Resource value aspects as an indicator for the technogenic landscapes phytocoenosis renewal

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Abstract. In the conditions of the southern taiga of the Amur Region in the gold mining areas after the cessation of work in the development of the recovery succession, there is a long period of time when there is no focus on zone type compliance. In place of spruce-fir forests, phytocoenosis is formed mainly by deciduous, low-value species. There is a risk that spruce and fir trees, an important resource for the economy, will be lost. Only after 70 years of self-recovery these species of trees appear on the dredge heaps. The aim of the studies is to study the regeneration succession and analyze aspects of the resource value of plant communities in dredge heaps in different recovery periods. It is proposed to use this analysis as an indicator of the focus of recovery succession in technogenic landscapes. This will make it possible to predict further development of phytocoenosis and to plan and carry out work to facilitate the processes of reforestation of valuable resources in taiga forests.

1. Introduction

Once the human impact has ceased, the destroyed ecosystems tend to regain their original appearance and eventually match the type of coenosis that is typical of the area. Renewal of vegetation in technologically disturbed landscapes is possible either through the establishment of cultural plant communities or through self-growth. Unfortunately, today the self-replenishment potential of ecosystems, especially in northern areas, has been significantly undermined and the cultural phytocoenosis established as a result of reclamation cannot, by definition, match the local vegetation type. All this jeopardizes the possibility of regaining the lost potential of economic and biosphere resources. Along with this, the lack of human and material resources makes it difficult to carry out recultivation in the northern regions. Using the example of the taiga zone of the Komi Republic (Russian Federation), I.B. Archegova [1] notes that the rate of natural resource development in the northern regions significantly exceeds the tempo of restoration work. The share of recultivated land in this region does not exceed 6% of the total affected area. This situation is typical for the northern climate zone of the country. The shrinking area of the taiga in the boreal forest belt is becoming increasingly important for the economy and the biosphere. This includes the loss of valuable taiga wood resources and changes in the global carbon cycle. The search for criteria or markers for both restoration succession and reclamation processes is becoming relevant. Such indicators could, at certain stages, determine the need for and extent of work to promote restoration processes in technogenic landscapes.
2. The aim of the research
Is the study of recovery succession in technogenic landscapes after gold mining in the South Taiga zone of the Amur Region and the analysis of aspects of the resource value of vegetation as an indicator of the direction of development of plant communities.

3. The object and methods of the research
The research has been carried out in the north of the Amur Region of Russia (Selemdzhinsky district, southern taiga zone) at the dredge landfills of the former Tokur mine. Successions of self-vegetation were studied in areas where gold mining was completed ten, thirty-five and seventy years ago [2]. Routine research aimed at studying the composition, structure and some other indicators of plant communities have identified aspects of resource importance among the plants inhabiting the dumps.

4. The results of the research
The area of the Maly Karourak River valley, where the dredge areas of the former Tokur mine are located, is situated in the spruce-fir forest zone. The forests formed by the dark-bark spruce (Picea ajanensis (Lindl. et Gord.) Fisch. ex Carr.) and Khingan fir (Abies nephrolepis (Trautv.) Maxim.) are found in the middle and upper mountain belt of the north-west Pacific Basin, reaching their maximum distribution in Middle and South Sikhote-Alin (3). In the Amur Region such forests occupy only 2.2% of the forest-covered land and are considered the most valuable in terms of economic value [4] (Yaborov, 2000).

Spruce and fir plantations are found only in the river valley, while the Siberian (or Russian) larch (Larix cajanderi Mayr) mainly grows on the slopes of the hills surrounding the valley. Gold was mined using the dredge method for over 30 km downstream of the river from where the ore deposit was located. There are islets of native forest where ripe spruce and fir grows, which means that the seeds of these species are freely transported to areas where drag work has ceased. However, a study of vegetation at sites 10 and 35 years of age of restoration showed virtually no evidence of these species (table 1).

Table 1. The aspects of resource value growing on sites the dredge landfill of different age of self-restoration.

| Species                          | Time of restoration, years | Degree of resource value | Application                                      |
|----------------------------------|----------------------------|--------------------------|-------------------------------------------------|
| Abies nephrolepis (Trautv.) Maxim. | 10 35 70                  | +                        | Very high In the timber chemical industry, medicine, construction |
| Actaea erythrocarpa (L.) Fisch    |                            | +                        | Medium In medicine                               |
| Alnus hirsuta (Spach) Fish. ex Rupr.| + + +                     |                         | Medium In the forest chemical industry, medicine, firewood, for forest reclamation purposes |
| Betula platyphylla Sukacz.        | + + +                      |                         | Medium In forestry, forestry amelioration and landscaping, on firewood, in medicine |
| Daphne koreana (L.) Nakai        | + +                        | Low                      | Low In medicine                                  |
| Larix cajanderi Mayr             | +                          | High                     | High In the timber and chemical industry, medicine, construction |
Padus avium Mill. + + Low For decorative purposes

Picea ajanensis (Lindl. et Gord.) Fisch. ex Carr. + Very high In the timber and chemical industry, medicine, construction

Populus suaveolens Fisch. + + + Low In the timber and chemical industry, medicine

Pteridium aquilinum L. + High Harvesting resource, for food purposes, in medicine, in horticulture

Ribes pauciflorum Turcz.ex Pojark. + + Medium Harvesting resource, for food purposes, in medicine, in horticulture

Ribes triste Pall.) + + + Medium Harvesting resource, for food purposes, in medicine, in horticulture

Rosa amblyotis C.A. Mey. + + + Medium Harvesting resource, for food purposes, in medicine

Rubus komarovii Nakai + + Medium Harvesting resource, for food purposes, in medicine, in horticulture

Salix martilloides L.; S. brachypoda (Trautv et Mey.) Kom. + + + Low As a valuable early honeycomb, in medicine

Sambucus rasemosa L. + + Low Honeycomb, for decorative purposes, in medicine

Larch has been found in one of the ten-year-old sites, and only small spruce and fir trees grow in some of the 70-year-old sites. Apparently, it is only by this time that favorable conditions for the growth of these species begin to emerge in the heaps. It is known that spruce and fir trees form well only under the canopy of the first-tier trees [3]. Another factor favoring the spread of conifers seems to be the formation of humus horizons in soil formations by this time, as confirmed by the description of the soil sections (table 2).

Table 2. The morphological description of a soil section on a seventy-years-site self-restoration of a dredge landfill.

| Dump of the dredge of the former Tokur mine, Maly Karourak River valley, Selemdzhinsky district, Amur region, Russia. |
| The top of the dump. |
| Vegetation - birch forest with mixed grass and cereals. |
| 70th year after the formation of the dredge landfill. |
| Soil: Humus accumulative lythostrate. |
Soil horizon | Capacity | Description
---|---|---
0 | 0–3 cm | Good and poorly decomposed leafy and grassy fall, leaves of trees, the transition is sharp.
Ud | 3–6 cm | Dark brown, turf formed by living and dead roots of herbaceous plants, grainy, the transition is sharp.
Uh | 6–8 cm | Homogenously colored, lightly loamy, granular, loose, rooted, transition is evident.
Uc | 8–10 cm | Grey, lumpy-grained, abundantly rooted, the transition is gradual.
2Uc | 10–50 cm | Gray, heavy loamy, inclusions of pebbles and sand, rarely roots.

At the decadal dumps, the soil formation is classified as an initial lythrostrate, by the 35 years of recovery as an organo-accumulative lythostate and there are no humus horizons in the soil structures at these sites.

Only by the 70 years of recovery the soil sections in the dumps begin to show well-defined horizons of leaf and grass deposition. Below are the horizons of turf and a small (2 - 3 cm) humus-like horizon. Superficial soil formation here is classified as humus accumulative lythrostrate [5, 6].

The presence of fertile horizon in the soil seems to be a prerequisite for successful settlement at the dumps of dredged gold mining spruce and fir. The lack of larch spruce can be explained by the distance of the natural plantations of this species from the dumps. Larch is known to be less demanding on soil conditions and is usually quite successful in settling man-made land [7]. According to V.T. Yaborov [8], the minimum distance for successful distribution of larch seed when vegetation resumes at gold mining sites is 100-150 m.

The analysis of the vegetation inhabiting the dump sites of the dredge gold mine shows that the plants mainly belong to the "pioneers" of the forest, which, unlike the exploiters, are quickly replaced and lead to the formation of secondary forests that do not correspond to the native, typical of the area. Given that indigenous forests, in this case spruce and fir forests, have a high resource value, the formation of secondary forests appears to be a negative factor in restoring the resource potential of the area.

Pioneer groups have different resource values of varying importance. For example, Siberian silver birch, Mongolian poplar and Manchurian alder have low resource values and can be used as a source of construction and fuel wood. Some shrubs (Kamchatka Rose Hip, Rubus Komarovii Nakai, blackcurrant and redcurrant) are valuable as a wildcrafting resource. Eagle fern is valuable as a food crop and is harvested in large quantities in the Amur Region. However, given the remoteness and sparse population of the study area, the resource value of all these species is not very significant. Conversely, conifers such as the Dahurian larch, the dark-bark spruce and the Khingan fir belong to trees of high resource value. Despite the fact that these trees reach technical maturity by their 70-80th years of development, analysis of aspects of the resource significance of plants inhabiting man-made landscapes should be focused on the appearance of these very high-value species in the undergrowth. The settlement of dumps by indigenous forest representatives (after 70 years) seems to indicate that the regeneration succession is beginning to move in the direction of compliance with the typical local community.

While the absence of conifers in the phytocoenosis of 10 and 35-year-old dump sites is an indicator of the loss of the ecosystem's ability to self-reproduce to indigenous forest types. The establishment of this criterion leads to the implementation of measures to facilitate the restoration of man-made landscapes. For example, activities such as hillside cultivation and dredging.
5. Conclusion

The analysis of the resource value aspects of the vegetation inhabiting the manmade landscapes formed as a result of dredge gold mining in the southern taiga of the Amur Region is an indicator of the direction of the regeneration succession. When species dominating indigenous and local forests (spruce, fir, larch) are introduced into the phytocoenosis, the succession develops towards the reforestation of forests with high resource value, which is of great national economic importance. While low-value deciduous species are mainly present among the aspects of resource value, the succession is developing towards the formation of secondary forests that do not have important resource values. This marker allows for early forecasting of measures to promote restoration processes.

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