Features of biodiversity of the Uchursky landscape nature reserve (Ayano-Maiskoye district of Khabarovsk Territory)

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Abstract. It was revealed that the botanical and geographical feature of the vegetation cover of the Uchursky complex nature reserve is its position in the zone of convergence of the continental and monsoon climates, claimed by sharply contrasting phlorogenetic elements of the vegetation cover. The gradient of continentality – oceanicity in the vegetation cover is quite clearly traced between the eastern and western macroslopes of the mountain systems of the Uchur River basin. A complex history of the formation of the territory, the height difference from 1,000 to 2,000 meters, the variety of rocks created the conditions for the existence of floristic complexes of different ecology and origin. In this regard, on the territory of the nature reserve, an overlap of the marginal zones of plants ranges of oceanic and continental origin was found, which defines the richness of the region’s biodiversity, but makes both species and communities unstable. The uniqueness of the flora of the Geran Ridge was revealed, with the main core formed by species of non-Angarid origin, concentrated on the weathering crust of the basic rocks. The participation of alpinogenic, arctic and arctic-alpine species is noted. The pine-larch forests, which are unique in their species composition, are found on the outcrops of carbonate rocks on the right bank of the Uchur River, opposite the mouth of the Lyalmi River and in the Uchur-Ulkan interfluve. In this area, there are 79 species of endemic highland species of North Asia. The Red Book of Khabarovsk Territory includes 37 species of vascular plants, 4 species of lichens and 1 representative of the kingdom of mushrooms.

1. Introduction
Due to its inaccessibility, the basin of the Uchur River was previously developed only by indigenous peoples as a transit point for migrations. This “Uchur trail” was used by Poyarkov in 1643–1646 and Middendorf, who carried out a difficult route from Yakutsk to Udskoi Ostrog town in 1844.

The first observations of the pioneers served as an important stimulus for the research of the Ayano-Transbaikal and Yakutsk complex expeditions by the Council for the Study of Production Forces of the USSR Academy of Sciences. The high mountainous areas of the Uchur basin remained practically unexplored. In connection with the creation of the Uchursky landscape nature reserve, the most important task is to study the landscape attractions and biodiversity of this area.

2. Materials and Methods
The work is based on many years of field research carried out in the 1990s and the early 2000s by the ecological-geographical team of the Institute of Water and Environmental Problems of the Far Eastern Branch of the Russian Academy of Sciences. The key sites were located on the Geran Ridge at the headwaters of the Lyalmi, Maimakan and Uyan rivers (1,600–2,020 m above sea level), as well as in the valley of the Lyalmi, Uchur and Ulkan rivers (300–500 m above sea level). 350 geobotanical
descriptions were made, 20 profiles were laid, vegetation of 20 key areas was mapped, the full species composition of 5 specific floras was identified, and a herbarium was collected (1,500 sheets). When processing the field materials, the methods developed by Yurtsev were used [10]. Plant names were given according to the summary “Vascular Plants of the Soviet Far East” using the Plant of the Word online database and IPNI (the International Plant – Name Index) 2021 at http://www.ipni.org. When mapping vegetation of key areas, topographic maps of medium and large scales, satellite images of the average spatial expansion of Landsat satellites, ETM+, TM sensors were used.

3. Result and Discussion

According to the scheme of physical and geographical zoning, the studied territory of the Uchur river basin belongs to the Baikal-Dzhugdzhor region [6], occupying the southern part of the Aldan Upland. It represents the outskirts of the oldest Siberian platform.

The mountains of the Uchur basin are characterized by a combination of gentle slopes, deep notched box-like valleys with leveled watershed surfaces, reaching up to 3 km in width and 1,500-1,800 m in height. The flattened watersheds are the remnants of the Cretaceous-Paleogene surface of the denudation alignment, lying above 1,500 m [3]. The relief at the headwaters of the left bank of the Uchur is represented by alpine-type peaks reaching 2,000 meters in height.

The peculiarity of the relief of this morphostructure is a combination of alpine-type and block structures, an abundance of traces of Pleistocene glaciations, the presence of nival lawns and glacial relics of Arctic origin in the communities.

Within the Uchur basin, three altitudinal belts have been identified: forest (mountain-taiga), subalpine and alpine zones. Mountain taiga occupies a wide range of absolute heights from 300 to 1,200 meters. It is formed by the most resistant to natural and climatic conditions species – larch (Larix gmelinii). The sharply continental climate of mountain morphostructures located in the “barrier shadow” of the Tokinskii Stanovik, a relatively less moisture contributes to the widespread distribution of larch and pine-larch forests in the Uchur basin.

They are confined to the slopes and tops of the mountains. On the northern slopes, the border of forest vegetation is 150–200 m lower than on the southern ones. Sometimes the abundance of block debris, especially on slopes of 30° steepness, violates this pattern. In some areas of Geran, the cloak of mobile talus on the slopes reaches 700–800 meters, dropping to the thalweg of the valleys. In areas sheltered from the wind, which serve as “corridors”, the forest rises up to 1,300 m. However, on steep slopes exposed to fires in the basins of the Taranda and Lyalmi rivers, the upper border of the forest does not rise above 600–800 m [8].

On the moist, well-drained areas of the slopes of the Ulkan ridge, there are lingonberry-Siberian pine larch forests, the steeper slopes are clad with Siberian pine larch forests with alder forests. Dry convex slopes of Geran (the Lyalmi-Syutyukyan interfluve) are covered with sparse cedar-elfin-larch larch forests. Gentle slopes, plateau-like ridges with hilly micro- and mesorelief associated with the activity of permafrost, are occupied by dwarf-birch-sphagnum-ledum-larch open forests. They are also typical for low-drained areas of the first terrace of the lower reaches of the Ulkan and the upper reaches of the Uchur. Due to the close occurrence of the permafrost, good conditions are created for waterlogging. Sphagnum-lerdum-dwarf-birch-larch openings begin immediately behind the coastal ridge, which rounds the watercourse. Overmature lingonberry-lichen with dwarf cedar larch forests are common on the beach ridge.

Oligotrophic rows of open larch forests and non-forest vegetation are most often formed by subshrub-sphagnum-shrub communities, known under the general name of dwarf birch forests, widespread in the cold and cold-temperate zones of the Eastern Siberia and the Far East, being landscape in the ecosystems of the Okhotsk region. The edificators are species of the birch and willow families. Middendorff’s birch (Betula middendorffii), dwarf birch (B. fruticosa), lean birch (B. exilis), blueberry willow (Salix myrtilloides), darkening willow (S. fuscescens) are edificators of sparse larch and pine forest communities in the Uchur basin. These formations are poor in vascular plants; sedges (Carex tenuiflora, C. canescens, C. globularis, C. sabynensis), lousewort (Pedicularis labradorica, P. oederi, P. skeptrum-carolinum) and heather shrubs (Andromeda polifolia, Cassiope tetragona, Ledum palustre), etc. are noted most often.

Eutotrophic rows of vegetation are represented by willow, poplar-chozenia types of plantations. Willow stands represent a short-term stage in the development of vegetation on gravel. Edificators are
dew willows (Salix torida), Schwerin’s (S. schwerinii), Udskaya (S. udens) and others. Chozeni-poplar groves are formed on thicker alluvial deposits. In the floodplains of the Ulkan and Uchur, they do not form powerful forests on low terraces bordering watercourses, but are marked by narrow discontinuous ribbons. The water protection larch forests along the Ulkan and Uchur are characterized by an average productivity of stands and a variety of dwarf pine and alder undergrowth. The grass community is dominated by reed-sedge-forb groups.

Dark coniferous forests are noted along the valleys of mountain streams. They stretch in a narrow, intermittent strip to the upper border of the forest. Edificators, such as ayan and Siberian spruce (Picea ajanensis and P. sibirica), are found singularly as an admixture to mountain larch forests. Ayan spruce formations are characteristic of better humidified slopes of eastern exposures, both Geran and Ulkan ridges. Reed-forbs formations are formed in the lower part of the calcareous slopes with good moisture. The shrub-grass cover is represented by tall grasses, among which are common: rhubarb (Rheum compactum), buttercup and Okhotsk aconites (Aconitum ranunculoides, A. ochotensis), Steller’s bog (Limnas stelleri), corydalis (Corydalis paeonifolia), etc.

Fragments of pine-larch and pine formations are a contrast against the background of forest vegetation of the Okhotsk type. They are confined to the limestone outcrops of the right bank of the Uchur and the Uchur plateau. The canopy is dominated by steppe species common with Siberia, Mongolia and Central Asia: fescue (Festuca altaica, F. jacutica), bluegrass (Poa angustifolia, P. argunensis), saussurea (Saussurea ajanensis, S.changiniana), sedges (Carex trautica, C. pediformis), Rhaponticum carthami, Forniciuncum uniflorum), etc.

In the subalpine belt of the Uchur basin, intermediate communities, represented by cryophilic medium-grass lawns, develop. The specificity of Geranian lawns is that half of the projective cover is formed by shrubs (Phylloodoce caerulea, Empetrum sibiricum, Loiseleuria procumbens, Dryas octotopetalae). Lichens and mosses cover up to 30%. Synusiae of vascular plants make up 20% of the coverage of the test plots. The basis is formed by East Siberian and Arcto-Alpine sedges (Carex rigidioide, C.misandra) and hyp окружа монтане (Carex sabynensis, C.melanocarpa) and arcto-alpine representatives of vascular plants: Pachypleurum alpinum, violet (Viola alpina), arctic and polar willow (Salix arctica, S. polaris), cinquefoil (Potentilla hynarctica), buttercups (Ranunculus nivalis, R. hyperboreus), etc.

Above 1,300–1,400 meters, the kingdom of the mountain tundra begins at the headwaters of the Uchur. Its wide distribution here, as, indeed, everywhere within the mountains of the Far East, is determined by a high humidity of the air, coupled with moderate temperatures of the growing season and extremely low one in winter with an insignificant thickness of the snow cover. These factors predetermine the widespread development in the mountain-tundra belt (erosional landforms, coarse-grained, blocky and gravelly substrates), which are inhabited by eosophiles.

In the highlands of the Uchur basin, a special place is occupied by lichen-gravelly-dryad tundras. They are confined to flat saddles and watershed plateaus, where anorthosites are significantly destroyed and form rubble-gritty covers and placers. Areas enriched with a fine earthy substrate are usually turfed with dryads (Dryas ajanensis, D. viscasa, D. integriofila), which are highly active species in the Uchur basin. The landscape role of the dryads, it seems, should be associated with the composition of the rocks. Dryads are not widespread in the southwestern section of the Ulkan ridge and Dzhugdzhur, which are composed of granites and gneisses.

In the rubble-dryad tundra, sedges (Carex rigidioide, C. alitcola), cobresia (Kobresia myosuroide, K. jacutica), oxytrope (Oxytropis pumilio, O. tilingii), bluegrass (Poa glauca, P. arctica), saxifrages (Saxifraga nudicaulis, S. aestivalis, S. stelleriana, S. merckii), willow (Salix sphenophyllda, S. recurvigemmis), saussurea (Saussurea changiniana, S. congesta), etc. play a large role.

The total number of rare and endangered plant species of the Uchursky reserve included in the Red Book of the Russian Federation includes 8 taxa: Borodinia tilingii, Rhodiola rosea, Smelowskia inopinata, Cyripedium calceolus, Valeriana ajanensis, Calypso bulbosa, etc.; two lichens: Lobaria retigera, L. pulmonaria and one fungus: Conoderma lucidum. Many of them are ancient monotypic genera formed in remote periods of epochs, such as Borodinia tilingii [10].

In the opinion of most researchers, in the Paleogene in the south of the Aldan Highlands, there was a surface of denudation leveling. Its absolute heights did not exceed 800 m, relative ~ 200–300 m. Spore-pollen spectra from the sediments of the ancient hydraulic network and weathering crusts (the Uchur – Uyan watershed) indicate the dominance of deciduous forests (beech, walnut, hickory, etc.), and from
conifers – sequoia and cypress [2]. In the Oligocene, against the background of the general uplift of the mainland, a mountainous relief was formed, polydominant Turgai forests develop. Further development of the region’s landscapes is taking place in conditions of absolute heights. In the Pliocene, vertical differentiation of landscapes occurs. The mountains went beyond the forests, so-called loaches appeared. Mountain tundra groupings were formed on them, which soon conquered the upper belt of the mountains from Transbaikalia to Beringia [9].

In the second half of the Early Quaternary, due to the uplifts and regression of the Sea of Okhotsk, the watersheds of the Tokinsky Stanovik and Geran reached 2,000 m absolute height. In the Middle Quaternary, due to the regression of the Sea of Okhotsk, forest-tundras with dwarf birch and dwarf cedar were spread.

In the Late Quaternary, uplifts continued in Western Okhotsk region, and two glaciations appeared. The first was the most significant, the snow line dropped to 800–1,000 meters and glaciers of the tar and valley types (up to several tens of kilometers long) developed. Even considering that these data of Chemekov [9] are somewhat exaggerated, as Gotvansky believes [1], then all the same their area looks impressive.

Continuing uplifts destroyed the ancient flattened relief, which remained on separate massifs and ridges, far from the main bases of erosion, such as on the Tyrkano-Maysky watershed. This discontinuous strip of mountains along the watershed of the Lena and Okhotsk basins (the eastern part of the World Divide) was the main migration route throughout the Quaternary period. It is this belt, the most elevated and never covered by mountain-valley glaciers, that ensured the penetration of endemic species of the Sea of Okhotsk coast to the Stanovoy Ridge during the transgressions, and continental species of the Angarid center into Okhotia [10]. In the Late Quaternary epoch, with the reduction of forests and the development of open treeless spaces, the migration of high-mountain taxa from Central Asia and Eastern Siberia to the mountain tundra of the World Divide and Geran takes place. Artifacts are isolated localities of Waldheimia tridactylities, Shangin’s saussurea, Polyakov’s and pseudo-narrow-leaved saussurea (Saussurea schanginiana, S. poljakowii, S. pseudoangusifolia), Smirnov’s and argun bluegrass (Poa smirnovii, P. argunensis), etc.

During the humid segment of the Holocene, on the territory of the mountainous and lowland part of the Uchur basin, dark coniferous and larch forests expanded their ranges, displacing representatives of the high-mountain, steppe and forest-steppe vegetation cover elements, which by the end of the Holocene remained on the tops of mountains and on dry steep slopes composed of carbonate rocks.

4. Conclusion

The territory of the Uchursky reserve is a reserve of intact ecosystems of the Western Okhotsk region. The forest cover of the Uchur and its tributaries is about 52%, which ensures the stability of the ecosystem. At present, after the fires in the middle part of the Uchur basin, the forest cover has decreased by 10%, which negatively affects the water content of this river.

The list of vascular and spore plants includes 370 species. Of these, 88 taxa are strictly alpine, 110 plants are montane (mountainous), 41 species are high-latitude plants (arctic and arcto-alpine). The largest group is composed of taiga-boreal representatives – 131 species, which are widespread on the Eurasian continent.

The flora of plant communities of the most elevated areas in the headwaters of the Uchur and its right bank includes a small complex of plants associated by their origin with the Pacific coast. These are representatives of the Beringian, Okhotsk and Okhotsk-Kamchatka types of habitats.

The plant communities of the peneplaned mountain areas on the left bank of the Uchur contain a predominant set of species of continental origin. Basically, these are Angarid plants, in the interpretation of Yurtsev [10], characterized by East Siberian – Far Eastern ranges. Thus, in the Uchur basin, an overlap of the marginal zones of the areas of plants of continental and oceanic origin was revealed. This determines the richness of the biodiversity of the Uchur basin, on the one hand, and on the other hand, imparts instability to individual plant complexes and determines a high number of rare taxa and endangered plant species included in the International and Red Books of the Russian Federation, in which there are 8 representatives, 3 of them are protected by the CITES Convention and the Red Leaf. The Red Book of Khabarovsk Territory includes 32 species of vascular plants. Of the lichens, 4 species and one representative from the kingdom of mushrooms are subject to special protection.
The total number of rare species classified in the Red Books of different levels is 37 taxa (10% of the total number of species in the Uchur basin). Of the total number of species, 79 species of endemic alpine plants of North Asia grow in the Uchur basin.

The main feature of the vegetation cover of a complex territory is the environment-forming factor in the ecosystem. Here, taiga vegetation is a key element of the landscape, because its destruction leads to the destruction of the entire recovery system. The forests of the southwestern part of the Aldan Upland, by mistake of the forest management organization, were classified as exploitable. Felling of spruce, larch, pine and Siberian pine forests can significantly disrupt the ecological functions of ecosystems (water protection, water regulation, biostation), undermine the stocks of the commercial fauna of the unique area and reduce the recreational potential.

The organization of the Uchursky complex nature reserve is relevant and timely.

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