Assessment of key habitats of suburban forests in Krasnoyarsk

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Abstract. Biodiversity is closely linked to common environmental and conservation issues of rare plant and animal species. Key habitats contribute to solving the limited tasks of preserving local (small) areas. Moreover, these areas are important for the conservation of ecosystem components, rare, vulnerable, endemic, relict and Red Book species. A survey of key habitats was carried out in a number of neighborhoods of the suburban forests of the city of Krasnoyarsk. In this article, key habitats were assessed according to three criteria: age, marketability, and anthropogenic impact. It was established that the key habitats allocated in the Krasnoyarsk forestry area are in satisfactory condition. To preserve these areas, it is recommended to reduce the anthropogenic load and develop a system of protective measures in order to preserve biodiversity.

1. Introduction

Biodiversity is closely related to the general environmental and conservation problems of endangered plants and animals [1, 2]. Key habitats contribute to solving only limited tasks to preserve local (small) areas, which, certainly, is not enough to maintain biodiversity, but is nevertheless one of the territorial forms of forest nature conservation [3, 4]. The key habitat is the forest area, the most important from the point of view of conservation of ecosystem components, rare, vulnerable, endemic, relict and Red Book species [5]. Habitats that are of great importance for the conservation of biodiversity include both individual sites and forest elements [6, 7, 8].

2. Material and methods

The purpose of the work is to assess the status of key habitats of forest vegetation in the Krasnoyarsk forestry of the Krasnoyarsk Territory.

A survey of key habitats was carried out in 9, 10, 96, 87 quarters. Areas of forest were studied around permanent and temporary water bodies, streams, temporary watercourses; sections of the most old-growth forests among ripe and mature stands; forest areas on stony placers, rock outcrops; forest areas during the transition from closed to open areas; forest areas on steep slopes, cliffs; plots of dark
coniferous forests among light coniferous and deciduous; forest areas on karst formations; forest areas with a lot of dead fall and dead wood; rare species of plants.

According to various sources, each key habitat corresponds to a description consisting of several parts: the main feature for isolation, topography and soil, vegetation, boundary delimitation [9]. The description is accompanied by photographs illustrating the typical outlook of a key habitat and photographs of rare species that can be found within it. A total of 9 types of key habitats and 7 rare plant species are described.

Krasnoyarsk is located in the central part of Central Siberia. The territory of the city is included in the Krasnoyarsk district of the forest-steppe subzone of the Krasnoyarsk-Kansk province, the sub-taiga zone and island forest-steppes of the Central Siberian country. The vegetation in the suburban area is different: the left bank of the Yenisei is a typical forest-steppe, and the right bank is a dense mountain taiga. The city is surrounded by forests. Their total area is 5332 ha [10].

The identified key habitats should be described for further certification and transfer for protection. For each type of habitat, a dominant feature has been proposed, which should be guided by when identifying on the ground [11].

### 3. Results and discussion

The main key objects of the territory are:

- Forest areas around permanent and temporary water bodies, flooded areas in floodplains of rivers, streams, temporary waterways, places of groundwater pinching out.
- This site is located in quarter 87, the species composition is mixed pine and birch, age 110 years, tame (floodplain, grassy boggy) or tall grass types prevail. There are no traces of anthropogenic impact. Such a habitat performs a hydrological function.
- Forest areas on stony placers, rock outcrops.
- The site is located in quarter 87; pine dominated by birch is dominant in the tree layer. Rocky, lingonberry forest types prevail. They protect from water and soil erosion.
- Forest areas on steep slopes, cliffs.
- The site is located in the quarter 96; pine forests with an admixture of other species (birch, aspen, and larch) predominate. Forest types vary widely depending on the exposure of the slope and moisture conditions: lichen, lingonberry, forbs, green moss, etc.
- Forest areas during the transition from closed to open areas.
- The site is located in quarter 9, plantations on the top and upper slope with a group of establishing undergrowth. The species composition is pine, birch and aspen.
- Areas of dark coniferous forests among light coniferous and deciduous.

The site is located in quarter 9. Dark coniferous species grow in areas with high air humidity. Soils are soddy-podzolic, light loamy, moist, medium-power. In the stand there is a pine mixed with birch, establishing undergrowth of pine and birch. The ground cover is diverse, with ferns, tall grasses, shrubs (blueberries, etc.).
- Forest areas with a lot of dead wood.

The site is located in quarter 10. The plot contains coniferous and deciduous trees of varying degrees of decomposition, including large trunks (with a diameter of 0.5 m or more), as well as dead trees and motts (high stumps).
- Forest areas with a lot of dead fall.

The site is located in quarter 87. The plot contains coniferous and deciduous trees of varying degrees of decomposition, including large trunks (with a diameter of 0.5 m or more).

Table 1 presents an example of a description of the key habitat “Forest areas with a large number of dead wood” [12].
It is recommended to keep the deadwood intact, taking into account the buffer zone with a size equal to the height of the canopy. Forest areas with accumulation of detritus of varying degrees of decomposition (dead wood, high stumps, and dead fall) are categorized as non-operational [11].

In the presented article, key habitats were assessed by three criteria: age, marketability, and anthropogenic impact (table 2) [13].

The age of the stand is the age range used to characterize the age structure of the stand depending on the breed. It enables to evaluate the state of the object with time [14].

The ripening age of the forest stand is the age at which the forest stand acquires quantitative and qualitative indicators that are most consistent with the objectives of the economy. The species distinguish between quantitative, technical, renewal and other ripeness of the stand [14].

It is distinguished:

- young forest stand, or young growth - at the age from its closure to the end of the second age class;
- middle-aged forest stand - from the beginning of the third age class to the ripening age;
- ripening stand – an age class which precedes the age of ripeness;
- ripe forest stand - reaching the age of ripeness;
- overgrowing stands - at an age exceeding the beginning of the ripening period by two or more age classes.

The marketability class is an indicator of the quality of the wood stock of ripening, ripe and overripe stands. It is determined by the percentage of commercial timber output from the total stock of the stand or the number of business trees from the total number of trees in the stand. It makes it possible to assess the state of the object, taking into account the state of trees [14].

Table 1. Description of the key habitat “Forest areas with a lot of dead fall”.

| Research parameters                  | Research result                                                                 |
|--------------------------------------|---------------------------------------------------------------------------------|
| Site location and area               | Quarter 87. Division 45. Area of 7.9 hectares                                   |
| Characteristics of the stand (composition, age, D, N) | 10P + B 130 years. D = 36 cm, H = 21 m                                         |
| Features extracted                   | On the site there is a dead fall of various species of varying degrees of decomposition, including trees (with a diameter of 50 cm or more), as well as other large detritus. |
| Relief                               | Not specific. The microrelief is usually well pronounced: bumps and hollows (outfalls) of different sizes and development. The soils are gray, forest podzolic, light loamy, fresh, medium-power. |
| Vegetation                           | Forest type: P_{OCPT}. Forest stands are renewed with the growth of trees on fallen trunks and stumps. |
| Traces of anthropogenic activity     | Not visible                                                                     |

The following formula was used for an overall assessment of key habitats:

\[
OKM = OKM_A + OKM_{KT} + OKM_{AH},
\]

where \( OKM \) – final assessment of the site;
\( OKM_A \) – plant age rating;
\( OKM_{KT} \) – valuation based on marketability class;
OKM<sub>AH</sub> – anthropogenic load rating.

Assessment of stands by age was carried out according to a 3-point system: 0 - disturbed stand; 1 - young growth; 2 - ripe, ripening stand of III class bonitet and lower; 3 - ripe, ripening forest stand of I, II classes bonitet.

The scale of points for classes of marketability corresponds to the following structure (I class - 4 points, III class - 2 points).

Habitat assessment by anthropogenic impact was carried out in three groups: high, medium and low load (3-point scale).

Based on the total score - 10 points, a scale was developed for assessing the status of key habitats (<4 - unsatisfactory, 5-8 - satisfactory, 9-10 - good).

The predominant species is pine, both in pure and mixed stands. The marketability class is 3, 4. By age, these stands belong to the maturing stands.

Based on the class of marketability, the age of the stands, points and an overall assessment of the status of key habitats were determined. The results are listed in table 2.

Key habitats were characterized by a variety of source objects: pure pine and mixed pine and birch plantations mixed with aspen, larch; height varied from 17 to 25 m; diameter from 16 to 36 cm; age from 60 to 130 years.

**Table 2. Assessment of key habitats.**

| Name | Age rating | Overall score and assessment | Marketability class rating |
|------|------------|-------------------------------|---------------------------|
| Key habitat No. 1, species composition: pure 10P + B, 130 years. D = 36 cm, H = 21 m | 3 | 7 | satisfactory |
| Key habitat No. 2, species composition: mixed 8B2P, 65 years old. D = 26 cm, H = 22 m | 2 | 5 | satisfactory |
| Key habitat No. 3, species composition: mixed 9B1P, 60 years. D = 26 cm, H = 21 m | 2 | 5 | satisfactory |
| Key habitat No. 4, species composition: mixed 8P2B, 110 years. D = 36 cm, H = 25 m | 3 | 7 | satisfactory |
| Key habitat No. 5, species composition: pure 10P, 70 years. D = 16 cm, H = 17 m | 3 | 6 | satisfactory |
| Key habitat No. 6, species composition: mixed 8P2B, 65 years old. D = 24 cm, H = 24 m | 3 | 6 | satisfactory |
| Key habitat No. 7, species composition: mixed 5B3A2P, 60 years old. D = 26 cm, H = 22 m | 2 | 5 | satisfactory |
Key habitat No. 8, species composition: mixed 9P1B, 110 years. satisfactory
\[ D = 30 \text{ cm}, \quad H = 25 \text{ m} \]

Key habitat No. 9, species composition: mixed 8B1P1L, 75 years old. satisfactory
\[ D = 26 \text{ cm}, \quad H = 22 \text{ m} \]

4. Conclusion
As a result of the work carried out, it was established that the key habitats allocated in the Krasnoyarsk forestry are in satisfactory condition. To preserve these areas, it is recommended to reduce the anthropogenic load and develop a system of protective measures in order to preserve biodiversity.

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