Effectiveness and Social-Ecological Spillover of Protected Areas: understanding scale dependencies

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Background

• Protected areas are effective strategies for biological conservation inside park boundaries
  (e.g. Chape et al. 2005; Nagendra 2008)

• Growing interest in the effects of protected areas on surrounding landscape, in terms of:
  • Deforestation
    (e.g. Defries et al. 2005; Leroux & Kerr 2012)
  • Human population increase
    (e.g. Wittemyer et al. 2008; Joppa et al. 2009)

• Two competing hypotheses:
  • “Spillover”: protection of park spills over, resulting in dampened change in buffers zones
  • “Leakage”: avoided change inside parks is displaced to surrounding area, the land use leaks to buffer zones
Studies investigating social-ecological spillover of protected areas

1. Focus on forest cover alone
2. Use of nationwide averages
3. Study of anthropogenic drivers and landscape responses in isolation

Forest loss around protected areas

(DeFries et al. 2005)

Deforestation in East Africa

(Green et al. 2013)

Population change around protected areas

(Wittemyer et al. 2008)
Research aim

• How do protected areas influence their surroundings?
  – Investigate land cover change, not just forest loss
  – Couple with potential anthropogenic drivers, such as human population increase
  – Study patterns at different scales: both national trends and trends around individual parks
South Africa as a case study

National Land Cover 2000 & 2009
Remapped 2000 data set to 2009 land cover classes

- National Park
- Natural
- Cultivation
- Degraded
- Urban Built-up
- Waterbodies
- Plantations
- Mines

Map of land cover in South Africa in 2009, with National Parks and 5 consecutive 10 km-wide buffer zones.
Methods

- 19 South African National Parks
- 5 x 10 km-wide buffer zones
- 500 random points per NP & buffer zone
- 250 000 random control points

Two types of analyses:
- Buffer analysis of land cover change
- 1:1 point matching on 6 covariates:
  - Land cover (NLC 2000)
  - Population density (SA Census 2001)
  - Elevation (STRM)
  - Slope (STRM)
  - Distance to nearest town (SA Census 2001)
  - Distance to nearest road (VMAP)
Buffer Analysis
Land cover change: buffer analysis

South African National Parks, 2000-2009

Land cover change by park

Some parks show a positive gradient of change with distance from park...

... whereas others portray a negative gradient of change with distance from park
Matching Analysis
• NPs are effective in avoiding land cover change
  – within boundaries
  – in surroundings (positive spillover)

• Hints of environmental gradients around national park boundaries
Potential drivers
Population change: matched samples

South African National Parks, 2000-2009
Population change: matched samples
Conclusions

• NPs are effective in avoiding land cover change
  – within boundaries
  – in surroundings
  → evidence of positive spillover

• Human population does not grow significantly around protected areas on a national scale

• But need to look at patterns around individual parks in more detail, especially at coupling land cover and population change

• Most importantly: conclusions depend heavily on the scale at which results are aggregated
Thank you

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