with available knowledge from tundra and delta landscapes into a preliminary Land Unit classification for the Pechora basin, using a pixel size of 250×250 m (Den Hollander et al., in prep). Using land cover and geology as main parameters, the following main physiographic units (FU) were identified: 1) forests; 2) mountains & tundra; 3) fens & bogs; 4) water & shore; and 5) anthropogenic zones.

Based on main vegetation types and geomorphological elements, the physiographic units can be split up into main vegetation formation or ecotope vegetation types. For the FU "forests", in addition to "mixed forest" and "disturbed forest", 5 mono-species forests ecotopes types could be distinguished: "Pine", "Spruce/Fir", "Birch", "Aspen", and "Willow". The FU "mountain & tundra" is subdivided into "mountains", "northern tundra" and "southern tundra". The FU "fens & bogs" distinguished only one ecotope "fens & bogs", while the FU "water & shore" distinguishes the ecotope types "rivers", "lakes" and "shores". Finally, the FU "anthropogenic zones" distinguishes the ecotope types "grasslands" and "intensive disturbance"

The ecotope types can be further subdivided into LUs based on a more detailed vegetation typology, usually based on the undergrowth vegetation, mainly consisting of dwarfshrubs, mosses or lichens. Aquatic ecotopes types, especially rivers and lakes, are further subdivided on the basis of geomorphology and hydrological characteristics, of particular importance for fish populations.

Subsequently, the LUs are labelled with a code, an acronym, based on main ecotope type and undergrowth vegetation (Table 3.2.1).

*Field observations*

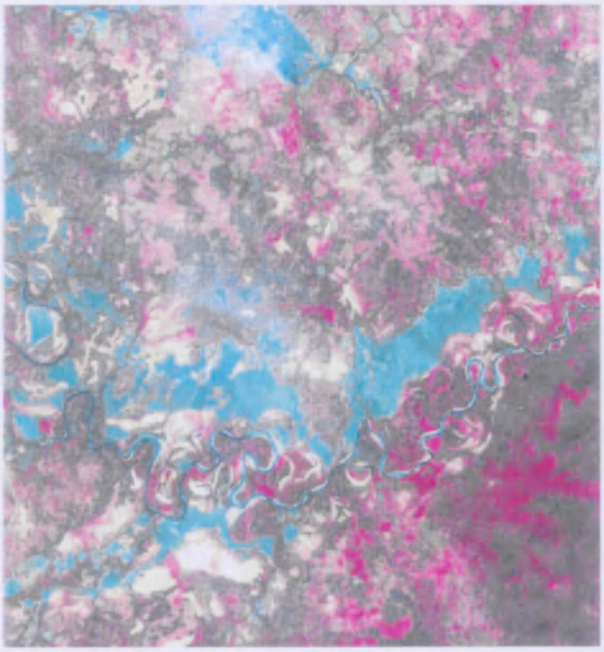
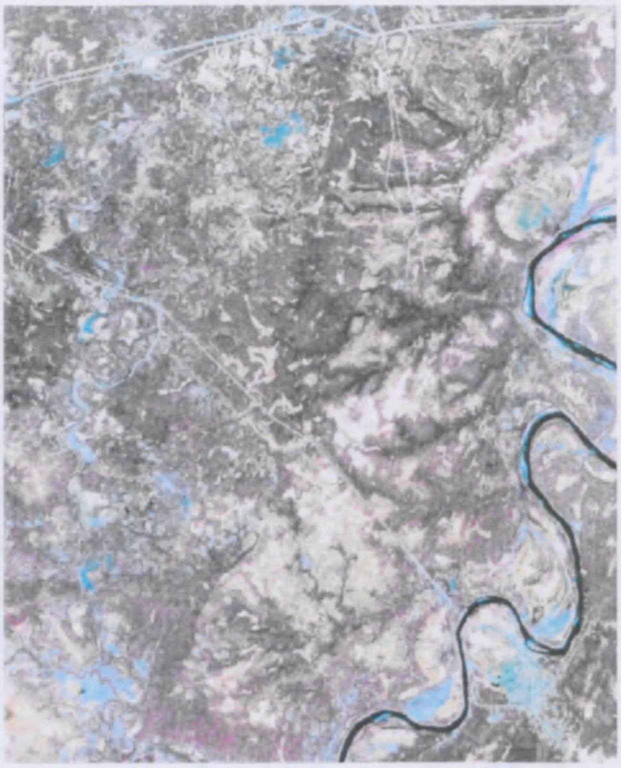
For all study areas visited in 2003, the analysis of the general landscape and vegetation structure was aided by printed images, scales 1:250,000 and 1:50,000, of Landsat TM7 false colour composites (figure 3.1.1). All field teams were also equipped with knowledge on the Land Units preliminary defined after the 2002 field expedition, knowledge which was used to classify field sites based on their geomorphologic and vegetation properties.

All field teams used the printed Landsat false colour composite images to select research plots in distinguishable, homogenous map units of sufficient size. Where possible, the selection of research plots was additionally aided by the forest inventory map, scale 1:25,000. The forest inventory map represents a classification based on forest vegetation formation, with details on the moss and herb undergrowth layer. Subsequently, the field teams collected groundtruth information on landscape parameters within their field of interest.

**Table 3.2.1** Integrated landscape classification for the Pechora River Basin, based on Remote Sensing image interpretation and vegetation surveys.

| FU | Ecotope type | Vegetation type | Land Unit |
|---|---|---|---|
| Forests | Pine forests (>70%) | Pine, Greenmoss type | FPg |
| | | Pine, Lichen type | FPl |
| | | Pine, Haircap moss | FPp |
| | | Pine, Sphagnum type | FPs |
| | Spruce/Fir forests (>70%) | Spruce, Greenmoss | FSg |
| | | Spruce, Haircap moss (Pol. Comm) | FSp |
| | | Spruce, Sphagnum | FSs |
| | | Spruce, Herb forest | FSh |
| | Aspen forests (>70%) | Aspen, Greenmoss | FAg |
| | | Aspen, Herb forest | FAh |
| | Birch forests (>70%) | Birch, Greenmoss | FBg |
| | | Birch, Lichen | FBl |
| | | Birch, Haircap moss (Pol. Comm) | FBp |
| | | Birch, Sphagnum | FBs |
| | | Birch, Herb forest | FBh |
| | Willow forests (>70%) | shrubs and trees | FWs |
| | Mixed forests | Pine dominated | FMp |
| | | Spruce/Fir dominated | FMs |
| | | Aspen dominated | FMa |
| | | Birch dominated | FMb |
| | | Willow dominated | FMw |
| | Disturbed forests | Clear-cut Greenmoss type | FDg |
| | | Clear-cut Lichen type | FDl |
| | | Clear-cut moss type | FDm |
| | | Clear-cut Sphagnum type | FDs |
| | | Burnt | FDb |
| Fens & bogs | Fens & bogs | rich fen | XFf |
| | | tall sedges marsh | XFc |
| | | transitional bog | XFt |
| | | poor fen, Sphagnum bog | XFs |
| | | wooded bog | XFw |

| FU | Ecotope type | Vegetation type | Land Unit |
|---|---|---|---|
| Mountain & tundra | Mountains | bare rock | XMb |
| | | glacier, snow | XMg |
| | | mountain tundra | XMt |
| | | Fir forest | XMf |
| | Northern tundra | dwarf shrub-Lichen | XNl |
| | | dwarf shrub-small hummock-moss | XNh |
| | | Cotton grass-Sphagnum | XNc |
| | Southern tundra | Willow-Birch shrub, open, graminoid | XSo |
| | | Willow-Birch shrub, closed | XSc |
| | | wet shrub tundra-Cotton grass polygons | XSw |
| | | forest tundra mosaic | XSf |
| Water & shore | Rivers | main course | WRm |
| | | small river, creek | WRs |
| | | oxbow, connected | WRc |
| | | oxbow, disconnected | WRd |
| | | sandbank | WSs |
| | | gravel bank | WSg |
| | Lakes | river lake | WLr |
| | | mountain lake | WLm |
| | | tundra lake | WLt |
| | | peat bog lake | WLp |
| | Shores | marine | WCm |
| | | large bay | WCl |
| | | lagoon & tidal brackish | WCt |
| | | freshwater riverine | WCf |
| | | dunes | WSd |
| | | tidal flats | WSt |
| | | coastal meadow | WSm |
| | | coastal river delta | WSr |
| Anthropogenic | Grassland | meadows, grazed | AGg |
| | | meadows, haylands | AGh |
| | | meadows, abandoned | Aga |
| | Intensive disturbance | urban area | AAu |
| | | gardens, ruderal communities | AAr |
| | | drainage, ditch | AAd |
| | | infrastructure | AAi |

Typical Landsat TM7 false colour composites as used during the 2003 field research in the upstream section of the Pechora basin.

Note: Left image – Landsat TM7 false colour image, bands 4,3,2, date of acquisition 23 July 2000, Surroundings of Kurya, with features of forest fires, open Pine-lichen forests (bluish), secondary forests (light reddish), peat bogs (whitish), undisturbed mature spruce forests (dark red); Right image – Landsat TM7 false colour image, bands 4,3,2, date of acquisition 17 July 2001, Vel'yu-Pechora interfluvial area with features of anthropogenic disturbances (bluish, village of Troitsk-Pechorsk, roads & pipelines), forest fires and Pine-lichen forests (bluish), peat bogs (greenish, whitish), Spruce and mixed forests (reddish, brownish). Approximate scale 1:250,000. Source: RWS-Survey Department, Delft, The Netherlands.

As such, information collected during the field work 2003 will be transformed into formalised knowledge on remote sensing classification training sites, which will be passed to specialists involved in the classification of the Pechora river sub-basins.

*References*

1. Hollander, H. den, van Eerden M.R. & Leummens H., 2003. Preliminary large-scale landscape classification of the Pechora Basin using MODIS. RWS-MD/RWD-RIZA, Delft/Lelystad, in preparation;
2. Leummens H., Ponomarev V.I. & van der Sluis T. (Eds.), 2002. Pechora ecosystems – Research and basin-wide management programme: report of a field work mission to the Bolshaya Synya sub-basin. RIZA/IB/Alterra, Lelystad/Syktyvkar/Wageningen.