

Climatic conditions of tundra and steppe formations in the Altai highlands

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The data on climate and vegetation of the Altai highland depressions are mapped in this paper. Investigations were conducted in June-July 2018 within the Bertek depression (the Ukok Plateau) and the Khindiktig-Khol' area that are decided to be the study objects. Also, the meteorological data of Bertek and Mugur-Aksy (about 40 km east to Khindiktig-Khol' Lake) were applied. The study was financially supported by Russian Foundation for Basic Research (RFBR) (Grant №18-05-00860).

During the investigations, the standard meteorological researches were carried out, using the automatic weather station HOBO and albedo survey. What is more, the detailed characteristics of vegetation cover were compiled. The steppe (*Poa attenuata*, *Helictotrichon hookeri*, *Festuca lenensis*) and tundra patterns (*Betula rotundifolia*, *Dryas oxyodonta*, *Kobresia myosuroides*) are typical of Khindiktig-Khol' area. In some cases, the intarsia of two communities is founded. The steppe vegetation (*Festuca kryloviana*, *Poa attenuata*, *Ptilagrostis mongolica*) is predominant in the Bertek depression, whereas the tundra patterns are insignificant.

Vegetation cover of the depressions develops under the conditions of short-term vegetation period and undergoes the negative impact of low summer temperatures. The mean July temperatures of the described depressions (Bertek – +9.3°; Khindiktig-Khol' – +10.8°) are lower than the average values of the plain steppe/forest-steppe (the mean July temperature of forest-steppe is from +18° and higher). Moreover, the July temperatures of the studied areas are lower than in the forest-tundra of North Eurasia (from +12 – +13° and higher). Due to the low summer temperatures the trees cannot grow in the Bertek and Khindiktig-Khol' areas. Hence, the depressions should have resembled the tundra landscape zone with the mean July temperature +7.5 – +12°. However, the continuous cover of tundra cenoses is impossible due to the arid climate. We estimated the Vysotskii-Ivanov's precipitation-evaporation coefficient (K) (ratio of annual precipitation to annual evaporation). The K-coefficient of Khindiktig-Khol' equals 0.74, whereas in Bertek – 0.61. These values are lower than the K-coefficient of North European tundra (>1.5).

Microclimatic observations of the neighboring areas with the different tundra and steppe cenoses show that the species, which are forming tundra with the dwarf birch (*Betula rotundifolia*), have unique features, thus creating favorable conditions for the existence of this community. Comparing to the steppe area, the air during the daylight heats better not only above the tundra pattern, but also beneath it. Moreover, the dwarf birch (*Betula rotundifolia*) keeps the snow cover, which results in a better soil humidification and a reduction in seasonal freezing. Consequently, these factors result in diverse vegetation cover and appearance of exclusive tundra and steppe mixture in Khindiktig-Khol' depression.