# Land-use change, protected area effectiveness, and wildlife dynamics in post-Soviet European Russia

Anika Sieber[1], Leonid M. Baskin[2], Patrick Hostert[1], Kelly W. Jones[3], Alexander V. Prishchepov[4], Volker C. Radeloff[5], Nikolai V. Uvarov[6], and Tobias Kuemmerle[1]

[1]Geography Department, Humboldt-Universität zu Berlin, Germany
[2]A.N. Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, Russia
[3]Department of Human Dimensions of Natural Resources, Colorado State University, USA
[4]Department of Geosciences and Natural Resource Management, University of Copenhagen, Denmark
[5]Department of Forest and Wildlife Ecology, University of Wisconsin-Madison, USA
[6]Oksky State Nature Reserve, Russia

## Background and methods

### Breakdown of the Soviet Union in 1991

➢ Socio-economic and political upheaval triggered widespread land-use change (LUC) and reduced funding for nature conservation

➢ Large mammals are particularly sensitive to LUC, because they require large and well-connected habitats
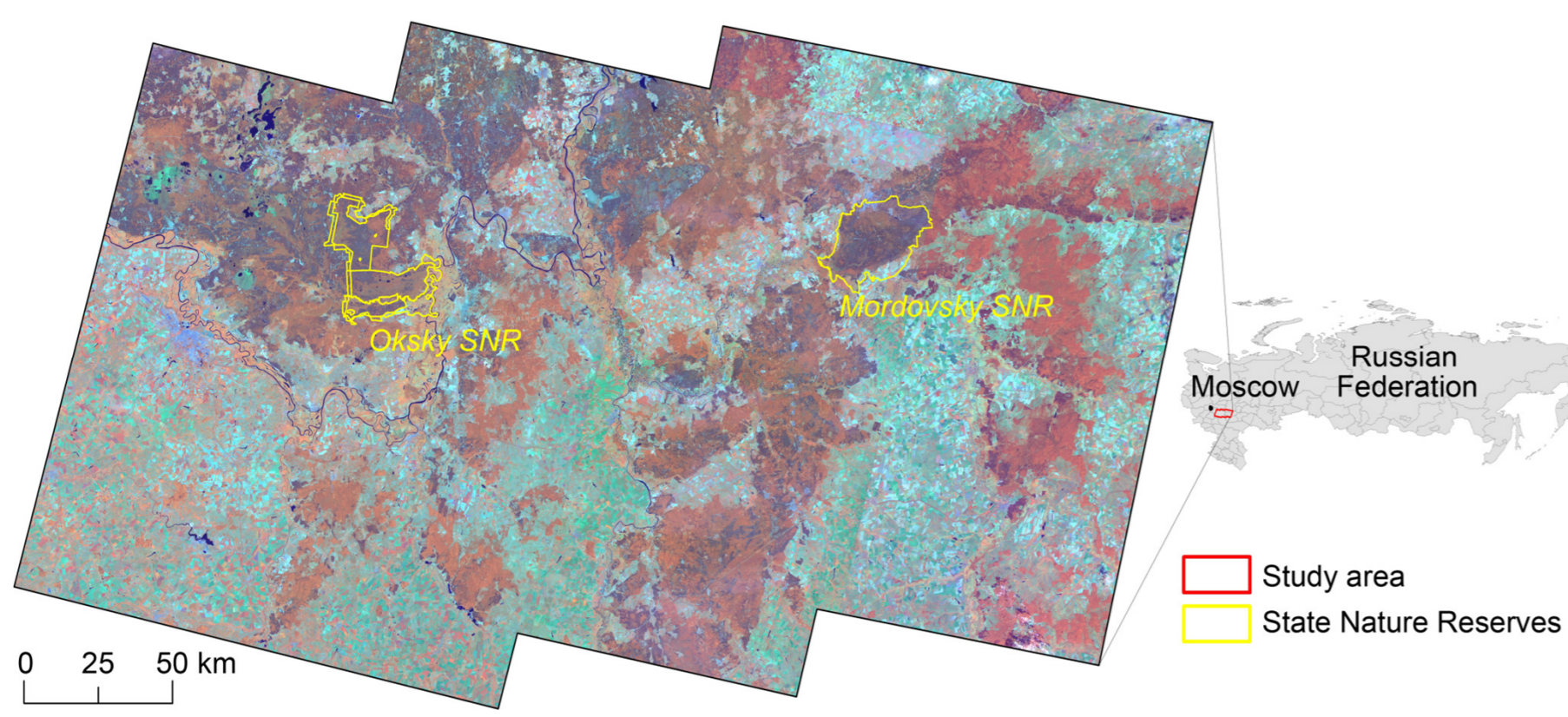


**Fig. 1: Study area** with Oksky and Mordovsky State Nature Reserves in European Russia (USGS, false color Landsat images with footprints 176/22 (2007-05-31), 175/22 (2000-05-28), and 174/22 (2007-08-21); *Sieber et al. 2013*)

### Russian protected area network

➢ 103 strictly protected scientific state nature reserves (zapovedniks, IUCN Ia)

➢ Long-term biodiversity monitoring annually published in the Chronicles of Nature since the 1960s

➢ Winter track counts provide species' occurrence and abundance data

### Our objectives were

1) To assess post-Soviet **land-use change**,
2) To evaluate the **effectiveness** of Oksky and Mordovsky State Nature Reserves,
3) To explore changes in the **habitat availability** and **population dynamics** of wild boar (*Sus scrofa*), moose (*Alces alces*), and wolf (*Canis lupus*)

### Data

➢ 38 Landsat TM and ETM+ images

➢ Winter track counts from Oksky State Nature Reserve and the Ministry of Natural Resources and Ecology of Ryazan Oblast, Russia
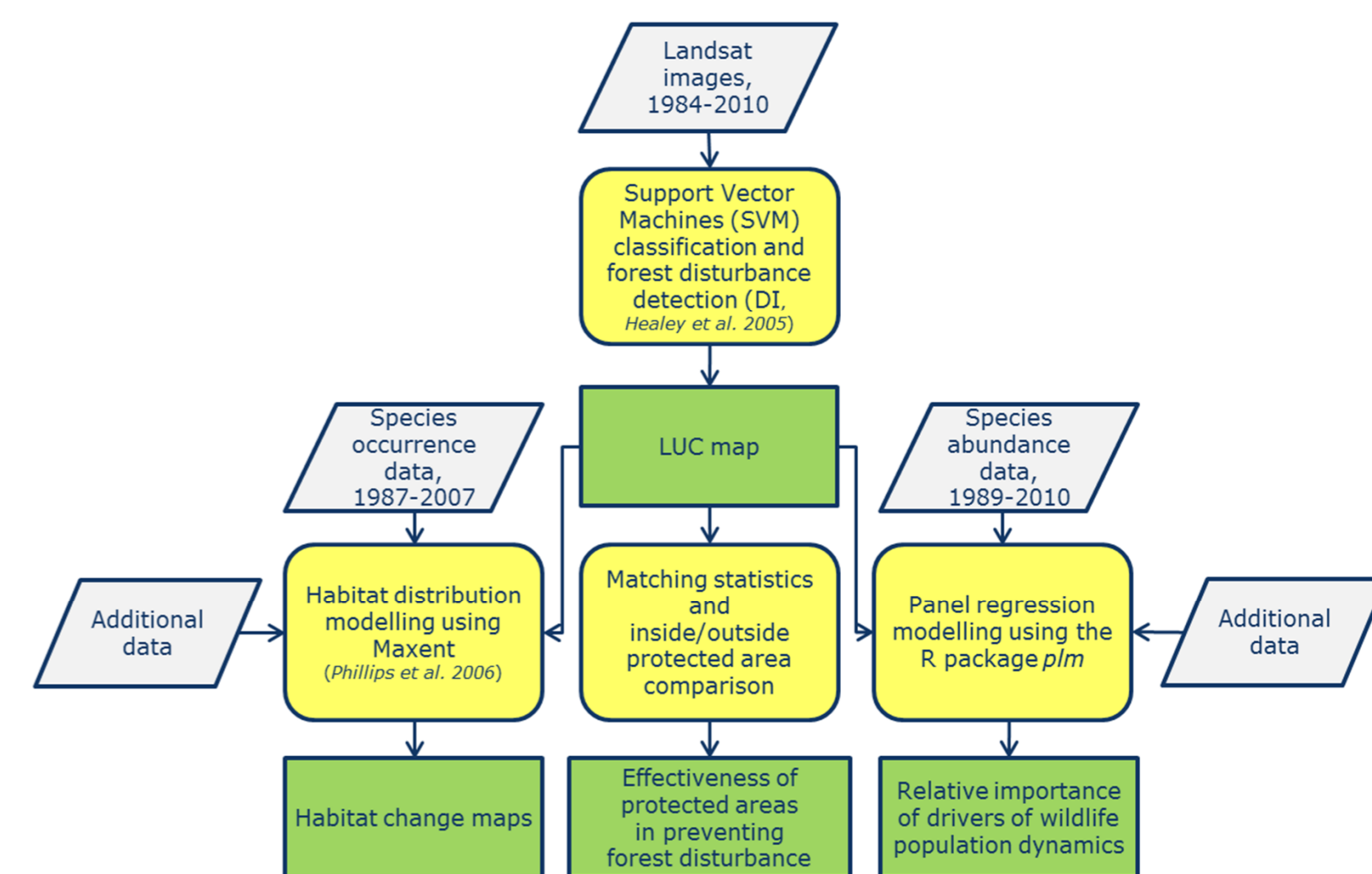


**Fig. 2: Work flow** showing **input data** (gray parallelograms), **methods** (yellow rounded rectangles), and **results** (green boxes)

## LUC and protected area effectiveness

### Widespread farmland abandonment and changes in forest cover

➢ 40% of the 1988 farmland abandoned in 2010 + natural succession

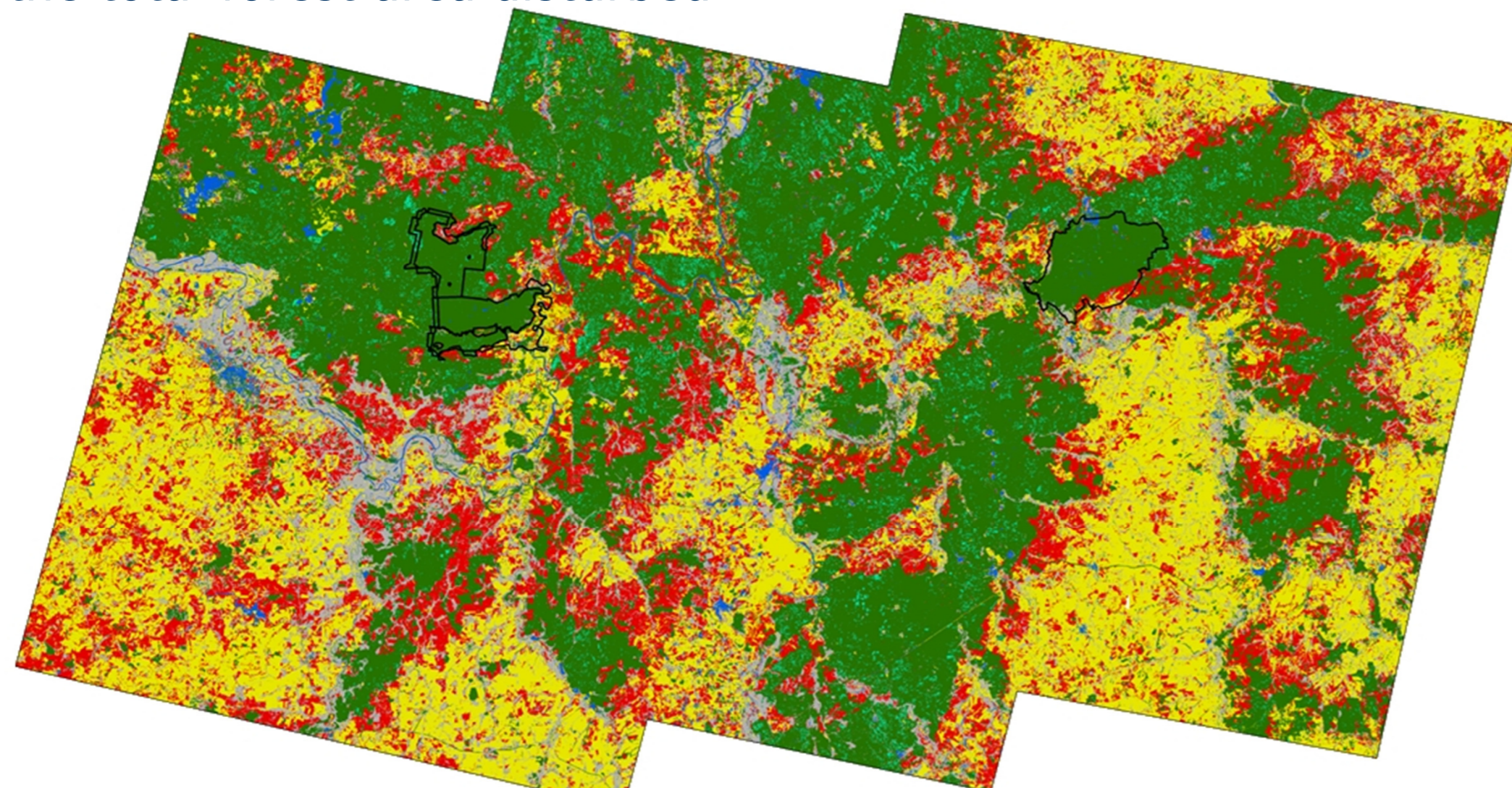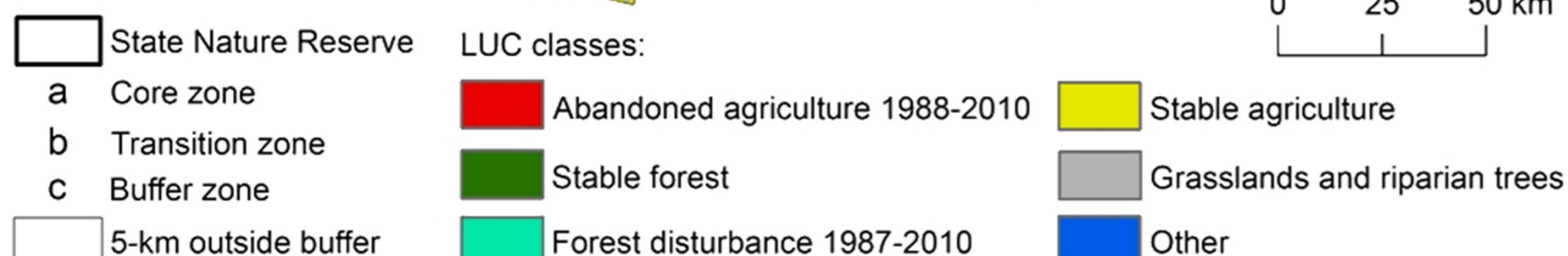➢ 5% of the total forest area disturbed



Fig. 3: Post-Soviet land-use change (LUC) within the study area (*Sieber et al. 2013*)

State Nature Reserve
a Core zone
b Transition zone
c Buffer zone
5-km outside buffer

LUC classes:
- Abandoned agriculture 1988-2010
- Stable forest
- Forest disturbance 1987-2010
- Stable agriculture
- Grasslands and riparian trees
- Other

### Protected areas effective in preventing forest disturbances

➢ Significantly lower relative probabilities (up to -3.5%; matching statistics) and lower rates of forest disturbance inside than outside of the protected areas
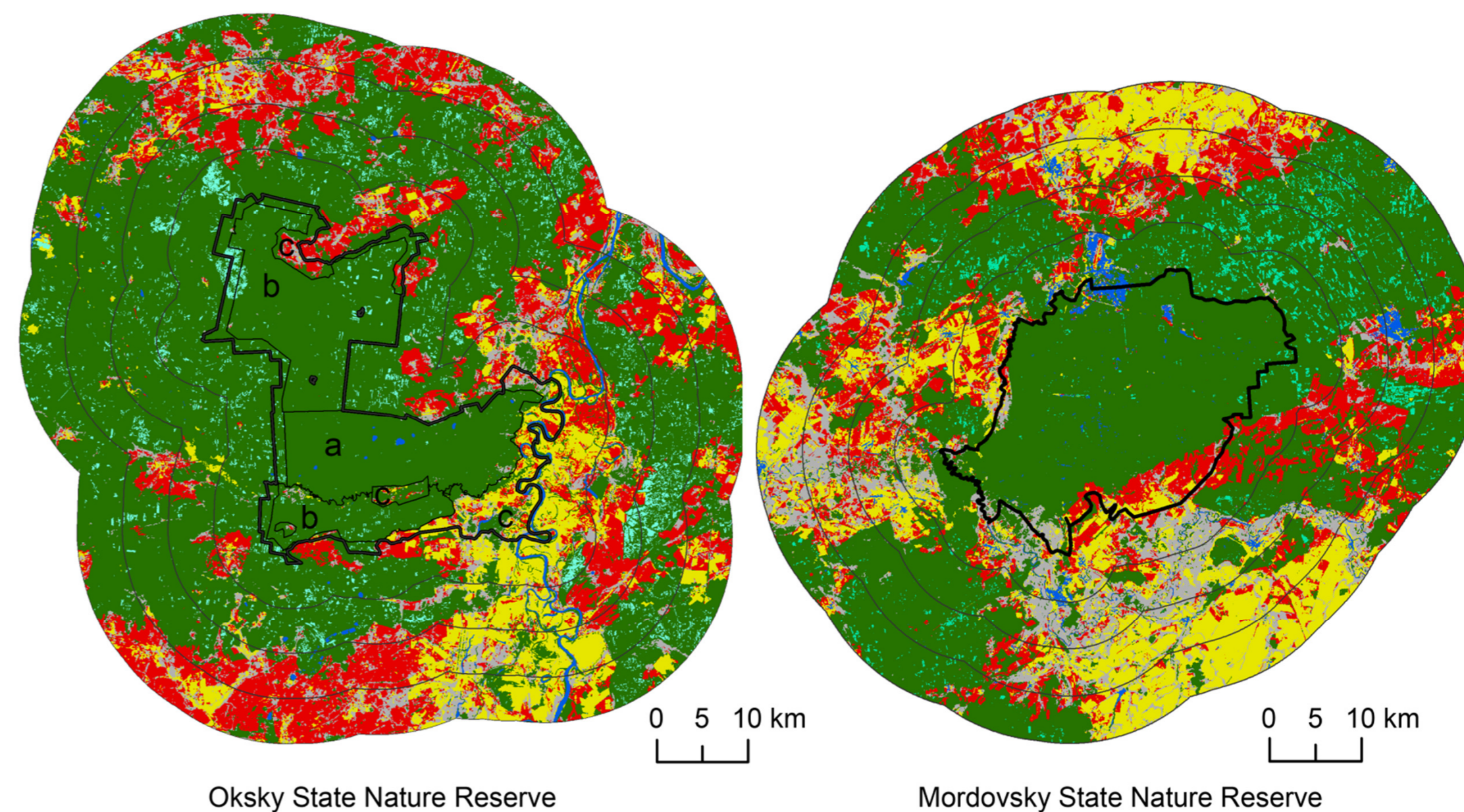


Oksky State Nature Reserve

Mordovsky State Nature Reserve

**Fig. 4: Post-Soviet land-use change (LUC) inside and outside protected areas**, incl. ring-shaped buffers within 0-5, 5-10, 10-15, and 15-20 km of the outermost boundary (see legend of Fig. 3; *Sieber et al. 2013*)

## Habitat change and population dynamics

### Increasing potential habitat of large mammals in post-Soviet times

➢ Substantial habitat gain inside and outside of Oksky State Nature Reserve on abandoned farmland
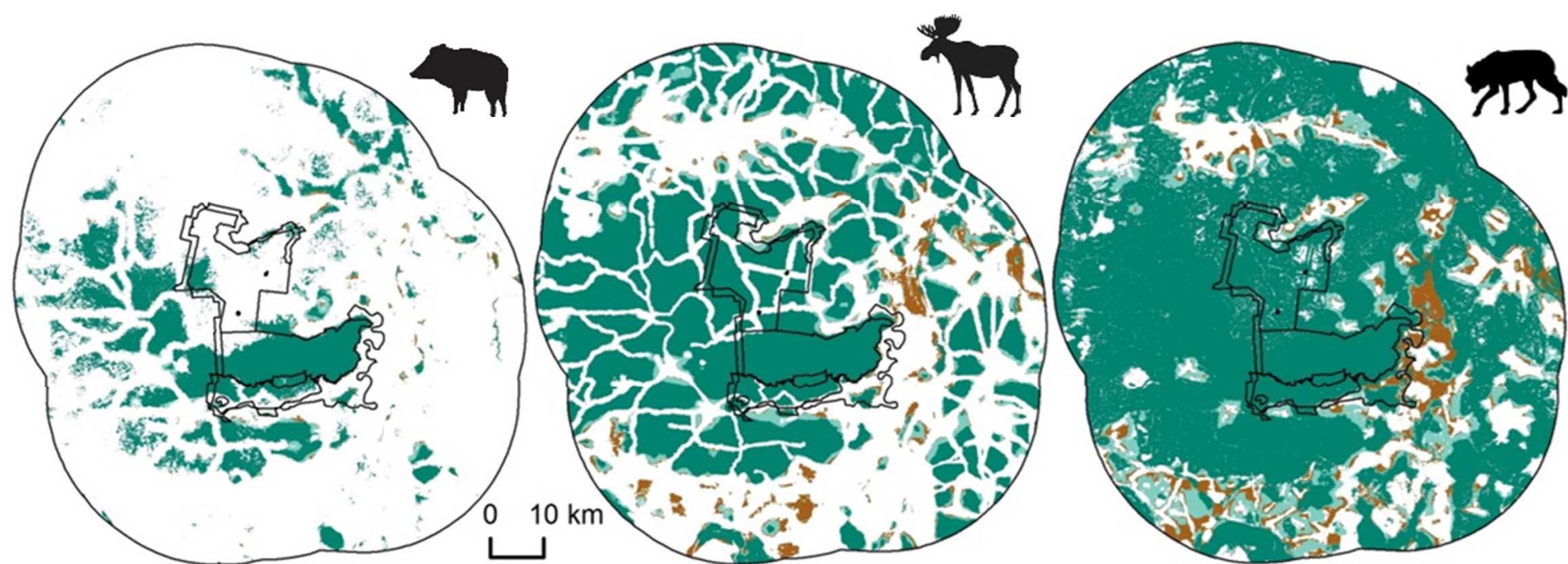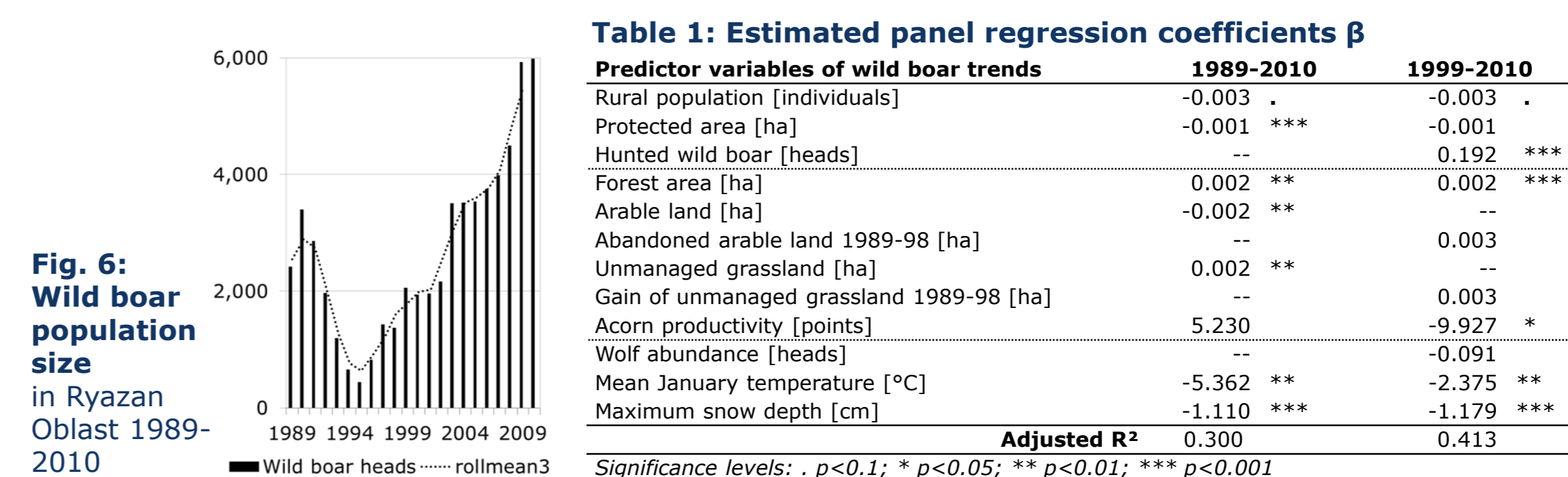


Fig. 5: Share of potential habitat within Oksky State Nature Reserve (OSNR), its protection zones (A = core zone, B = transition zones, and C = buffer zone), and 30-km surroundings (outside), and highlighted (in Red) percentages of relative area changes 1987-2007 (*Sieber et al. 2015*)

### Population trends affected by human impact via hunting and LUC

➢ Variables related to **hunting**, **land-use change**, and **natural mortality** significantly important for wild boar trends (*Sieber et al. in prep.*)



Fig. 6: Wild boar population size in Ryazan Oblast 1989-2010
■ Wild boar heads ···· rollmean3

**Table 1: Estimated panel regression coefficients β**

| Predictor variables of wild boar trends | 1989-2010 | | 1999-2010 | |
|---|---|---|---|---|
| Rural population [individuals] | -0.003 | . | -0.003 | . |
| Protected area [ha] | -0.001 | *** | -0.001 | |
| Hunted wild boar [heads] | -- | | 0.192 | *** |
| Forest area [ha] | 0.002 | ** | 0.002 | *** |
| Arable land [ha] | -0.002 | ** | -- | |
| Abandoned arable land 1989-98 [ha] | -- | | 0.003 | |
| Unmanaged grassland [ha] | 0.002 | ** | -- | |
| Gain of unmanaged grassland 1989-98 [ha] | -- | | 0.003 | |
| Acorn productivity [points] | 5.230 | | -9.927 | * |
| Wolf abundance [heads] | -- | | -0.091 | |
| Mean January temperature [°C] | -5.362 | ** | -2.375 | ** |
| Maximum snow depth [cm] | -1.110 | *** | -1.179 | *** |
| **Adjusted R²** | 0.300 | | 0.413 | |

*Significance levels: . p<0.1; * p<0.05; ** p<0.01; *** p<0.001*

### Summary

➢ Substantial habitat expansion of large mammals due to post-Soviet rewilding trend in European Russia

➢ Long-term data on land use and wildlife species are very valuable to assess the effects of land-use change on habitat and population trends

**References:**
Sieber, A. et al. 2013: Landsat-based mapping of post-Soviet land-use change to assess the effectiveness of the Oksky and Mordovsky protected areas in European Russia. *Remote Sensing of Environment* 133, 38-51.
Sieber, A. et al. 2015: Post-Soviet land-use change effects on large mammals' habitat in European Russia. *Biological Conservation* 191, 567-576.
Sieber, A. et al. *in preparation*: Hunting and land-use change impacts on wild boar population dynaimcs in European Russia after the breakdown of the Soviet Union.

## Download poster

**Web** www.hu-geomatics.de

https://twitter.com/HumboldtRemSens

## Contact information

**Anika Sieber**
anika.sieber@geo.hu-berlin.de
Phone: +49.30.2093.6834
HU zu Berlin | Geography Department
**Geomatics** and **Conservation Biogeography**