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The Pechora river basin

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Pokrovskaya 1967). The research was aimed at dividing the water bodies into types. The authors discovered 97 algae taxa, green and blue-green algae dominated the diversity. Brief data on the phytoplankton of the Pechora estuary (Kiselev, 1930) does not include the delta or coastal tundra.

Nowadays, algae of the phytoplankton of the water bodies of the Pechora Delta are studied most thoroughly (Stenina *et al.*, 2000). Algae are studied from algological samples from 17 water objects situated directly in the Delta. Phytoplankton samples are collected in 1996-99 within the framework of the project "Structure and dynamics of the Pechora Delta ecosystems". More than 200 species from 6 divisions are discovered. Diatoms had the highest diversity (Fig. 6.4). Ecological-geographical analyses were performed. The distribution

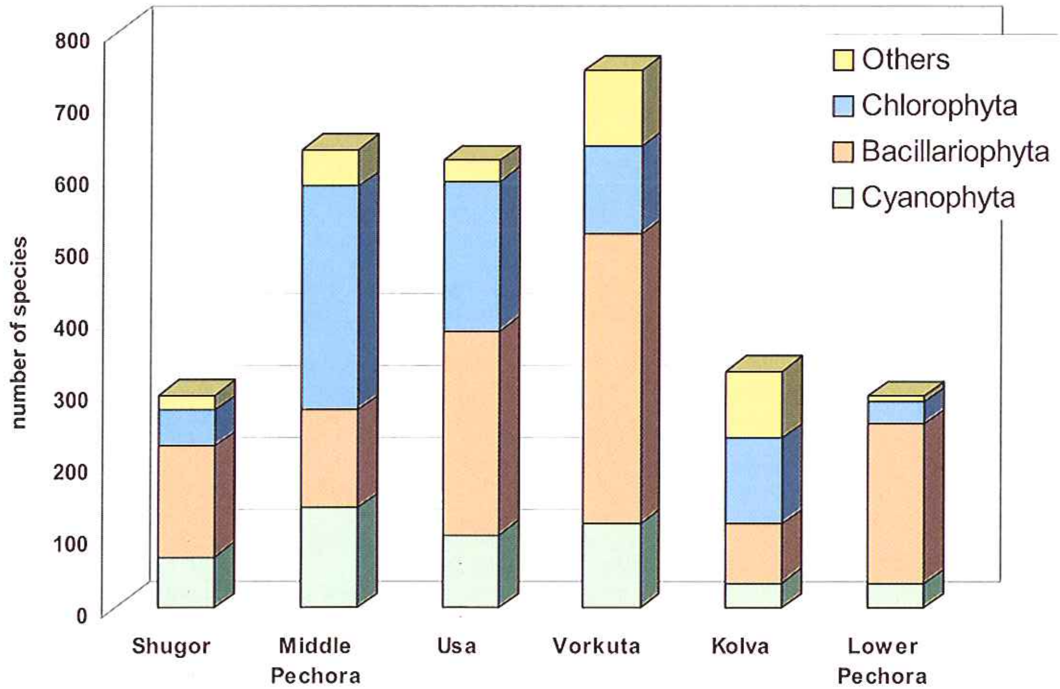

Figure 6.4 Diversity of the main divisions of algae in the most intensively investigated river basins.

of algae in different water bodies is analysed. Diatoms are studied and environmental consequences of oil drilling upon water ecosystems of the Ortina (the Pechora tributary) are determined (Stenina, Khokhlova, 1998; Stenina, 1998b). Diatom analysis of bottom sediments is performed in the Kolva river basin (Davydova & Servant-Vildary, 1996), in the Leptakurja watercourse (6 km above the Usa mouth) and in the Korovinskaya Bay (Lukin et al., 2000) for reconstruction of natural and man-induced changes in the ecosystems of the river Pechora.

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7. MACROPHYTES

Composition and distribution

F.V. Sambuk (1930) was the first to publish data on composition and distribution of macrophytes in the Pechora basin. He singled out five different regions of this river. The two first regions are mountain and sub-mountain parts, the third and the fourth are situated on the plain terrace, while the fifth region is the delta.

Community of *Petasites radiatus.*

Sambuk notes that the Pechora "is exceptionally poor in aquatic plant species" (Sambuk, 1930: p. 72). He discovered only 17 species of aquatic vascular plants along the riverbed and in some floodplain water bodies (Table 7.1). Here, *Petasites radiatus* (J.F.Gmel.) Holub, *Scirpus lacustris* L., *Caltha palustris* L., *Butomus umbellatus* L., *Carex acuta* L., *Carex aquatilis* Wahlenb., *Carex vesicaria* L., *Equisetum fluviatile* L., *Potamogeton alpinus* Balb., *Batrachium trichophyllum* (Chaix) Bosch., *Sparganium emersum* Rehm., *Sparganium minimum* Wallr. etc. were registered. The first two species were "most typical" for the river Pechora, according to the author. *Petasites radiatus* is typical for habitats with stony substrate; *Scirpus lacustris* prefers salty sites. F.V. Sambuk registered the northern border of distribution for the latter species, 64°N. The plain area where the Pechora follows the meridian is the richest in macrophytes. The lower flow of the river and its upstream are poor in water plant diversity.

F.V. Sambuk (1930) marked two main types of overgrowing of the river. First, one sees *Caltha palustris*, sometimes *Petasites radiatus*, *Butomus umbellatus* and *Persicaria amphibia* (L.) S.F.Gray on the water edge. Further on comes *Scirpus lacustris, which* dominates salty pebbles. There is often regrowth of *Potamogeton* and *Sparganium* species, in front of reed. By the second type of overgrowing, *Equisetum fluviatile*, *Carex acuta*, *C. aquatilis* and *C. vesicaria* grow on the riverbank and descend into the water. They often occupy broad stripes of the Pechora shallow water. In such sites, *Scirpus lacustris*, *Butomus umbellatus*, together with *Potamogeton* and *Sparganium* species, go deeper into the river.

More detailed information about aquatic vascular plants is given by O.S. Zvereva in a summary "Specific features of biology of the main rivers of the Komi ASSR" (1969) The author divides the river bed and the river valley into three regions: upper Pechora – from the source till the confluence of the river Volosnitsa, middle Pechora – from the mouth of the Volosnitsa till the mouth of the Usa, lower Pechora – from the mouth of the Usa till the mouth of the Pechora.

According to O.S. Zvereva (1969), the upper Pechora has a sufficiently high degree of development of aquatic plants. On stony sites of the riverbed, one can see prosperous *Petasites radiatus* together with masses of water moss *Fontinalis* sp. The vegetation is maximally developed near banks of slow-flowing stretches and in oxbow lakes with a silt bottom. Here O.S. Zvereva (1969) found *Nuphar lutea* (L.) Smith, *Potamogeton lucens* L., *P. perfoliatus* L., *Hippuris vulgaris* L., *Ceratophyllum demersum* L., *Utricularia vulgaris* L., and Chara algae (*Nittela* sp.).

O.S. Zvereva (1969) discovered 46 species of higher plants in the middle Pechora (in the riverbed and in the floodplain water bodies). According to the later revised data of the same author (Zvereva, 1971) 60 species were found, albeit only 33 of them can be attributed to typical aquatic plants. These registered aquatic plants constituted 80% of the macrophytes known to that time in the Pechora basin as a whole (Table 7.1). Plant species diversity is extremely high in the place where the Pechora crosses the Troitsko-Pechorsky ancient lake site. The published list of species (Zvereva, 1971) numbers nine species of the genus

Coastal Carex communities.

Table 7.1 Species list of macrophytes based on the data of cited authors (see page 55)

Species	1*	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Alisma plantago-aquatica L.			+	+		+	+	+											
Sagittaria natans Pall.								+											
Sagittaria sagittifolia L.				+				+											
Cicuta virosa L.			+	+			+	+	+										
Calla palustris L.								+											
Bidens tripartita L.																			
Petasites radiatus (J.F.Gmel.) Holub	+	+	+				+		+				+	+	+	+	+	+	+
Petasites frigidus (L.) Fries													+						+
Myosotis palustris (L.) L.							+	+	+				+						
Rorippa amphibia (L.) Bess.	+					+							+						
Rorippa palustris (L.) Bess.						+			+										
Butomus umbellatus L.	+		+	+			+	+											
Callitriche hermaphroditica L.			+			+		+		+	+		+	+	+	+	+	+	+
Callitriche palustris L.			+			+	+	+	+	+	+		+						
Ceratophyllum demersum L.		+		+				+	+			+				+		+	+
Carex acuta L.	+		+			+	+	+	+				+			+			+
Carex aquatilis Wahlenb.	+					+	+	+	+			+	+	+	+	+	+	+	+
Carex caespitosa L.													+						
Carex rhynchophysa C.A.Mey.			+				+	+					+						
Carex rostrata Stokes				+			+	+				+	+		+			+	
Carex vesicaria L.	+		+	+			+	+				+							
Carex sp.		+										+				+			
Eleocharis acicularis (L.) Roem. et Schult.															+			+	
Eleocharis palustris (L.) Roem. et Schult.			+			+	+		+		+	+							
Scirpus lacustris L.	+	+	+				+	+											
Equisetum arvense L.												+	+	+		+	+	+	
Equisetum fluviatile L.	+	+	+	+			+	+	+			+	+	+	+	+	+	+	+
Equisetum palustre L.			+				+	+					+			+			
Equisetum sp.						+													
Myriophyllum spicatum L.				+		+		+		+	+		+	+	+		+	+	+
Myriophyllum verticillatum L.				+	+		+	+						+		+	+		+
Hippuris vulgaris L.		+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Hydrocharis morsus-ranae L.			+		+			+											
Juncus filiformis L.	+								+				+						
Triglochin palustre L.													+						
Mentha arvensis L.									+				+						
Lemna minor L.				+				+	+		+	+	+						
Lemna trisulca L.				+				+		+	+		+	+	+	+	+	+	+
Utricularia intermedia Hayne								+											
Utricularia vulgaris L.		+		+				+	+			+	+						
Menyanthes trifoliata L.				+		+		+	+		+	+	+						
Nuphar lutea (L.) Smith		+	+	+		+	+		+			+							
Nuphar pumila (Timm) DC			+	+		+	+		+			+							
Nymphaea candida Presl				+			+												
Nymphaea tetragona Georgi			+	+			+		+			+							
Arctophila fulva (Trin.) Anderss.						+			+	+	+		+	+	+	+	+	+	+
Agrostis stolonifera L.			+			+	+		+				+						
Alopecurus aequalis Sobol.									+				+						
Phalaroides arundinacea (L.) Rausch.	+								+				+						
Phragmites australis (Cav.) Trin. ex Steud.				+				+											
Persicaria amphibia (L.) S.F.Gray	+		+	+		+	+		+		+	+	+					+	
Rumex aquaticus L.													+		+				
Potamogeton alpinus Balb.	+			+		+		+	+	+	+		+	+	+		+	+	
Potamogeton berchtoldii Fieb.			+	+		+	+	+	+	+	+		+	+	+		+	+	+
Potamogeton friesii Rupr.									+		+		+				+		
Potamogeton gramineus L.			+			+	+	+	+		+		+	+	+		+	+	
Potamogeton lucens L.		+	+	+	+		+	+	+			+				+			
Potamogeton obtusifolius Mert & Koch																			
Potamogeton natans L.				+			+	+	+										
Potamogeton pectinatus L.				+	+			+	+	+	+		+	+	+		+	+	
Potamogeton perfoliatus L.		+	+	+			+	+	+	+	+	+	+			+		+	+
Potamogeton praelongus Wulf.									+	+	+		+		+	+		+	
Potamogeton subretusus Hagstr.																		+	+
Naumburgia thyrsiflora (L.) Reichenb.									+			+	+						
Batrachium aquatile (L.) Dumort.	+																		
Batrachium circinatum (Sibth.) Spach.																		+	
Batrachium eradicatum (Laest.) Fries							+				+		+			+			+
Batrachium trichophyllum (Chaix) Bosch.				+		+	+	+	+	+	+		+	+	+	+		+	+
Caltha palustris L.	+		+	+			+	+	+		+		+	+	+	+	+	+	+
Ranunculus flammula L.									+										
Ranunculus hyperboreus Rottb.										+	+		+		+				
Ranunculus pallasii Schlecht.											+		+						
Ranunculus reptans L.	+					+		+					+		+	+		+	+
Ranunculus lapponicus L.													+					+	
Ranunculus gmelinii L.						+			+	+	+		+	+	+		+	+	
Ranunculus repens L.						+			+				+						
Comarum palustre L.			+	+		+	+	+	+			+	+			+			+
Sparganium angustifolium Michx.				+		+	+				+								
Sparganium emersum Rehm.	+	+	+	+		+	+	+	+				+						
Sparganium hyperboreum Laest.			+				+		+	+	+	+	+		+			+	
Sparganium minimum Wallr.	+		+	+		+	+	+	+	+	+	+	+						
Fontinalis sp.		+										+			+	+			
Nittela sp.		+													+	+			

Potamogeton, five species of the genus *Carex*, five species of the genus *Sparganium*, four species of the family Nymphaeaceae etc. Changing edaphic conditions were the main reason for a considerable increase in the diversity of water plants in the given sector of the river, according to the opinion of O.S. Zvereva (1969; 1971). The author (Zvereva, 1969; 1971) marked that the stable bottom and compact ground were favourable for the composition of water plants communities of this site. As it was observed in the upper Pechora, the highest species diversity (up to 28 species) was discovered in oxbow lakes. Some species, e.g. *Nymphaea candida* Presl., *N. tetragona* Georgi, *Myriophyllum spicatum* L., *Sagittaria natans* Pall., *Potamogeton natans* L., *P. alpinus*, *Sparganium angustifolium* Michx., *Phragmites australis* (Cav.) Trin. ex Steud. were recorded exclusively in lakes.

Community of *Scirpus lacustris*.

The almost complete absence of higher water plants in the riverbed is a specific feature of the composition and distribution of water plants in the lower Pechora (Zvereva, 1969) (Table 7.1). The major part of aquatic plants (from a total of 34 discovered in this sector by O.S. Zvereva (1969) was found in oxbow lakes. Only in rare cases *Myriophyllum verticillatum* L., *Hydrocharis morsus-ranae* L., *Potamogeton perfoliatus* and *P. pectinatus* L. were registered in sites with very low water. In isolated floodplain lakes, which have no connection with the riverbed, Zverera (1969) noted 16 species. The vegetation was dominated by *Equisetum fluviatile*, species of the genus *Carex*, *Sparganium angustifolium*, as well as by *Potamogeton alpinus* and *P. gramineus* L. Also registered were *Hippuris vulgaris* and amphibionts – *Rorippa amphibia* (L.) Bess. and *Persicaria amphibia*. Often, as is noted by O.S. Zvereva (1969), monodominant communities formed by *Potamogeton alpinus*, *P. pectinatus*, *P. perfoliatus*, *Myriophyllum spicatum* and *Hippuris vulgaris* developed in such lakes.

Tributaries and water bodies of their floodplains

Average density of the river net of the Pechora basin is 0.48 km/km^2 (Atlas of the Komi Republic, 1997). The main arms of the Pechora are the Usa, the Izhma, the Tsilma, the Pizhma, the Ilych and the Shugor. Hydro botanic studies were performed in the Usa basin (Popova, Solovkina, 1957; Khantimer, 1964; Vekhov, 1991b), in the Timan rivers (the Pechorskaya Pizhma and the Soiva) (Getsen, 1968) and in the lower Pechora (Vekhov & Kuliev, 1986), obtaining data on macrophytes.

In 1955, during the hydrobiological works of E.I. Popova and L.N. Solovkina (1957), six lakes of the Usa valley (middle part) were examined (Table 7.1). The list of discovered macrophytes included 23 species. The authors show the dependence of macrophyte species diversity upon position of the lake in the relief, feeding source, degree of running water, and physical and chemical properties of water and soil.

The studies of I.S. Khantimer (1964) on macrophytes of the Usa and some of its tributaries confirmed the previous data on the poor species diversity of water bodies of the lower Pechora. Poor diversity, according to Khantimer (1964), is explained by the same climatic reasons already noted by Sambuk (1930), Zvereva (1969) and others. Khantimer (1964) adduced the information that some macrophytes have reached the northern frontier of their distribution in the area under study. The list of macrophytes numbered 49 species. 17 of them are proper aquatic plants, 25

Nuphar lutea.

* 1 – Sambuk, 1930; 2 – Zvereva, 1969 (Upper Pechora, river bed); 3 – Zvereva, 1969 (Middle Pechora, river bed); 4 – Zvereva, 1969 (Middle Pechora, floodplain water bodies); 5 – Zvereva, 1969 (Lower Pechora, river bed); 6 – Zvereva, 1969 (Lower Pechora, floodplain water bodies); 7 – Zvereva, 1971 (Middle Pechora, river); 8 – Zvereva, 1971 (Middle Pechora floodplain water bodies); 9 – Khantimer, 1964 (Usa river); 10 – Vekhov, 1991c (Elets river); 11 – Vekhov, 1991a, 1991b (Vorkuta and its vicinities); 12 – Popova, Solovkina, 1957 (Lakes of the Usa river valley); 13 – Vekhov, Kuliev, 1986 (Lower Pechora); 14 – Getsen, 1964 (Vashutkiny lakes); 15 – Katanskaya, 1970 (Padimey lakes); 16 – Kochanova, 1976 (Kharbey lakes); 17 – Getsen, 1978 (Vashutkiny lakes); 18 – Getsen, 1978 (Padimey lakes); 19 – Getsen, 1978 (Kharbey lakes).

plants of humid habitats and 7 species of bog-water habitats. The composition of water plants was more diverse in floodplain water bodies still connected to the river. The riverbed was most poor in macrophytes. It is noted that lake ecotopes are adaptations of plants penetrating northwards, albeit on the whole tundra lakes are poorer than taiga lakes. Khantimer (1964) reported on the distribution of *Cicuta virosa L.* in sedge overgrowth of the area upstream, a species that is found nowhere else. Plant communities of the Usa water bodies are dominated by *Carex aquatilis, C. acuta, Petasites radiatus, Equisetum fluviatile, Arctophila fulva* (Trin.) Anderss., *Potamogeton perfoliatus, P. gramineus, Ceratophyllum demersum* etc.

In different water bodies of the river Elets (tributary of the Usa) 16 species of macrophytes were registered (Vekhov, 1991c); most of them are plurizonal and boreal species (Table 7.1). N.V. Vekhov (1991c) has analysed their species composition, distribution in biotopes, features of growing and degree of abundance in floodplain oxbow lakes, riverbed, water bodies of the basin and main arms. It is shown that the sub-alpine area of the basin has the highest diversity of macrophyte flora (16 species). Communities of this part of the basin abound with *Potamogeton pectinatus, P. alpinus, P. perfoliatus, Sparganium hyperboreum Laest., Myriophyllum spicatum* and *Lemna trisulca L.* Only eight species are registered in the alpine part. Most widespread are *Arctophila fulva* and *Lemna trisulca*. There are almost no macrophytes in the proper riverbed. For the distribution of the most common species altitude borders were noted: *Arctophila fulva* and *Lemna trisulca* – 300 to 400 m above sea level, *Sparganium hyperboreum* and *Hippuris vulgaris* – 250 to 300 m above sea level.

The results of the research on macrophytes of the Timan tributaries of the Pechora show (Getsen, 1968), that the Pechorskaya Pizhma had the highest diversity of macrophytes. Here (and in its floodplain lakes) 29 macrophyte species were found. In the river Soiva (the secondary tributary of the Pechora, the middle Pechora basin) 17 species were discovered. Twelve taxa were common for both rivers. Unfortunately the author does not give the whole list of macrophytes of these rivers. M.V. Getsen (1968) marks that overgrowth of the river banks often consisted of *Petasites radiatus, Equisetum sp., Carex sp.* and *Caltha palustris*, with a very rare admixture (exclusively in the Pechorskaya Pizhma) of *Phragmites australis*. Thick overgrowth of submerged plants (*Potamogeton gramineus, Sparganium sp., Batrachium trichophyllum*, with admixture of *Butomus umbellatus* and *Potamogeton natans*) was typical for lake-shaped extensions and for inlets with slow current. On certain sandbanks of the Soiva, only *Potamogeton gramineus* and *Batrachium trichophyllum* developed abundantly. *Potamogeton alpinus, P. lucens, Callitriche palustris L., Myriophyllum spicatum and Scirpus lacustris* (forming small but thick brakes) could be found exclusively in the Pechorskaya Pizhma. *Utricularia vulgaris L., Nuphar lutea*, and *Lemna minor L.* were found in both rivers. *Lemna trisulca L., Potamogeton friesii Rupr., P. perfoliatus, Sparganium emersum, Ceratophyllum demersum* was noted only in the Pechorskaya Pizhma and *Nymphaea tetragona* only in the Soiva.

N.V. Vekhov and A.N. Kuliev (1986) examined specific features of the macrophyte distribution in different water bodies of the lower Pechora (the northern Timan, the western Bolshezemelskaya Tundra) (Table 7.1). 64 species of macrophytes were discovered. The poorest species composition was displayed by the thermokarst lakes on peat lands and palsa bogs (six species). The most diverse flora of macrophytes and submersed water plants was found in the floodplain water bodies (57 species). Analysing the data, the authors (Vekhov & Kuliev, 1986) discuss the degree of non-native character of the regional flora.

Tundra lakes

The Pechora basin lays in two natural climatic belts, the taiga and tundra zones. The tundra sector of the river contains a number of lake systems. Geobotanical study was performed on the Vashutkiny (Getsen, 1964; Zvereva *et al.*, 1964), the Padimey (Katanskaya, 1970) and Kharbey (Kochanova, 1976) lakes. The information on macrophytes of these lake systems is summarised in the chapter "Hygro- and hydrophytes" of the monograph "Flora and fauna of water bodies of the European North" compiled by M.V. Getsen and E.I. Popova (1978).

The species composition of the studied lakes has many features in common. The vegetation cover of the lakes consists of a number of water and land-water plants: from 18 in the Vashutkiny lakes (Getsen, 1964) to 30 in the Padimey lakes (Katanskaya, 1970) (Table 7.1). This number of plants species varies considerably between different lakes. E.g., according to E.I. Kochanova (1976), in the lake Peljazhje of the Kharbey system, three macrophyte species were registered, while in the lake Bolshoi Kharbey of the same system 21 species were noted.

Plants submerged in water (*Batrachium trichophyllum, Potamogeton pectinatus, P. perfoliatus, Myriophyllum spicatum, M. verticillatum* etc.) are a prevailing ecological-biological group. Besides the above-mentioned plants, green mosses (*Fontinalis sp., Calliergon sp., Drepanocladus sp.*) and Chara algae or Stoneworts (*Nittela sp.)* can be found in almost all the lakes. Amphibious plants are represented by such species as *Arctophila fulva, Carex aquatilis, Petasites radiatus, Equisetum fluviatile, Caltha palustris* etc.

Twelve plant species are considered key species of the communities in the lakes of the systems under study, i.e. *Arctophila fulva, Carex aquatilis, C. acuta, Ceratophyllum demersum, Equisetum fluviatile, Potamogeton praelongus* Wulf., *P. pectinatus, P. perfoliatus, Myriophyllum spicatum*, mosses and Chara algae.

In large tundra lakes macrophytes do not form large overgrowth bands along the banks. Vegetation is limited by strong winds and waves. Only *Petasites radiatus* prefers sites beaten by waves. As a rule, plant overgrowth in tundra lakes forms exclusively on the leeward side and in bays protected by high banks. Overgrowth is characterized by a homogeneous composition dominated by one or two species. Nevertheless, zonal distribution of macrophytes of tundra lakes can be distinctly traced. Littoral parts of minor lakes overgrow completely.

As a result of their phenological observations of water plants O.S. Zvereva and co-authors (1966), V.M. Katanskaya (1970) and E.I. Kochanova (1976) were able to discern the following seasons in the development of aquatic vascular plants of the tundra zone.

- Biological spring: middle – end July, characterized by an budding vegetation of *Arctophila fulva, Carex aquatilis, Equisetum fluviatile*;
- Biological summer: August, characterized by passing generative phases of macrophytes, and by maximal phytomass;
- Biological autumn: end August–September, characterized by mass withering and dying of plants.

Flora

The data concerning the floristic composition of macrophytes in water bodies of the Pechora basin are summarized in reviews (Arctic Flora ..., 1960-1987; Flora of the north-eastern European part ..., 1974-77; Rebristaya, 1977; Flora of the European part ..., 1974-1996; Zheleznova, 1994; Lisitsina & Papchenko, 2000).

The list of vascular plants in the water bodies of the Pechora basin, based on the data of the cited reviews, includes 81 species (Appendix 7). Nowadays these data need revision because of new information on the regional flora (Vekhov & Kuliev, 1986; Vekhov, Kuliev & Morozov, 1986; Vekhov, 1991a, 1991b; Lavrenko *et al.*, 1995; etc.) and new herbarium collections. Recently, the list of water mosses contains 21 species (Zheleznova, 1994).

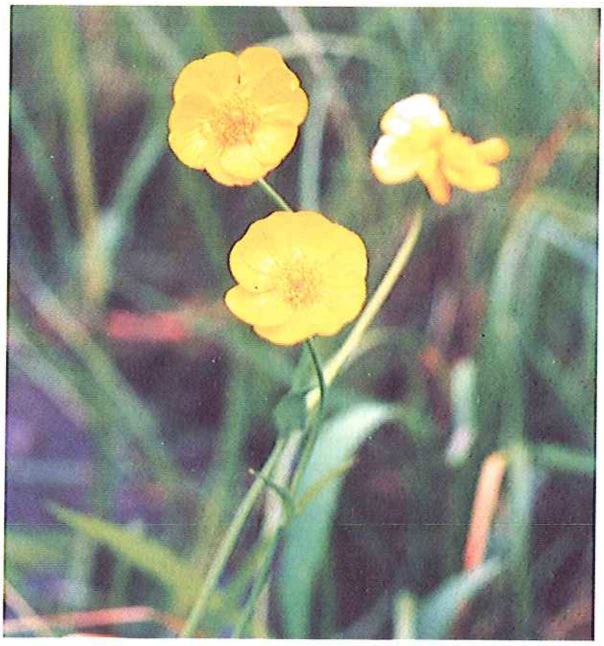
Study of productivity

In tundra lakes (Padimey lakes – Katanskaya, 1970 and Kharbeyskie lakes – Kochanova,1976) the productivity of certain communities has been studied. All plant material from 1 m^2 was cut and dried and dry weight was measured (Table 7.2).

Table 7.2 Productivity of some macrophytes in different tundra lakes

Species	Padimey lakes (Katanskaya, 1970) airdry weight, g	Kharbeyskie lakes (Kochanova, 1976) wet weight, g
Equisetum fluviatile	420	31-170
Arctophila fulva	225-780	till 3800
Carex aquatilis	340	52-140
Potamogeton perfoliatus	40	11-460

Nymphaea candida.



Ranunculus lingua.

Impact of man

The results of the study of macrophytes in the water bodies of the Vorkuta industrial complex, adjudged three groups of macrophytes with different reactions to anthropogenic loads. The three groups displayed a different degree of tolerance to human impact (Vekhov, 1991a; Getsen *et al.*, 1992): (1) species enduring no anthropogenic load – *Hippuris vulgaris* and *Ranunculus pallasii*; (2) species of the natural flora that increase their abundance in human habitats – *Potamogeton alpinus, P. berchtoldii* Fieb., *P. pectinatus, Sparganium hyperboreum, Batrachium eradicatum* (Laest.) Fries, *B. trichophyllum, Menyanthes trifoliata* L., *Lemna trisulca, Myriophyllum spicatum, Potamogeton gramineus, Eleocharis palustris* (L.) Roem. et Schult., *Sparganium minimum*; (3) adventitious species widely settling in anthropogenic habitats – *Lemna minor.*

A number of species display a specific response to different forms of anthropogenic impact (increasing biomass, inhabiting non-typical habitats, degradation of overgrowth etc.). Analysing the flora of macrophytes of artificial water bodies in the Vorkuta town vicinities, N.V. Vekhov shows (1991b) that the macrophyte flora of man-made water reservoirs consists of plurizonal and boreal species, which usually surrender to dominant species in natural habitats. These species are the first plants to inhabit new artificial water bodies. Succession of dominating species is typical for artificial habitats of the urban landscapes of Vorkuta.

Rare and endangered plants

Eight species among the Pechora macrophytes are entered in the Red Data Book of the Komi Republic (Red Data Book, 1998). These are *Eleocharis quinqueflora* (Hartm.) O. Schwarz., *Nymphaea candida, Nymphaea tetragona, Ranunculus lingua* L., *Ranunculus pallasii* Schlecht., *Ranunculus hyperboreus* Rottb., *Ranunculus pygmaeus* Wahlenb. and *Veronica anagallis-aquatica* L.

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8. AQUATIC INVERTEBRATES

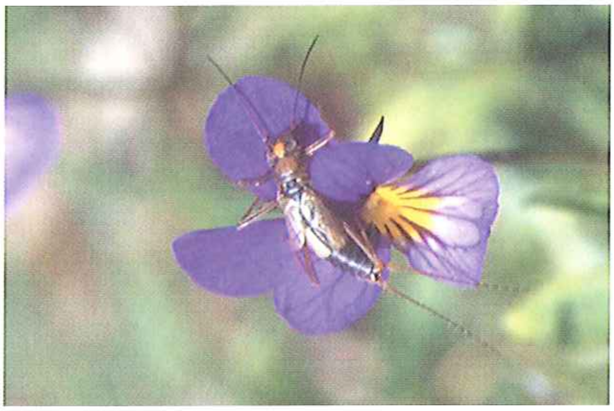
The first descriptions of the fauna of aquatic invertebrates of the Pechora basin are found in the reports of A.V. Zhuravsky (1904, 1909 etc.) and V.M. Rylov (1971, 1918). The beginning of hydro biological studies in the region is connected with the name of S.A. Zernov, who took part in the Northern scientific-commercial expedition in 1919-20, led by V.K. Soldatov. Later on, the results of the analysis of plankton and benthos samplings of this expedition were partly used in the course "General Hydrobiology" (Zernov, 1934) and in a number of publications on Crustacea (Derzhavin, 1923; Decksbach, 1926), and molluscs (Zhadin, 1933). A large contribution to the study of the biology of waters of the Pechora basin was also made by the specialists of the Moscow State University who collected data on plankton, benthos and fish feeding of the upper stream of the Pechora and Ilych rivers in1941 and 1944 and summarized these in the work "Fish of the upper Pechora" (Nikol'sky *et al.*, 1947; Chernova, 1947). The knowledge on fish feeding was increased still further by data collected during several years for the upper Pechora by the specialists of the Pechoro-Iluchsky Zapovednik (Teplov, 1951; Vladimirskaya, 1953).

Belaya Kedva river is a typical water course of the Timan range.

Systematic hydro biological and faunistic studies of the water bodies of the Pechora basin have started since the foundation of the Research Base AS USSR in Syktyvkar (later reorganized into the Komi Branch of AS USSR, renamed to Komi Science Centre UrD RAS in 1988). During 1942-48 and 1952-53 hydrobiological research was conducted in the middle and upper stream of the Pechora, over a stretch of 700 km from the village of Kozhva to the village of Ermitsa, and in the lower stream of the river Usa over 300 km from the mouth. This research resulted in summary reports (Zvereva, Ostroumov, 1953; Zvereva *et al.*, 1953; Zvereva, 1956) and other articles on the fauna of these rivers (Zvereva, 1953a, b; Lastochkin, 1953; Likharev, 1953; Lepneva, 1953; Okhotina, 1953; Rubtsov, 1953; Chernova, 1953). Additional studies of fish feeding resources in the basins of the upper and middle stream of the Pechora and Usa were conducted in 1955-58. Besides running waters of the region, floodplain water bodies were studied, and lists of hydro fauna were complemented (Borutsky, 1962; Bratsev *et al.*, 1962; Zabolotsky, 1959; Zakharenko, 1962; Zvereva, 1962a, b; Kir'yanova, 1962; Kuchina, 1962; Lukin, 1962; Popova, 1962a, b; Popova & Solovkina, 1957; Rubtsov, 1962; Solovkina, 1962, 1963; Finogenova, 1962). The results of the first extensive period of studies of aquatic invertebrates of the Pechora are summarized by O.S. Zvereva in her monograph "Peculiarities of the biology of the main rivers of Komi ASSR" (1969). The work is full of factual material: the lists of the aquatic fauna of the Pechora basin consisted of 592 species and forms by that time. O.S. Zvereva revealed the main features of the biology of the Pechora, verified the hypothesis about the heterogeneity of the fauna of this river and singled out four hydrobiological areas having gradually changing characteristics of population composition and differences in biological productivity.

In the 1960-70s the Komi branch of AS USSR carried out hydro biological studies on large lake-river systems of the Bolshzemelskaya Tundra, belonging to the Pechora basin, in the framework of the International Biological Program. These studies revealed the comprehensive species composition of the aquatic fauna, the autochthonous character of the production processes and the rich feeding supplies for fish (Baranovskaya, 1976; Hydro biological studies on fishery development of lakes of the far North, 1966; Popova, 1976a, b; Sidorov, 1974; Flora and fauna of water bodies of the European North, 1978). In these years, in connection with the planned transfer of part of the water discharge of the northern rivers into the Volga basin, profound studies of the hydro biology of the Pechora basin were conducted (Akatova, 1971; Baranovskaya, 1971, 1983; Bratsev *et al.*, 1962; Varushkina, 1967; Vlasova *et al.*, 1964; Zvereva, 1971;

Water courses of the Pechora river are populated by rich and diverse fauna of invertebrates. The photo shows mass first flight of amphibiotic insects.



Stone flies are amphibiotic insects. Adults are frequently met on riverside vegetation. The photo shows a short-winged male Perlodes dispar Ramb.

Kazlauskas & Shubina, 1983; Kovalenko, 1983; Kornilova, 1967, 1970; Kornilova & Letoval'tsevo, 1964; Leshko, 1983, 1991; Popchenko, 1971; Rubtsov, 1971; Solovkina & Sidorov, 1971; Solovkina & Tsember, 1971; Tutunnik, 1983; Tsember, 1983; Chuksina, 1970; Shubina, 1971). The results of these studies showed that transfer of the Pechora water discharge would cause negative changes in the hydro biological regime of the Pechora riverbed and pre-mouth parts of its Timan and Ural tributaries.

Present-day research on the Pechora and its numerous tributaries is carried out in several directions. One of them is connected with the complex studies of the river life period of the Pechora Salmon. From the 1970s till the present time the Komi branch of AS USSR has been conducting hydro biological and faunistic studies in the river basins of mountain rivers of the Urals and Timan, which are included into the system of salmon watercourses of the Pechora basin (Zhitsova & Loskutova, 1986a, b; Leshko *et al.*, 1996; Loskutova, 1983; Medvedev & Shepeleva, 1983; Novikova, 1984; Ostroushko & Bel'tukova, 1983; Ponomarev *et al.*, 1998a, b, 1998, 2000; Sidorov, 1979; Sidorov & Shubina, 1974, 1981, 1990; Fefilova, 2000; Shubina, 1979a, b, 1983, 1997; Shubina & Loskutova, 1994a; Shubina & Martynov, 1977, 1990; Shubina & Orlov, 1991; Shubina, Shubin, 2000). A number of them is not yet subject to anthropogenic impact and that is why the main parameters of their river ecosystems give an idea of the natural structure of biocenosis of mountain rivers. From 1976 till 1991, for the first time stationary seasonal observations on benthos in the river Shchugor were conducted. The results of the hydro biological studies of the river are summarized in the monograph of V.N. Shubina (1986). Basic regularities of benthos formation in mountain rivers are singled out, the diversity of the aquatic fauna of the Shchugor basin is described (528 species of invertebrates are registered, from which 200 species have not yet been recorded for the Pechora basin) and the ecological and zoogeographical peculiarities of the Shchugor are shown. From this work resulted important practical conclusions about the stability of the feeding resources for fish in salmon rivers of the North Urals have been made. These feeding resources appeared to be no reason for the reduction in the number of Salmon *Salmo salar* L., which is observed in the Pechora basin now.

During the last years the Komi Science Centre UrD RAS, in parallel with hydro biological monitoring in watercourses of the Pechora, has begun to carry out regular fauna sampling in lakes of the northern and sub polar Urals (Ponomarev *et al.,* 1995; Ponomarev & Loskutova, 1997, 1999), as well as in lakes in the Pechora delta (Leshko, 2000; Sadyrin, 2000) and has continued the work in the lakes of the Bolshezemelskaya Tundra (Sadyrin, 1998; Sidorov *et al.*, 1999). A number of summarizing works on aquatic invertebrates of the Pechora basin has been published: on molluscs (Leshko, 1998), water beetles (Rogovtsova, 1998), stone flies (Zhiltsova & Loskutova, 1999) and Ephemeroptera (Sadyrin, 1999).

In the Pechora basin water courses and lakes have become polluted in connection with the development of raw materials resources of the Urals and Timan, the intensive development of the oil, gas and mining branches of industry and the growth of populated localities. This pollution has a negative influence on the invertebrate fauna of the water bodies of the Pechora. The ever growing anthropogenic influence in areas of waste discharge has lead to degradation and structural reorganisations of the initial biocenosis of the water layer and bottom, impoverishment of the aquatic fauna and reduction of the general production potential of the fauna (Baranovskaya & Fefilova, 1995; Vekhov, 1982; Kuz'mina, 1995; Leshko & Gurovich, 1993, 1994; Loskutova, 1995, 1999; Ponomarev & Cherizova, 1995; Ponomarev & Shubina, 1998; Fefilova & Shubin, 1999; Shubina, 1995a, b, 1996, 1997; Shubina & Estaf'ev, 1998; Shubina & Loskutova, 1994a). The future studies of aquatic invertebrates of the Pechora basin are aimed at a further inventory and at finding a solution for the ecological problems of the region. Especially the Ural and Timan mountain rivers demand a great deal of attention, because of their extreme importance for fishery, their rich water life and the fact that they are the main sources of pure water for the river Pechora. In order to carry out projects of development of the natural resources in the Pechora basin, a strict regime of protection of all parts of the complex river system is necessary, taking into account regional peculiarities of discharge, hydrography and biology of water bodies.

Composition and distribution of invertebrates in water bodies of the Pechora basin

Because of the high speeds of the current of the upper streams of the Pechora and its mountain tributaries of the Urals and Timan, riverbed zooplankton is developed very poorly. It is presented mainly by benthic forms

(Baranovskaya, 1971, 1995; Zaboltsky, 1959; Kornilova, 1967; Nikol'sky *et al.*, 1947; Tutunnik, 1983; Fefilova, 2000; Shubina, 1986). Zooplankton communities of these rivers consist of species of Rotatoria, Cladocera, and Copepoda, adapted to conditions of mountain streams. In the centre of rivers zooplankton number does not exceed 1000 individuals per m³, while biomass is about 3.0 mg/m³. It consists of no more than 10 components (*Lecane luna* (Mull.), *Euchlanis, Trichotria, Bosmina longirostris* (O.F.M.), *Nauplii, Harpacticoida* etc.) with domination of benthic Rotatoria (Fig. 8.1).

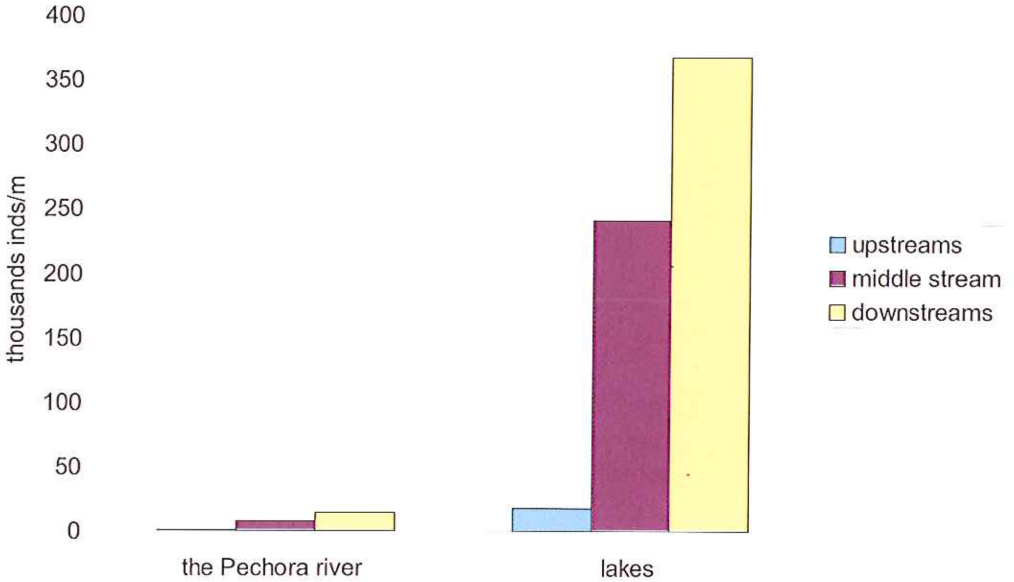


Figure 8.1 Dynamics of zooplankton numbers in the water bodies of the Pechora basin (Zvevera, 1969).

In riverbeds of the Pechora and its tributaries zooplankton develops in the territory of the Pechora plain in deep-water river sites with a slow current and relatively well-developed higher aquatic vegetation (Baranovskaya, 1971; Zvereva, 1969; Deksbach, 1923). Along the shores and associated with macrophytes, zooplankton number in the middle course of the Pechora reaches 33.2 thousand individuals per m³ with a biomass of 91.0 mg/m³.

These parameters are much higher in channels of the Pechora: 290.8 thousand individuals per m³ and 621.2 mg/m³, respectively. In channels of the middle Pechora zooplankton number is maximal 154.4 thousand individuals per m³ and biomass 3.3 g/m³ (Baranovskaya, 1971). In water bodies of the middle Pechora 93 species and forms of zooplankton are determined. In ancient lakes sites of the Pechora the greatest species diversity and quantitative development is found, in combination with a well-developed floodplain. In the riverbed of the lower stream of the Pechora plankton life is poor (2-24 thousand ind/m³) because of sedimentation processes and represented mainly by transitional species originating from the channels. In isolated lakes of the floodplain of this region the zooplankton composition is poorer than that in the riverbed; its number is insignificant (1-8 thousand ind/m³). During spring floods, in other pre-riverbed water bodies that are connected with each high concentrations of zooplankton organisms are observed, mainly of Cladocera (*Bosmina sp.*): its number can reach 7 million individuals in one m³ (Zvereva, 1969). High numbers of plankton invertebrates (in average 45 thousand ind/m³, maximum 1500 thousand ind/m³, from which 99% is Rotatoria) are registered in the riverbed of the Usa, a large tributary of the middle stream of the Pechora, along the shores and associated with macrophytes. Zooplankton is richly developed in lakes of the valley of the Usa: the number of individuals in one m³ of water varies between 46.5 and 1090.5 thousand (Popova & Solovkina, 1957).

In channels of the Pechora delta an enormous development of zooplankton with a strong prevalence of young Cladocera *Sida crystallina* (O.F.M.) and *Eurycercus lamellatus* O.F.M. is found in the regrowth zone, due to the slow or completely calm current. Rotatoria plankton here contributes less than 0.1% to the total biomass. In summer time channels of the Pechora delta show a high zooplankton production, offering rich food resources to young fish, due to the domination of Copepoda and Cladocera. The highest values of biomass and numbers of zooplankton in the channels of the Pechora are 12.7 g/m³ and 24.5 thousand ind/m³ (Chuksina, 1970). In lakes of the Pechora delta the zooplankton number is more than 85.26 thousand ind/m³ because of mass development of Rotatoria of the genus *Keratella*, but biomass is lower, being 0.93 g/m³ (Sadyrin, 2000).

The greatest diversity of fauna of plankton invertebrates (100 species and forms of *Rotatoria* and 109 species of *Cladocera* and *Copepoda*) is revealed in lakes of the Bolshezemelskaya Tundra. In the pelagic plankton of these lakes Rotatoria dominate in number (60-95%) and Crustacea (about 60%) in biomass. In the coastal line Rotatoria dominate in density as well as in biomass. The littoral zone of higher aquatic plants is distinguished by a high quantitative development of zooplankton. Parameters of zooplankton productivity of the lakes Vashutkiny and Kharbeyskie are high for water bodies of the Far North: numbers reach 184 thousand ind/m^3, maximum 920 thousand ind/m^3, biomass 0.38 g/m^3, maximum 10.8 g/m^3 (Baranovskaya, 1976; Hydrobiological studies and fishery development of lakes of the Far North, 1966). In the Pechora basin as a whole more than 300 species and forms of invertebrates are registered, among which the share of Rotatoria is more than 50%, that of Cladocera 25% and of Copepoda 25%.

The benthos of water bodies of the Pechora basin reveals representatives of 34 groups of invertebrates: *Porifera, Hydrozoa, Turbellaria, Nematoda, Nematomorpha, Oligochaeta, Hirudinea, Mollusca, Bryozoa, Phyllopoda, Cladocera, Ostracoda, Harpacticoida*, other *Copepoda, Mysidacea, Amphipoda, Hydracarina, Araneina, Tardigrada, Collembola, Odonata, Ephemeroptera, Plecoptera, Hemiptera, Coleoptera, Megaloptera, Neuroptera, Trichoptera, Lepidoptera, Simuliidae, Ceratopogonidae, Culicidae, Chironomidae, Diptera n/det.* (Hydrobiological studies and fishery development of lakes of the Far North, 1966; Zvereva, 1953a, 1956, 1969, 1971; Zvereva & Ostroumov, 1953; Zvereva *et al.*, 1953; Kornilova, 1967; Kornilova & Letoval'tseva, 1964; Kuchina, 1962; Leshko, 1991; Leshko *et al.*, 1993, 1994, 1996; Popova, 1962a, 1976a; Solovkina, 1963; Flora and fauna of water bodies of the European North, 1978; Shubina, 1971, 1986, 1995a,b; Shubina & Shubin, 2000) (Table 8.1). In lakes only *Nematomorpha* and *Mysidacea* are registered. In running waters *Turbellaria, Phyllopoda, Neuroptera, Lepidoptera, Culicidae* were found, though *Turbellaria* and *Phyllopoda* are indicated as occurring in bays and oxbows of rivers (Zvereva, 1969). Among watercourses the smallest number of groups of invertebrates – 13 groups – is registered in benthos of the riverbed of the low stream of the Pechora, the greatest number – 27 groups – in mountain rivers of the Urals and Timan.

Table 8.1 Composition of invertebrates in water bodies of the Pechora basin

Invertebrate groups	Watercourses, riverbed			Lakes			
	Upper course	Middle course	Lower course	Ural mountain	Middle, lower course	Pechora delta	Bolshezemelskay Tundra
Porifera	-	+	-	-	+	-	-
Hydrozoa	+	+	-	+	+	+	+
Turbellaria	-	-	-	-	+	-	+
Nematoda	+	+	+	+	+	+	+
Nematomorpha	+	-	-	-	-	-	-
Oligochaeta	+	+	+	+	+	+	+
Hirudinea	+	+	-	+	+	+	+
Mollusca	+	+	+	+	+	+	+
Bryozoa	+	+	-	-	+	-	-
Phyllopoda	-	-	-	+	+	+	-
Cladocera	+	+	+	+	+	+	+
Ostracoda	+	+	-	+	+	+	+
Harpacticoida	+	+	-	+	+	+	+
Other Copepoda	+	+	+	+	+	+	+
Mysidacea	-	-	+	-	-	-	-
Amphipoda	+	-	-	+	+	+	+
Hydracarina	+	+	+	+	+	+	+
Araneina	+	+	-	-	+	-	+
Tardigrada	+	+	-	-	+	-	+
Collembola	+	+	-	+	+	-	+
Odonata	+	+	+	-	+	+	-
Ephemeroptera	+	+	+	+	+	+	+
Plecoptera	+	+	+	+	+	+	+
Hemiptera	+	+	-	-	+	-	+
Coleoptera	+	+	-	+	+	+	+
Megaloptera	+	-	-	+	+	+	+
Neuroptera	-	-	-	-	+	-	-
Trichoptera	+	+	+	+	+	+	+
Lepidoptera	-	-	-	-	+	-	-
Simuliidae	+	+	+	-	+	+	+
Culicidae	-	-	-	-	+	+	-
Ceratopogonidae	+	+	-	+	+	-	+
Chironomidae	+	+	+	+	+	+	+
Diptera n/det.	+	+	-	-	+	-	+
Total	27	25	13	21	32	21	25

The most diverse benthos population is found in plain lakes of the middle stream of the Pechora and in lakes of the Bolshezemelskaya Tundra: here 25 to 32 benthos groups are revealed (Bratsev *et al.*, 1962; Vlasova *et al.*, 1964; Zvereva, 1962a, 1969; Sidorov, 1974; Flora and fauna of water bodies of the European North, 1978; Shubina, 1971). In the benthos of lakes of the low stream of the Pechora and the delta 21 groups of invertebrates are determined (Zvereva, 1969; Varushkina, 1967; Leshko, 2000). The same number of groups is registered in (pre-)mountain lakes of the Urals (Ponomarev *et al.*, 1995; Ponomarev & Loskutova, 1997, 1999). Individual lakes do not exhibit a high benthos diversity. Less than half of the groups, revealed in lakes of the Pechora basin, are occurring regularly (Oligochaeta, molluscs, Cladocera, Copepoda, larvae of Chiromidae). Most groups make only a very small percentage in numbers.

Studies of the systematics of benthos of the Pechora basin are far from being finished yet, but already more than 1200 taxa are registered there (Akatova, 1971; Boritsky, 1962; Hydrobiological studies and fishery development of lakes of the Far North, 1966; Zhadin, 1933; Zhil'tsova & Loskutova, 1986a,b; Zakharenko, 1962; Zvereva, 1953b, 1962b, 1969; Kazlauskas & Shubina, 1983; Kir;yanova, 1962; Kovalenko, 1983; Kuzmina, 1995; Lastochkin, 1953; Lepneva, 1953; Lashko, 1983, 1998; Likharev, 1953; Loskutova, 1983, 1995; Lukin, 1962; Medverev & Shepeleva, 1983; Novikova, 1984; Ostoushko, Bel'tukova, 1983; Okhotina, 1953; Ponomarev et al., 1998, 2000; Popova, 1962b, 1976b; Popchenko, 1971; Rogovtsova, 1998; Rubtsov, 1953, 1971; Rylov, 1917, 1918; Sadyrin, 1999; Sidorov & Shubina, 1990; Solovkina & Tsember, 1971; Finogenova, 1962; Flora and Fauna of Water Bodies..., 1978; Tsember, 1983; Shubina, 1986, 1995a, b; Shubina & Loskutova, 1994a). The largest number of species (more than 250) is registered for larvae of Chironomidae; they are massively occurring on the bottom of rivers and lakes of the Pechora basin (Fig. 8.2). The second most occurring group (112 registered species) are the Trichoptera; they are widely spread in running waters of the region and are important for fish feeding. Up to 100 species belong to Oligochaeta, water mites, Ephemeroptera, water beetles and lower Crustacea. 55 species of molluscs are found in the Pechora basin and 33 species of Plecoptera. The other groups studied are represented by less than 30 species. A number of benthos groups are not determined up to species.

Specific habitat conditions in the upper streams of the Pechora and its salmon tributaries coming from the Timan and Northern and sub polar Urals, give an opportunity for primary development of lithorheophilic biocenosis, confined to stable pebble – boulder ground in rifts, thresholds, flowing parts of stretches and ditches. It characterizes the benthos of the riverbed of these rivers, and is distinguished by an abundant and varied fauna. Specific to the fauna of the Ural and Timan salmon rivers are cold loving, rheophilic species, with high requirements concerning oxygen regime and water quality. Larvae of amphibiotic insects, among which ancient divisions of Richoptera, Ephemeroptera and two-winged flies dominate, condition species diversity and quantitative composition of benthos. Average number and biomass of benthos in the upper Pechora are 25 thousand ind/m^2 and 4.7 g/m^2 respectively. In main salmon tributaries of the northern Urals they range from 9.23 to 29.2 (on the average 18.1) thousand ind/m^2 and from 2.33 to 6.93 (on the average 4.1) g/m^2; in rivers of the sub polar Urals from 7.6 to 45.8 (on the average 18.3) thousand ind/m^2 and from 3.8 to 9.3 (on the average 5.9) g/m^2 (Fig. 8.3).

In the middle stream the Pechora becomes quiet, its character is plain, but gradients of the bottom are variable, being reflected in changeable current speeds. River bottom often consists of pebbles with vegetative fouling, but sandy-gravel sediments and outcrops of parent rocks are also met. Representatives of 25 groups of invertebrates are registered in benthos of the riverbed of the middle stream of the Pechora (Fig. 8.4). The population of stable stony grounds and coastal stands of higher aquatic plants is especially diverse. Here a great number of molluscs, leeches, mites, Trichoptera larvae, dragon flies, Chironomidae and Ephemeroptera are observed. In areas of sandy sediments, where small forms of Oligocheta, Nematoda and Chironomidae larvae live, benthos is poor (biomass less than 1 g/m^2) as a result of alluvium. The numbers of benthos in

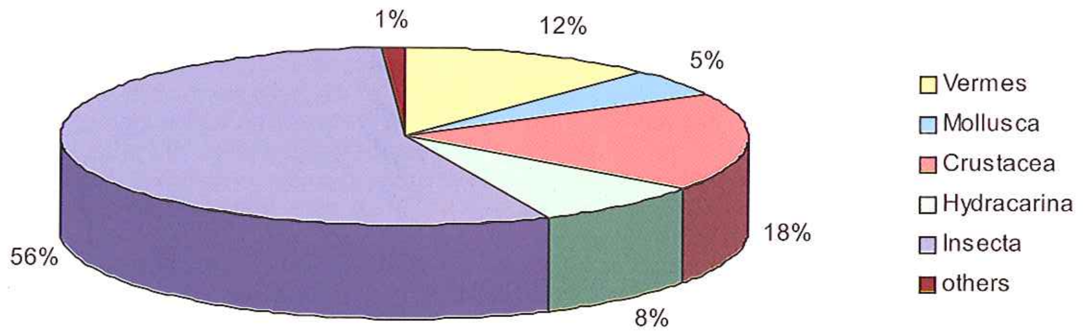


Figure 8.2 The share (%) of the main invertebrate groups in the water bodies of the Pechora basin (Zvevera, 1969).

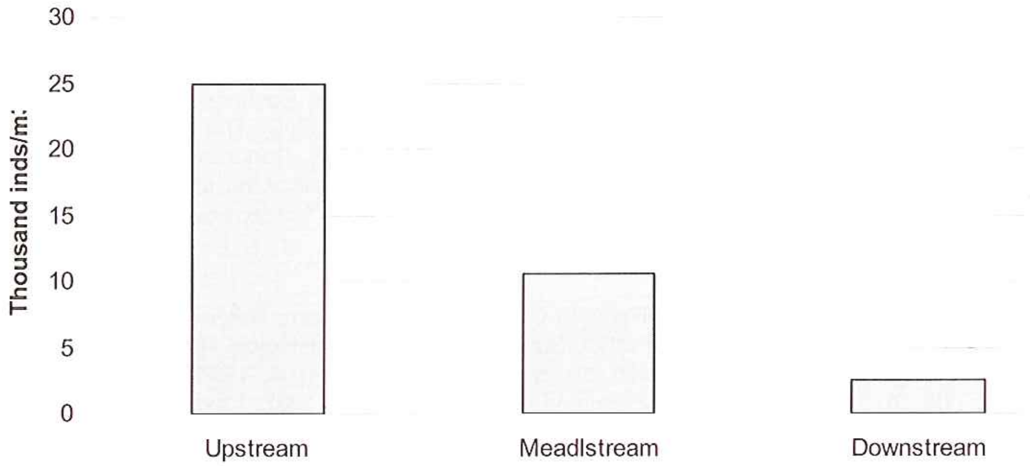


Figure 8.3 Dynamics of zoobenthos numbers in the Pechora river-bed from the headwaters till the mouth.

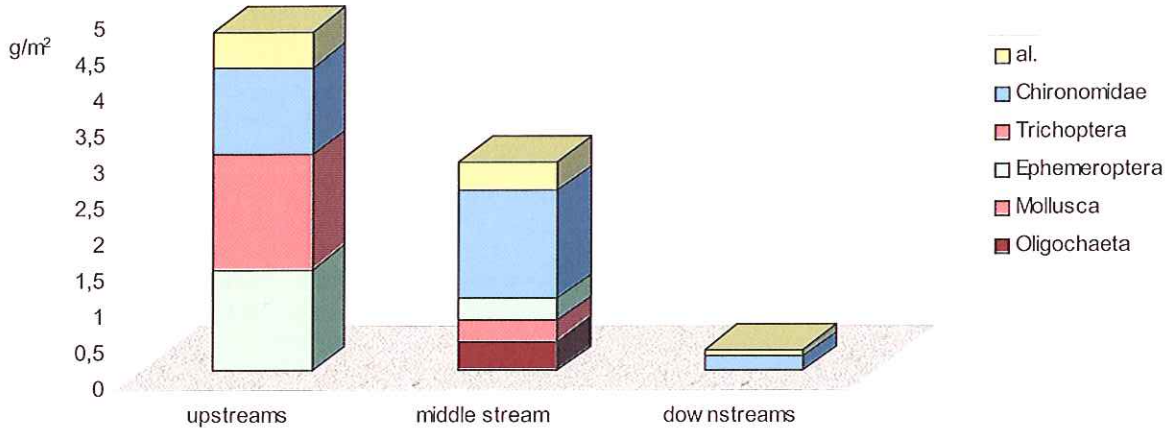


Figure 8.4 Dynamics and structure of zoobenthos biomass in the Pechora river-bed from the headwaters till the mouth.

the middle stream of the Pechora are very variable: the average number is 10.6 thousand ind/m^2, maximum 27 thousand ind/m^2, while the average biomass is 2.8 g/m^2, maximum up to 39.5 g/m^2. The rare pre-riverbed lakes of the middle Pechora are strongly eutrophic and their fauna composition is diverse – representatives of 29 groups of invertebrates are registered. Only in this area of the Pechora *Neuroptera (Sisyra)* are revealed and also *Bryozoa (Cristatella mucedo* Guvier*)* and *Hydrozoa* are met in great numbers here. Average biomass of lake benthos is 27 g/m^2, while maximal biomass is 260 g/m^2. Chironomidae larvae, molluscs and Oligochaets predominate in the benthos.

The lower Pechora was formed much later, after recession of the Wьrm glaciations (Zvereva, 1969). This fact puts an indelible stamp on the hydrographic situation of its valley. In its low stream the Pechora does not represent a united flow. Due to its well-developed floodplain and the alluviums of the sandy riverbed, it forms a complex network of oxbows, channels and numerous floodplain water bodies. A lingering fall of spring waters, sharp fluctuations of the water level, a sandy mobile riverbed and a severe climate influence the development of organic life of the low Pechora. Benthos of the riverbed in the low stream of the Pechora consists of 13 groups of invertebrates with a considerable predominance of small forms of psammorheophilic larvae of Chironomidae, Oligochaeta and Nematoda. Thus biomass of benthos is low (0.02-0.5 g/m^2) and numbers are small (0.1-5.0 thousand ind/m^2). The species poverty of benthos of the main riverbed of the low Pechora and the relative benthos richness of channels and oxbows of the river determine where high-caloric feeding resources of fish, and hence young fish, are concentrated. Benthos of isolated lakes of the floodplain is not rich. Only in pre-riverbed lakes, directly connected with the Pechora, biomass of benthos increases due to molluscs, larvae of Chironomidae and Oligochaeta, and reaches 40-50 g/m^2. In low streams of the Pechora researchers of SevPINRO carry out regular observations on feeding resources of partly migratory Whitefish. As basic food components for young Whitefish in the Pechora delta V.P. Kornilova (1970) names zooplankton and larvae of Chironomidae. Molluscs, larvae of Trichoptera and other invertebrates are of great importance to the subsequent age groups. Kornilova's main conclusion is that feeding conditions for Whitefish of all age groups in the Pechora delta are rather favourable and do not limit numbers.

In the benthos of lakes of the Bolshezemelskaya Tundra, situated in the region of the ancient territory of the European North, 25 groups of invertebrates are determined, among which more than 400 species are registered. Chironomidae, Oligochaeta, lower Crustacea and molluscs provide the bulk of benthos biomass and numbers. The most diverse is the benthos of stony and silted sandy grounds of the littoral zone. With the increase of depth one observes a regular decrease in benthos density and biomass. Average number of benthos in some lakes of the studied systems varies from 0.4 to 97.0 thousand, maximum 203.0 thousand ind/m^2; average biomass varies from 1.3 to 30.0, maximum up to 103.0 g/m^2. Average biomass of benthos of the Vashutkina system is 12.4, of Kharbeyskaya 4.65 g/m^2. On the basis of these parameters lakes of the Bolshezemelskaya Tundra can be referred to as mesotrophic, presented by various types.

Larvae and pupae of caddis flies Patamophylax latipennis (Curtis) are typical inhabitants of the bottom of the North Ural rivers.

During hydrobiological research, special attention was paid to the great heterogeneity – "mosaics" – of the aquatic fauna and the general biological productivity of the Pechora and the water bodies of its floodplain. Zvereva (1969) determined that this phenomenon depended on peculiarities of the hydrography and geomorphology of the valleys, connected with the Quaternary history of the region. Most species of the invertebrate fauna of the Pechora basin are found in basins of ancient rivers of the northern and sub polar Urals and Timan. The distribution of many species is limited by the maximal glaciation's area. This led to the suggestion about a possible existence of refuge areas in the sub Urals and sub Timan during the Wьrm period (Zvereva *et al.*, 1962; Shubina, 1986). The assessed variation in the biological production and biocenotic relations in rivers and lakes of the Pechora basin bring about significant differences in distribution and quality of feeding resources for fish. A special characteristic of the invertebrate aquatic fauna of the Pechora basin is the presence of "Siberian" elements side by side to elements of the fauna of the European North-West in some groups of invertebrates (Trichoptera, Ephemeroptera, Molluscs, Oligochaeta, leeches, Chironomidae etc.) In the lower stream of the Pechora *Pontoporeia affinis* Lindstr., *Gammaracanthus lacustris* Sars, *Mysis relicta* Loven – relicts of marine after-glacial transgression – are found (Derzhavin, 1923). Cases of their occurrence in the upper Pechora are not known.

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