

The transformation of vegetation vertical zonality affected by anthropogenic impact in East Fennoscandia (Russia)

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Ecosystems of East Fennoscandia have been affected by intensive anthropogenic influence that resulted in their significant transformation. Study of ecosystems in the framework of vegetation vertical zonality disturbance as well as its recovery allows to understand the trends of anthropogenically induced changes. The aim of the present research is the comparative analysis of vegetation vertical zonality of the two uplands in East Fennoscandia which may be considered as unaffected and affected by anthropogenic impact.

The objects of key studies carried out in the north-west of Kola Peninsula in the vicinity of the Pechenganikel Mining and Metallurgical Plant are represented by ecosystems of Kalkupya (h 357 m) and Hangaslachdenvara (h 284 m) uplands. They are characterized by the similarity in sequence of altitudinal belts due to the position on the northern taiga – forest-tundra boundary. Plant communities of Kalkupya upland have no visible signs of anthropogenic influence, therefore, they can be considered as model ecosystems of the area.

The sequence of altitudinal belts is the following:

- up to 200 m – pine subshrub and green moss (“zonal”) forest replaced by mixed pine and birch forest near the upper boundary;
- 200-300 m – birch crooked subshrub wood;
- above 300 m – tundra subshrub and lichen communities.

Ecosystems of Hangaslachdenvara upland have been damaged by air pollution (SO₂, Ni, Cu emissions) of the Pechenganikel Plant. This impact has led to plant community suppression and formation of barren lands. Besides the soil cover was significantly disturbed, especially upper horizons. Burying of soil profiles, represented by Podzols (WRB, 2015), also manifested itself in the exploited part of the area.

The vegetation cover of Hangaslachdenvara upland is the following:

- up to 130 m – birch and aspen subshrub and grass forest instead of pine forest (“zonal”);
- 130-200 m – barren lands instead of pine forest (“zonal”);
- above 200 m – barren lands instead of birch crooked subshrub wood, which stretched to the north-east, proving the leading role of prevailing southwestern winds in pollution spreading in the area.

As the anthropogenic impact decreases due to the Plant’s emissions decline, there have been identified signs of ecosystem restoration. The beginning restoration helps parvifoliolate forests to grow in barren lands, including the above-mentioned birch and aspen forest on Hangaslachdenvara upland. Reductive processes of soil formation are responsible for the development of soddy or raw humus horizons in the substrate overlaying the well-developed Podzols. Nevertheless, there is no restoration above 130 m on Hangaslachdenvara upland owing to the barrier effect, in other words, intensive deposition and accumulation of air pollutants on the upland’s top.

Thus, there has been defined that the anthropogenic impact led to total vegetation vertical zonality modification and physical disturbance of soil cover in East Fennoscandia. The typical taiga scheme of “coniferous forest – birch crooked wood – tundra subshrub and lichen communities” altitudinal belts was replaced by that of “parvifoliolate forest – barren land” altitudinal belts. However, after the reduction of anthropogenic influence “zonal” plant communities begin to restore gradually and weak developed soils are forming.