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STRUCTURE OF VASUYGAN MIRE BIOGEOCENOSES

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Vasyugan mire, as a type of landscape is highly peculiar. Its position in the transitive strip from the zone of deciduous woods caused the great diversity of vegetation and peat deposits; the principal cause of this fact is, most likely, various degree of salinity and leaching of the grounds.

It should be supposed that the formation of *Hypnum* sedge fen at the very top of watershed with the highest mark for this area, i.e. 146 m above sea level is an important factor.

Another feature of Vasyugan mire is the availability of special veretia-swampy mesh-polygonal fens. (Veretia represent polygonal swamps of transitional type). The specific feature of these mires is polygonal meshy image of the surface and a high degree of watering. The borders of their spreading are very well observed from the plane and in aerial photographs.

The comparisons of this data with the data over-land instrumental survey show that polygonal mires are associated with saucer-like depressions at the non-drained top of the watershed. At least slightly inclined slopes of watershed are occupied either by fens with ridges which are perpendicular or by raised bogs with pools and ridges.

The mosaic and complex transitional mires are not less original; definitely they resemble the aapa-complexes of the northwestern areas of the European part of Russia. It is necessary to notice especially that Vasyugan mire seems to be a unique place of wide spreading of transitional mires.

At Vasyugan mire the following types of vegetation can be classified:

High – 1. Ridge-hollow, 2. Ridge-pool, 3. Pine-sphagnum, 4. Sphagnum fuscum.

Transitional – 1. Wood-sedge, 2. Wood-sphagnum, 3. Pine-sphagnum, 4. Sedge, 5. Sphagnum, 6. Sedge-hypnum, 7. Forest.

Low – 1. Forest 2. Wood-sedge.

The amount of different phytocenoses at Vasyugan mire is rather large. In different types of mires they consist of definite chain of plant groupings, which characterizes the state of development and age of individual plots of Vasyugan mire. We shall dwell only on generalized types of swampy vegetation of Vasyugan mire.

Pine-shrub-sphagnum phytocenoses. Pine-shrub-sphagnum phytocenoses are widely spread at Vasyugan mire. They are associated with mire borders or with well-drained slopes with surface gradient 0.001–0.006 [7]. As well they occupy the most convex central plots of the mire and very often alternate with ridge-pool and ridge-hollow complexes, and create mosaic picture of the surface of Vasyugan mire.

In peatland science Siberian oligotrophic mires with pine-shrub-sphagnum groups are named as ryam (ryam is pine-sphagnum phytocenosis with swampy pine). Ryams are also found among vast eutrophic sedge-hypnum mires where their appearance and development are connected with conditions of scanty water and mineral regime and precipitation nutrition.

Let us consider first of all the ryams of oligotrophic mires. At Vasyugan mire the following variants of such ryams are found: ryams with *Pinus sylvestris f.* and *uliginosa* and ryams with *Pinus sylvestris f. litwinowii.*

First ryams (with *Pinus sylvestris f. and uliginosa*) are associated with the most convex central plots of the tract. In these so called “tall ryams” the height of trees amounts to 6–10 m, diameter of stems 8–15 cm, density of crown 0.5–0.8. The admixture of *Pinus sylvestris f. litwinowii and P.*

sibirica is insignificant. The undershrub layer is very luxuriant. The degree of undershrub coverage reaches quite often 70–80 %. *Ledum palustre* and *Chamaedaphne calyculata* are dominant and *Oxycoccus microcarpus* is rather luxuriant. The microrelief is hummocky. *Sphagnum fuscum* is dominant in the mossy layer. On the tops of hummocks the spots of green mosses are found: *Pleurozium schreberi, Dicranum polLisetum, D. affine*. At the hummock basis and in the depressions between hummocks the spots of *Sphagnum fuscum* are common; they are thickly pierced with stalks of *Mylia anomala.*

In tall ryams of the peripheral zone of Vasyugan mire the woody layer consists of *Pinus sylvestris f. uliginosa*. The young growth is mainly represented by *Pinus sylvestris, Betula pubescens*. As for the undershrub layer, *Ledum palustre* and *Chamaedaphne calyculata* are dominant. They are associated with mossy cushions and near-stem elevations. *Carex globularis* is abundant in the grass cover of the extreme ryams. *Sphagnum magellanicum* and *Sph.angustifolium* are dominants of moss cover. On the tops of hummocks of 40 cm high and on near-stem hillocks *Sph. fuscum* is found.

At pine stems and branches, shrub stems considerable quantity of lichens (epiphytes) is found. By A.A. Khramov and V.I. Valutsky [5], *Cetraria pinastri, Usnea hirta, U. comosa, Hypogymnia physodes, Parmelia olivacea* are most common.

Variant of ryams with *Pinus sylvestris f. litwinowii* is more widely spread. It can be considered as one of the first stages of development of woodless oligotrophic sphagnum and grass-sphagnum swamps in afforested phytocenoses. The ryams with *Pinus silvestris f. litwinowii* are especially typical for slopes of mire tracts. The arborescent layer in the ryams with *Pinus sylvestris f. litwinowii* is more thinned out: density of crown is 0.4–0.6; sometimes it falls to 0.3–0.2. The height of trees is 4–5 m, the stem diameter is 3-7 cm. *Pinus sylvestris f. wilkommii*, which grows here, is 1–2 m high, 1–3 cm in diameter.

The degree of undershrub coverage is high and amounts to 60–80 %. The ratio between individual species of undershrubs depends on the groundwater table. At the groundwater table below 50 cm the *Ledum palustre* is either dominating, or grows together with *Chamaedaphne calyculata*. *Andromeda polifolia* is the indicator of higher groundwater table (20–30 cm). *Betula nana* is rarely found. The associations such as *Pinus silvestris f. litwinowii – Ledum palustre – Sphagnum fuscum, Pinus sylvestris f. litwinowii – Ledum palustre + Chamaedaphne calyculata – Sphagnum fuscum* are most often spread.

Sph. fuscum; Sph. magellanicum and *Sph. angustifolium* are dominant in the moss cover, these are associated with hillock basis and depressions between hillocks. Their participation in the composition of in moss cover is not higher than 3–5 %. On the periphery of such ryams the depressions between hillocks are occupied by *Sphagnum angustifolium, Sph. magellanicum* is sharply pronounced on the slopes of the hillocks.

Let us return to the phytocenotic features of the ryams of eutrophic sedge-hypnum swamps the mention of which has already been made. *Pinus sylvestris f. litwinowii* is dominant in woody layer. As the degree of drainage and fluctuation of groundwater table from periphery to the center of the ryams increases one can observe the following change of the dominants of undershrub layer: *Andromeda polifolia → Chamaedaphne calicylata → Ledum palustre.* At the end of the Middle and especially the Late Holocene the part of atmospheric nutrition of the mires increased and the change in their plant cover has been outlined. In some cases eutrophic sedge and sedge-hypnum phytocenoses were transformed into sedge-sphagnum and sphagnum. The transfer to the oligotrophic stage is connected with the appearance of *Sph. russowii*, which was relatively rapidly displaced by typical oligotrophic species *Sph. fuscum*. Sometimes mesotrophic sphagnum phytocenoses turned into oligotrophic sphagnum ones where *Sph. magellanicum* and *Sph. angustifolium* were dominants.

So, in spite of the fact that the zonal mire type of the subbelt of birch-aspen forests represents eutrophic sedge-hypnum mires, oligotrophic pine-undershrub-sphagnum mires occupy considerable area of contemporary plant cover. Gradual but permanent transfer to oligotrophic stage is a principal contemporary tendency in the development of sedge-hypnum mires.

In the central part of Vasyugan mire the pine-undershrub-sphagnum formations appeared among vast eutrophic sedge-hypnum swamps prevail on small detached oligotrophic plots. Sometimes oligotrophic islets combine with each other and form larger and more complicated by configuration systems. In their plant cover on more elevated plots the pine-undershrub-sphagnum communities prevail which on the lower part of the slope give place to ridge-hollow phytocenoses, which alternate with narrow stripes of ridge-hollow-pool complexes.

Ridge-hollow complexes. Ridge-hollow complexes (RHC) are widely spread on Vasyugan mire. The plots of mire tracts occupied by ridge-hollow communities are usually as long stripes (from several tens cm to several hundreds m wide), they branch off as radial lines from central parts of the mire towards their extremes.

Depending on ratio of areas occupied by positive and negative relief forms the three variants of ridge-hollow complexes are classified: large-hollow, medium-hollow and small-hollow. The shape of ridges and correlation between the areas of ridges and hollow is closely connected to a considerable degree on surface incline. The area of hollows increases as the incline decreases.

Let us consider RHC on the example of the ridge small-hollow complex. Ridge-small-hollow complexes are found in the contact with Fuscum, pine-eriophorum-sphagnum or pine-undershrub-sphagnum phytocenoses with which they are connected genetically. In ridge-small-hollow complexes the hollows occupy 20–30 % of total surface. The hollows are slightly elongated without any strict orientation by relief. The watering of hollows is low. The water level is usually below 10–15 cm moss cover. The ridges are 3–10 m wide, sometimes 10–15 m; their height is 0.5–0.8 m. Not infrequently the ridges join and form islets occupied by pine-undershrub-sphagnum phytocenoses. On the ridges grows *Pinus sylvestris f. litwinowii* 3-5 m high, 5–10 cm in diameter. The admixture of *P. sylvestris f. willkommii* is insignificant, its height is 1–3 m, diameter 3–5 cm. Tree stand density amounts to 0.1–0.3, and the dead wood is common. *P. sibirica* of 6-10 height is typical.

The undershrub layer is rather well developed on the ridges, the degree of coverage rises up to 50-60 %, and sometimes it reaches 80 %. *Chamaedaphne calyculata* is abundant on the ridges under conditions of good drainage and *Ledum palustre* overgrows strongly. As the drainage becomes worse and groundwater table rises *Andromeda polifolia* becomes prevalent. The thin grass cover is represented by *Eriophorum vaginatum.* In moss cover the *Sphagnum fuscum* is prevalent. Along the slopes and at the ridge basis the dissemination of *Sph. angustifolium* and *Sph. magellanicum* are typical. In weakly watered hollows *Chamaedaphne calyculata*, *Andromeda polifolia, Oxycocus quadripetalis* are diffusively scattered. Total coverage is not more than 20 %. *Eriophorum vaginatum*, which forms hillocks 10–15 cm high, is luxuriant in the grass layer of the hollows. The hillocks occupy 35–45 % of total surface of the hollows. The coverage of *Scheuchzeria palustris* и *Carex limosa* decreases up to 10–15 %. The moss layer is represented by *Sphagnum balticum* and *Sph. fallax*. In the center of the hollows where groundwater table is at the depth of 10–15 cm from the surface, *Sph. majus* appears. The hollow extremes are occupied by *Sph. angustifolium*.

Transfers depending on the value and direction of the surface runoff connect ridge-hollow complexes of all three types with each other. Wide spreading of RHC is explained by the fact that they as pool-ridge-hollow complexes are the most sustainable forms of existence of the plant cover.

Pool-ridge-hollow complexes. In the pool-ridge-hollow complexes the strongly watered hollows alternate with secondary lakes or the lakes occupy central plots of large hollows. The lakes are elongated or rounded by shape. Their size varies strongly. Lakeside line is strongly broken. The

water depth is 0.8–1.3 m and the bottom is peaty. The lakes and hollows alternate with the ridges. The ridges take up 20–50 % of the surface. The ridge width is 1–3 m and the height is 0.2–0.4 m. The hollows and lakes take up 50–80 % of the surface.

Pinus sylvestris f. litwinowii grows on the ridges, its height is 3.5–5, diameter 8–10 cm and f. *willkommii* 1.0–3.5 m high and 5-7 cm in diameter*, Pinus sibirica* is found seldom. The density of crown is 0.2-0.3; often it falls to 0.1 and more. The undershrub layer is strongly developed; coverage amounts to 60-70 %; *Chamaedaphne calyculata* and *Ledum palustre* are mainly prevalent, *Andromeda polifolia* is also found. The grassy cover is represented by *Rubus chamaemorus. Sphagnum fuscum* is prevalent in the moss cover. Along the slopes and at the hillock basis the spots of lichen are common. The groundwaters on the ridges are rather low. The grass cover in the hollows is formed by *Carex limosa, Scheuchzeria palustris, Rhinchospora alba. The* coverage is 40–50 %; in the sites without moss cover the *Drosera rotundifolia* is common. As for the moss cover of the hollows, *Sphagnum majus and Sph. papillosum are predominant; Sph. balticum* is common on the peripheral part of the hollows.

It seems to be interesting to pay attention to such an interesting phenomenon as the development of regressive phenomena which become apparent in temporal cessation of peat formation and replacement of peat-forming plants by not peat-forming ones (lichen, liverworts, algae.

Not dwelling on different opinions on this problem [1, 2, 6 a.o.], let us take into account as follows: in Western Siberia where the main part of the mires is self-regulating systems. It has a certain attitude towards Vasyugan mire as well where dystrophic plots are insignificant, the development of regressive phenomena should be considered as one of homeostatic mechanisms of the existence of oligotrophic mire. The interruptions in peat accumulation give place to overgrowing and subsequent peat accumulation.

It is worth while noting that A.Y. Bronzov [3], when investigating Vasyugan mire paid attention to this phenomenon and then confirmed that this was a substantial evidence of the beginning of the quaternary (final) stage of their development.

The development of regressive phenomena in the hollows leads to appearance of “black hollows”. The process of destruction of vegetation begins from the settling of *Sphagnum maius, Cladodiella fluitans* on the surface. Simultaneously the *Sphagnum compactum* appears in the moss cover. As a result, the associations such as *Rhynchospora alba – Sphagnum compactum – Cladodiella fluitans – Rhynchospora alba – Cladodiella fluitans* appear. Gradually on the bare oxidized substrate only liverwort mosses and algae remain. The next stage is the formation of bog pools, which, in its turn, begin to overgrow by mosses adapted to the conditions of regressive stage of the development of oligotrophic mires. These mires are characterized by wide amplitude of fluctuation of medium acidity

<u>*Sedge-hypnum phytocenoses.*</u> The southern and southeastern part of Vasyugan mire is included into the province of subtaiga West-Siberian Atlantic eutrophic of sedge-hypnum mires. Sedge-hypnum phytocenoses are associated at the territory of Vasyugan mire with tremendous hollows with comparatively even vegetation. The grass layer is rather thin in the hollows. As for the sedges, the species are mostly spread as follows: *Carex diandra, C. chordorrhiza, C. limosa, C. omskiana*, sometimes – *C. rostrata, C. lasiocarpa. C. heleonastes and Rhynchospora alba* are found as solitary species. *Scheuchzeria palustris, Triglochin maritimum* are found in small amount but grow more often. Small accumulations are formed by *Equisetum limosum*.

The species such as *Menyanthes trifoliata, Comarum palustre, Cicuta virosa, Epilobium palustre, Pedicularis palustris and Utricularia intermedia* are mainly spread among the herbs. *Drepanocladus vernicosus* and *D. sendtneri* is prevalent in the moss layer. The former is prevalent in less watered sites; the latter grows in small watered depressions. *Calliergon trifarium* grows here as well.

Monotonous sedge-hypnum swamps are crossed in the direction perpendicular to surface runoff by narrow (1–2 m) and long (up to 1 km) peat bank (local name "veretiya"). These peat banks rise above sedge-hypnum swamps by 10–25 cm. In the sites without incline these peat banks stretch in different directions. The distance between these banks ranges from several meters to 50–200 m. In addition to peat banks (veretiya), the single islets of oligotrophic pine-undershrub-sphagnum phytocenoses are scattered on the surface of sedge-hypnum swamps. The diameter of such islets varies within the limits of several tens m (local name "shelomochki"). Shelomochki rise above the surface of sedge-hypnum mires by 50–90 cm [4].

Betula pubescens and *Pinus sylvestris* grow on peat bank one by one or as small groups; as for shrubs, *Salix lapponum* and *S. rosmarinifolia* are found here. Undershrub layer is rather luxuriant. *Betula nana, Andromeda polifolia* are mainly spread. *Ledium palustre* and *Chamaedaphne caliculata* are somewhat thinner. The grass layer of peat banks does not differ essentially by floristic composition from the grass cover of sedge-hypnum depressions.

The analysis of geobotanical descriptions by A.Y. Bronzov [3] for the southern part of Vasyugan mire evidences that notwithstanding rather numerous general floristic list of 46 species of undershrub, grass and moss layers, only two species such as *Carex limosa* and *Carex diandra* can be named as permanent ones for sedge-hypnum phytocenoses of eutrophic mires of Ob-Irtysh interfluve. Four species such as *Betula nana, Andromeda polifolia, Carex chordorrhiza, Menyanthes trifoliate* are found very frequently.

Sphagnum warnstorfii is prevalent in moss cover of the peat banks; *Tomenthypnum nitens* is dominant on the lower peat banks. *Sphagnum angustifolium, Sph. magellanicum, Sph. fuscum* grow at stem basis depending on the height of hillocks. The appearance of mesotrophic as well as oligotrophic "shelomochki" relates to subatlantic period. As it was noted above, the prevalent eutrophic sedge-hypnum stage, which was delayed in this zone up to present time, is caused by edaphic factors. As the peat deposit increases, the influence of bedding rocks on deposit structure decreases, ash content of peats decreases and favorable conditions spring up for development of sedge-hypnum phytocenoses into grass sphagnum peat banks (veretiya) and pine-undershrub-sphagnum (shelomochki).

BIBLIOGRAPHY

1. Bogdanovskaya-Guienef I.D. Plant cover of raised bogs of Russian Baltic. // Procedeengs of Petergof research institute of natural sciences. – Leningrad, 1928. – No. 5. (In Russian).
2. Bogdanovskaya-Guienef I.D. Regularities of sphagnum bog formation of raised type. – Leningrad: Nauka, 1969. (In Russian).
3. Bronzov A.Y. Raised bogs of Narym Territory (basin of river of Vasyugan)//Procedeengs of of peat research institute, 1930. – No. 3. (In Russian).
4. Bronzov A.Y. Typical mires in southern border of West-Siberian taiga flat plain //Soil Science 1936. – No. 2. (In Russian).
5. Khramov A.A., Valutsky V.I. Vegetation of basin of river of Chaya //Nature of West-Siberian taiga. – Novosibirsk: Nauka, 1973. (In Russian)
6. Lopatin V.D. "Smooth" mire (peat deposit and swampy facies) // Scientific notes of Leningrad university, geography,, 1954. – No. 9. (In Russian).
7. Romanova Y.A. Some morphological characteristics of oligotrophic mire landscapes of West-Siberian flat plain as a basis of their regioning // Nature of mires and methods of their research. – Leningrad: Nauka, 1967. (In Russian).