INSTITUTE OF GEOGRAPHY
Russian Academy of Sciences
Founded in 1918

«Greening» of Tundra as a Driver of the Current Trends of the Arctic Biota: Russian Perspective

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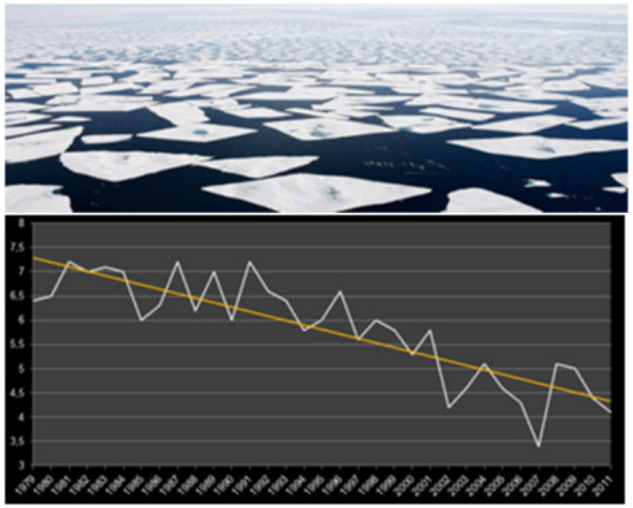
Researches in the Laboratory of biogeography of the Institute of geography, Russian Academy of Sciences on biogeographic effects of the Russian Arctic "greening”

1. Remote sensing of the space images (archive MODIS 2000 and 2014) for the whole territory of the Russian Arctic: experience on tree limit’s moving, tundra "greening“, increasing of the ecosystems’ productivity.
2. Evaluation of biodiversity: studying of Arctic mammals’ populations’ dynamics.
3. Data collection on the number and changes of migration routes of waterfowl birds.
4. Mapping of areas of indicator mammals and birds species during the last 100 years.

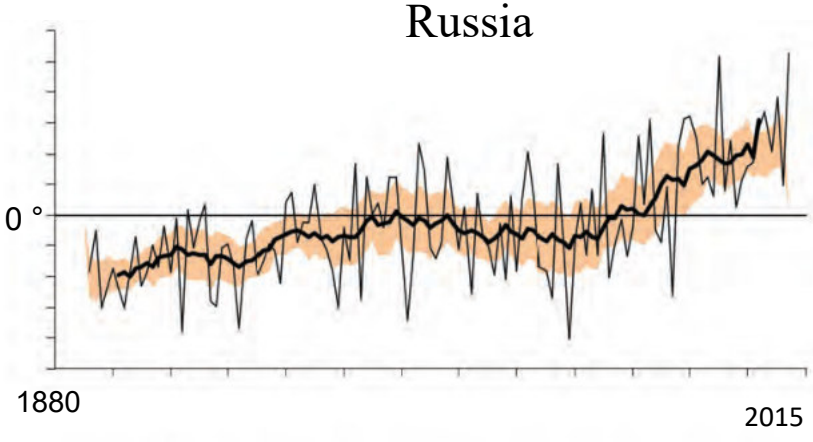
Reversible and irreversible effects of climate change and economic activities in Russian Arctic



Area of sea ice decreasing (the White sea)

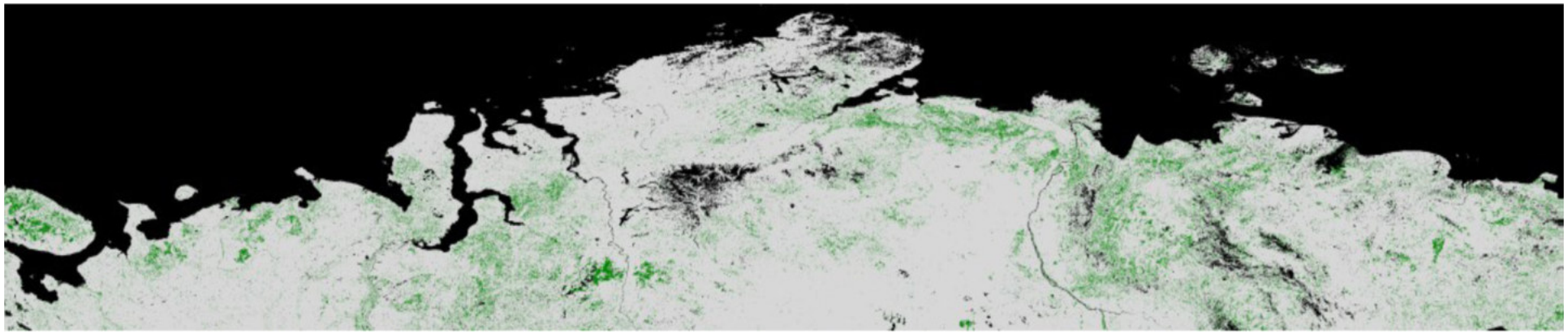
Resourse development & reindeer breeding

Changes of permafrost area's limits in Russia



Changes in anomalies of average annual surface air temperature averaged over the territory Russia (step 15 years; 0.8 ° C) [according *The second assessment report of the* ... 2014]

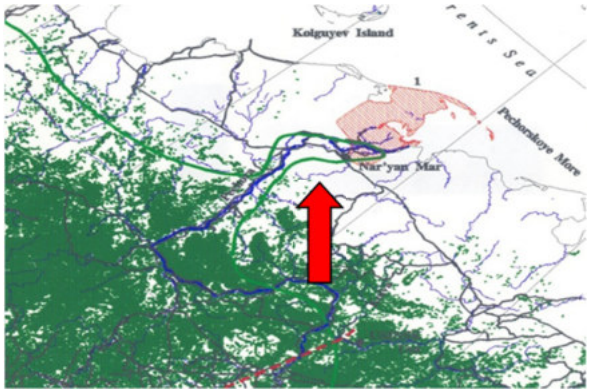
The effects of the Russian Arctic "greening" in the XXI century



- Changes of the composition and structure of vegetation: increasing of the complexity of the plant communities' structure and the life forms' spectrum
- The movement of the forest limit to the North (frontal – not fragments)
- Increasing of shrubs' cover and new effects - accumulation of snow, change of permafrost and soil regime, etc.)
- Increasing of the proportion of sedges and grasses in plant communities
- Decreasing of lichens cover (not only zoogenic, but also climatogenic)
- Invasions of alien species and their introduction in the nature ecosystems

Reversible and irreversible effects of climate change and economic activities in the Russian Arctic

Woods moved in some Arctic areas for dozens kilometres



Trend of shrub vegetation invasion to treeless biomes

Betula *Salix* *Duschekia*

Reversible and irreversible effects of climate change and economic activities in the Russian Arctic

Increasing of the proportion of sedges and grasses in tundra plant communities

Kandalaksha nature state preserve

Invasions of alien species and their introduction in the nature ecosystems

Hordeum jubatum

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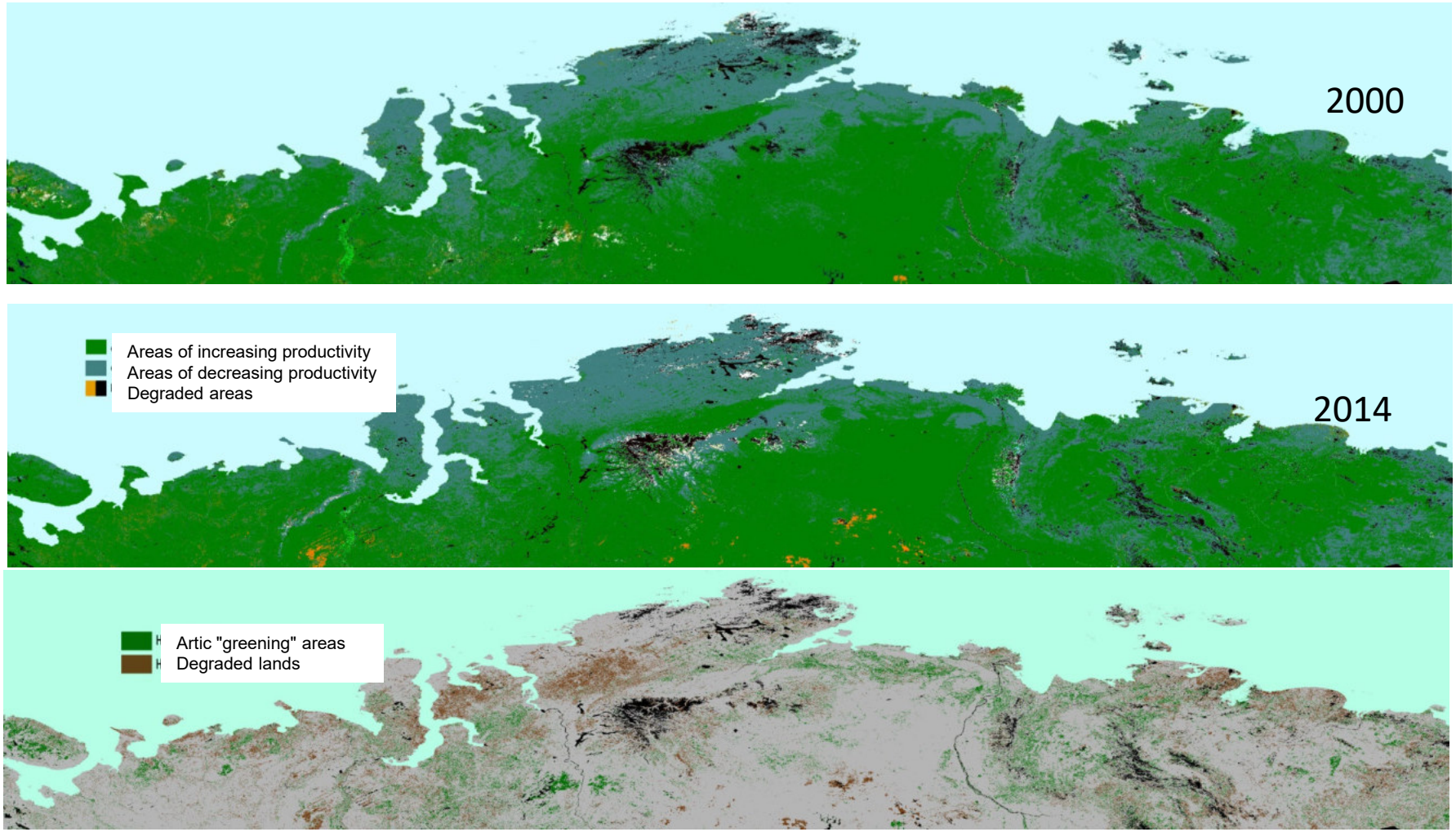
Erigeron canadensis

The process of the Russian Arctic "greening" based on remote sensing data (scenes of MODIS data 2000 and 2014)



Synergistic effects of vegetation dynamic on the area of nearly 300 thousand km2

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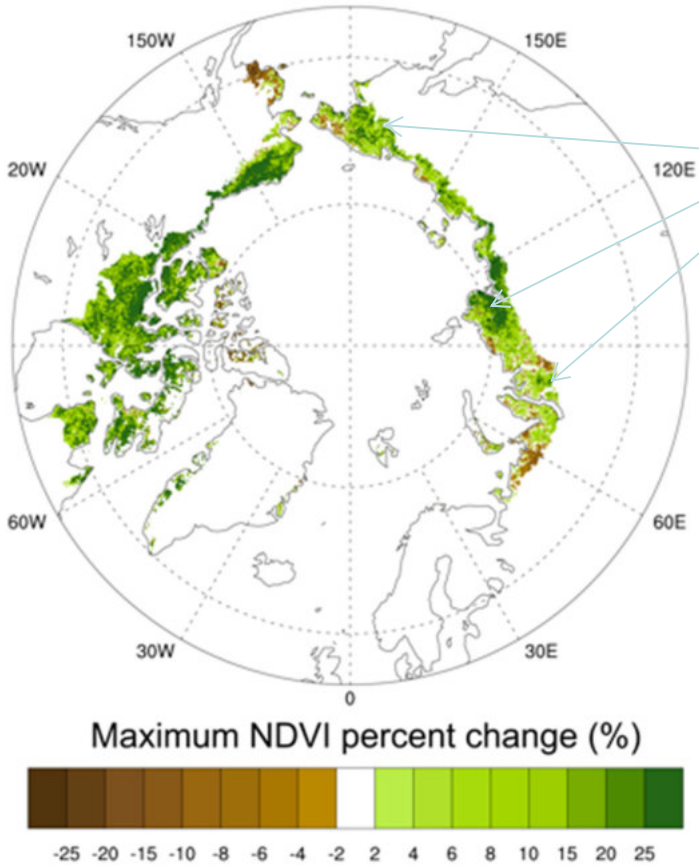
Comparing of the received data with the identified trends of changes (%) MaxNDVI in the circumpolar Arctic from 1982 to 2012 (Bhatt et al. 2013)



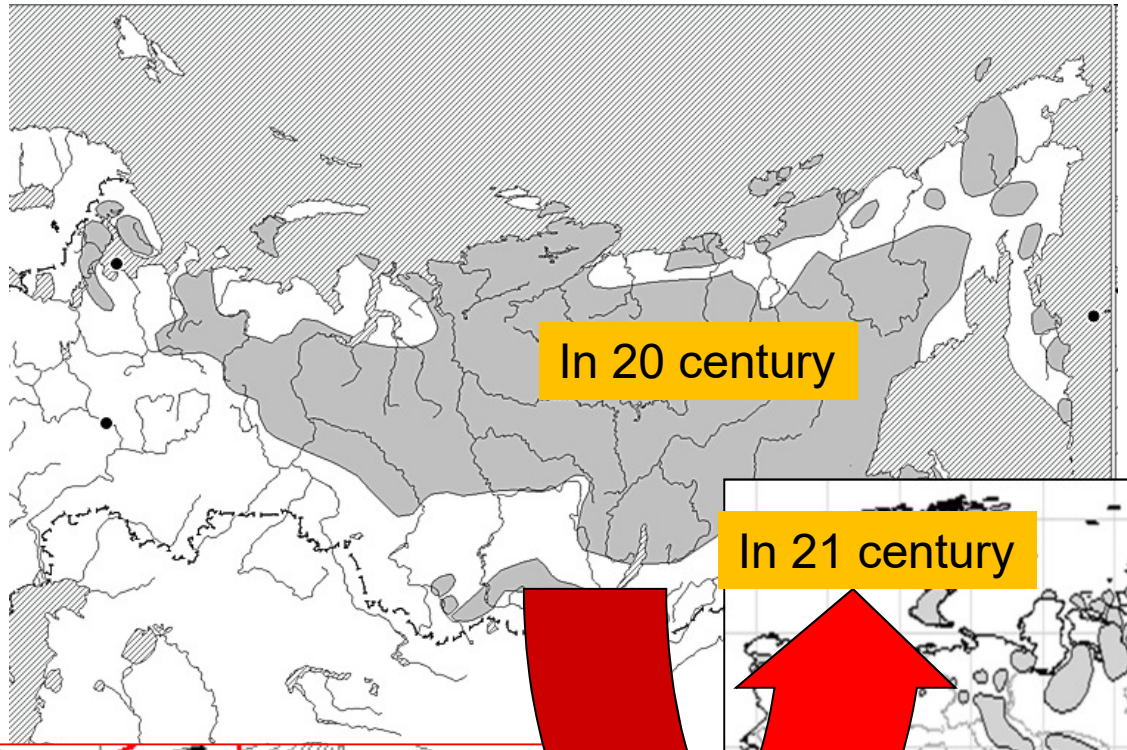
In Russian Arctic increase NDVI on 15-30%

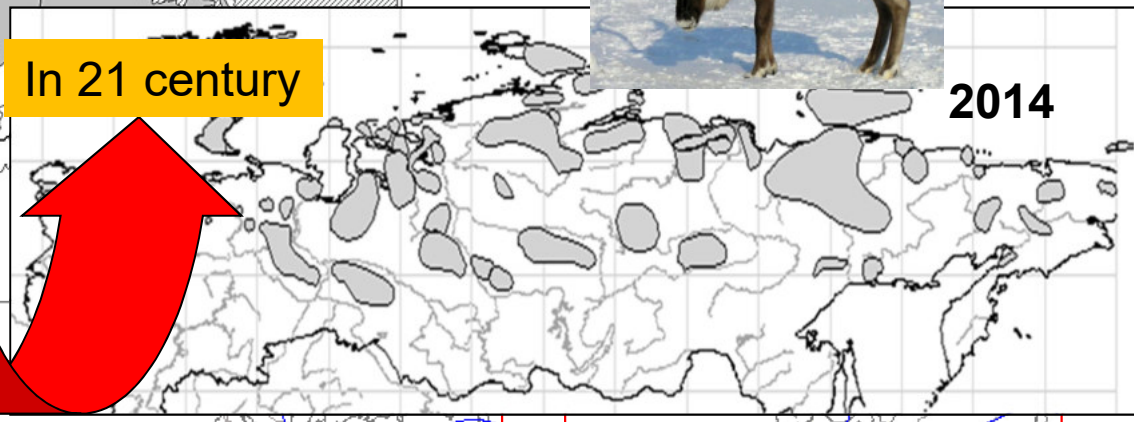
Bhatt, U. S., D. A. Walker, M. K. Raynolds, P. A. Bieniek, H. E. Epstein, J. C. Comiso, J. E. Pinzon, C. J. Tucker, and I. V. Polyakov. Recent declines in warming and arctic vegetation greening trends over pan-Arctic tundra. Remote Sens. (Special NDVI3g Issue), №5, 2013. Pp. 4229-4254.

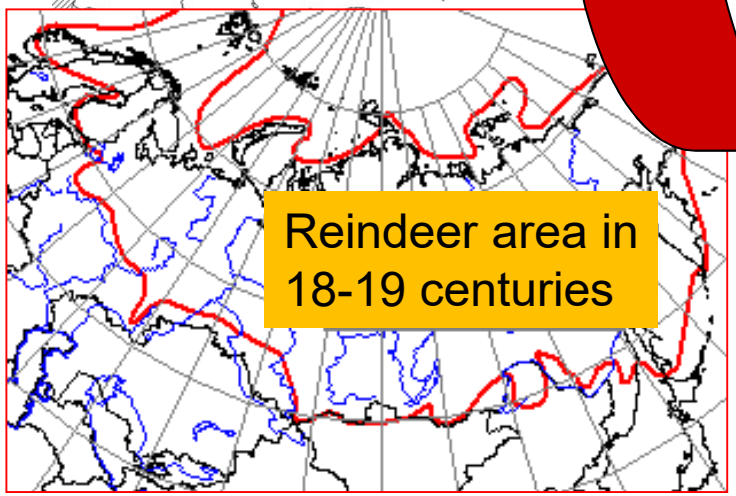
Synergistic effects on the Arctic animals

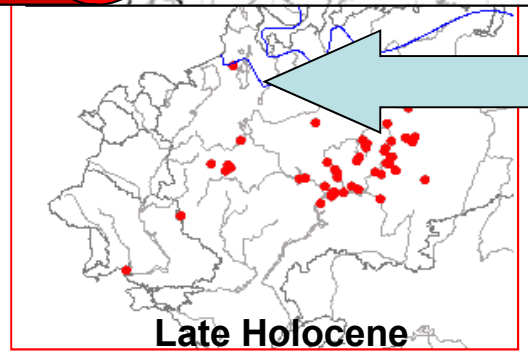
- The habitat fragmentation of reindeer
- The increasing of herbivorous arctic mammals' number
- Reduction and expansion of birds populations' areas
- The movement of boreal mammals to the North
- Changes of the migration routes of Arctic animals (birds, sea mammals)
- 3-4-year cycles' "attenuation" of number of lemmings
- Invasions of alien animals in the sea, in freshwater bodies and on terrestrial area
- Changes of fauna complexes in some regions at the expense of herbivore species

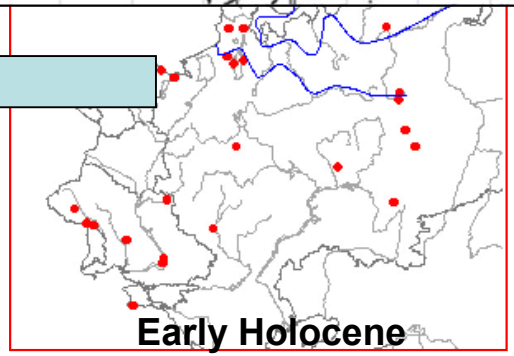
The changes of reindeer area in Russian Arctic











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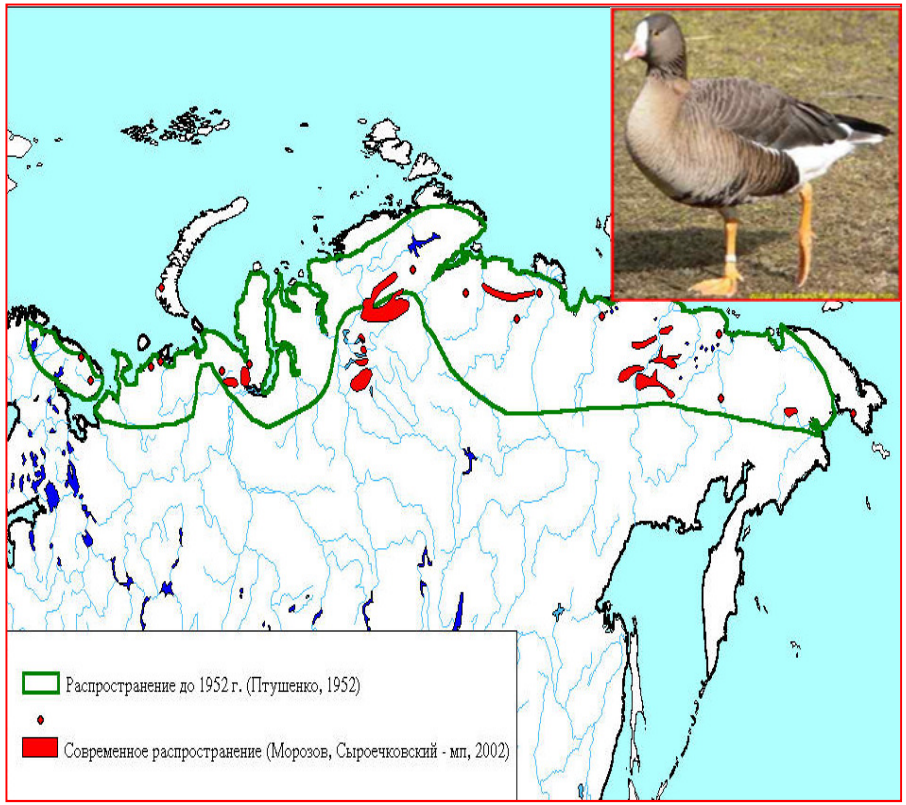
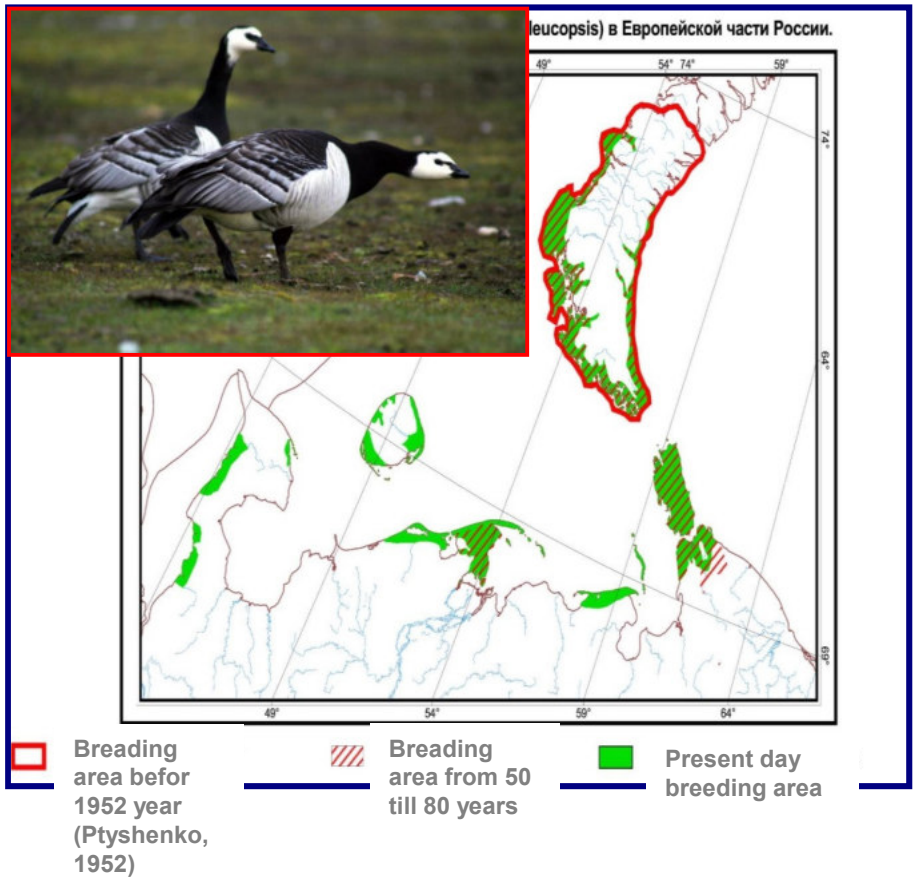
Dynamic of the goose-peeper's habitats - reduction (A) and Barnacle geese's ones – extension (B) in the XX century could be influenced by climatic changes and anthropogenic activities

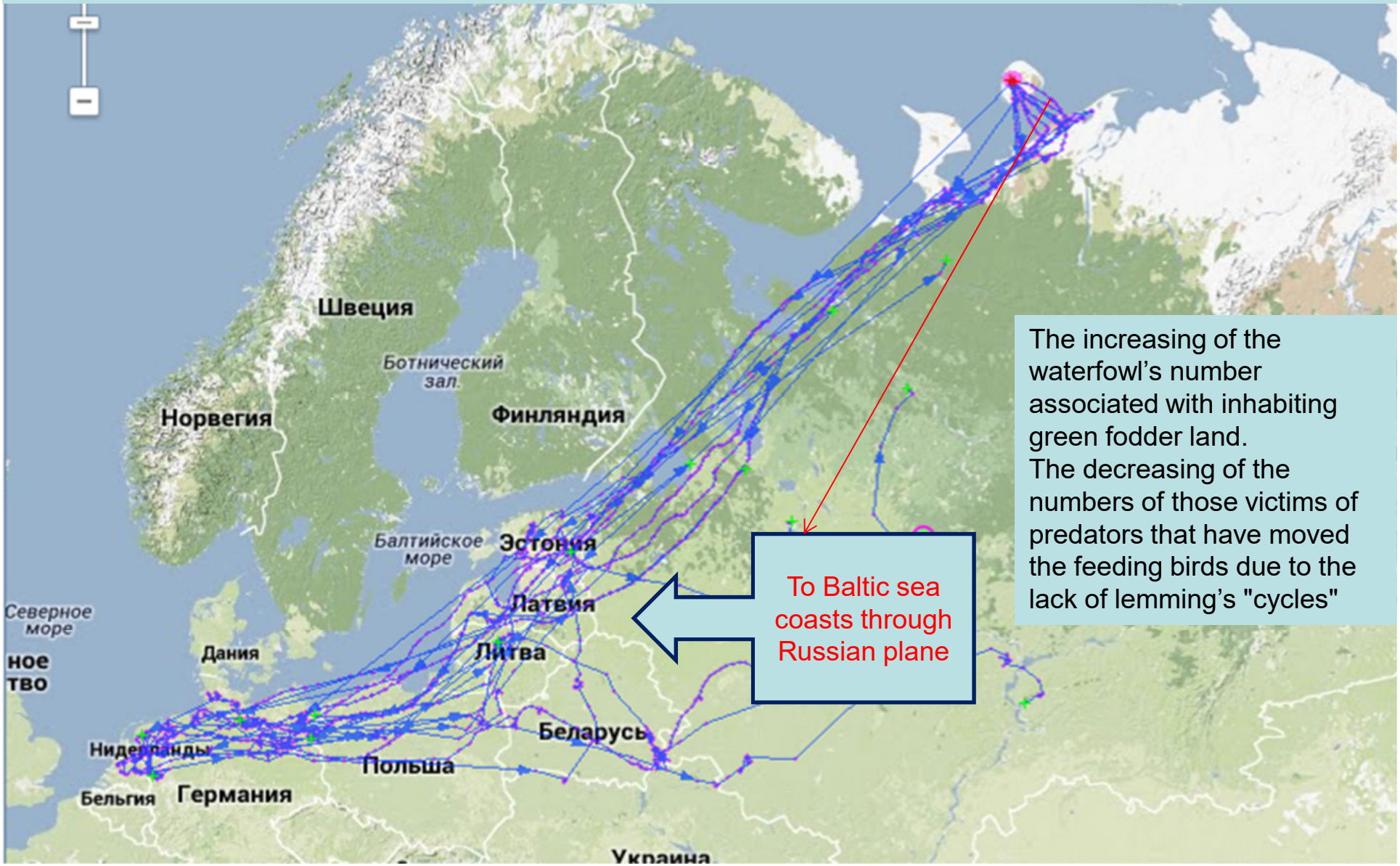
A



B



Changes of white-fronted goose's migration routes (data tagging GPS GSM sensors, 2014)
Laboratory of biogeography Institute of geography RAS, Institute max-Planck, Roscosmos



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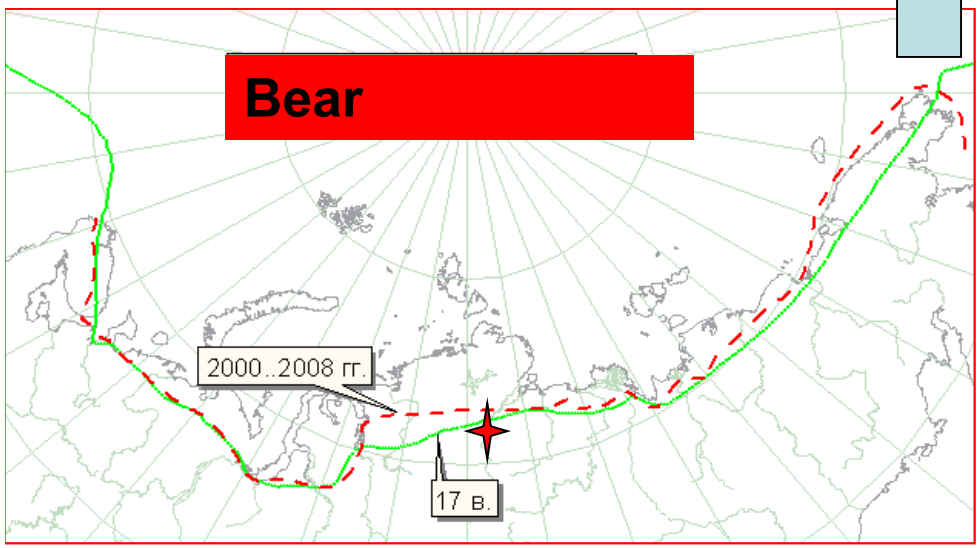
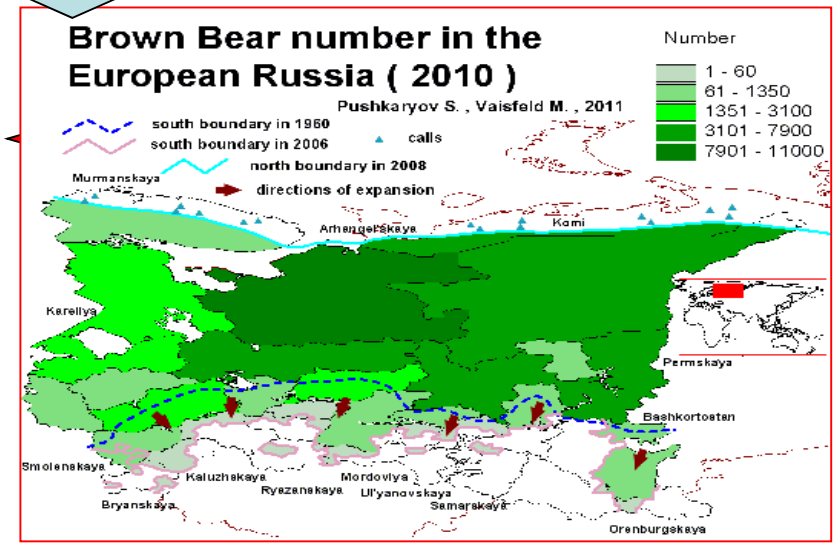
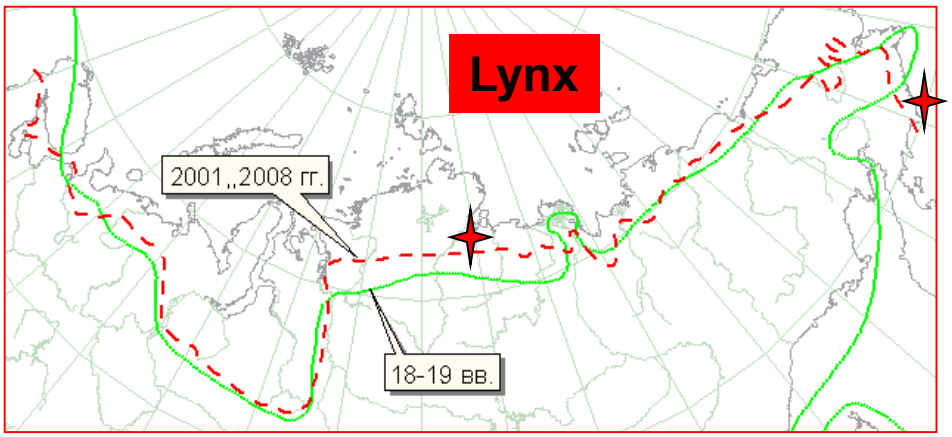
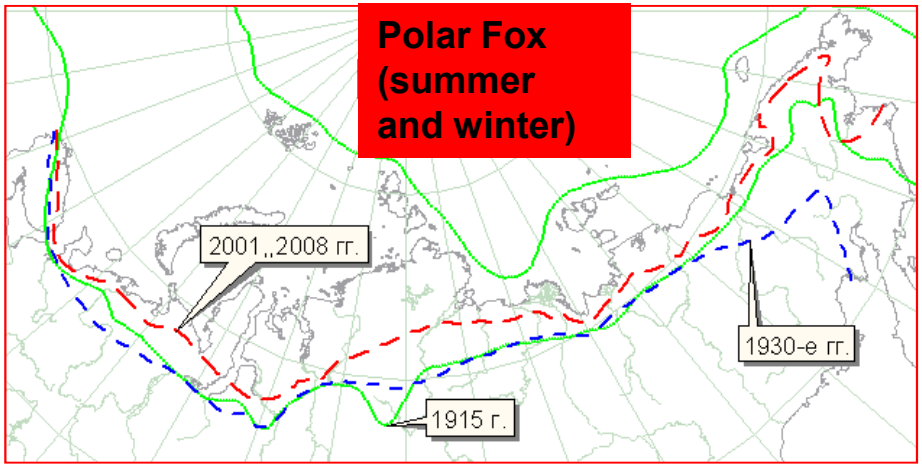
According: G. Tertitsky, P. Glazov

Movement of borders of mammals' distribution to the North

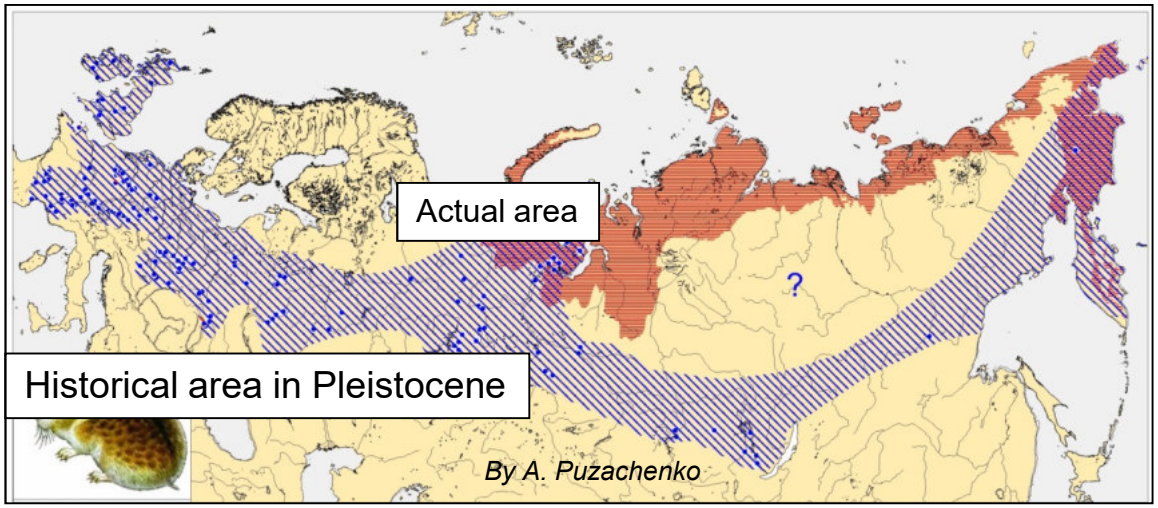


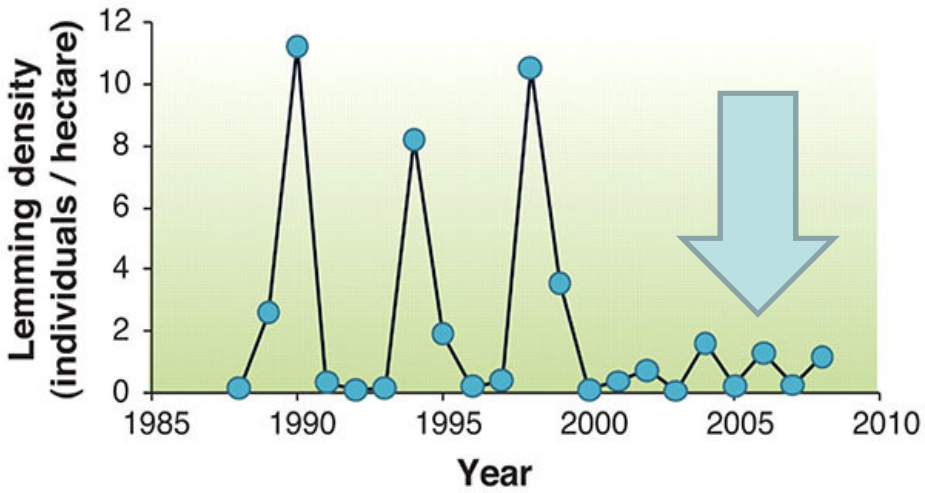




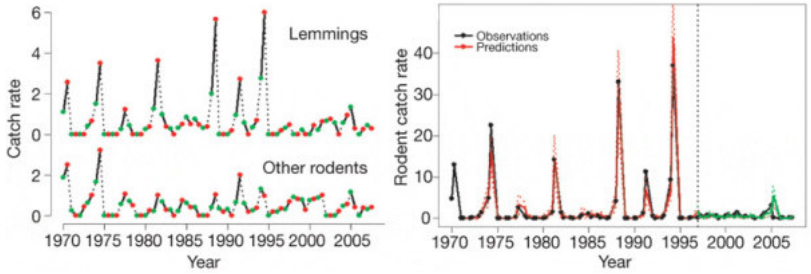


Lemmus - Dicrostonyx





Tundra “greening” is associated with cycles’ “attenuation" of number of lemmings in Arctic



Russian Arctic is another now. It is necessary to adapt activities of monitoring, biodiversity conservation, natural resources development and traditional landuse to the new conditions

1. Considering tundra as carbon-intensive communities, including it to the Post-Kyoto documents (Paris 2015) and use the carbon market as a mechanism for their conservation in protected areas (mechanism of protection)
2. Introduction of new "green standards" of the EU and the USA for the economic mega-projects, including the Standard 6 EU – biodiversity (mechanism of prevention)
3. Introduction of new mechanisms of "green economy" (mechanism of economic stimulation)
4. Development of a network of Arctic protected areas as elements of ecological framework (mechanism of adaptation to the joint influence of nature and anthropogenic factors)

Thanks for attention!

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