Land cover change in Eastern Europe and resulting effects on biodiversity

Radeloff, V., M. Dubinin, A. Prishchepov, C. Alcantara
University of Wisconsin-Madison

Baskin, L., A. Lushchekina, Russian Academy of Sciences

Perzanowski, K., Polish Academy of Sciences

Hostert, P., T. Kuemmerle, Humboldt University, Germany

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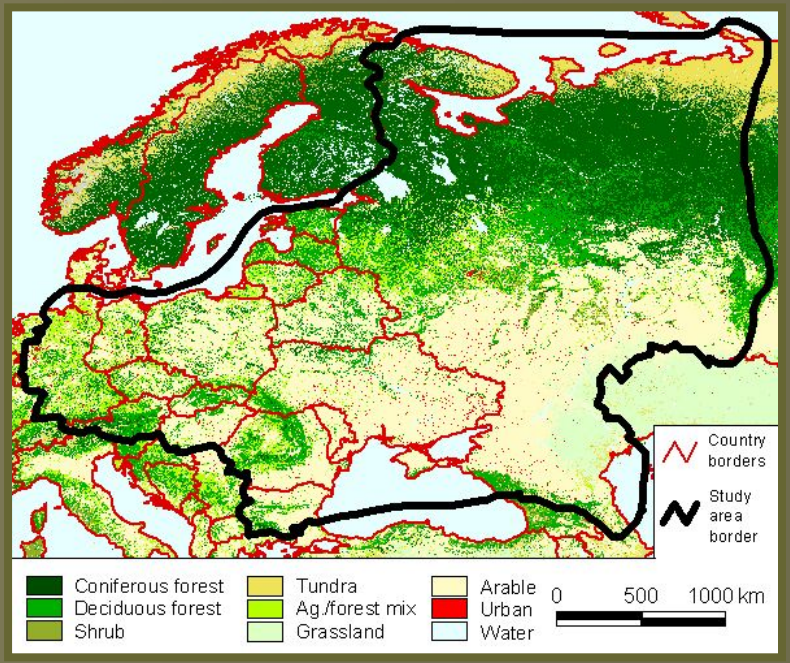
August 22, 2006, University of Maryland Inn and Conference Center

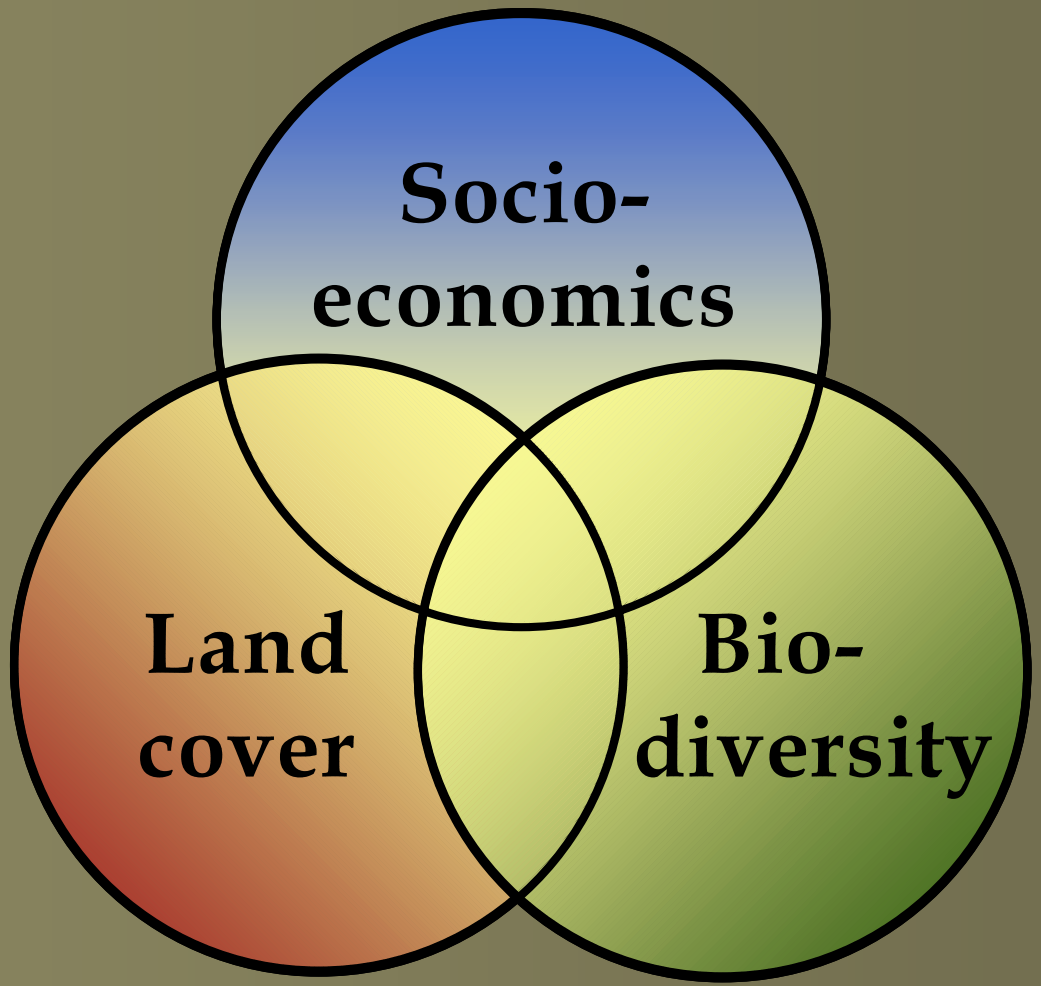
Introduction

- In 1990, the Soviet Union broke down, and with it's control on eastern Europe
- Socialistic state-economies shifted towards capitalistic free-markets
- Question: how did this socioeconomic change affect land use and land cover, and thereby biodiversity



Study area (MODIS land cover)

Introduction



Outline

File Edit View Add Tools Help
Norway
Finland
(Saint Petersburg)
Estonia
Latvia
Lithuania
(Copenhagen)
Denmark
(Moscow)
Belarus
Poland
(Warsaw)
(Prague)
Czech Republic
(Kiev)
Ukraine
Hungary
Moldova
Romania
(Belgrade)
Serbia and Montenegro
(Bucharest)
(Sofia)
Bulgaria
(Tirana)
Macedonia (FYROM)
Greece
Georgia
Armenia
Azerbaijan
(Baku)
1
2
3
4
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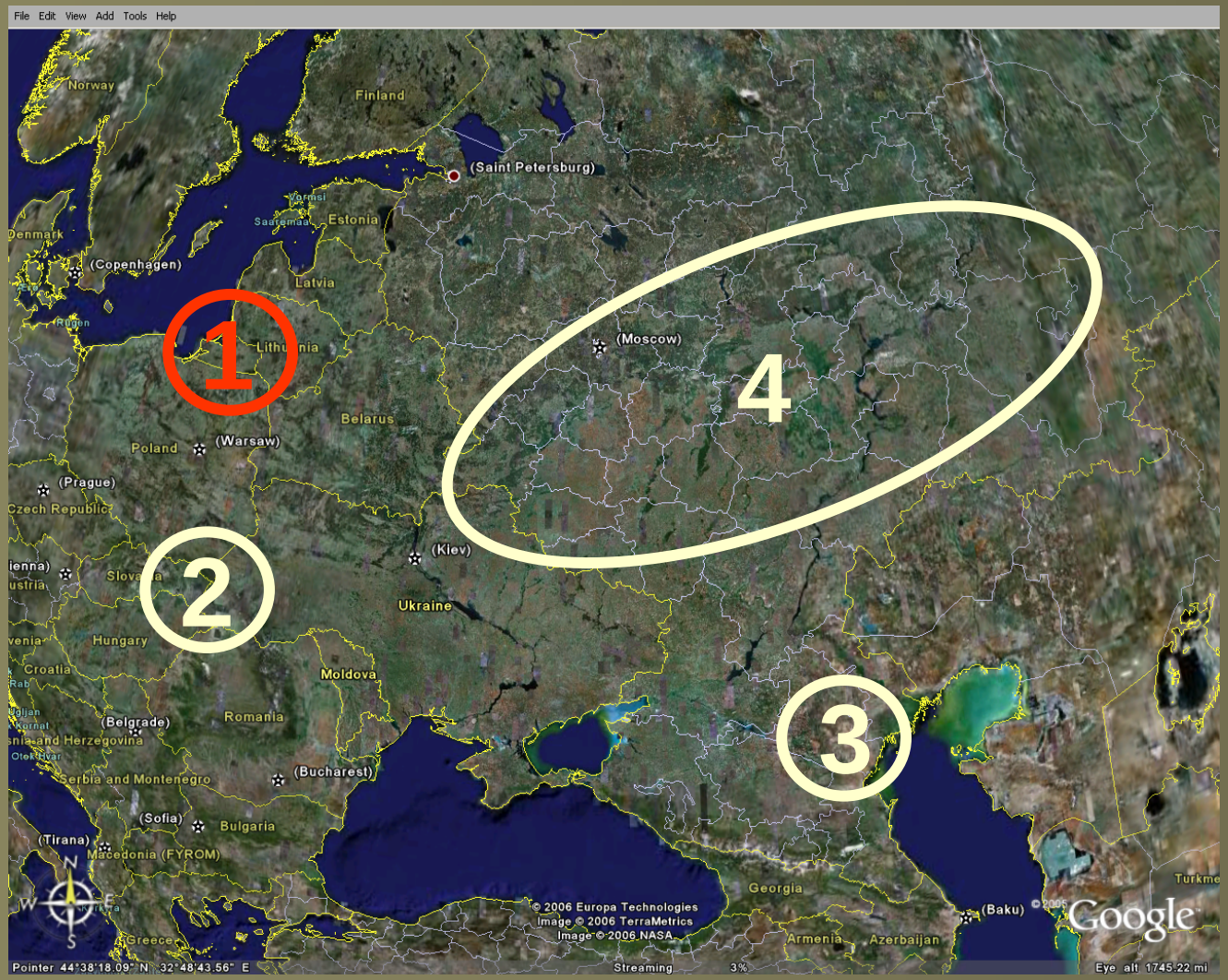
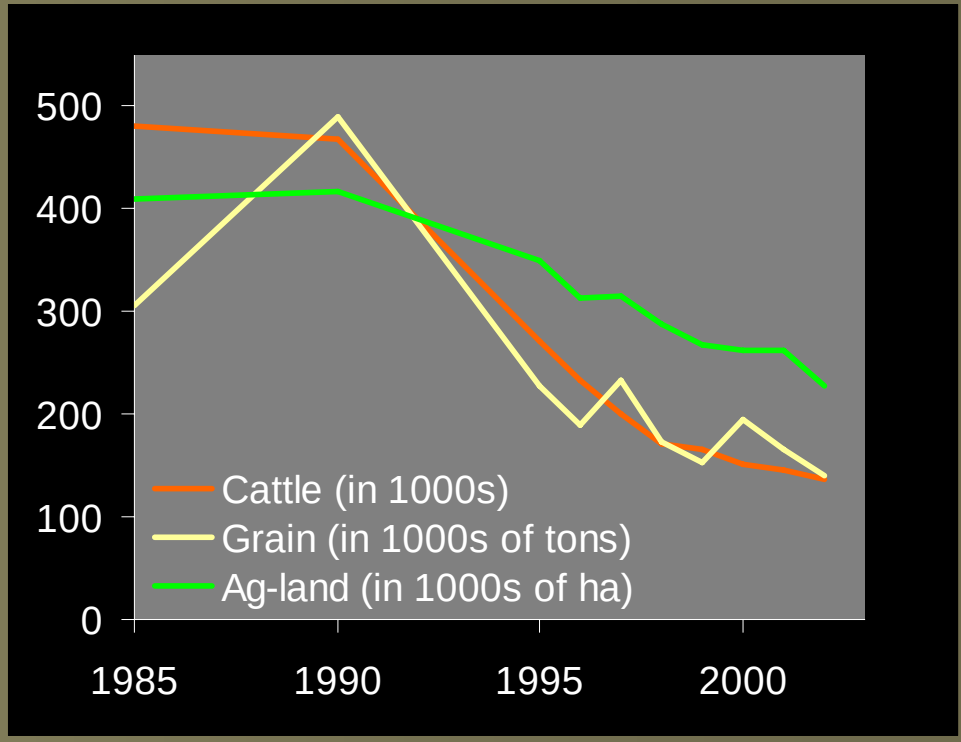
Google
Pointer 44°38'18.09" N 32°48'43.56" E
Streaming 3%
Eye alt 1745.22 mi

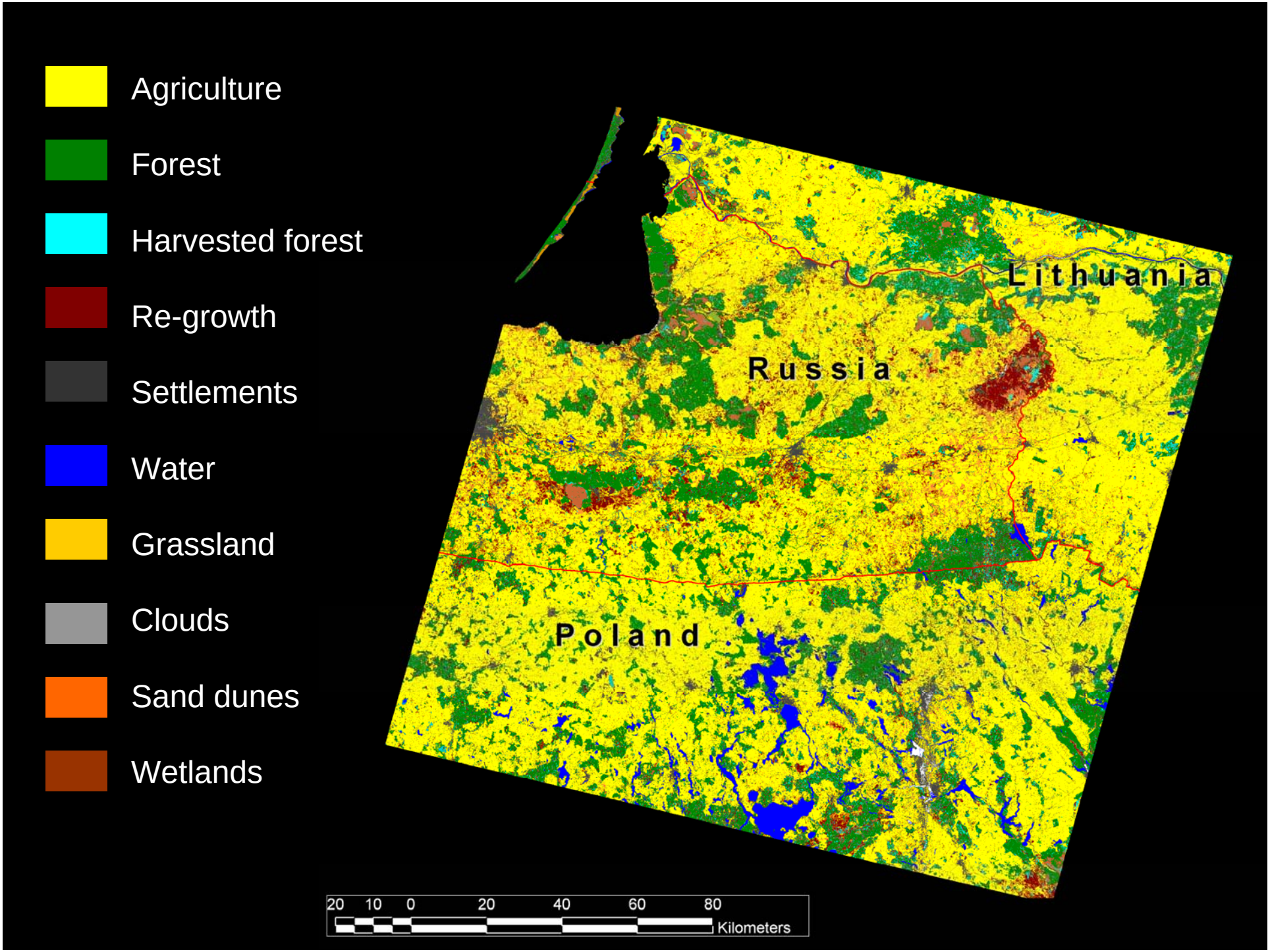
1. Kaliningrad

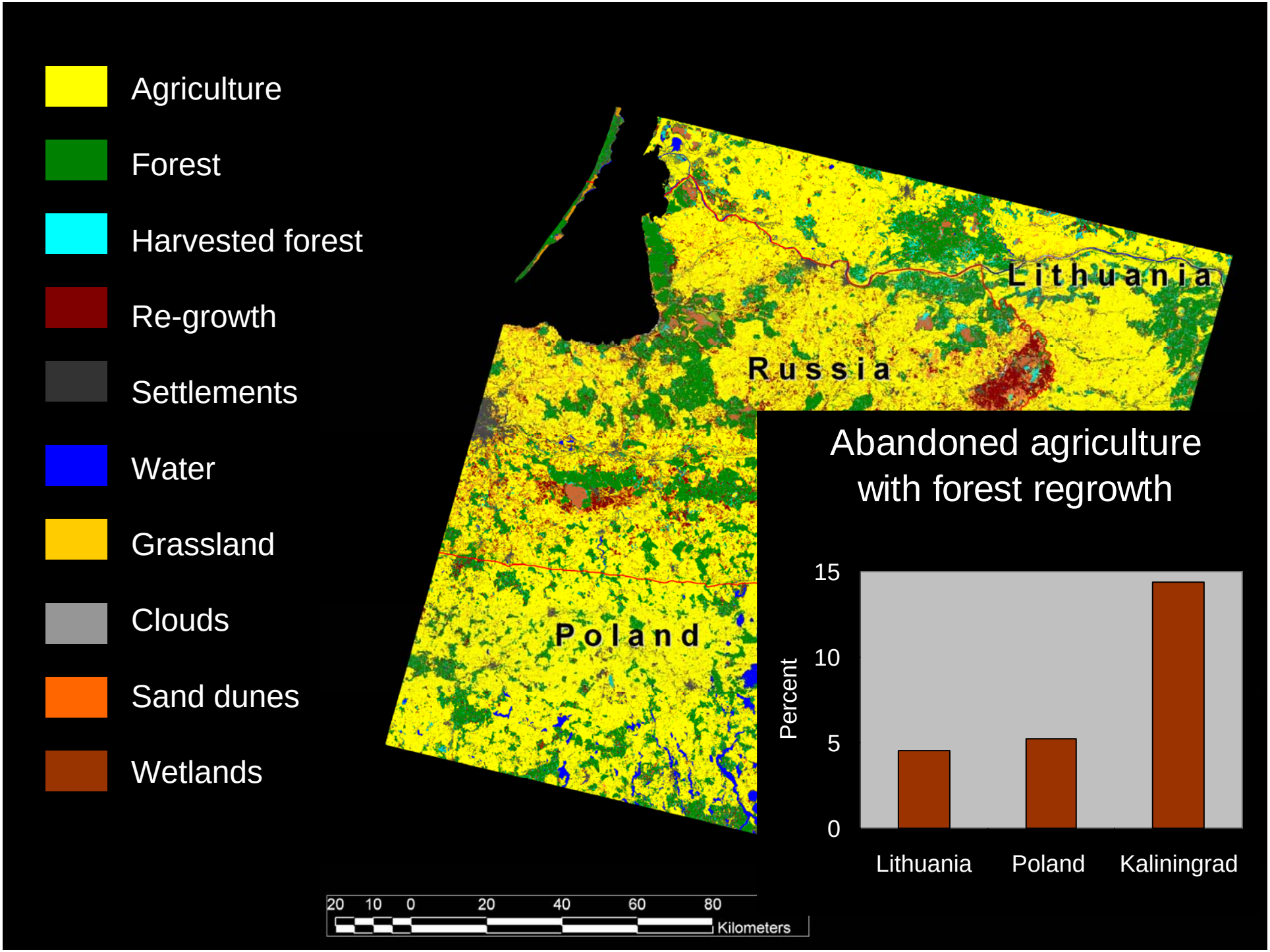


1. Kaliningrad

- Agricultural statistics show strong declines in row crops and livestock since 1990
- Landsat TM/ETM+ change detection 1988 – 2000
- Comparison with Poland and Lithuania




Agriculture
Forest
Harvested forest
Re-growth
Settlements
Water
Grassland
Clouds
Sand dunes
Wetlands
Lithuania
Russia
Poland
20 10 0 20 40 60 80
Kilometers


Agriculture
Forest
Harvested forest
Re-growth
Settlements
Water
Grassland
Clouds
Sand dunes
Wetlands
Lithuania
Russia
Poland
Abandoned agriculture with forest regrowth
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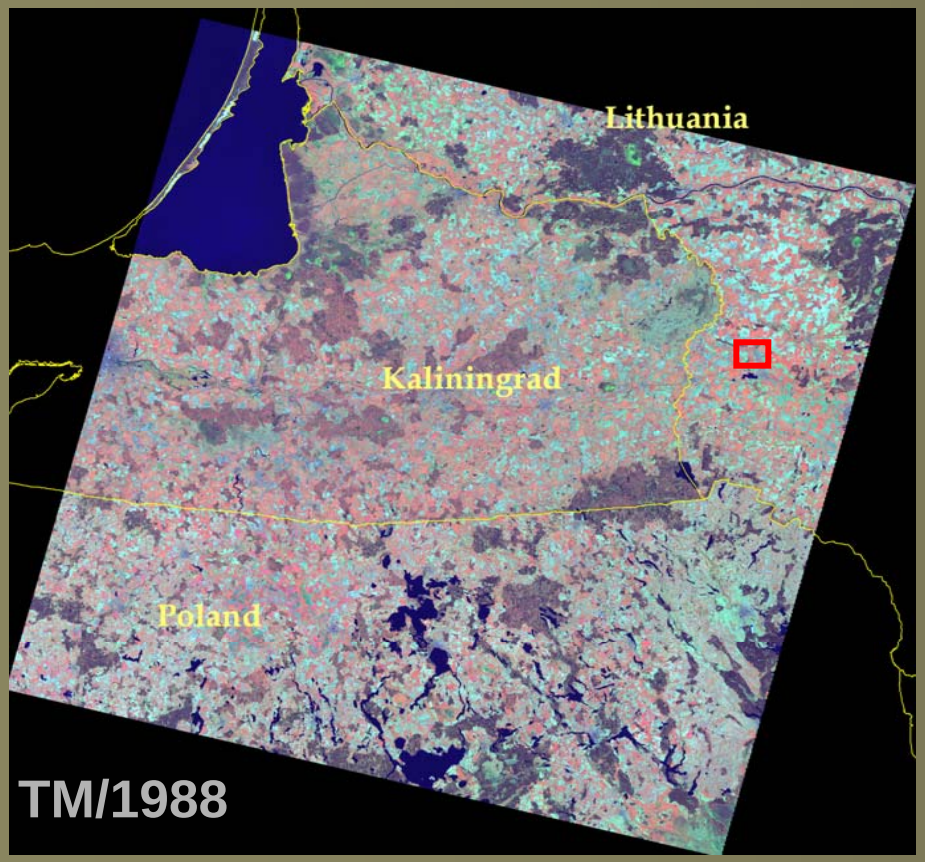
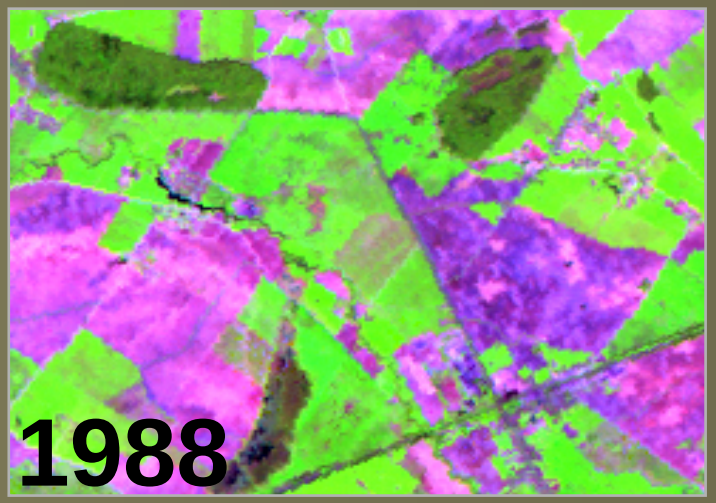
Poland
Kaliningrad
20 10 0 20 40 60 80
Kilometers

1. Kaliningrad





1. Kaliningrad

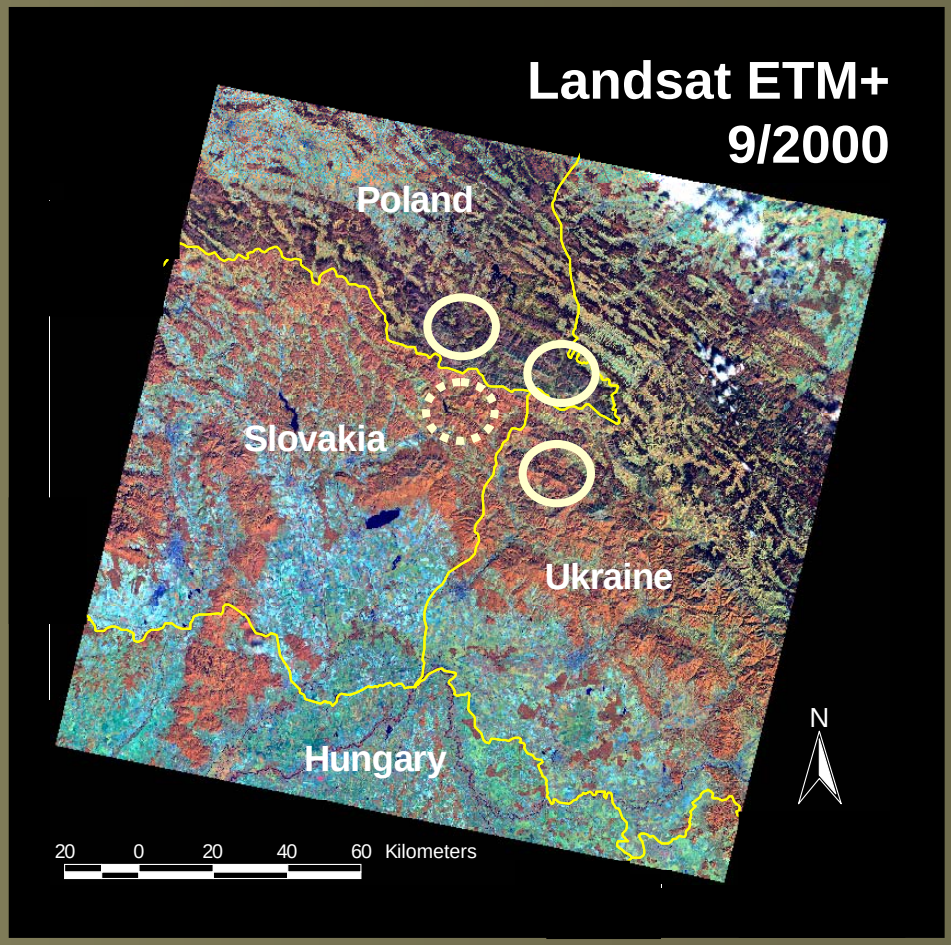
- Agricultural abandonment widespread
  - Forests are regrowing
  - Change in agricultural rotations
  - Farm fields are fragmenting under private ownership
- These trends are typical for the North of Eastern Europe
- Land cover change trends differ strongly among countries

2. Carpathians

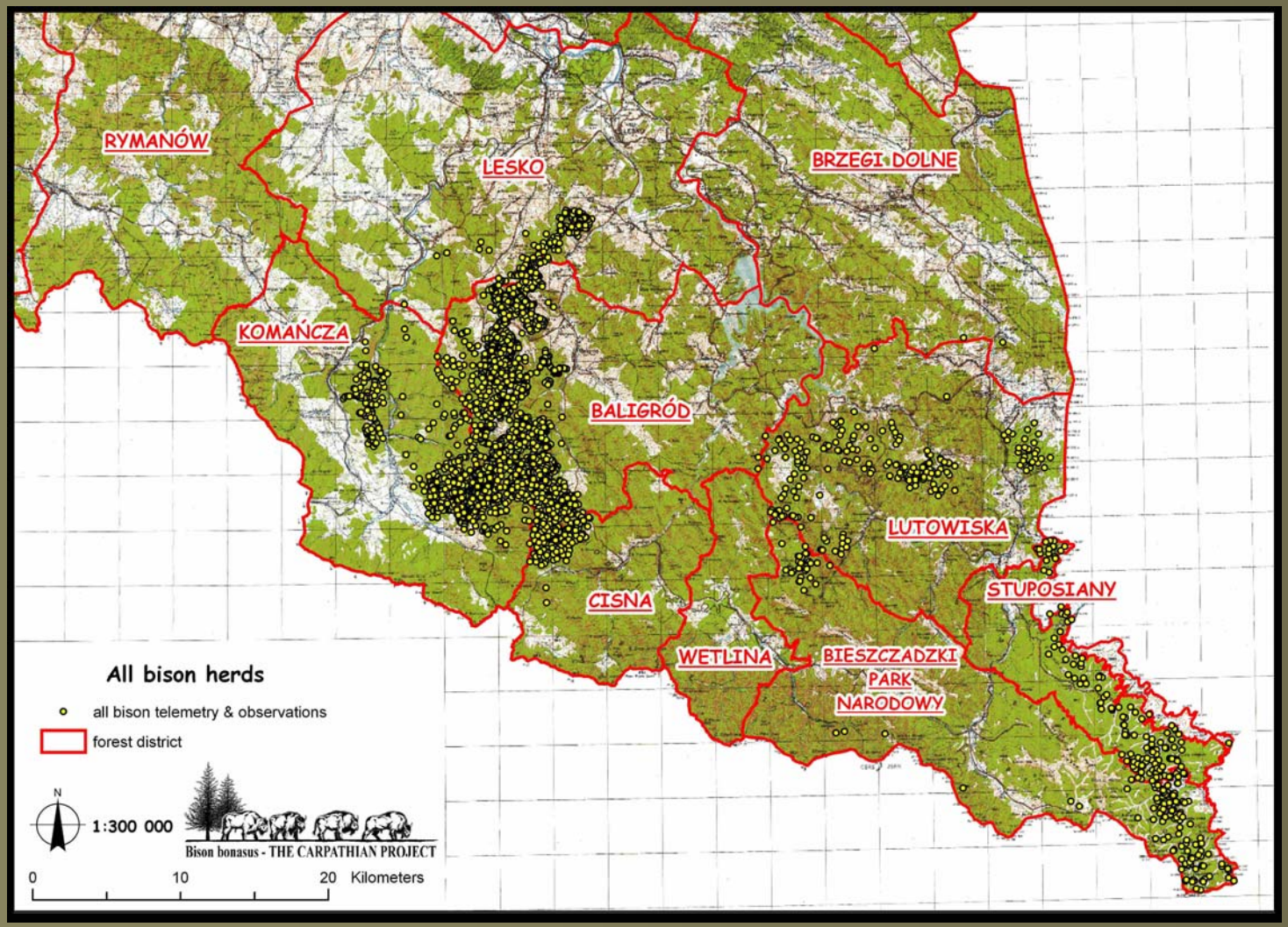
2. Carphathians

- Wild bison herds

Radiocollared bison in the Slovak Carpathians, Dec. 2004

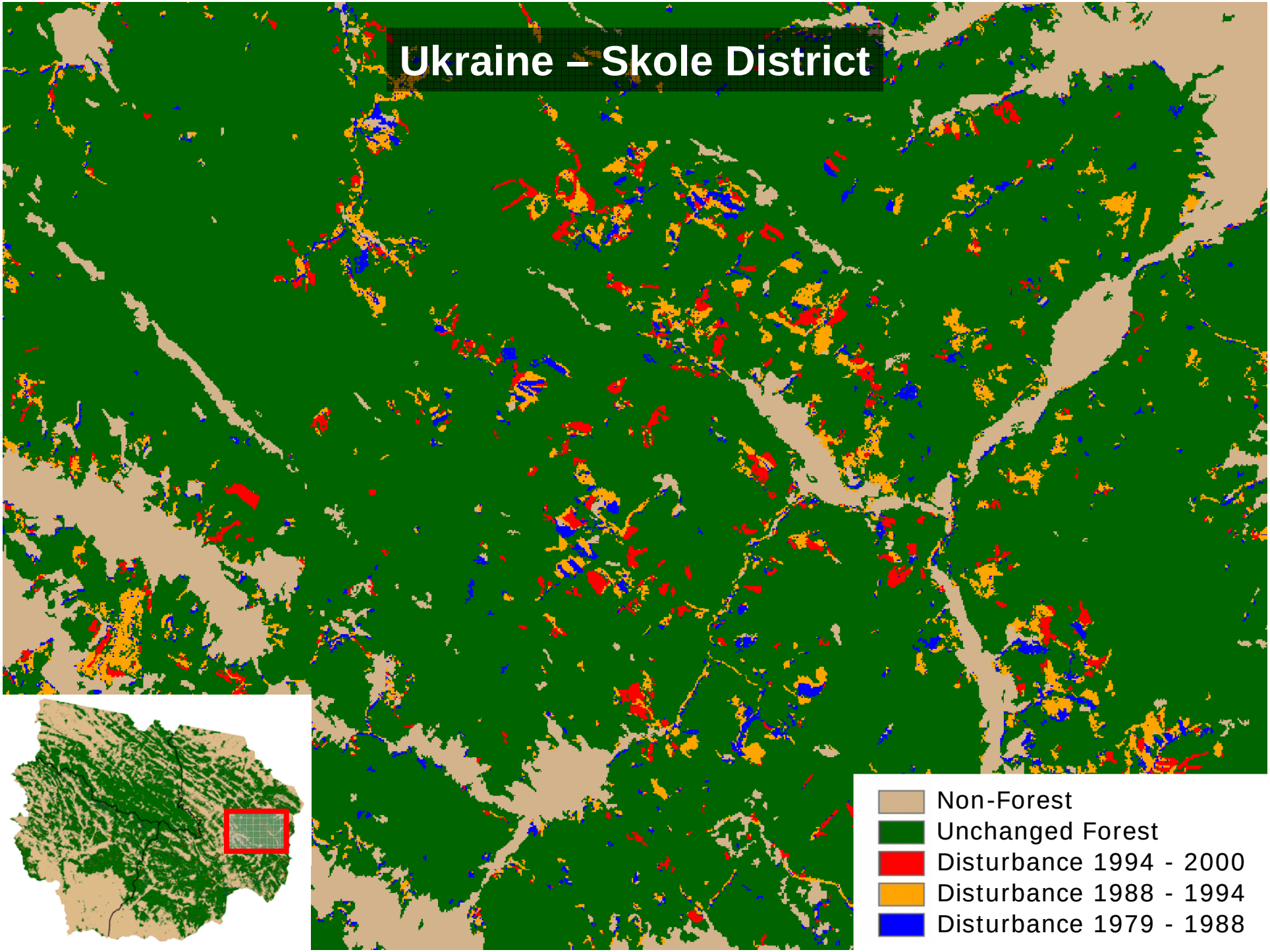


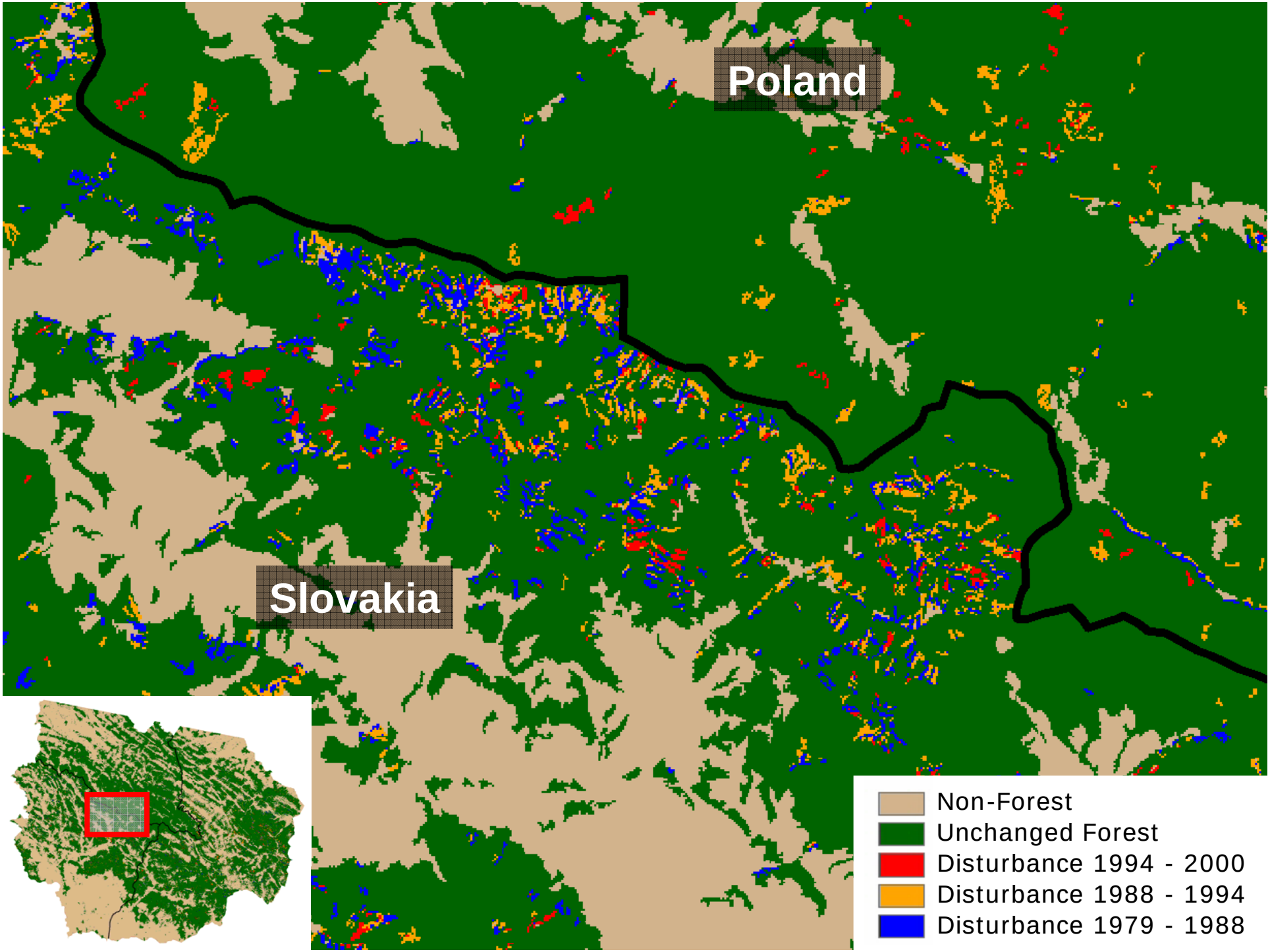
2. Carphathians

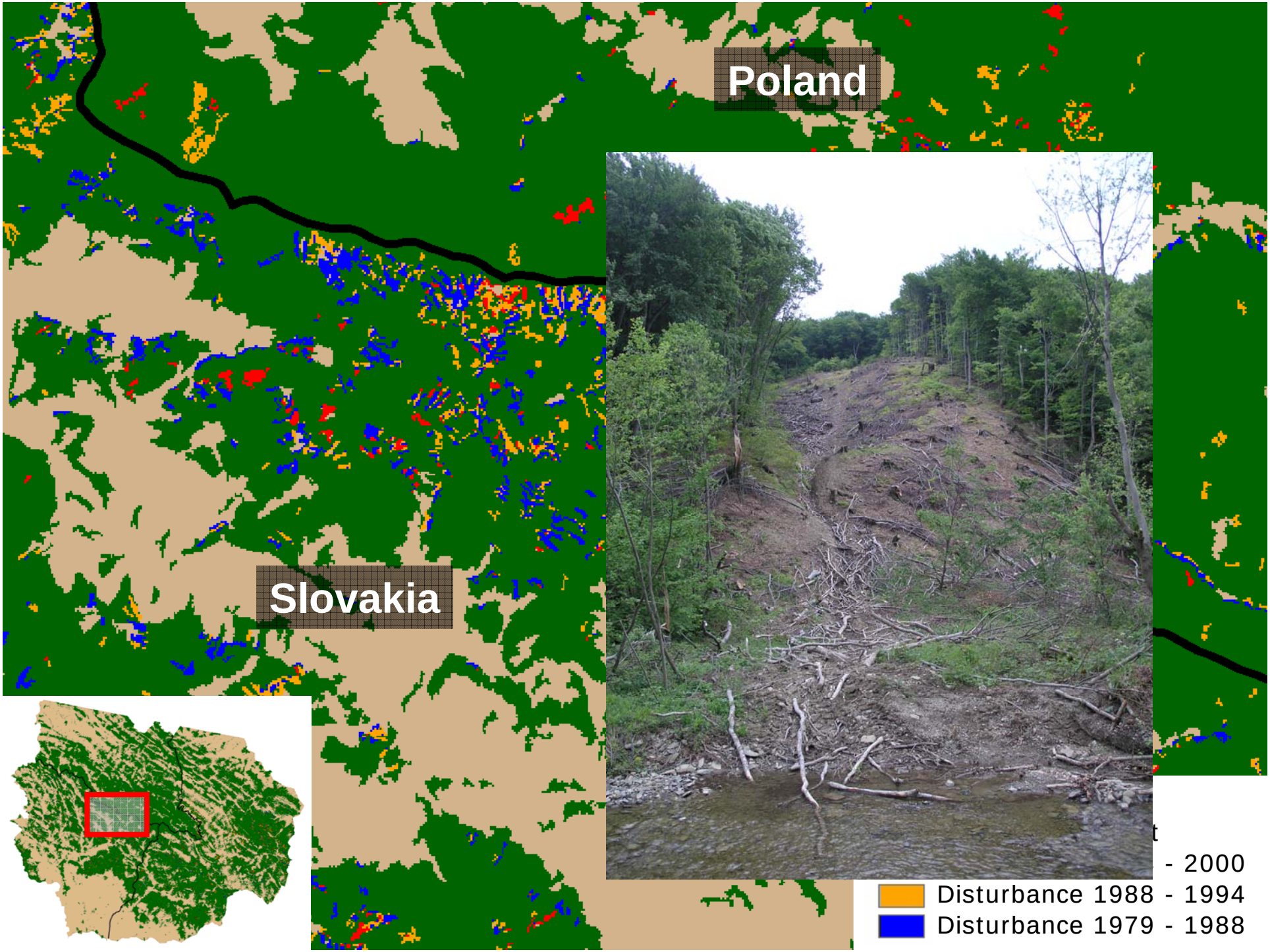


2. Carphathians

- Reports of widespread timber poaching
- Landsat MSS/TM/ETM+ change analysis
  - 1988 TM basemap forest/non-forest
  - Check if ’88 non-forest was forested in ’77 MSS
  - TC-disturbance index for ’88, ’94, ’00 TM/ETM+
  - Classification

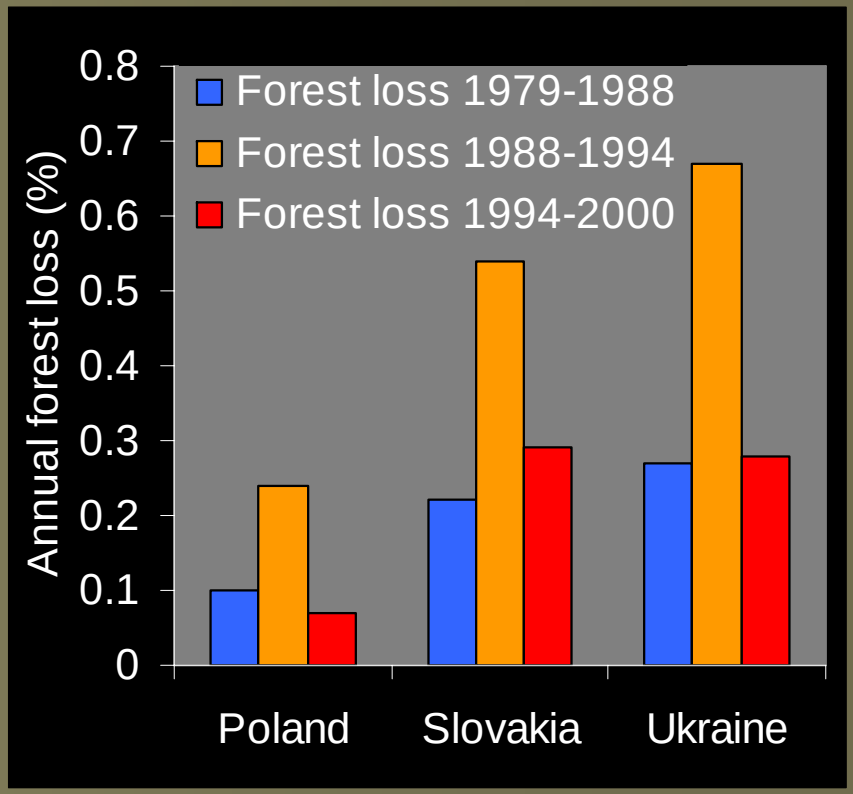

Ukraine – Skole District
Non-Forest
Unchanged Forest
Disturbance 1994 - 2000
Disturbance 1988 - 1994
Disturbance 1979 - 1988


Poland
Slovakia
Non-Forest
Unchanged Forest
Disturbance 1994 - 2000
Disturbance 1988 - 1994
Disturbance 1979 - 1988


Poland
Slovakia
- 2000
Disturbance 1988 - 1994
Disturbance 1979 - 1988

2. Carphathians

- Disturbance peaked around 1990, right after the transition from socialism to capitalism
- Strong differences among countries
- Annual forest loss rates in the Ukraine are up to 3 times higher



3. Kalmykia

File Edit View Add Tools Help
Norway
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Czech Republic
(Kiev)
Ukraine
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Moldova
Romania
(Belgrade)
Serbia and Montenegro
(Bucharest)
(Sofia)
Bulgaria
(Tirana)
Macedonia (FYROM)
Greece
Georgia
Armenia
Azerbaijan
(Baku)
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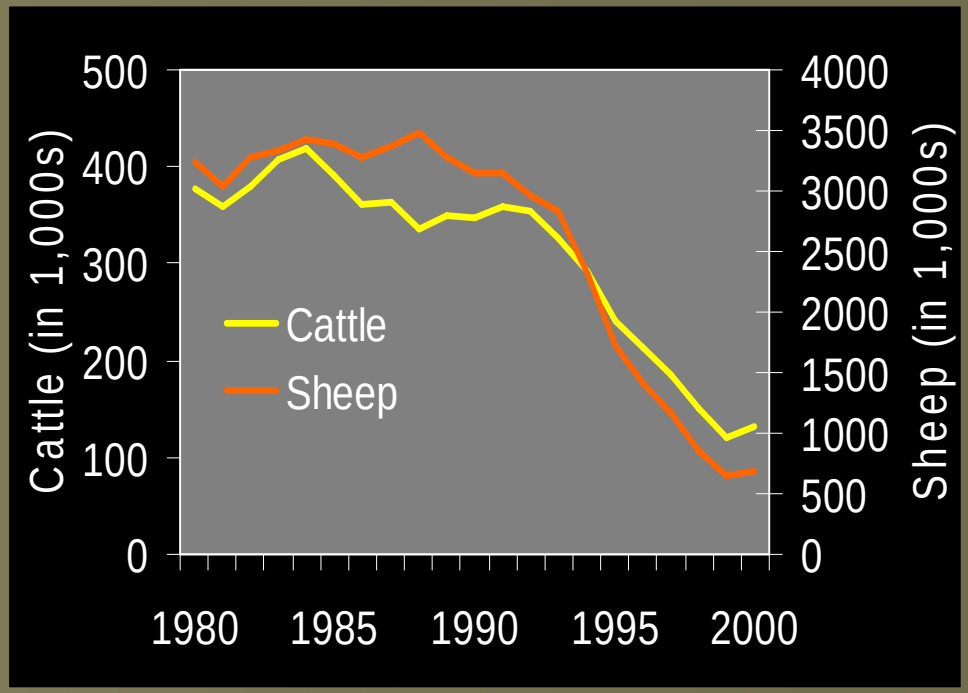
Google
Pointer 44°38'18.09" N 32°48'43.56" E
Streaming 3%
Eye alt 1745.22 mi

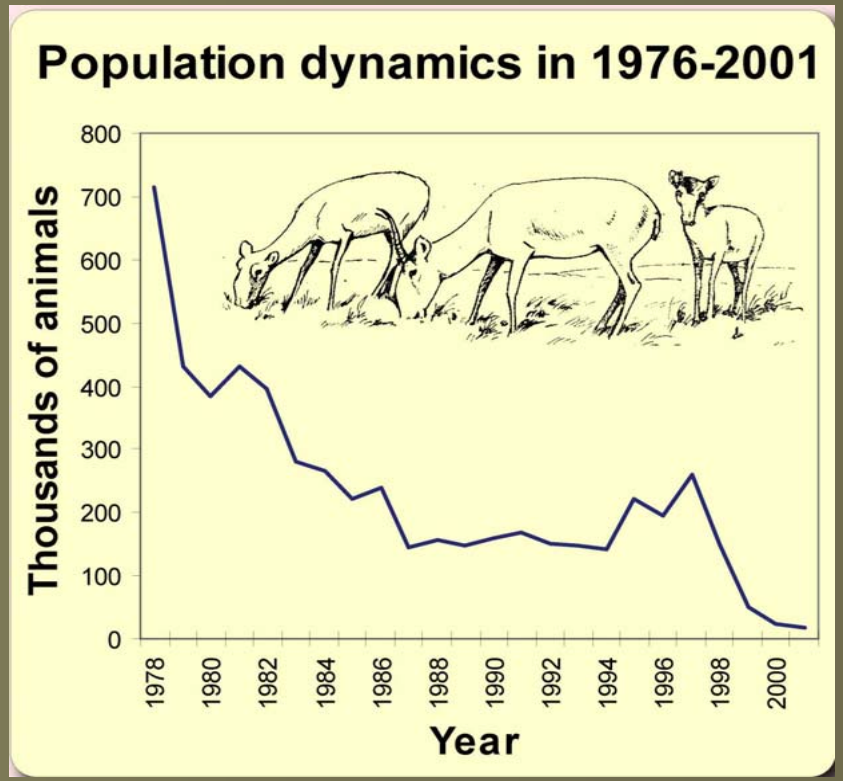
3. Kalmykia

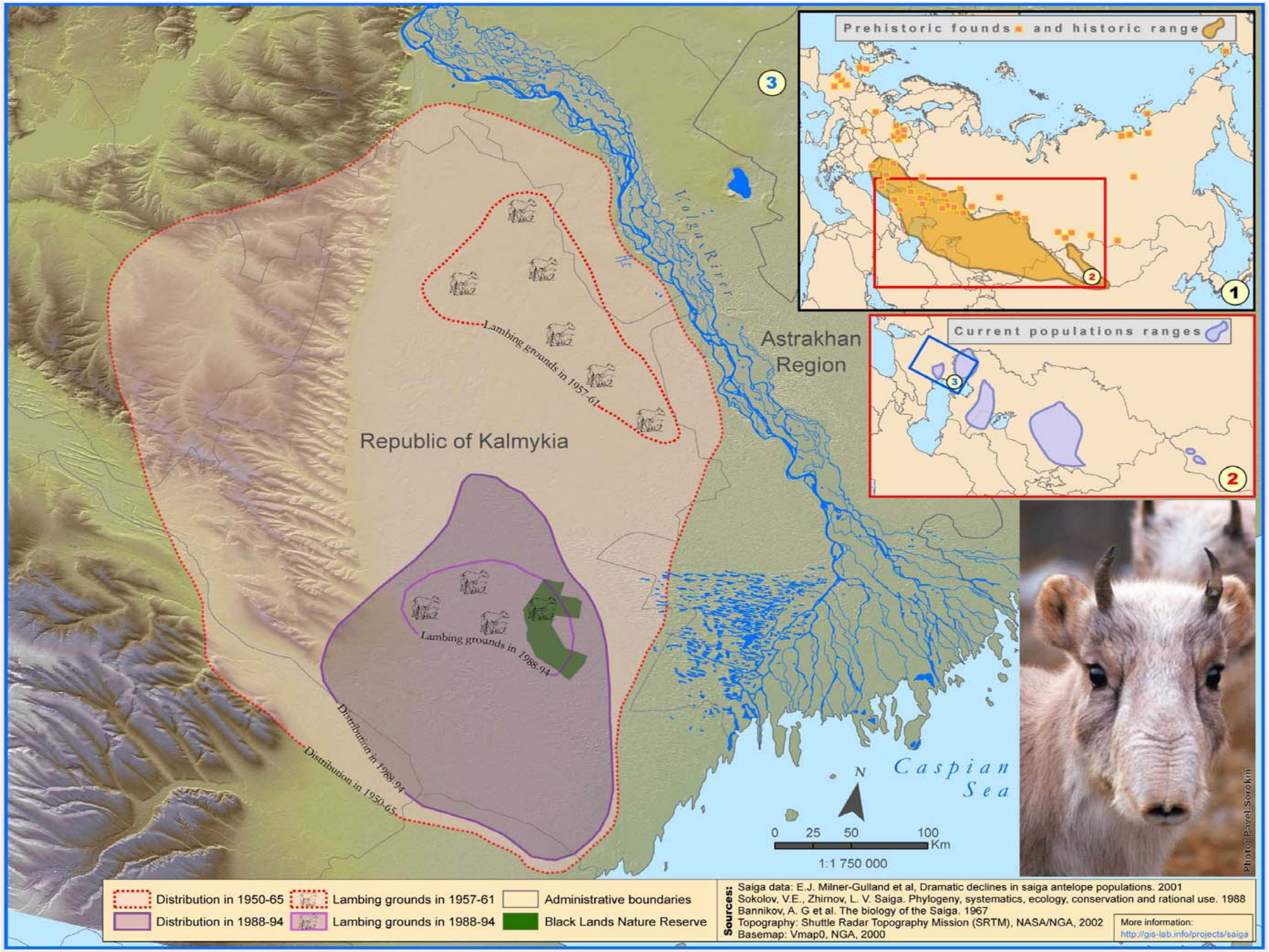
- Kalmykia is very dry, and dominated by short-grass steppe
- Row-crops were never common
- Livestock grazing was the main land-use



3. Kalmykia

✧Saiga populations have plummeted after 1990, largely due to poaching




Prehistoric founds and historic range
Current populations ranges
Volga River
Astrakhan Region
Republic of Kalmykia
Lambing grounds in 1957-61
Lambing grounds in 1988-94
Distribution in 1988-94
Distribution in 1950-65
Caspian Sea
N
0 25 50 100 Km
1:1 750 000
Photo: Pavel Sorokin
Distribution in 1950-65
Distribution in 1988-94
Lambing grounds in 1957-61
Lambing grounds in 1988-94
Administrative boundaries
Black Lands Nature Reserve
Sources:
Saiga data: E.J. Milner-Gulland et al, Dramatic declines in saiga antelope populations. 2001
Sokolov, V.E., Zhirnov, L. V. Saiga. Phylogeny, systematics, ecology, conservation and rational use. 1988
Bannikov, A. G et al. The biology of the Saiga. 1967
Topography: Shuttle Radar Topography Mission (SRTM), NASA/NGA, 2002
Basemap: Vmap0, NGA, 2000
More information:
http://gis-lab.info/projects/saiga

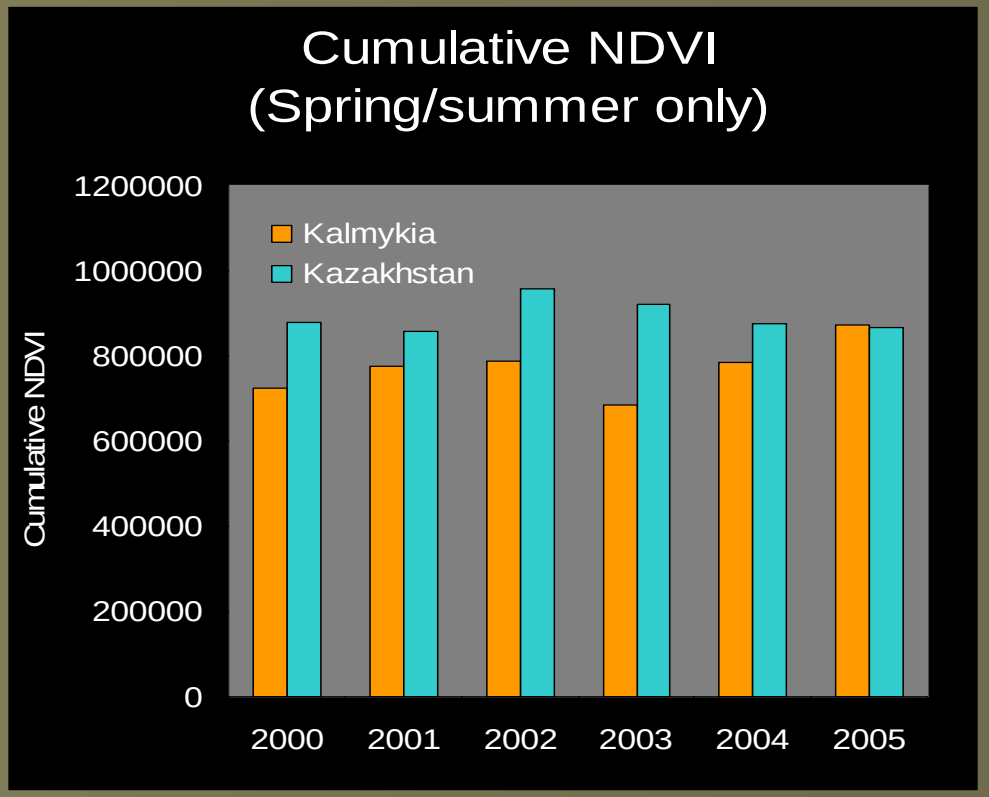
3. Kalmykia

- Saiga in Kalmykia no longer migrate, and they no longer use their traditional calving grounds
- How does range contraction affect saiga?

	Kalmykia	Kazakhstan
Male	25-43kg	37-49kg
Female	15-28kg	22-37kg

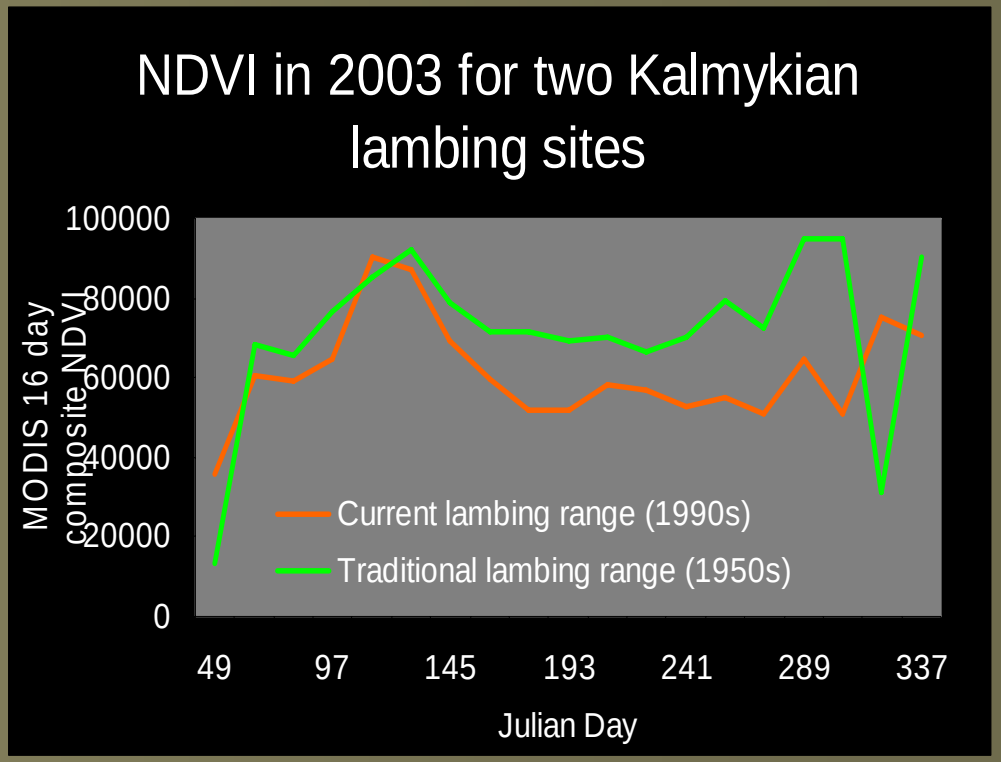
3. Kalmykia

✧Kalmykian summer grounds have lower NDVI during the growing season than those in Kazakhstan



3. Kalmykia

- Within Kalmykia, saiga are pushed into sub-optimal habitat
- NDVI is higher in the traditional calving grounds
- Realized niche versus ecological niche



4. Bears in European Russia

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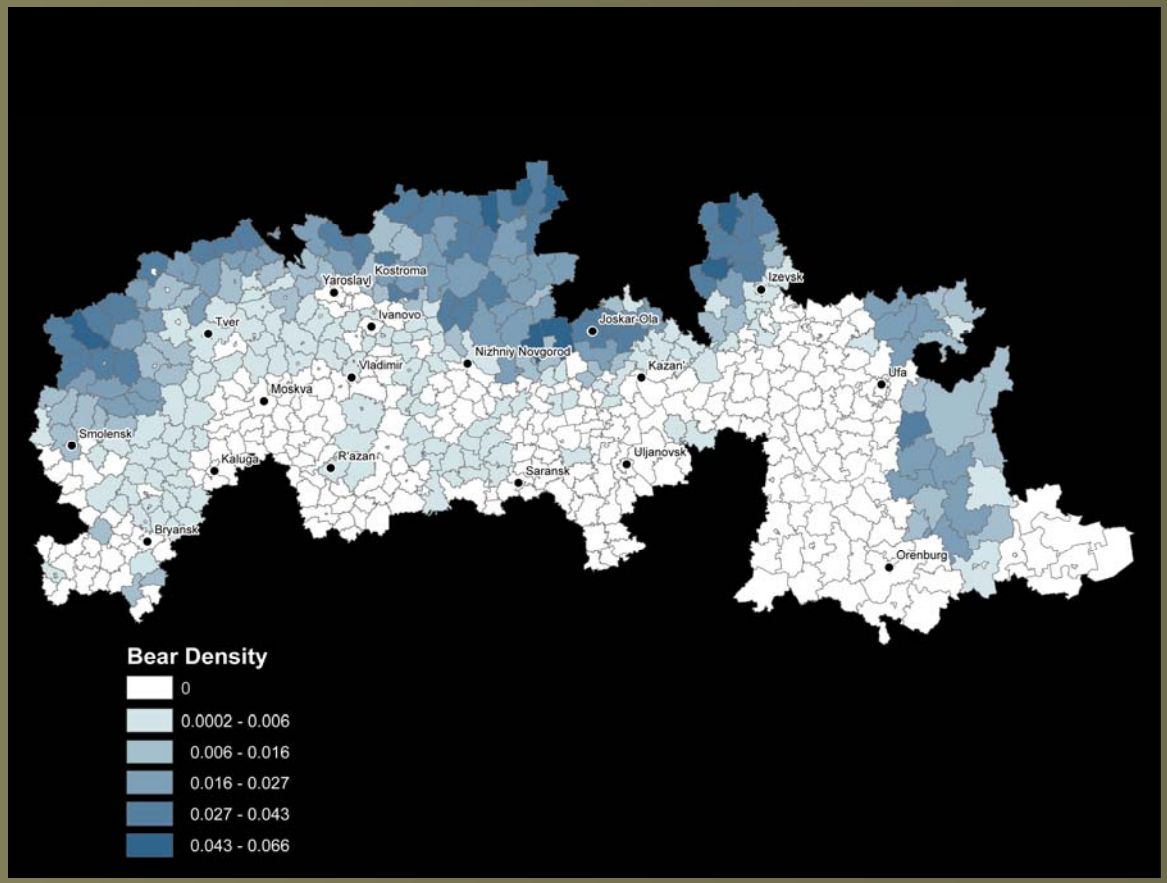
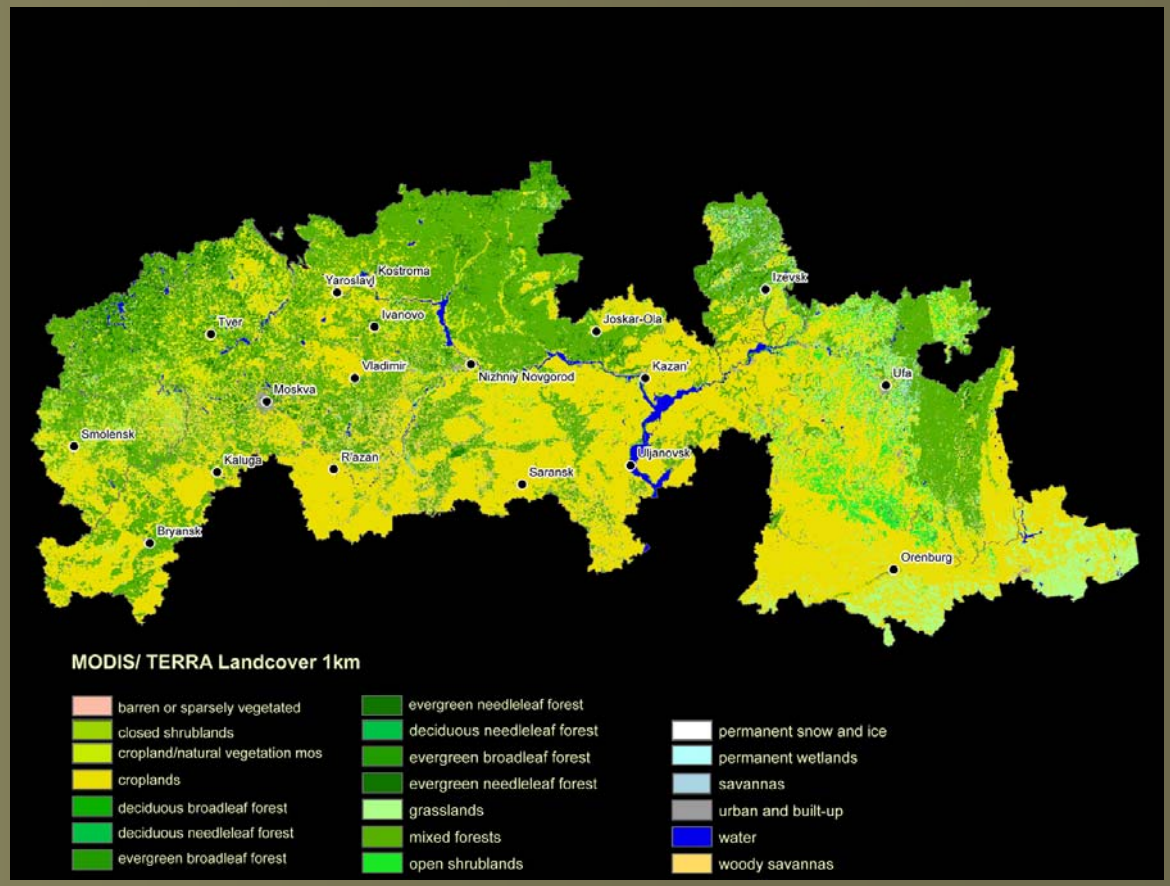
- Bears are expanding their range southward, dispersing from a large source population in the North
- 2000 density estimates from wildlife manag. authorities
- 529 districts



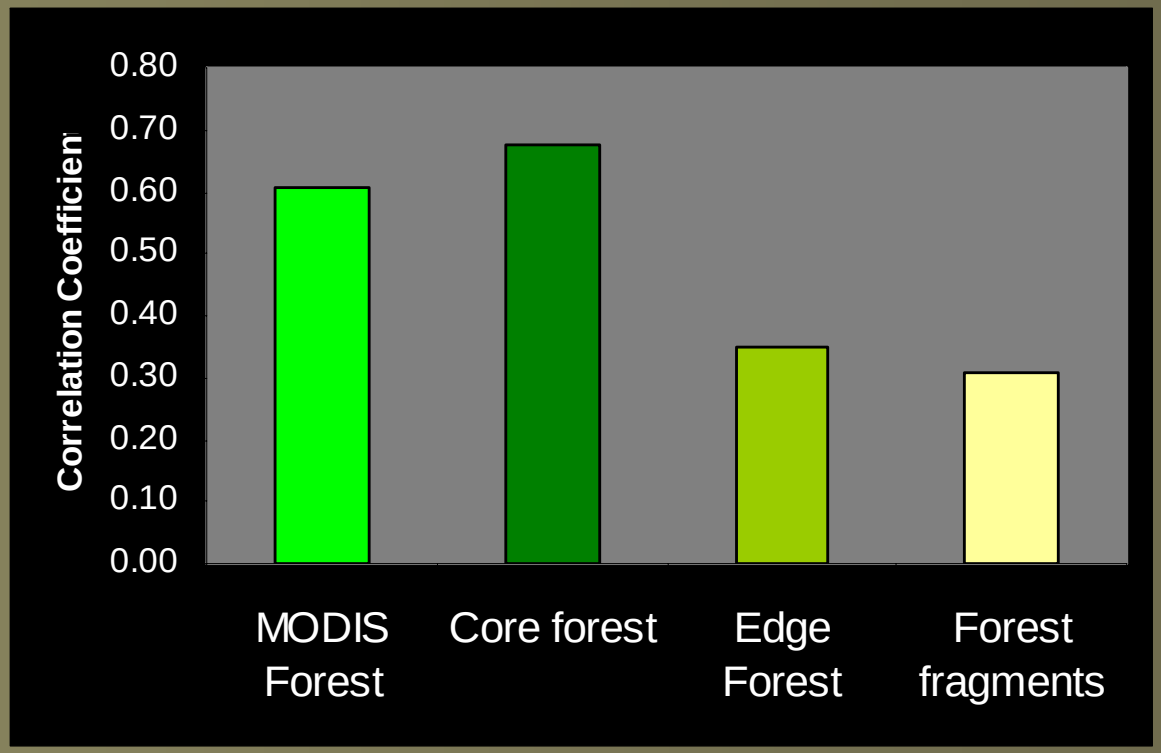
4. Bears in European Russia

- What affects bear distributions?
  - Forest cover
  - Forest fragmentation
  - Roads
  - Settlements
  - Rural population
  - Travel cost



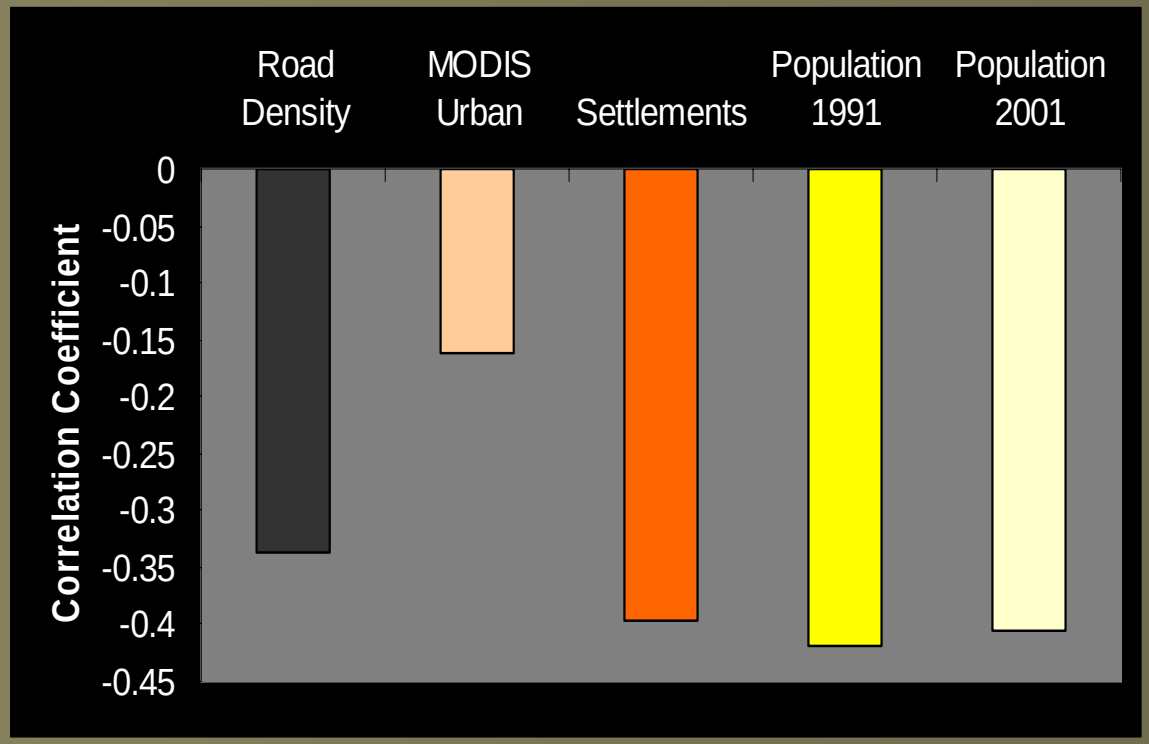
4. Bears in European Russia

- Bear density is correlated with forest cover, especially interior forest



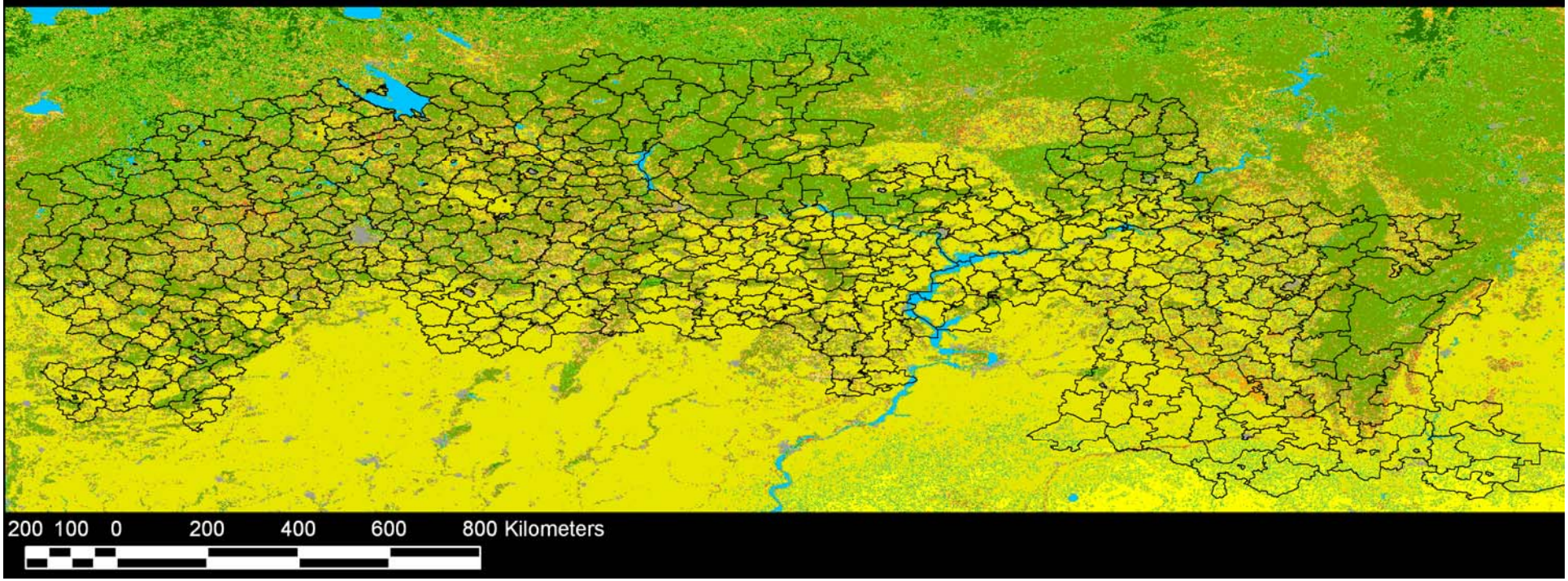
4. Bears in European Russia

- Human presence is negatively correlated with bear density



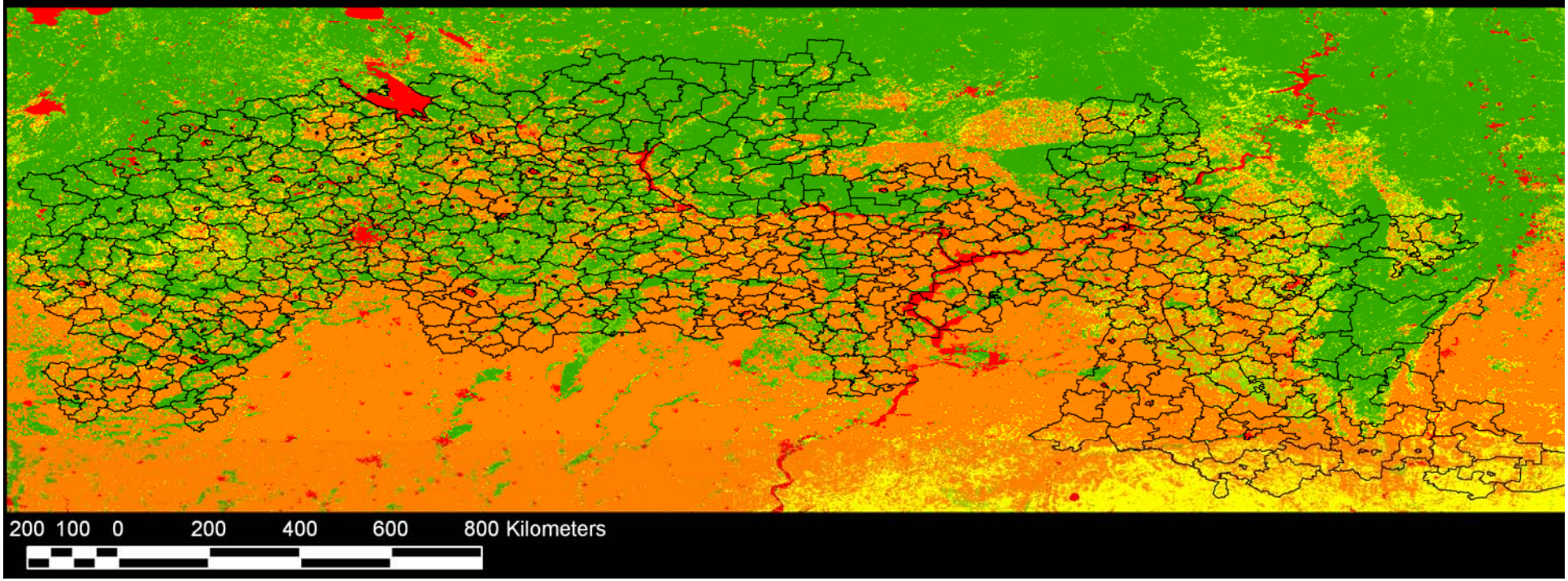
4. Bears in European Russia

Modis 12 Land Cover



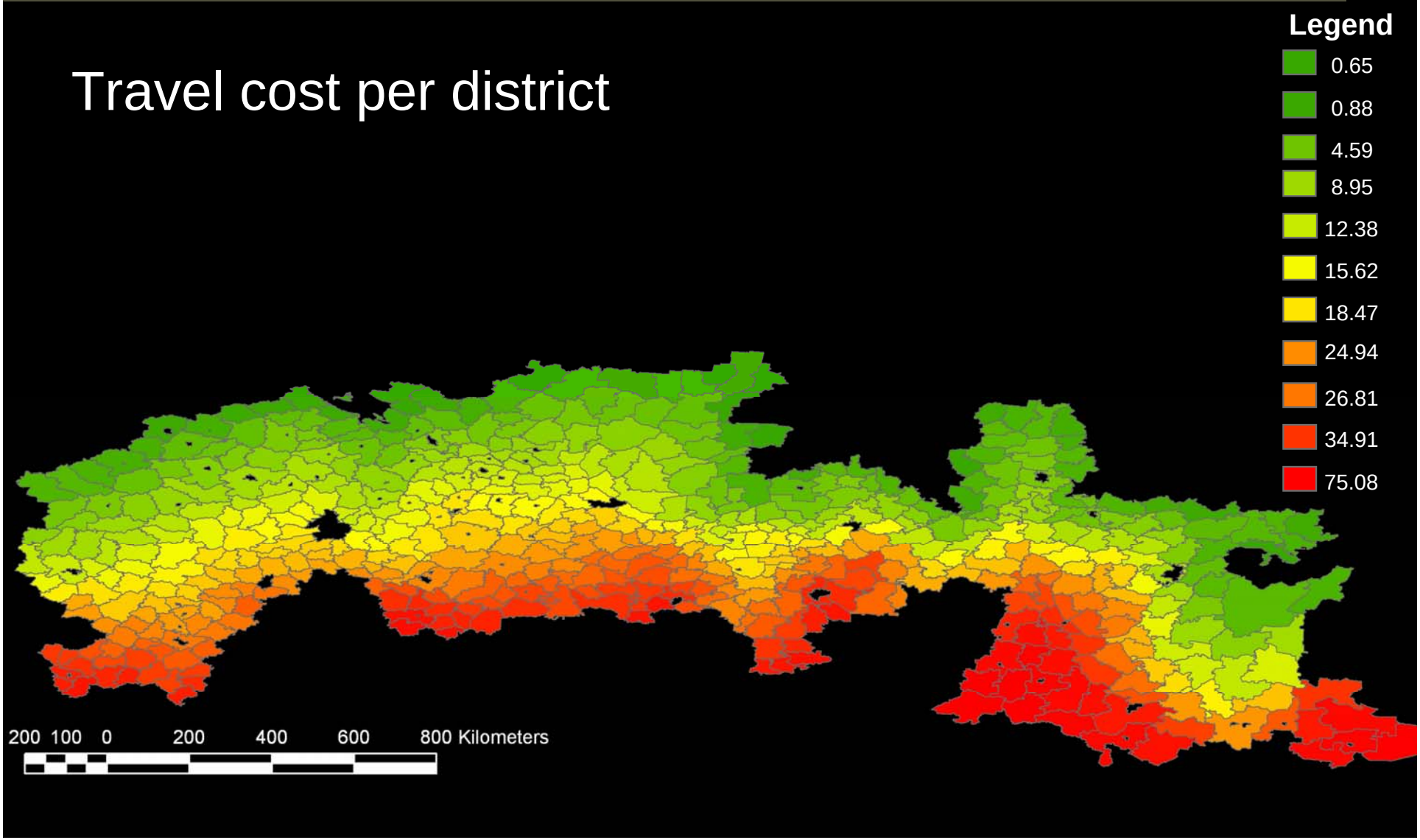
4. Bears in European Russia

Modis based travel cost



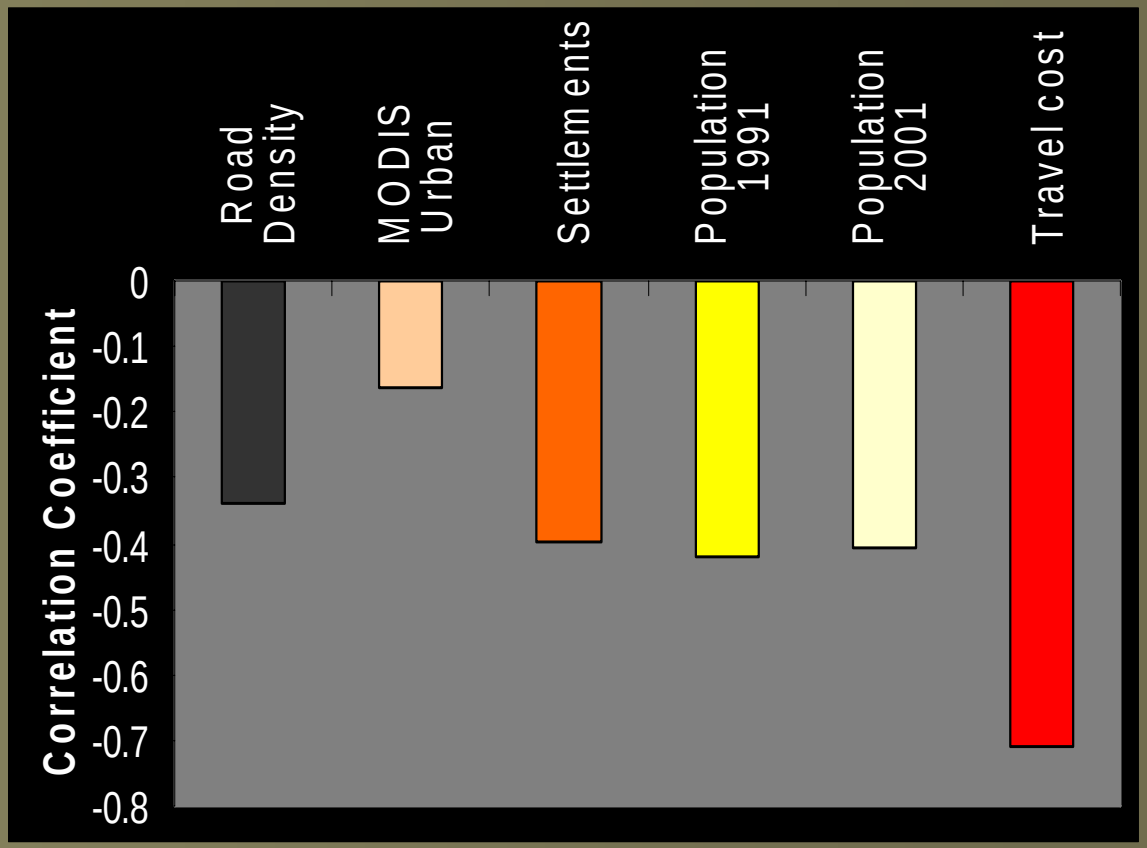
4. Bears in European Russia

Travel cost per district



4. Bears in European Russia

- Travel cost related to human disturbance is the most important negative factor for bear distributions
- Multiple regression explains 61% of the variability

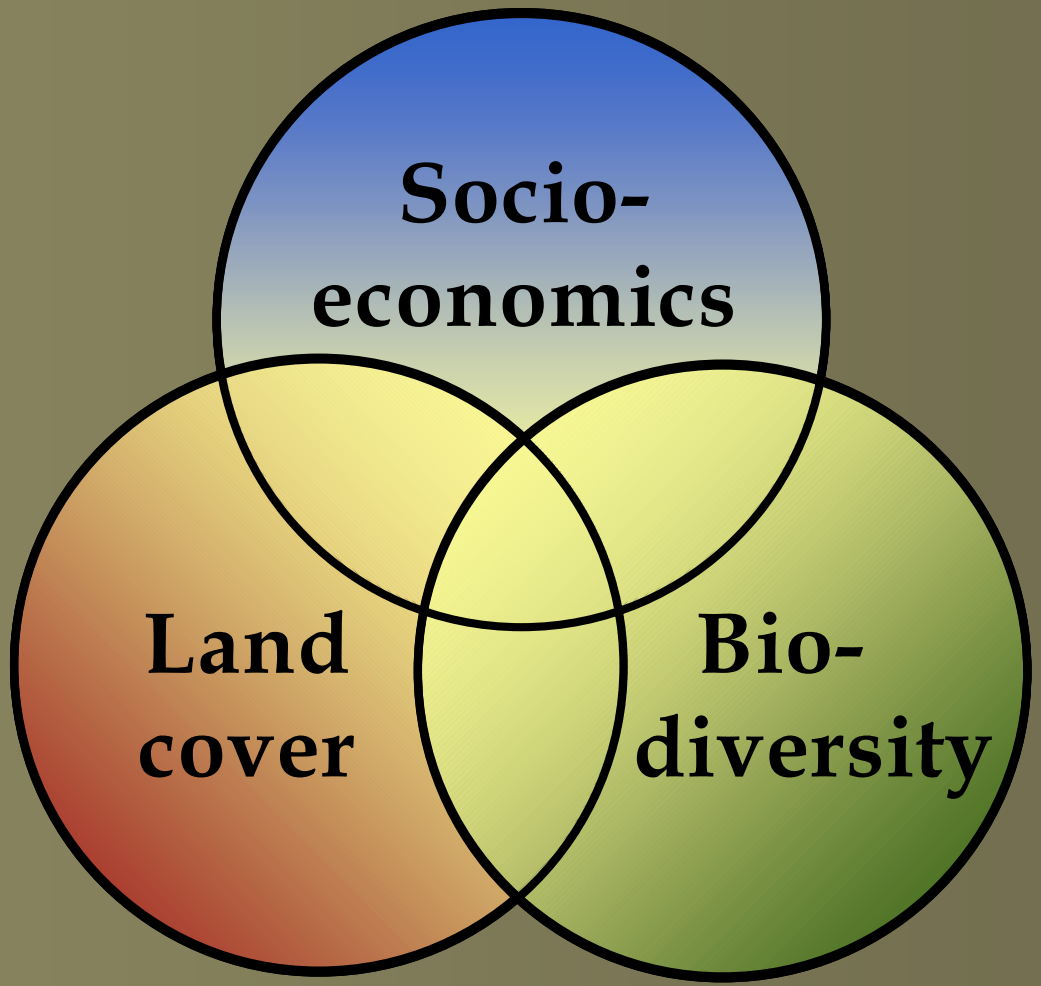


Conclusions

Conclusions

- Eastern European land cover is changing fast
  - Agricultural abandonment
  - Timber poaching
  - Lower livestock numbers
- Land use intensity is overall decreasing
  - This provides great opportunities for conservation
  - However, eroding legal structures and weakened law enforcement pose major threats
- Patterns differ substantially among countries
  - Socioeconomics, institutions, and policies matter

Conclusions



Conclusions

- Identify conservation risks and opportunities
  - Countries that are undergoing rapid landscape change require study
- Remote sensing can play an important role in explaining patterns of biodiversity
  - Assessments of land cover and land use change are powerful predictors of wildlife population patterns and trends

Thanks for support and collaboration

- NASA New Investigator and LCLUC Program
- U.S. Fish and Wildlife Service, Division of International Conservation

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- WWF Netherlands

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