**Volker C. Radeloff, Department of Forest Ecology and Management, University of Wisconsin-Madison**

# Post-USSR land cover change in Eastern Europe: socioeconomic forcings, effects on biodiversity, and future scenarios

## Background

*Eastern European land cover has changed substantially since the breakdown of the USSR in 1990*

✦ In some areas more than half of the farm-land has been abandoned and is converting to shrublands and forest

✦ Eastern Europe is 're-wilding' and that offers opportunities for biodiversity conservation

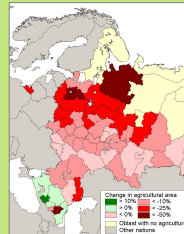✦ *This project will assess habitat change affecting umbrella species for biodiversity*



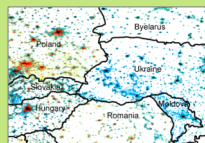Fig. 1 Change in agricultural area in Russian oblasts from 1991 to 1997[1]



Fig. 2 Change in nighttime lights 1993-2000. Yellow and red: more lights, blue: fewer lights[2]

✦ *Socio-economic trends and land cover change differ markedly among neighboring countries with similar ecological conditions*

✦ This provides the opportunity to study transboundary differences in space

✦ The comparison of pre- and post-1990 land cover change provides data on transboundary phenomena in time

*The project uses this 'natural experiment' to test hypotheses on the relative importance of environmental versus socioeconomic factors as controls and forcings of land cover and land use change*

## Study Objectives

*1) Monitor land use and land cover change (LULCC) across Eastern Europe from 1985 to 2002 using MODIS and Landsat TM/ETM+*

*2) Examine the role of socioeconomic and political changes as primary forcing functions affecting LULCC*

*3) Examine effects of LULCC in Eastern Europe on habitat availability for umbrella species for biodiversity*

*4) Spatially model potential future LULCC scenarios across Eastern Europe and examine potential biodiversity changes*

## Approach

✦ MODIS will provide data on current land use pattern. Spectral mixture analysis will be used to distinguish plowed from fallow fields

✦ Landsat TM/ETM+ data from 1985 to 2002 will provide information on land cover change

✦ Landsat scenes are selected along political borders to separate environmental constraints of LULCC from socioeconomic forcings



Fig. 3: Landsat scenes selected for land cover change analysis and cross-border comparisons
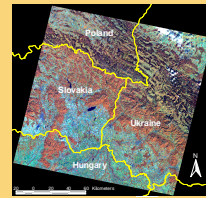


Fig. 4: Landsat TM scene 186/26 Sep. 2000, bands 4,5,3. Note differences in forest cover at the Polish-Ukrainian border

✦ The hypothesis is that agricultural abandonment is controlled at broad scales by the national economy and climate, and at fine scales by distance to markets, major roads, topography, and soil quality

✦ Resource selection function will identify habitat availability for European bison, brown bear and saiga antelopes, three umbrella species for biodiversity

✦ Three LULCC scenarios will be modeled using a land cover transition model

✦ Model results will reveal potential future forest de-fragmentation and wildlife habitat change
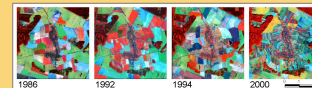


1986    1992    1994    2000

Fig. 5: Parcelization in the Ukrainian Carpathians.

## Timeline

| Year | Milestones |
|------|------------|
| 2005 | MODIS/TM image processing, socioeconomic data collecting, conceptual education web page design |
| 2006 | MODIS/TM image processing, regression LULCC versus socioeconomics, resource selection functions |
| 2007 | Accuracy assessment, future scenarios simulations, journal articles, web page dissemination |

## Education Plan

*Informal education about LULCC will be facilitated via a web-based active learning tool allowing simple wildlife habitat analysis and LULCC scenario modeling targeted for middle-school students*

✦ Web page visitors will examine LULCC from the perspective of a European bison (Carpathians), a brown bear (North-central Russia) and a saiga antelope (Kalmykia)

✦ The challenge to web page visitors is to identify what makes good habitat. They will overlay animal locations on maps of roads, landcover, settlements, etc. and rank the factors



Fig. 6: Radiocollared bison in the Carpathians, Dec. 2004

*Formal education will include six research internships for young scientists from Eastern Europe interested in remote sensing and LULCC science*

✦ Interns will join the research team for three months over the summer and take active part in this project

✦ Their main task will be a land cover classification for one Landsat scene in the study area

✦ Prior to their internship, candidates will collect ground truth data in the field

✦ Collaboration will continue after interns return home

## Significance

The project uses state-of-the-art remote sensing methods to monitor the patterns of land cover change in Eastern Europe, thus describing the *variability* of global change

It integrates land cover with socioeconomic and environmental data in a 'natural experiment' to examine the role of socioeconomic change as a primary *forcing function* on the Earth's systems

The *response* of ecosystems to these changes and the *consequences* are assessed via the habitat analysis for umbrella species for biodiversity in Eastern Europe.

And lastly, scenario modeling will *predict* the effects of different future land use trajectories on land cover and biodiversity in Eastern Europe

## Footnotes

[1] Data: www.ers.usda.gov/briefing/russia/
[2] Red: lights much brighter in 2000; yellow: new lights in 2000; blue: lights dimmer or missing in 2000; black: bright lights at both dates; gray: dim lights at both dates oblasts from 1991 to 1997 Data courtesy of C. Elvidge, NOAA-NESDIS

## Collaborators

Linas Balciauskas (Vilnius University, Lithuania), Leonid Baskin (Russian Academy of Sciences, Moscow), Patrick Hostert (Humboldt University, Berlin, Germany), Anna Lushchekina (Russian MAB Program and Russian Academy of Sciences, Moscow), Kajetan Perzanowski, (Polish Academy of Sciences, Ustrzyki Dolne, Poland), Wolfgang Schröder (Technical University Munich, Germany)

## Contact Information

Volker Radeloff
Department of Forest Ecology and Management
University of Wisconsin-Madison
1630 Linden Drive
Madison, WI 53706

Phone: 608-263-4349
Fax: 608-262-9922
E-mail: radeloff@wisc.edu
http://silvis.forest.wisc.edu