

Relationship between land cover, ecosystem use and biodiversity in the Czech Republic

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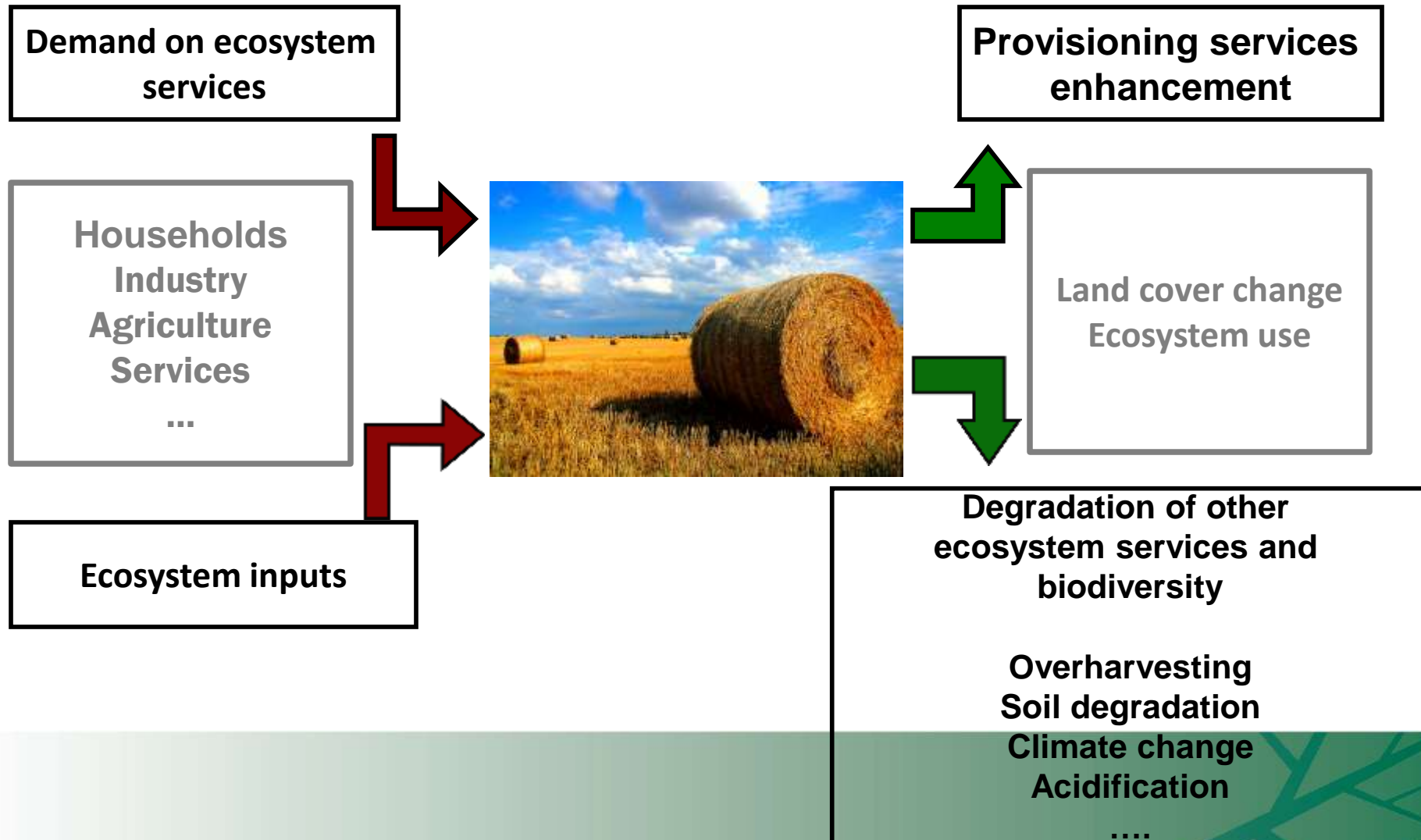


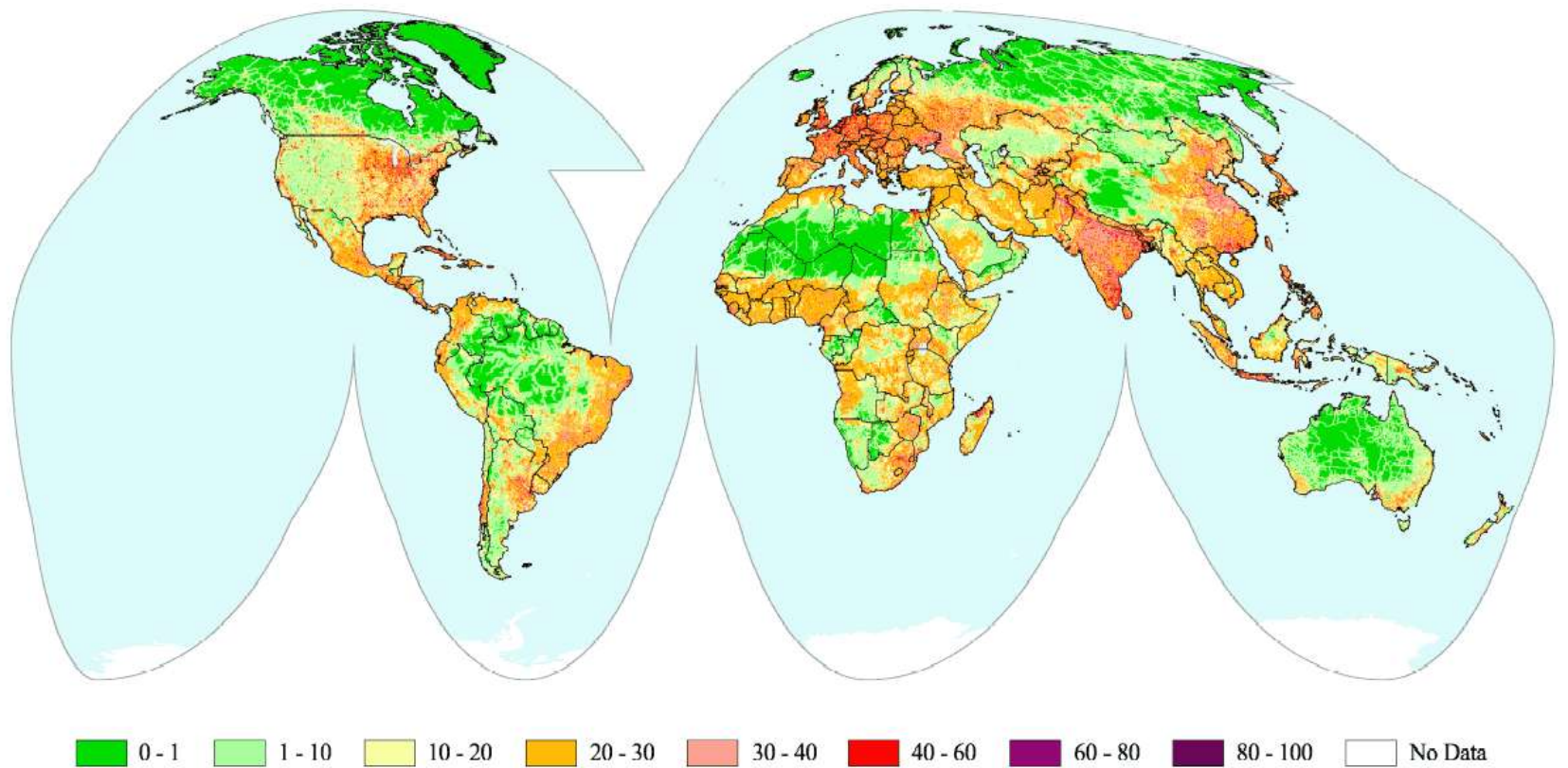
Aims of the analysis

- to what extent human activities influence natural land cover
- how to quantify human dominance of ecosystems
- how is biodiversity responding to human pressures
- what is the relationship between land cover and biodiversity in human dominated regions



Interactions between society and nature



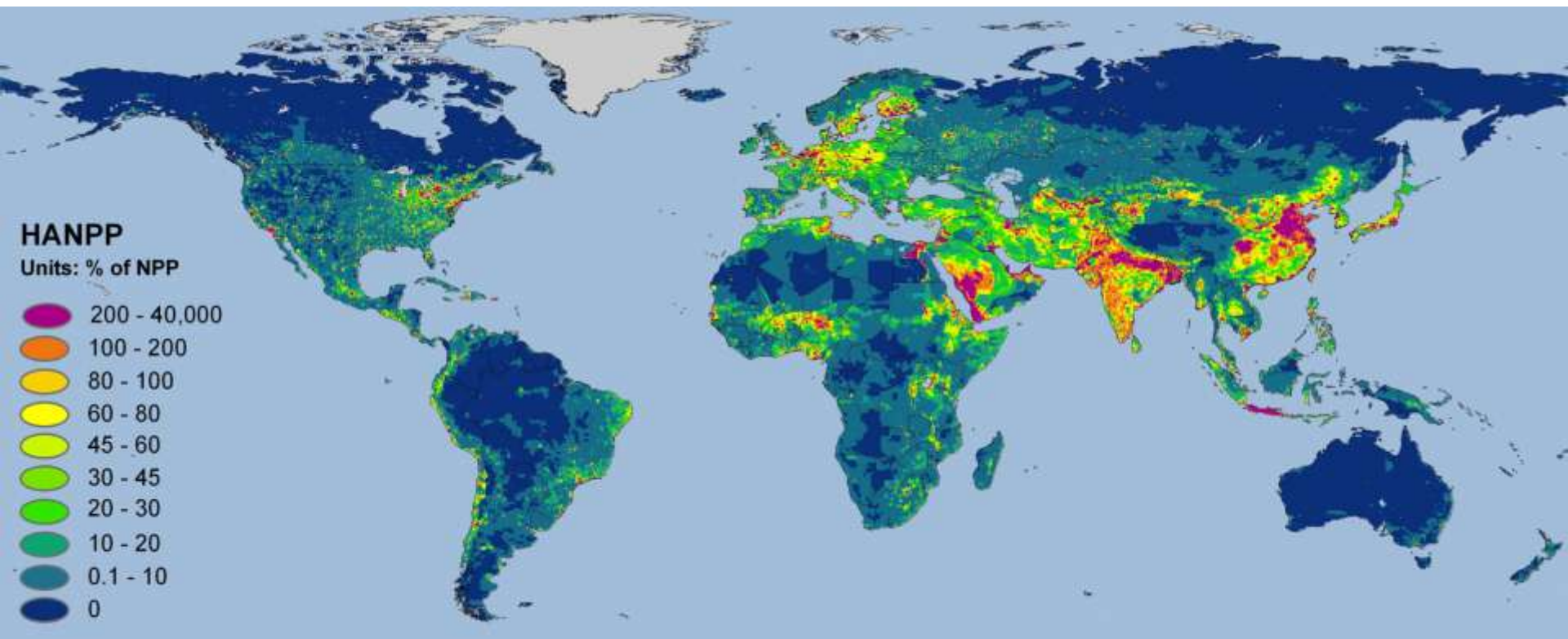


Human influence on ecosystems (Sanderson et al. 2002):

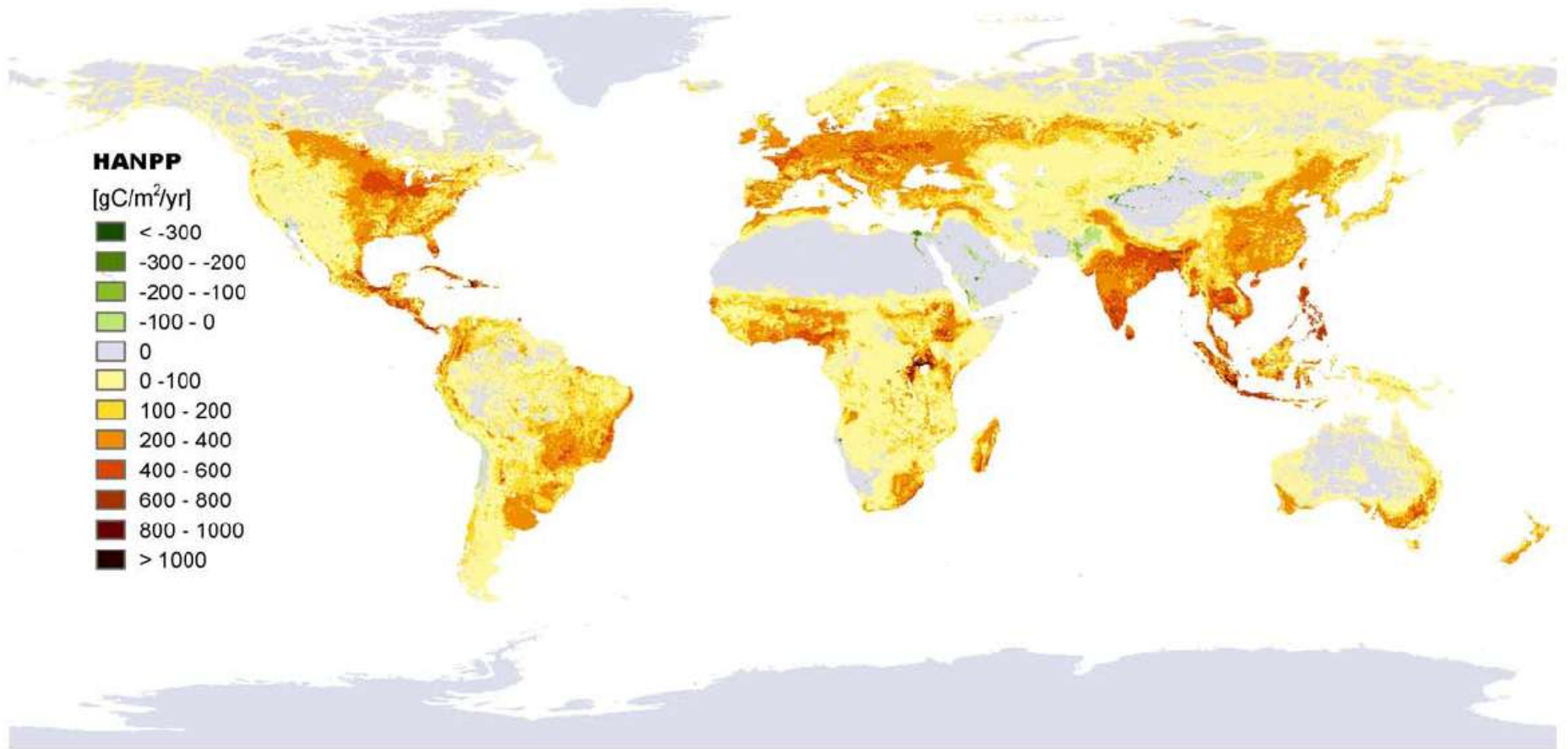
- human land use/land conversion,
- human access from roads, railways or major rivers,
- electrical infrastructure (indicated by lights detected at night),
- direct occupancy (higher human population densities)

How to measure human domination of ecosystems?

- Concept of **human footprint** (bioproductive area appropriated by socioeconomic/industrial metabolism or influenced by human activity) (Wackernagel et al. 2002; Sanderson et al. 2002).
- Human appropriation of net primary production (**HANPP**) (appropriated primary productivity of the biosphere)
(Vitousek et al. 1986, Rojstaczer et al. 2001, Imhoff et al. 2004, Haberl et al. 2007)



M. Imhoff et al., 2004, Nature 429, pp. 870-873



H. Haberl et al., 2007, PNAS 104, pp. 12942-12947

HANPP definition

$$HANPP = NPP_0 - NPP_t$$

$$NPP_t = NPP_{act} - NPP_h$$

$$HANPP = \Delta NPP_{LC} + NPP_h$$

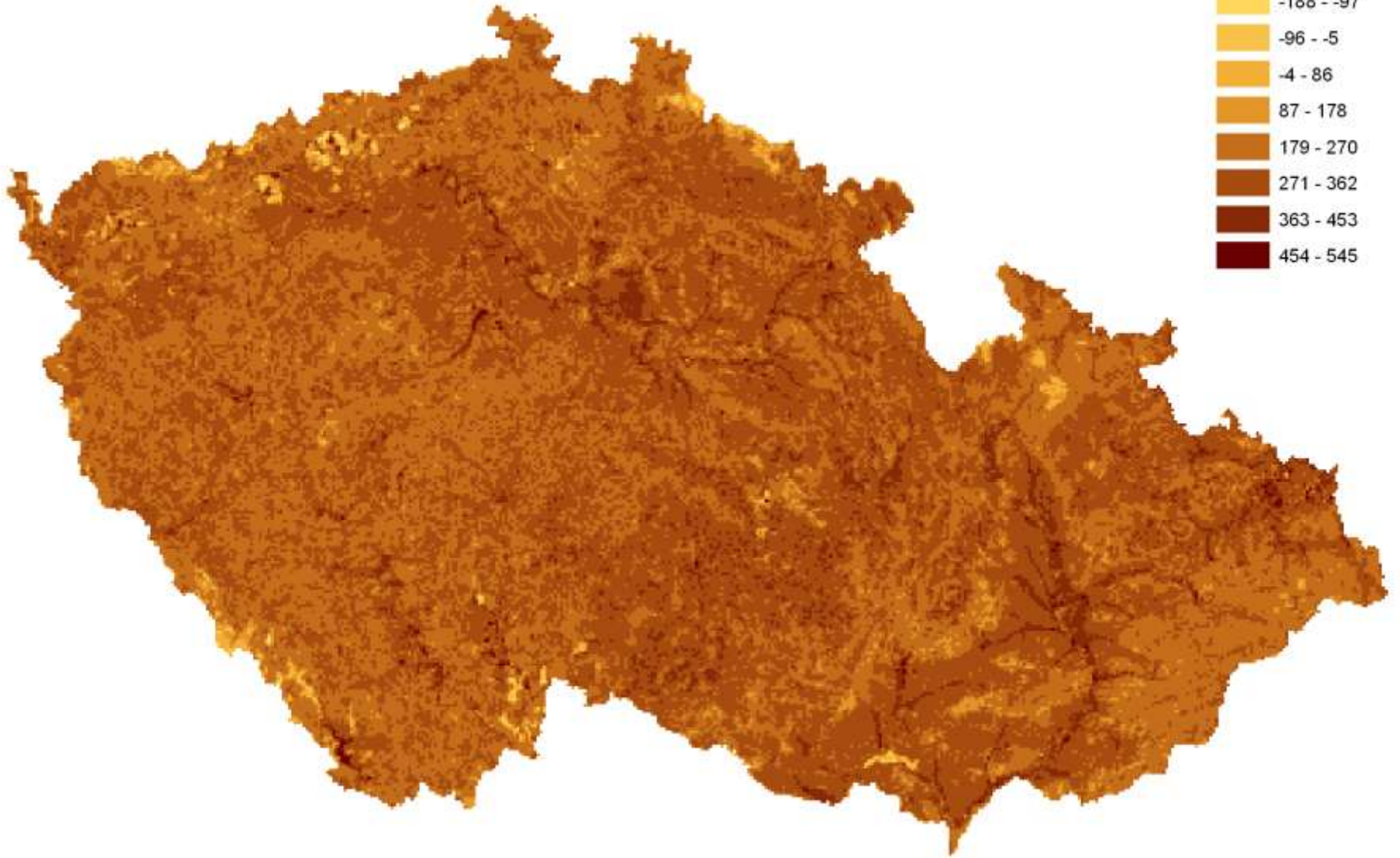
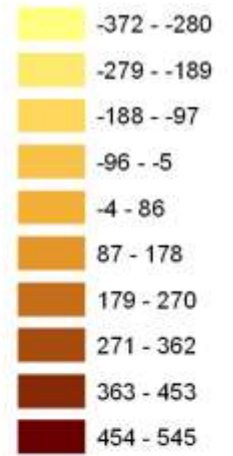
Definition by
Haberl 1997,
Haberl et al. 2007,
Erb et al. 2009

$$HANPP(\%) = \left[1 - \left(NPP_t / NPP_0 \right) \right] \times 100$$

HANPP in the Czech Republic

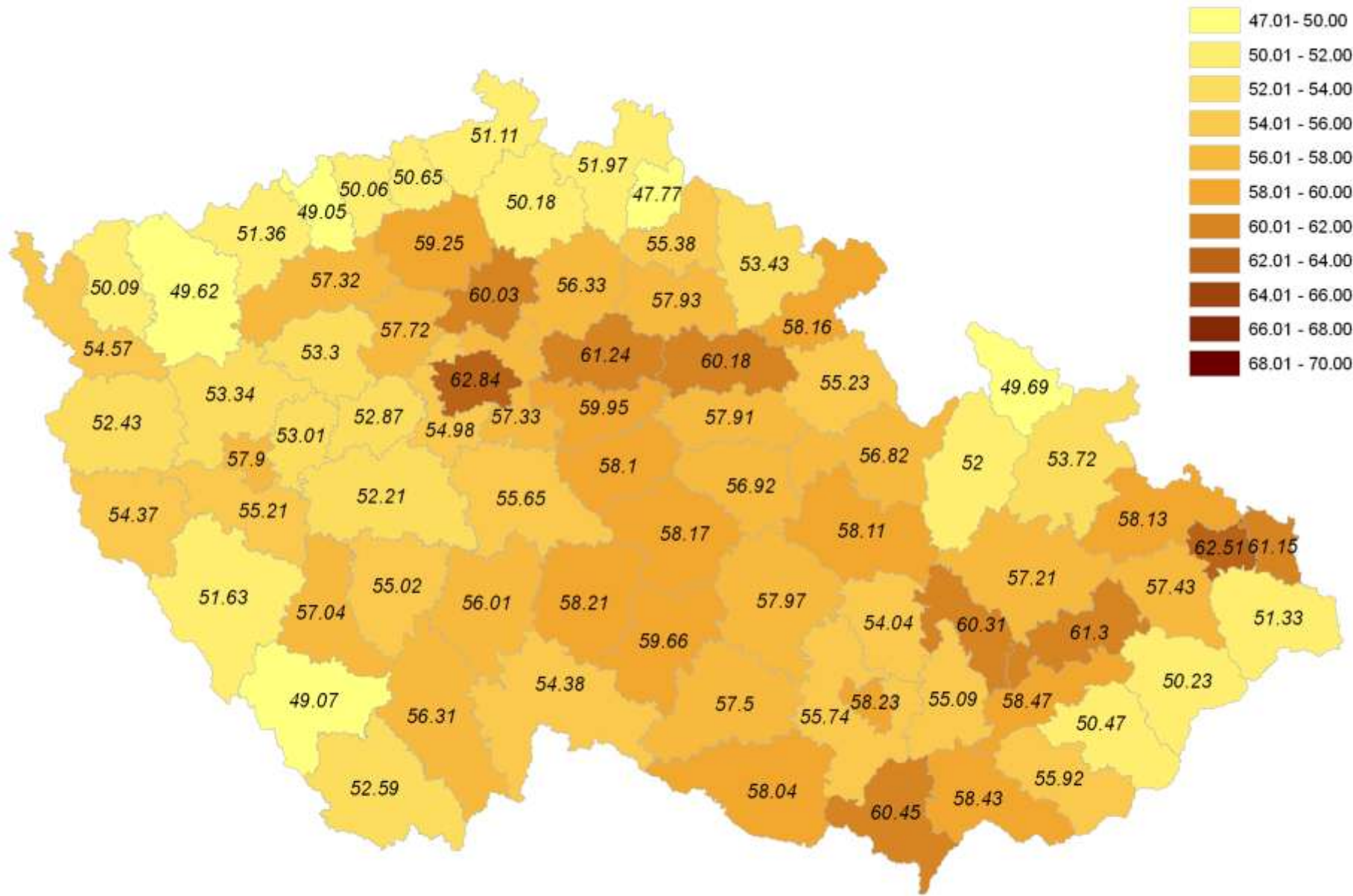
1. Aggregate (a)HANPP for the Czech Republic based on the LC-NPP bookkeeping model
2. $\Delta\text{NPP}_{\text{LC}}$ as a NPP difference between NPP_0 of natural vegetation and NPP_{ACT} of actual land cover
3. Harvested NPP_{H} calculated as a harvest expanded by biomass expansion factors (NPP_{H} equivalent), taking into account recovery rates
4. NPP_0 , NPP_{ACT} , NPP_{T} , NPP_{H} , and $\Delta\text{NPP}_{\text{LC}}$ in a 1km^2 grid based on Corine Land Cover 1990, 2000, 2006

HANPP 2006 [MgC/km²]

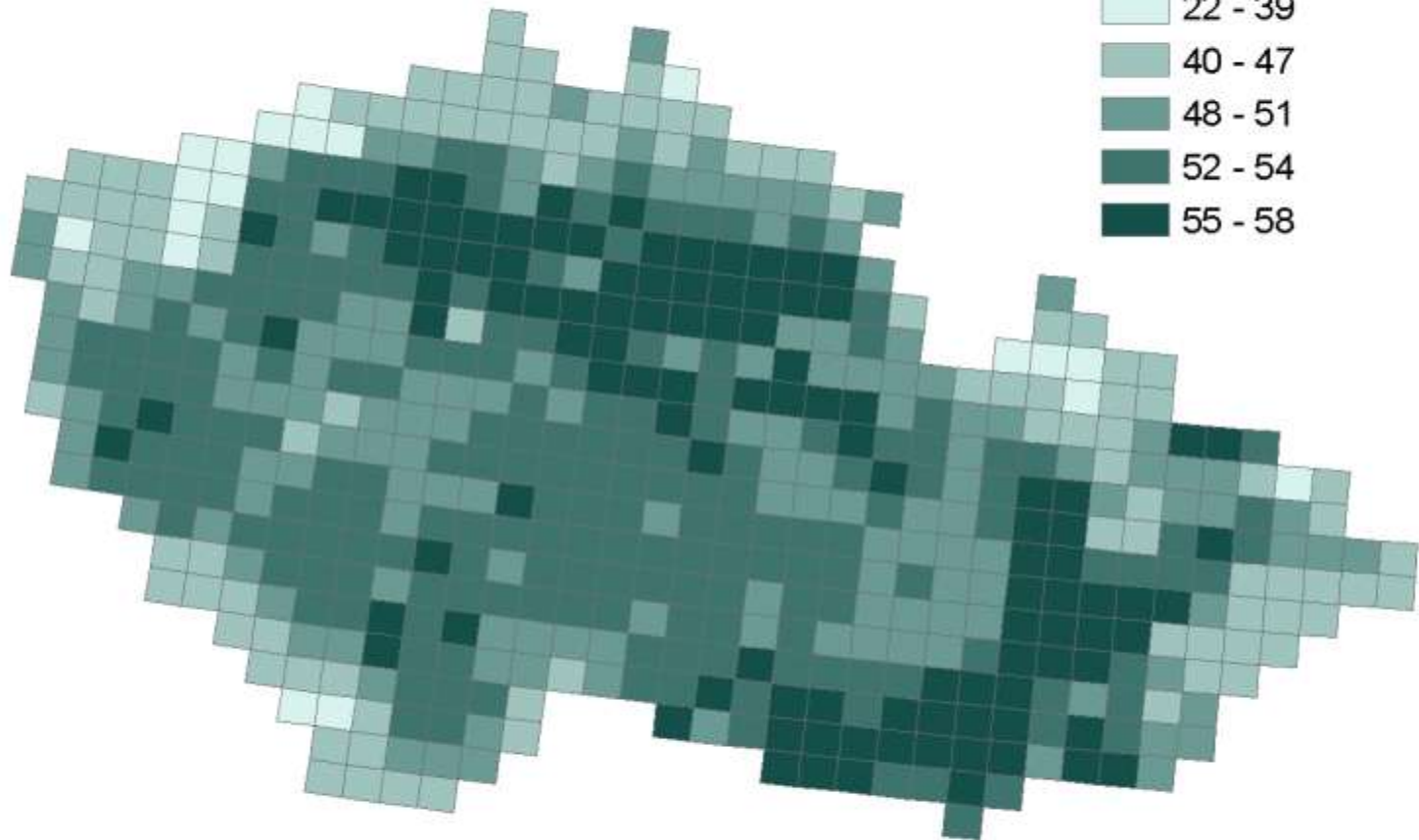
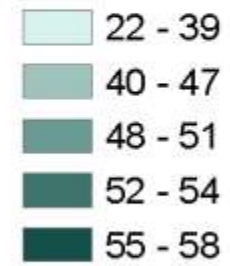


Vackar D. & Orlitová E., Regional Environmental Change, 2010

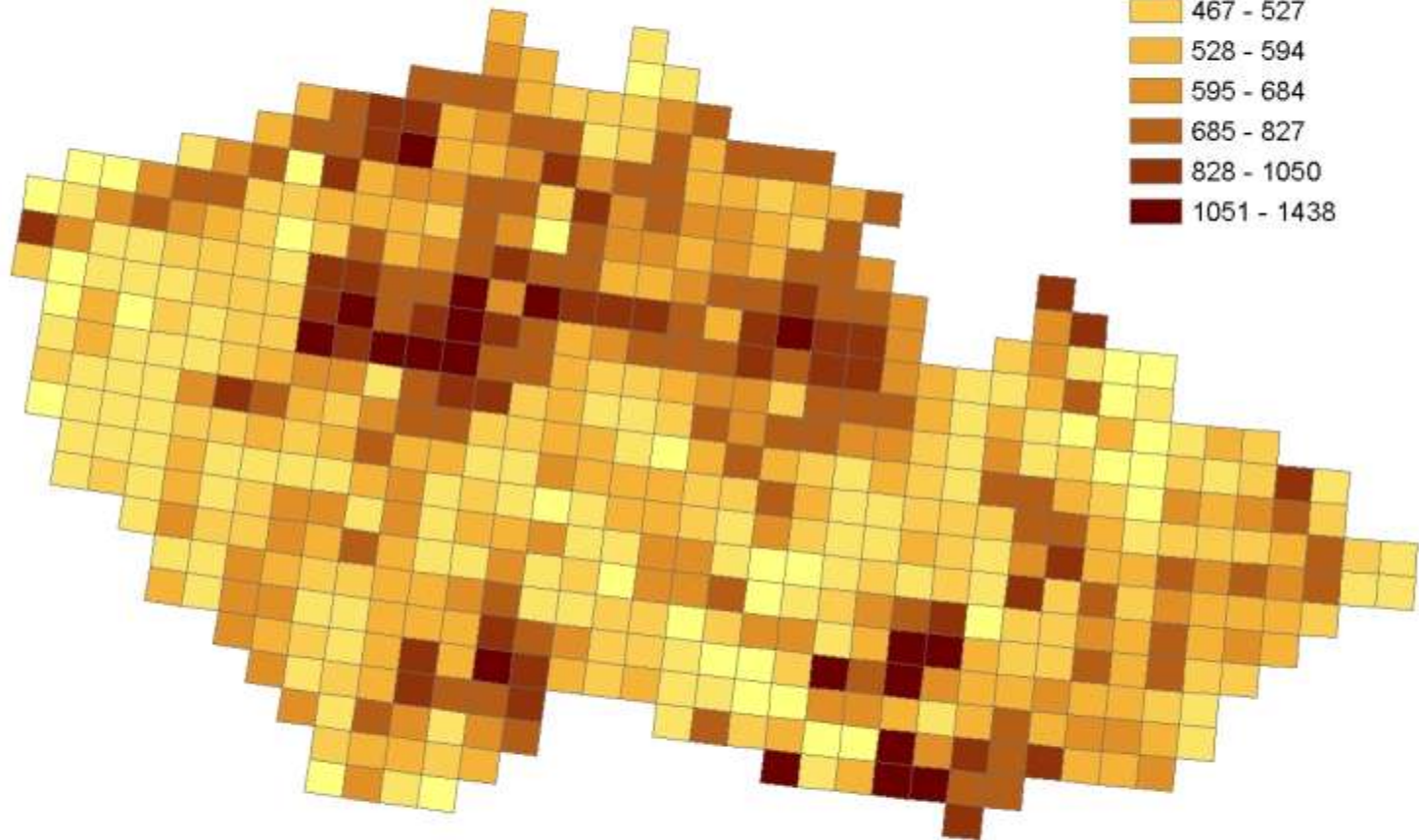
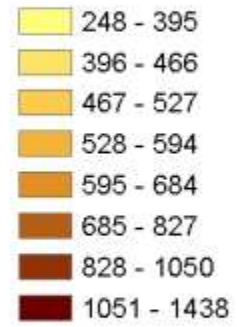
HANPP 2000 [%]

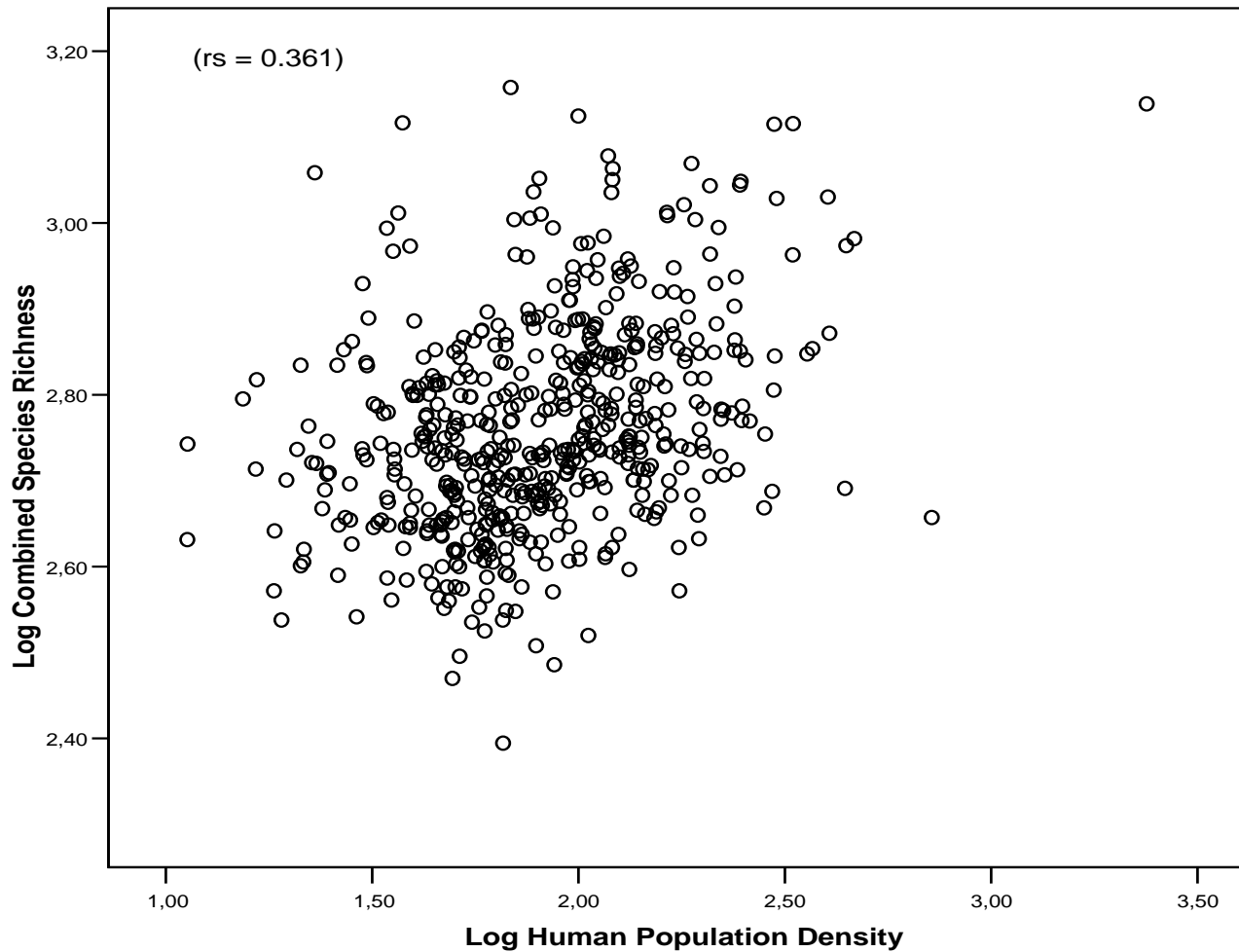


Gridded aHANPP (%)

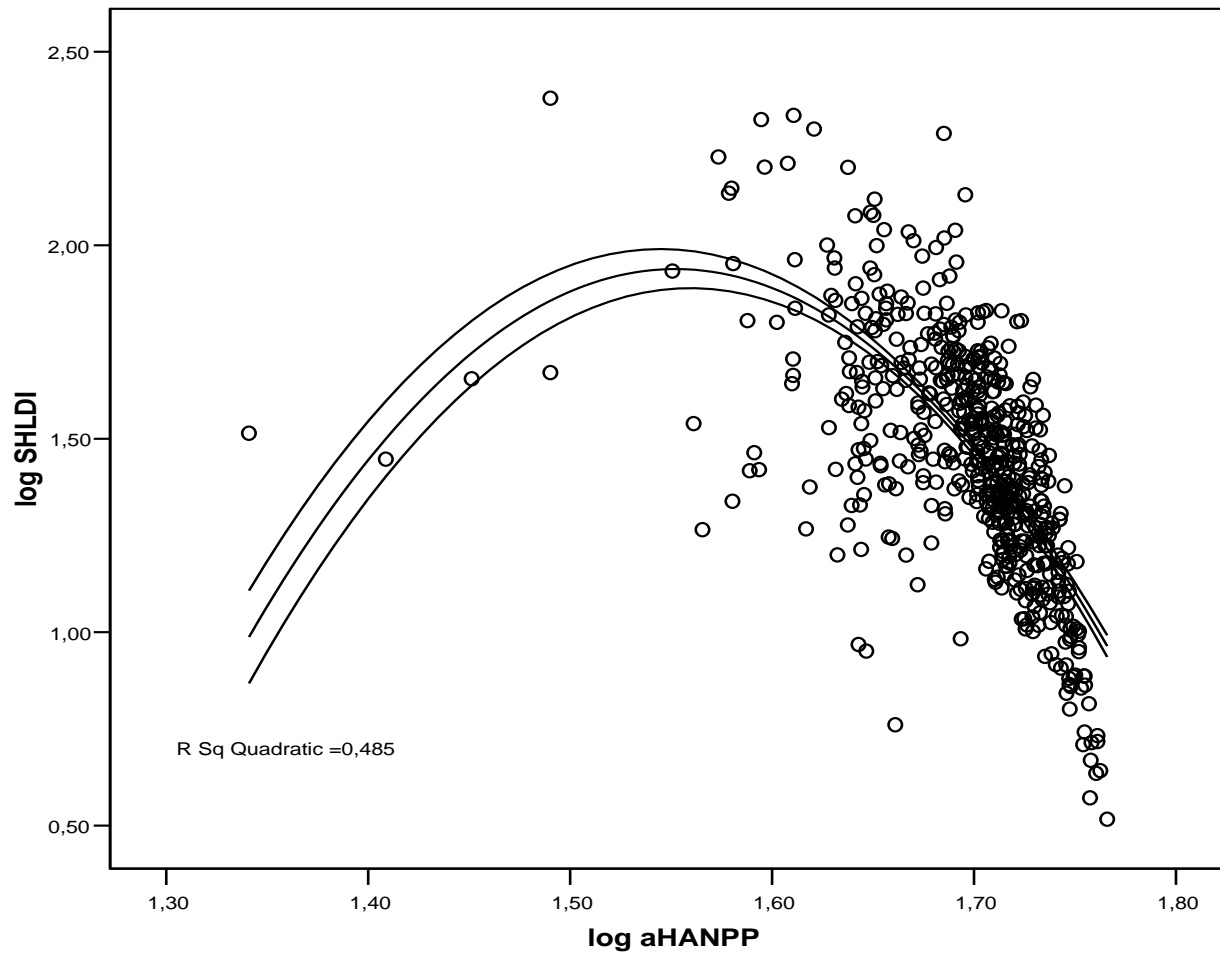


**Combined Species Richness
(No. of species)**





Species richness is positively correlated with human population density



HANPP and landscape diversity (Shannon diversity index based on land cover classes)

Cross-correlations land cover-species richness (r_s)

	URBAN	AGRI	PAST	FOREST	GRASS	BARE	WET	WATER
Inverte	0.310	-0.154	-0.056	0.053	0.151	0.055	0.186	0.196
Verteb	0.159	0.127	-0.072	-0.178	0.042	-0.038	0.120	0.321
Plants	0.518	0.164	-0.179	-0.247	-0.019	0.026	-0.071	0.152
REPT	0.055	-0.347	0.246	0.265	0.039	0.013	-0.011	0.062
AMPHI	0.270	0.124	-0.166	-0.164	0.016	-0.006	0.070	0.248
CARAB	0.433	-0.082	-0.051	-0.084	0.118	0.048	0.106	0.152
BUTTER	0.198	-0.099	-0.037	0.045	0.155	0.022	0.103	0.143
MAMM	-0.098	0.011	0.088	-0.024	-0.011	-0.023	0.108	0.049
SPIDER	0.110	-0.164	0.011	0.092	0.103	0.052	0.138	0.154
ELATERI	0.226	-0.123	-0.101	0.073	0.131	0.061	0.182	0.133
CERAM	0.287	-0.125	-0.157	0.106	0.157	0.039	0.166	0.150
BIRD	0.125	0.135	-0.063	-0.178	0.044	-0.038	0.120	0.297

Summary of findings

- **(a)HANPP reached 56% of potential natural productivity in 2006 (5% decrease 1990-2006)**
 - **Human activities influence biodiversity at species and landscape level but the relationship follows the intermediate disturbance hypothesis (highest diversity at intermediate levels of human impacts)**
 - **Ecosystem use intensity influences especially landscape diversity (hump-shaped relationship explained 48.5% of variance)**
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