# CHANGES OF THE RUSSIAN ARTIC BIOTA: THE SCALES AND FACTORS

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Recently due to the cumulative and cascade effects of climate warming and economic activities in the Russian Arctic, there have been significant changes in biota and ecosystems. It, may result in a change in the biogeographic status of the territory and the need to revise approaches and methods of territorial nature protection. So, in the Laboratory of Biogeography of the Institute of Geography investigations of the different-scale, different-time and multidirectional changes in the biota and ecosystems of the Russian Arctic are being conducted. The general aim of the studies is mechanisms and regularities of these processes revealing for optimization of nature use and correction of territorial nature protection in the Russian Arctic. Among the expected results are the regularities of the current dynamics of different groups of plants and animals, new data on changes in the distribution of Arctic species and the northward expansion of boreal species, a description of biogeographic phenomenology and “divisions” of biogeographic boundaries, mechanisms of changes of Arctic flora (invasions, etc.).

To date with the use of remote and ground-based research the following trends of the arctic biota and ecosystems have been revealed:

- as a result of synergetic effect of changing climate and expanding economic activities the territories with destabilized mode of development make more than 10% of the area of the Arctic zone of the Russian Federation (AZRF);

- the reasons for the destabilization of ecosystems - "greening" of the tundra - are mainly due to an increase in productivity and changes in the structure of vegetation cover, which is the driver of many modern processes of dynamics of Arctic biota (composition, distribution and changes in the number of Arctic birds and mammals);

- the mechanisms of trends in the composition and number of terrestrial vertebrates (birds, mammals) in some regions of the Arctic over the past decades associated with the effect of "greening" and the productivity growth of tundra vegetation are ascertained.;

- the peculiarities of changes in the area boundaries of the indicator mammalian Arctic species (Arctic fox, hoofed lemming, reindeer, muskox) are ascertained; the original circumpolar maps of the areas of species during maximum glaciation and at the present stage of climate warming are created; the climatogenic character of reorganizations is shown and the population status of these indicator species is predicted under the conditions of continuing warming and movement of boreal mammalian species to the north that capable to compete with the Arctic species;

- new data on changes in the numbers, timing and migratory routes of seabirds of the East Atlantic flyway are received in connection with the climate warming and habitat transformation in breeding and wintering areas by example of long-tailed duck and Barnacle goose;

- the analysis of the current dynamics of the numbers of Arctic rodents and Arctic foxes (over past 25 years) is performed for the whole territory of the Russian Arctic for the first time based on the data collected under the program "Arctic Birds: international data Bank of breeding conditions" (www.arcticbirds.ru). According to the results of spatial analysis (matrices reflecting the state of populations in 28 regions – from the Kola Peninsula to Chukotka since 1994 to nowadays), it is shown that the population cyclicity has a heterogeneous spatial pattern: its "extinction" is more pronounced in the European tundra zone, but the cycles are remaining at the Taimyr Peninsula, Northern Yakutia and the Chukotka Peninsula;

- the mechanisms of the wild reindeer area fragmentation are ascertained associated with the "greening" of the tundra and violation of the integrity of the vegetation cover in the summer and winter habitats respectively;

- the mechanisms of the “greening” are ascertained at the Kola Peninsula (forest and shrub area increase) and Kolguev Island (shrub area increase) against the background of the climate change and the modern strengthening of the economic activity; the increase of the alien plant species quantity in the

Russian Arctic and adventization of the flora in whole is recorded: from 4-5% at the Chukotka Peninsula to 20-40% in the north-western Russia;

- the analysis of remote information showed that the areas of degraded ecosystems prevailed over the areas of the natural cover restoring territories in the most of the Russian Arctic regions; the part of the areas with a stable ecosystem state (for the period 2000-2015) was from 60% (Murmansk region) to 98% (Chukotka Autonomous District); the prosperous state (more than 95% of territories with stable and restoring cover) was recorded besides Chukotka in the Arkhangelsk and Magadan regions); the catastrophic ecosystem degradation in absolute terms was recorded in the Tyumen region, the Republic of Komi and the Krasnoyarsk region (200-300 thousand km2), in relative terms – in the Murmansk region (about 37%), the Republic of Karelia (about 18%), the Tyumen region (15.5%), the Republic of Komi (about 15.5%).