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The role of agroecosystems in biodiversity conservation

1. Increas7oaing human pressure (conversion to agroecosygf vb l hjh dd cf cstems included) causes global biodiversity decli
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THEREFORE

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Agroecosystems & biodiversity

1. Increasing human pressure (conversion to agroecosystems included) causes global biodiversity decline

2. Species concentrate in the remnant natural areas

3. This is where most conservation efforts are directed

BUT

4. Conserving biodiversity in intact natural areas is not enough

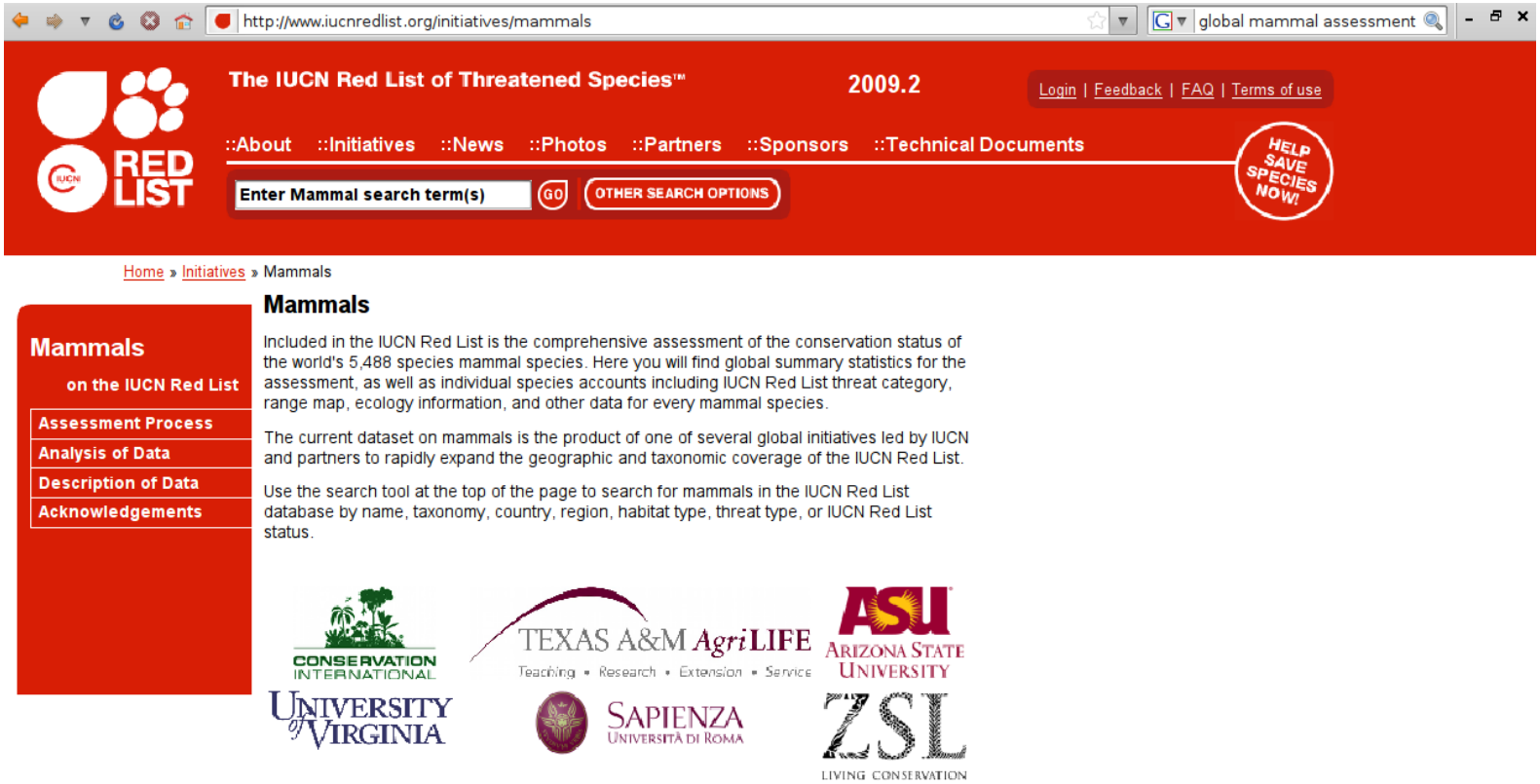
5. Future scenarios predict further loss of natural habitat

THEREFORE

6. Biodiversity must be conserved also in converted areas

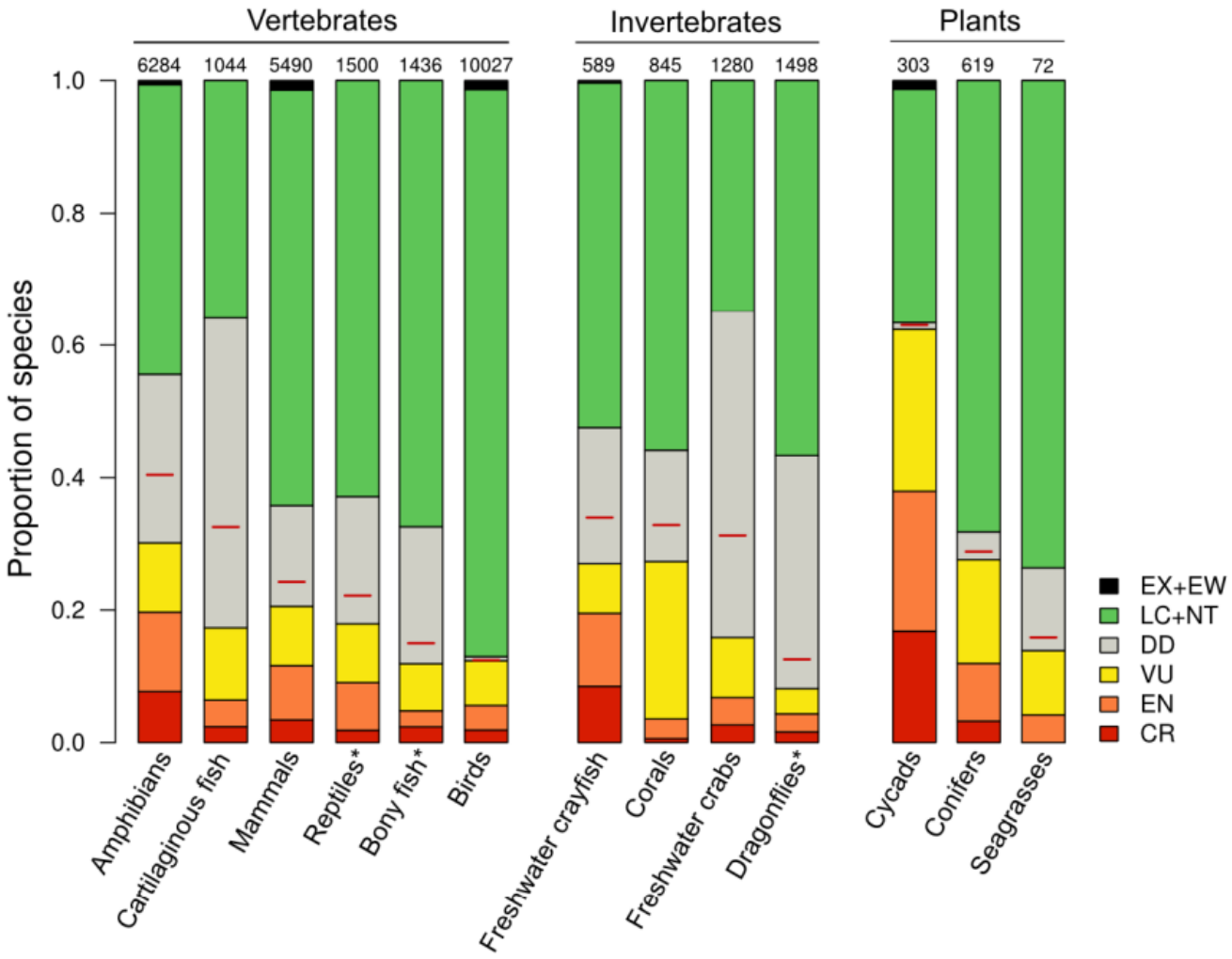
1. The increasing human pressure on the natural environment, including the conversion into agroecosystems, is causing the ongoing global biodiversity decline

The IUCN Red List



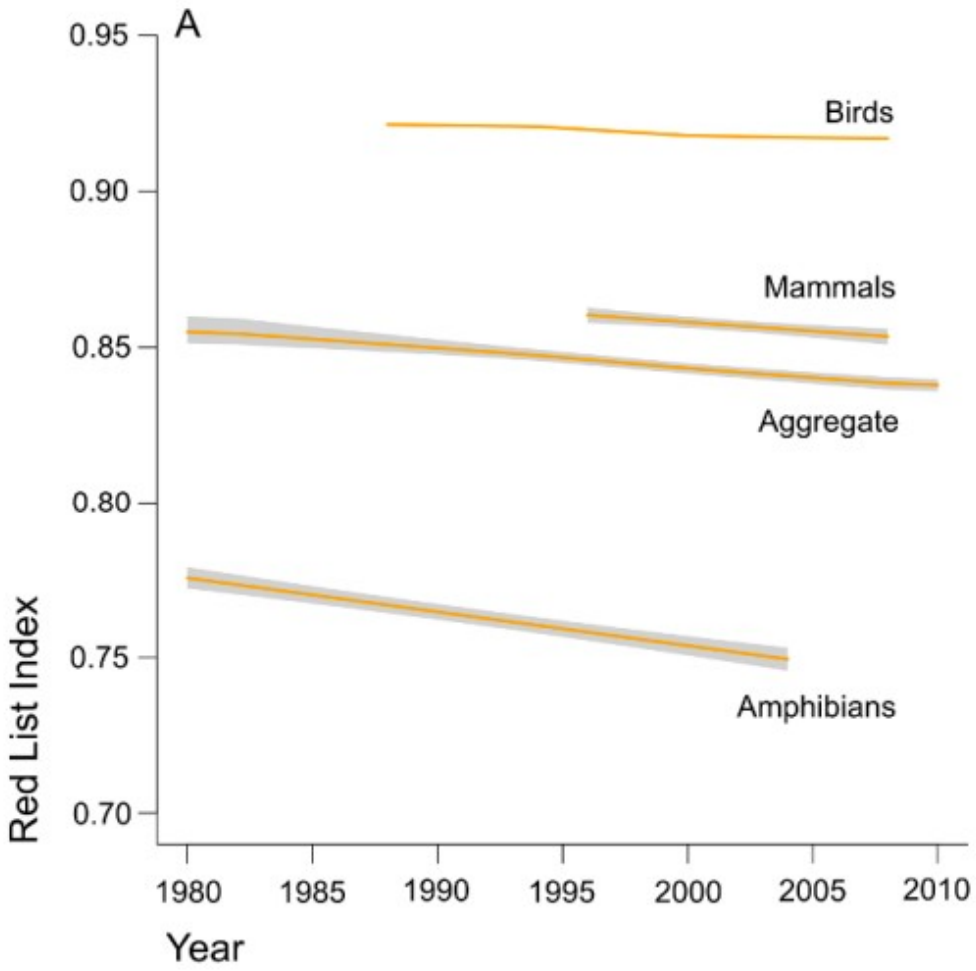
IUCN (2010) The IUCN Red List of Threatened Species. www.iucnredlist.org

Globally threatened species



Hoffmann, ..., , Rondinini et al. (2010) The impact of conservation on the status of the world's vertebrates. *Science* 330:1503

Global past trend of threat



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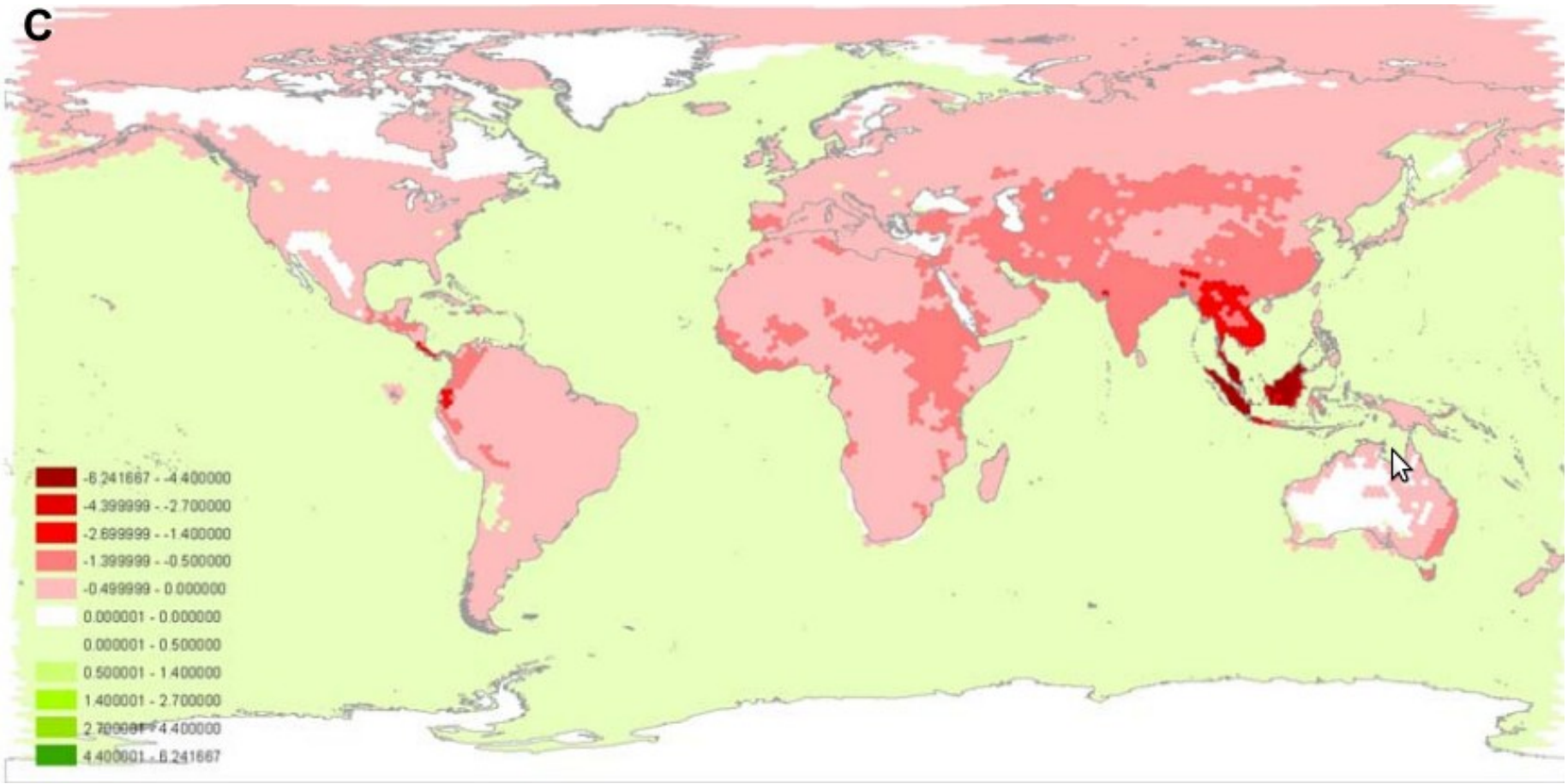
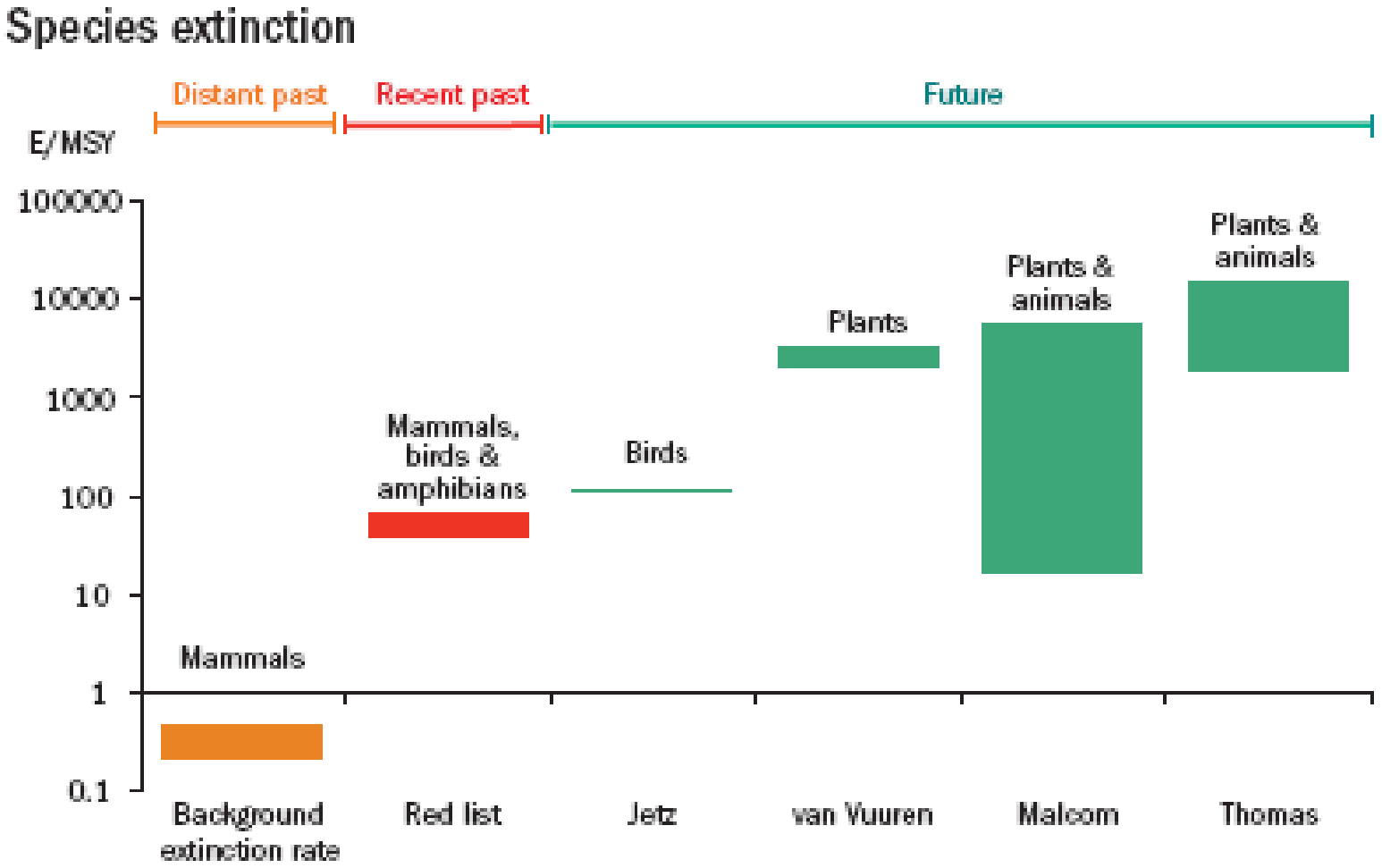
Global trend trend of threat



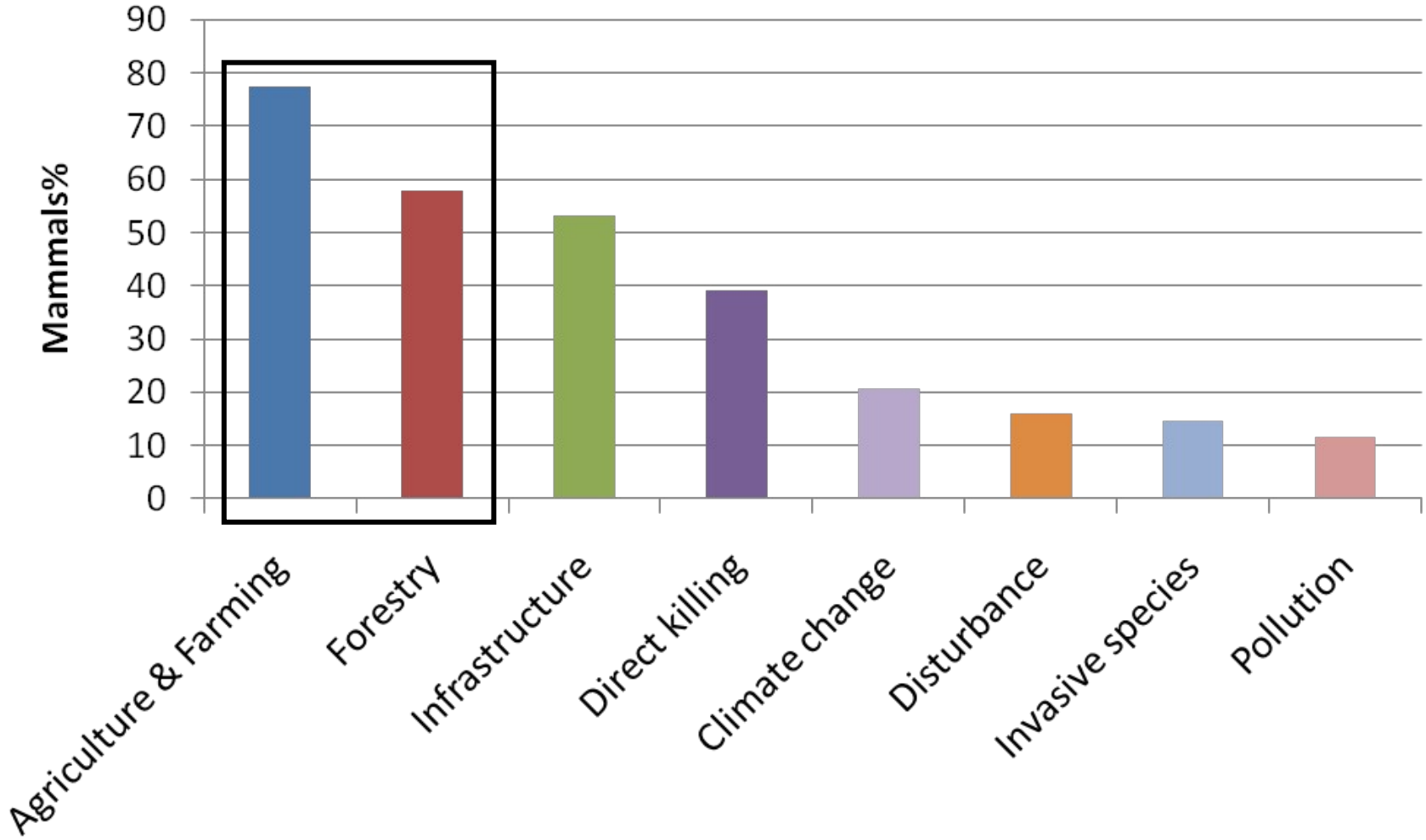
Hoffmann, ..., , Rondinini et al. (2010) The impact of conservation on the status of the world's vertebrates. *Science* 330:1503

Past, present and predicted global extinctions



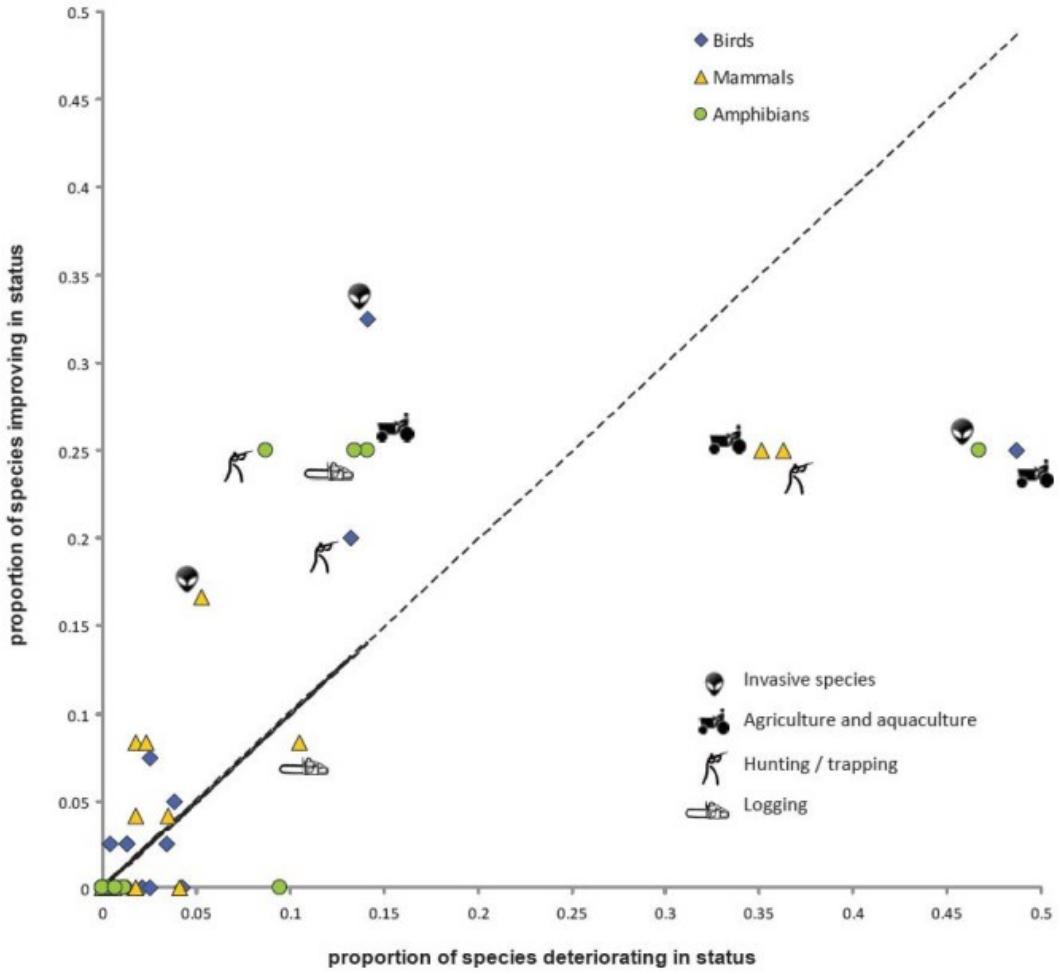
CBD (2010)

Global threats to mammals



Schipper, ... , Rondinini et al. (2008) The status of the world's land and marine mammals: diversity, threat and knowledge. *Science* 322:225

How we are dealing with threats globally



Hoffmann, ..., , Rondinini et al. (2010) The impact of conservation on the status of the world's vertebrates. *Science* 330:1503

2. Species concentrate in the remnant natural areas that are still intact or have not been extensively converted

Sample: 5030 (ca. 95%) terrestrial mammals

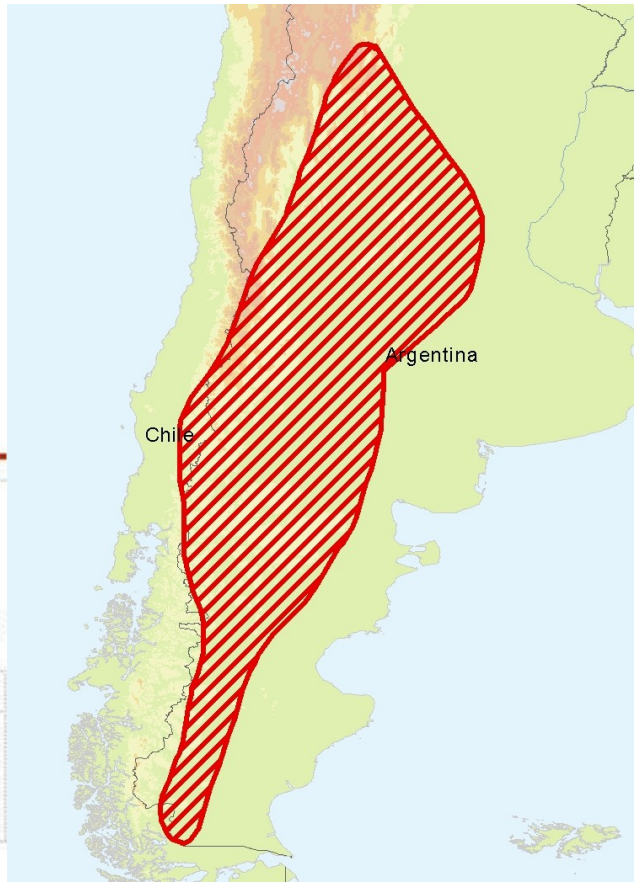
Order	Number of species
Afrosoricida	54
Carnivora	280
Cetartiodactyla	240
Chiroptera	1139
Cingulata	21
Dasyuromorphia	73
Dermoptera	2
Didelphimorphia	94
Diprotodontia	139
Eulipotyphla	442
Hyracoidea	5
Lagomorpha	92
Macroscelidea	16
Microbiotheria	1

Order	Number of species
Monotremata	5
Notoryctemorphia	2
Paucituberculata	6
Peramelemorphia	19
Perissodactyla	16
Pholidota	8
Pilosa	10
Primates	411
Proboscidea	2
Rodentia	2215
Scandentia	19
Sirenia	3
Tubulidentata	1

Rondinini et al. (2011) Global habitat suitability models of terrestrial mammals *Phil Trans R Soc B* in press

Species-habitat relationships

An example from
IUCN Red List website
for *Lyncodon patagonicus*



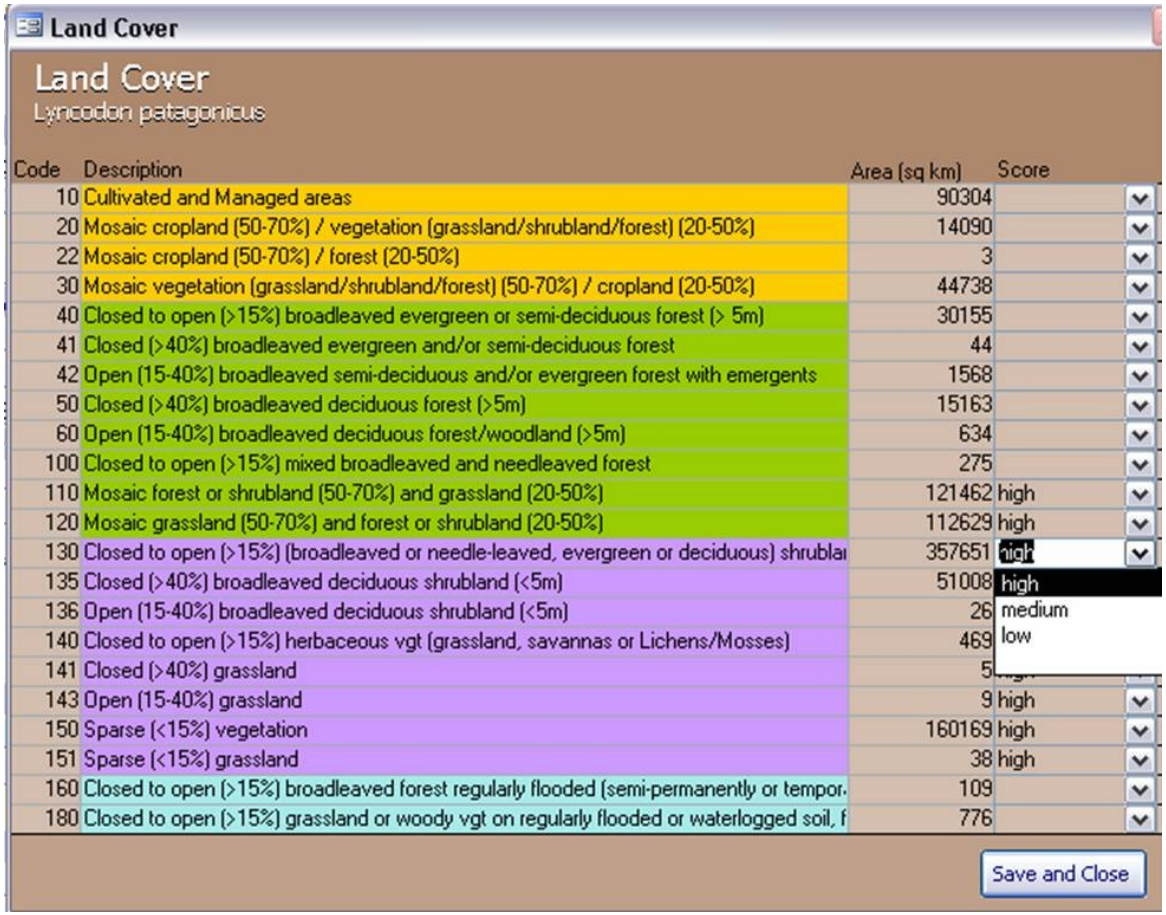
Range of
Lyncodon patagonicus

Habitat and Ecology [top]

Habitat and Ecology:	*Lyncodon patagonicus* is found in herbaceous and shrub steppes and xerophytic woodlands (Osgood, 1943; Prevosti and Pardiñas, 2001). Its habits are little known; available data indicate that *L. patagonicus* is nocturnal-crepuscular and that it preys on fossorial rodents and birds (Cabrera and Yepes, 1940; Koslowsky, 1904; Redford and Eisenberg, 1992). May be assopciated with tuc-tuc (*Ctenomys spp.*) communities (Tell *et al.* 2001).
Systems:	Terrestrial
List of Habitats:	3 Shrubland 3.4 Shrubland - Temperate 4 Grassland 4.4 Grassland - Temperate

Rondinini et al. (2011) Global habitat suitability models of terrestrial mammals *Phil Trans R Soc B* in press

Species-habitat relationships



Rondinini et al. (2011) Global habitat suitability models of terrestrial mammals *Phil Trans R Soc B* in press

Environmental variables

Globcover (ESA, 2008)
300m resolution

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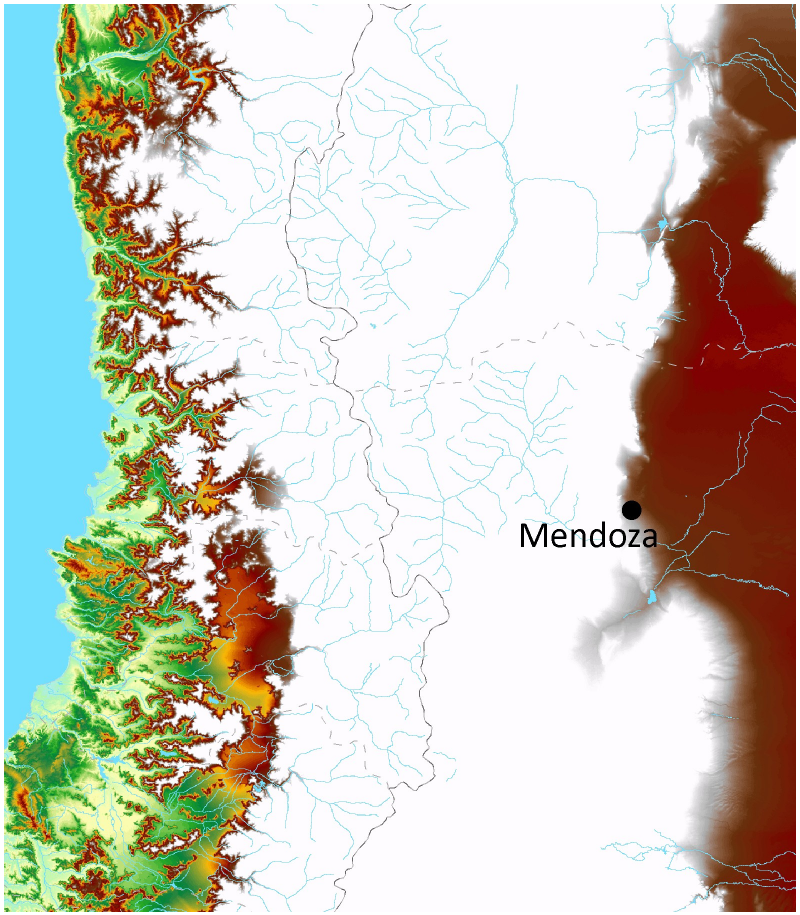
Environmental variables

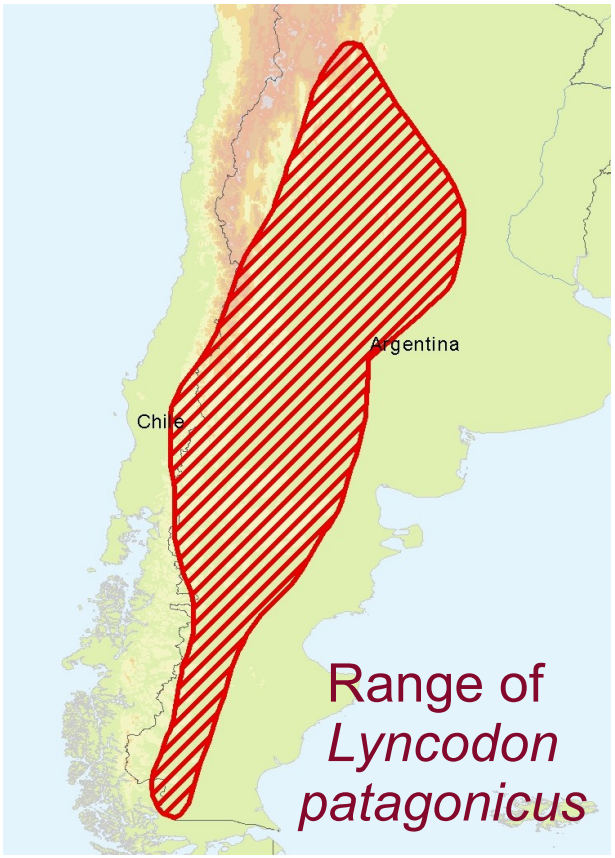


SRTM elevation (NASA and USGS, 2007) at 90m resolution

Globcover and SRTM water

Rondinini et al. (2011) Global habitat suitability models of terrestrial mammals *Phil Trans R Soc B* in press

Habitat suitability models (HSM)

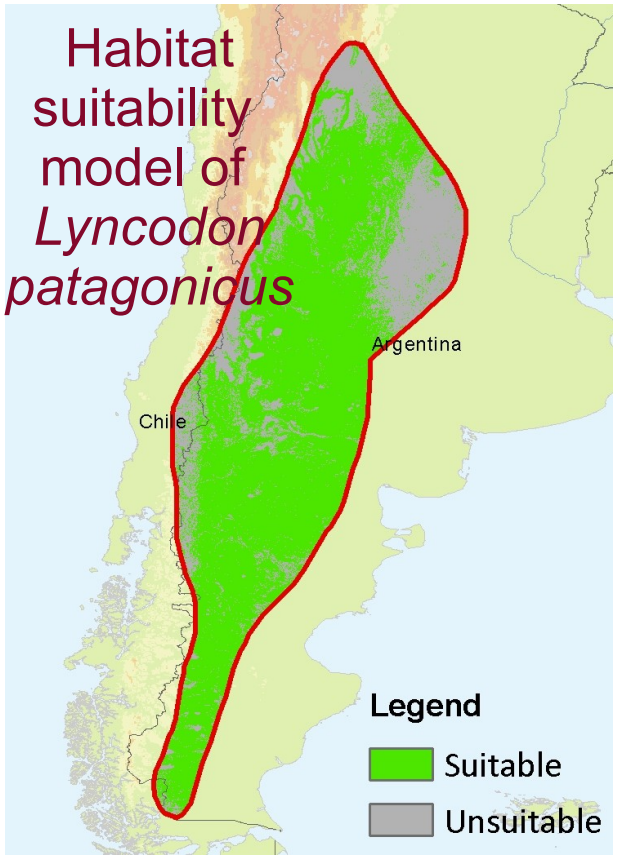


Habitat data

↓

Combined environmental variables:

Land cover
Elevation
Hydrology



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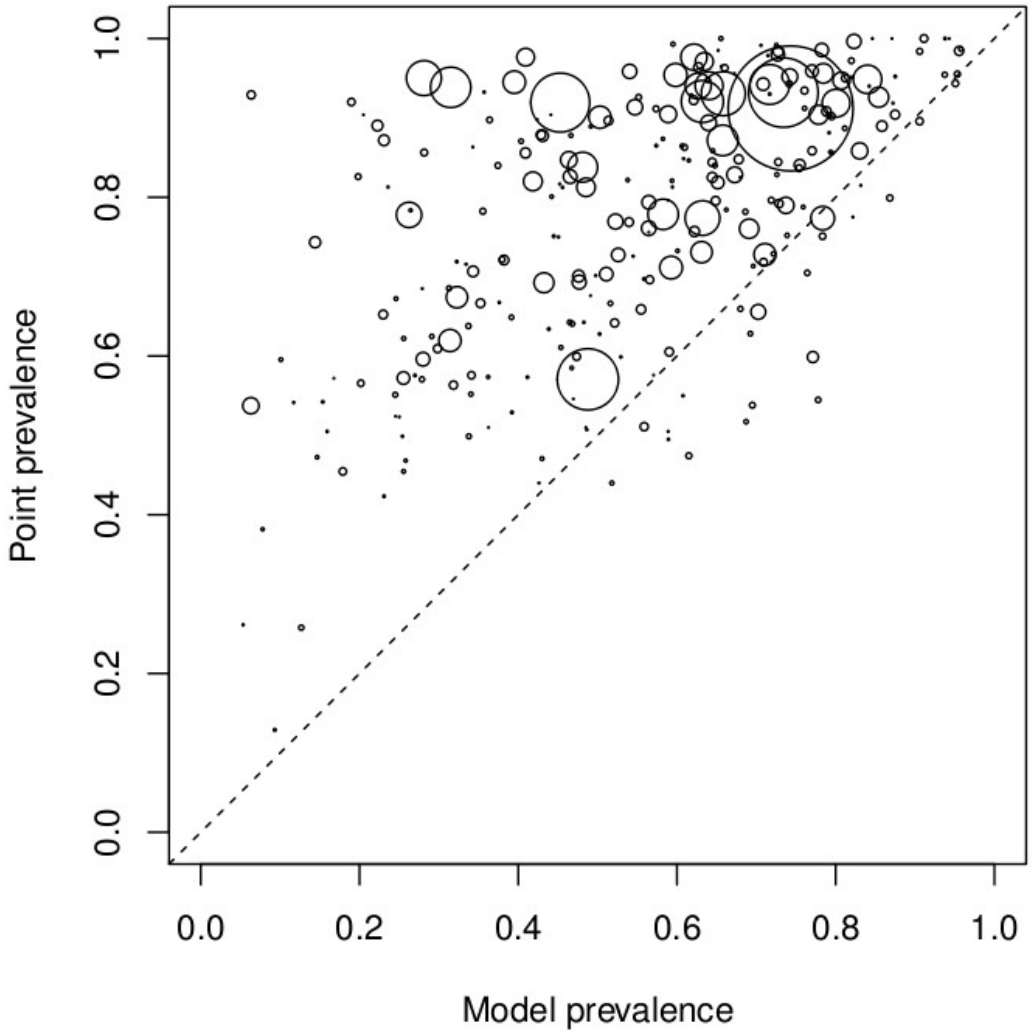
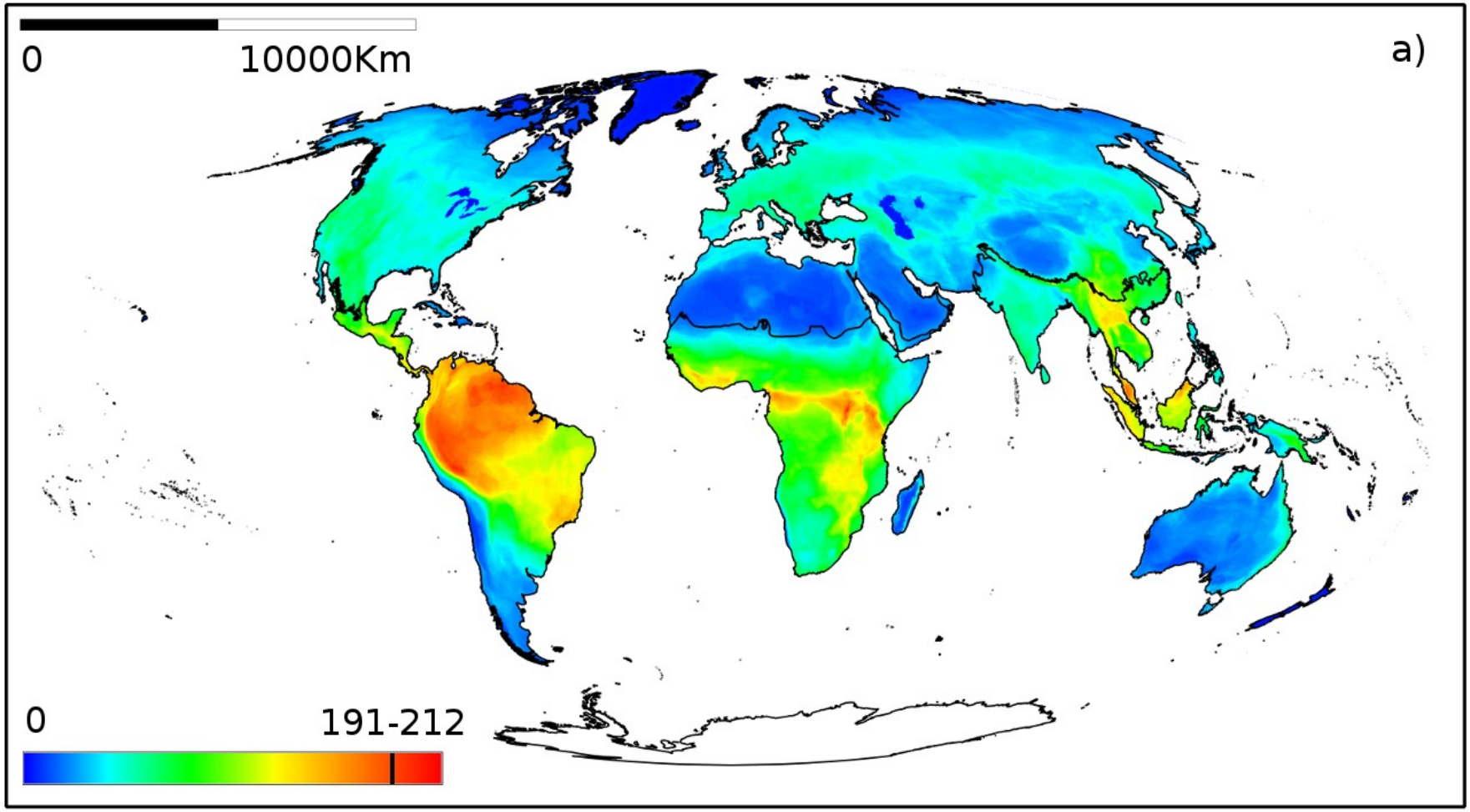
Results of HSM evaluation



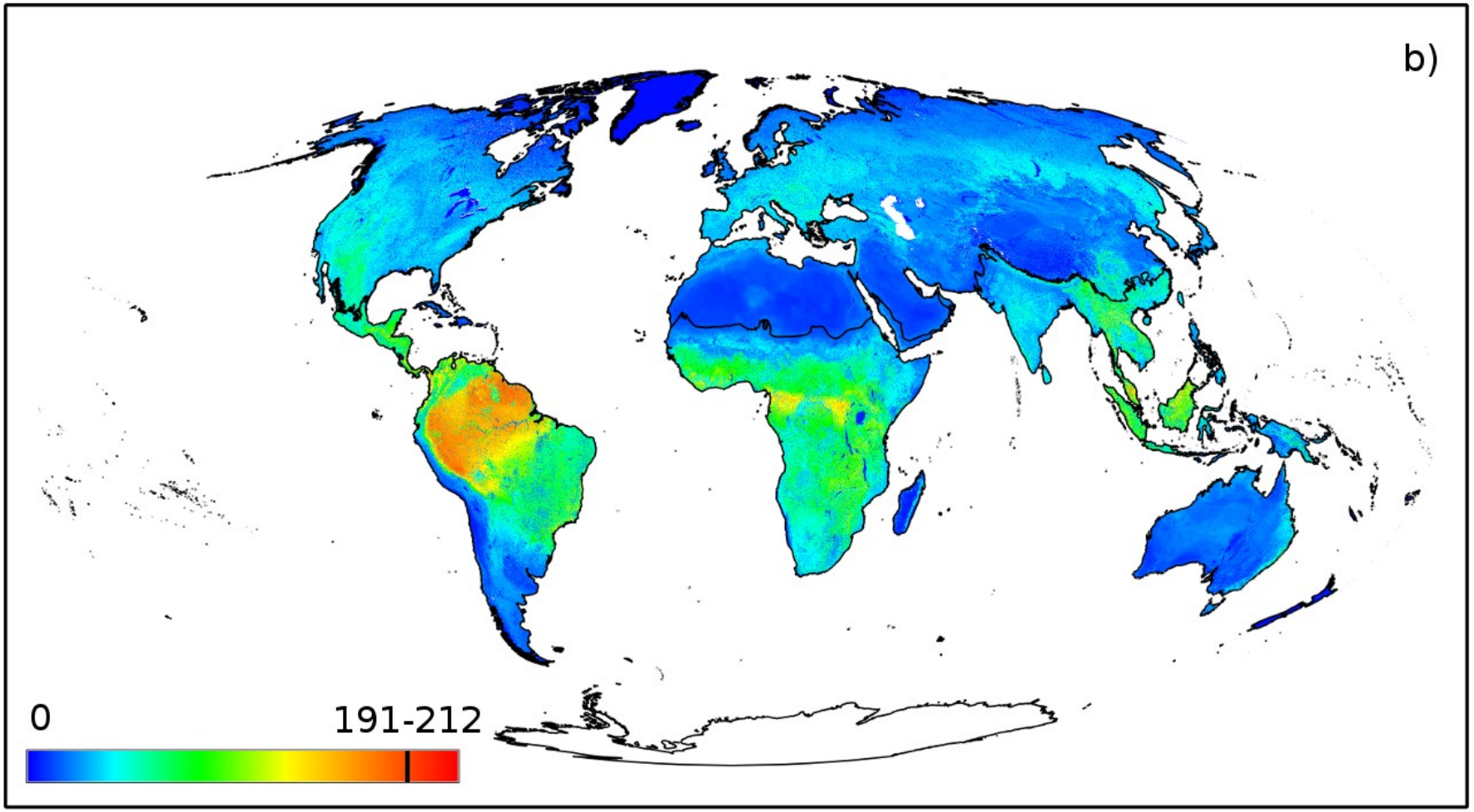
Rondinini et al. (2011) Global habitat suitability models of terrestrial mammals *Phil Trans R Soc B* in press

Global mammal richness (geographic ranges)



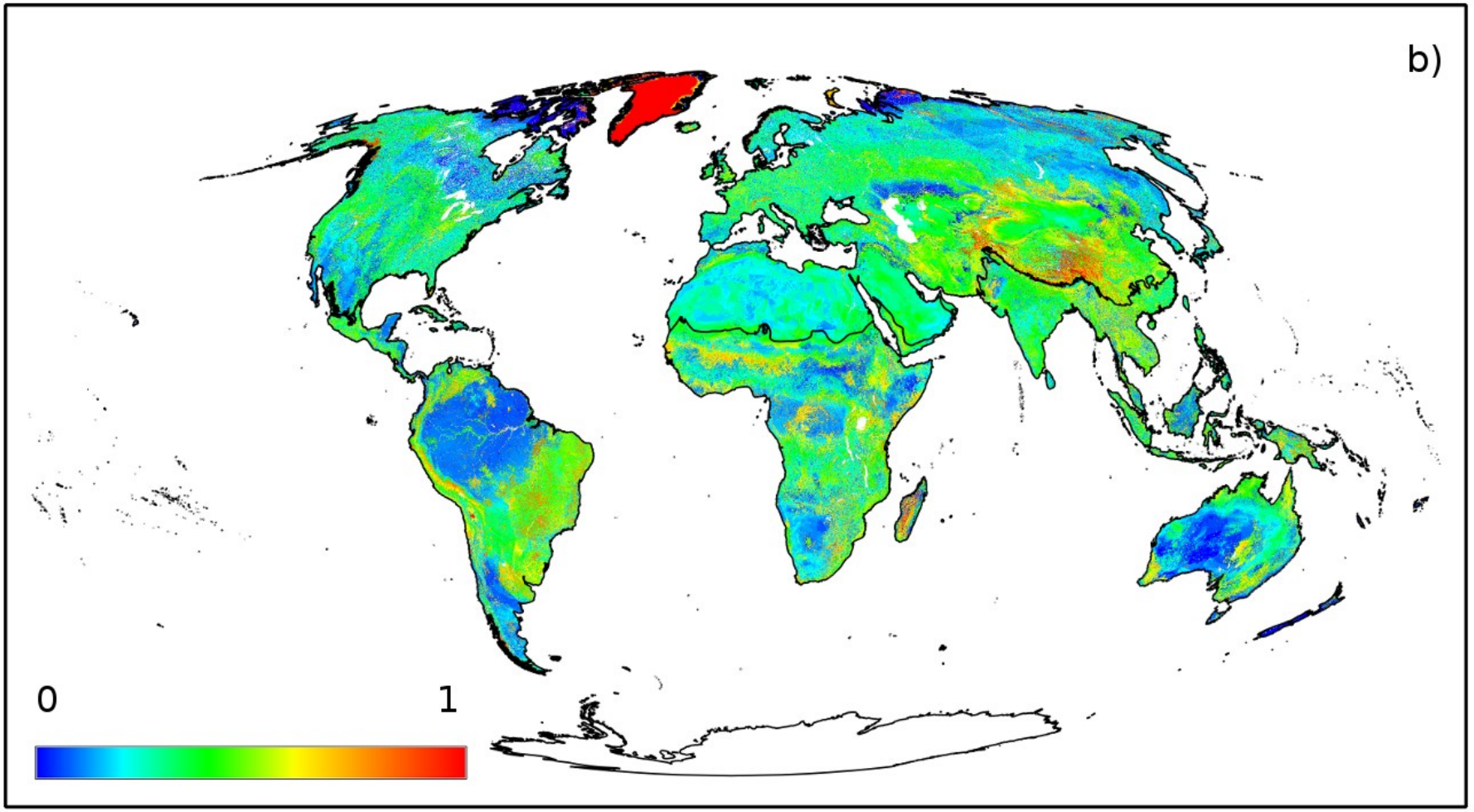
Rondinini et al. (2011) Global habitat suitability models of terrestrial mammals *Phil Trans R Soc B* in press

Global mammal richness (HSM)



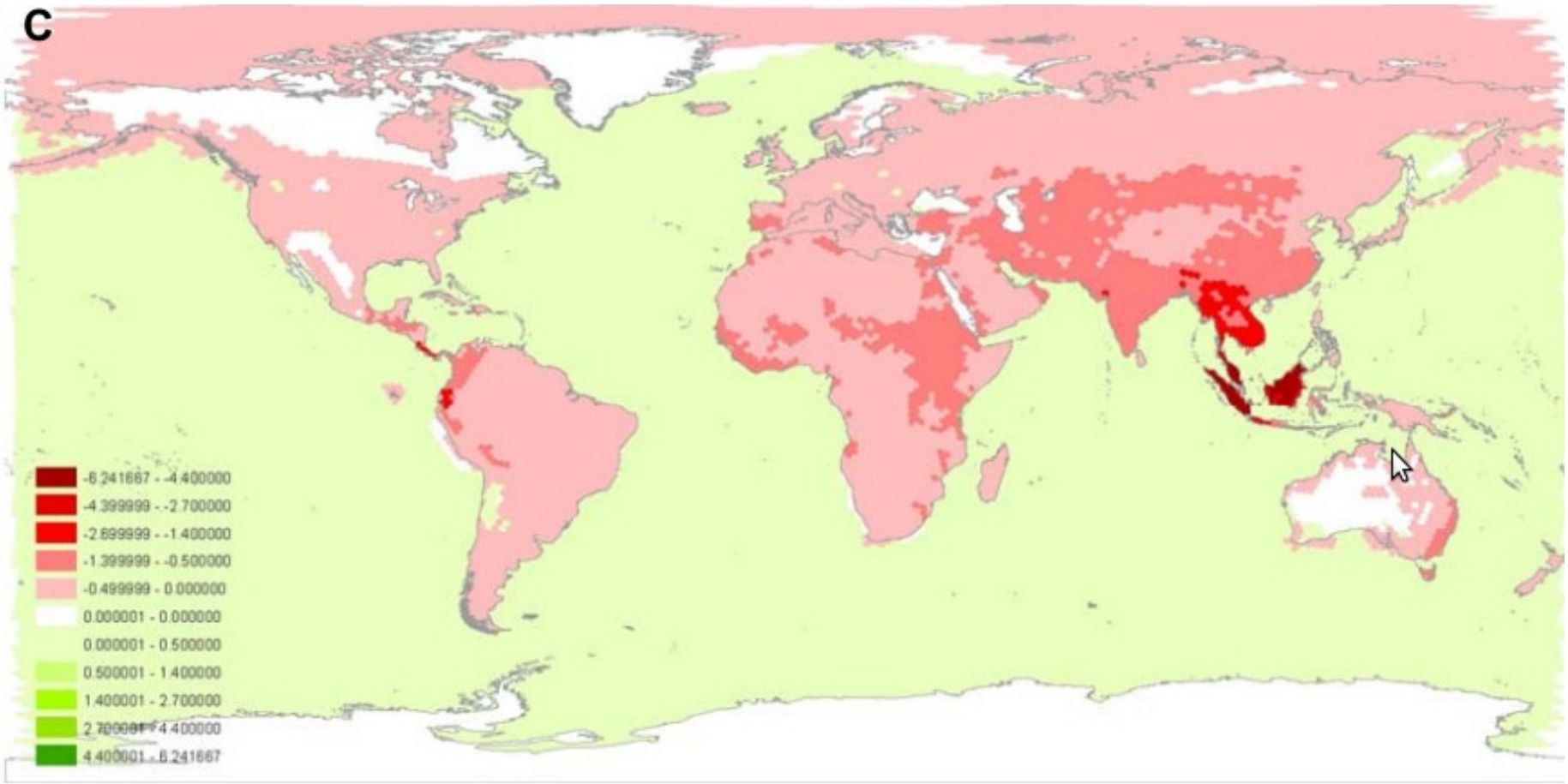
Rondinini et al. (2011) Global habitat suitability models of terrestrial mammals *Phil Trans R Soc B* in press

Relative difference (ranges - HSM)



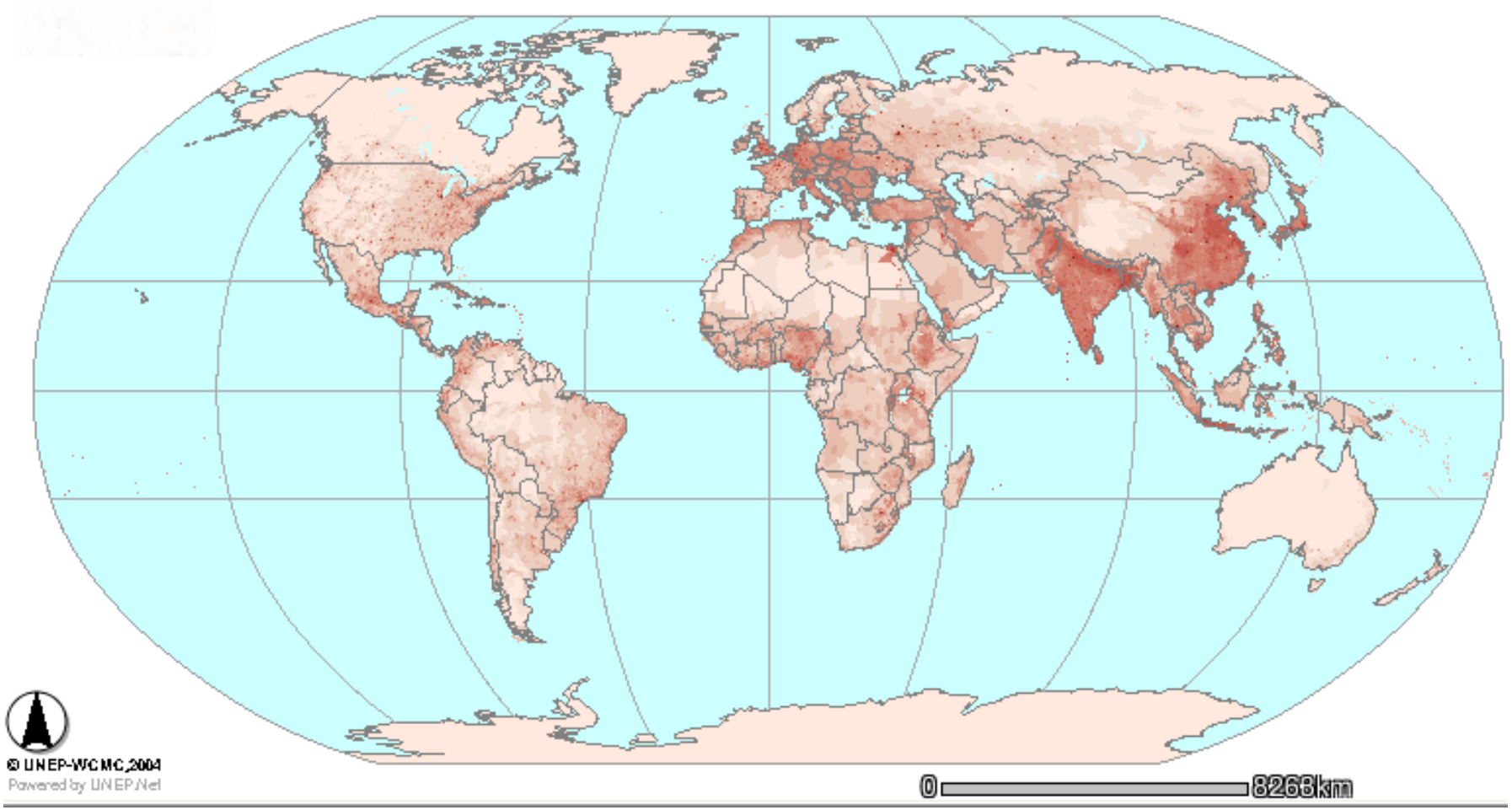
Rondinini et al. (2011) Global habitat suitability models of terrestrial mammals *Phil Trans R Soc B* in press

Global trend trend of threat



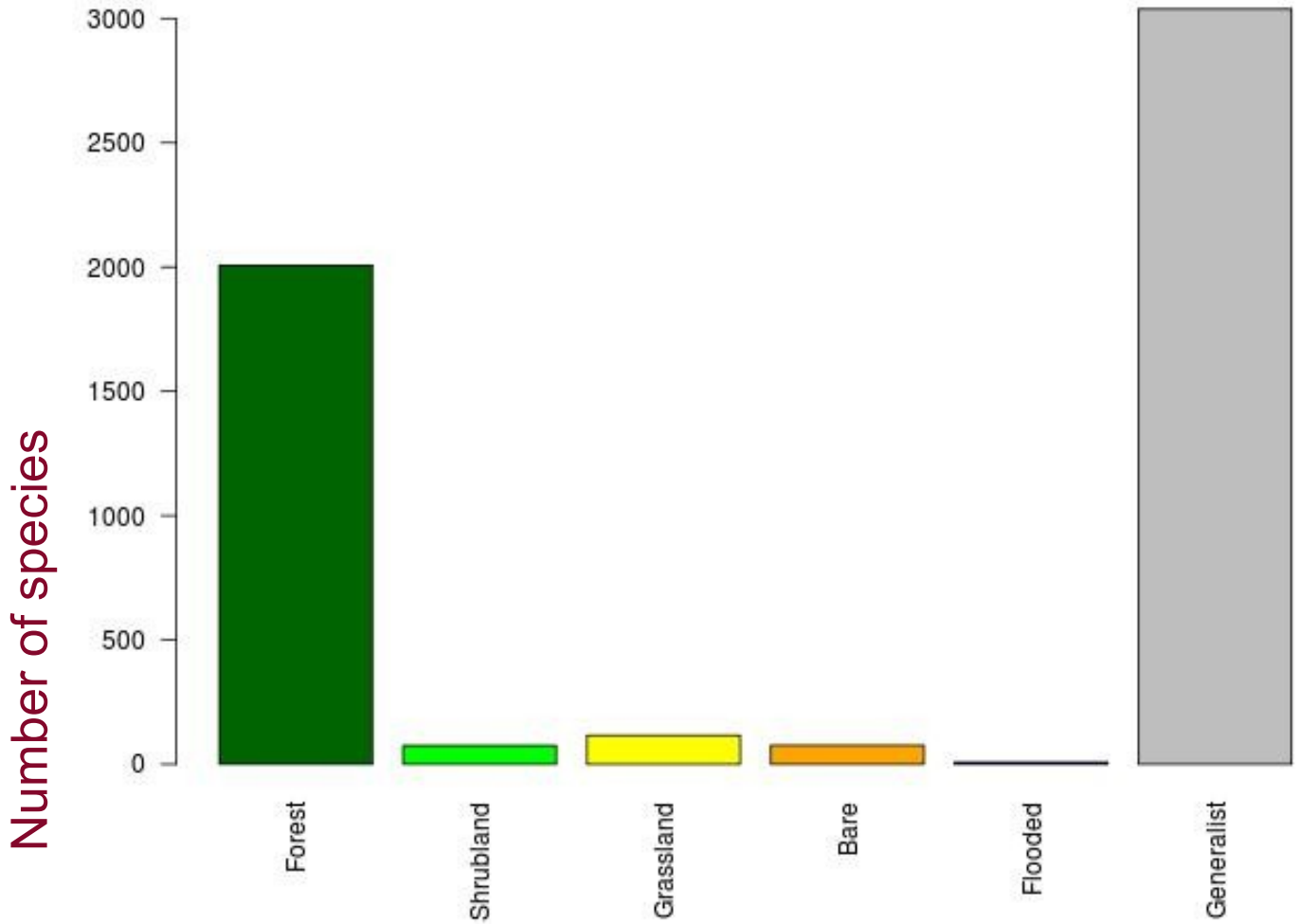
Hoffmann, ..., , Rondinini et al. (2010) The impact of conservation on the status of the world's vertebrates. *Science* 330:1503

Human population density



WCMC (2004)

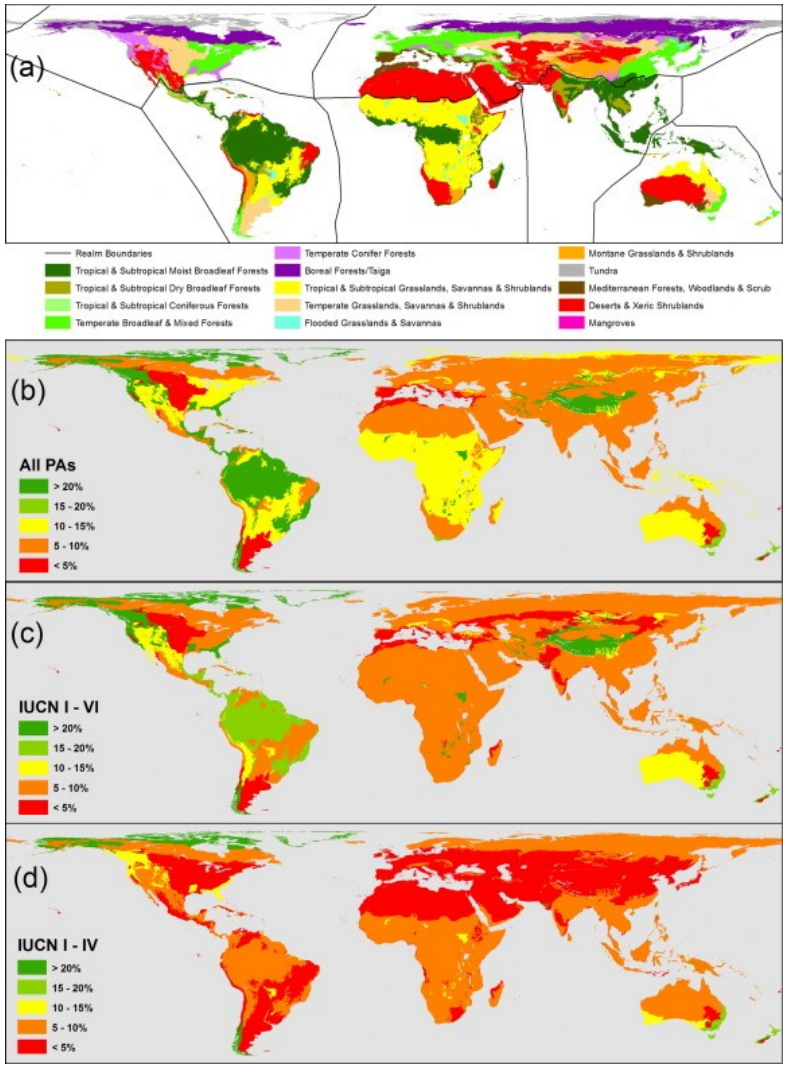
Mammal distribution by broad habitat type



Rondinini et al. (2011) Global habitat suitability models of terrestrial mammals *Phil Trans R Soc B* in press

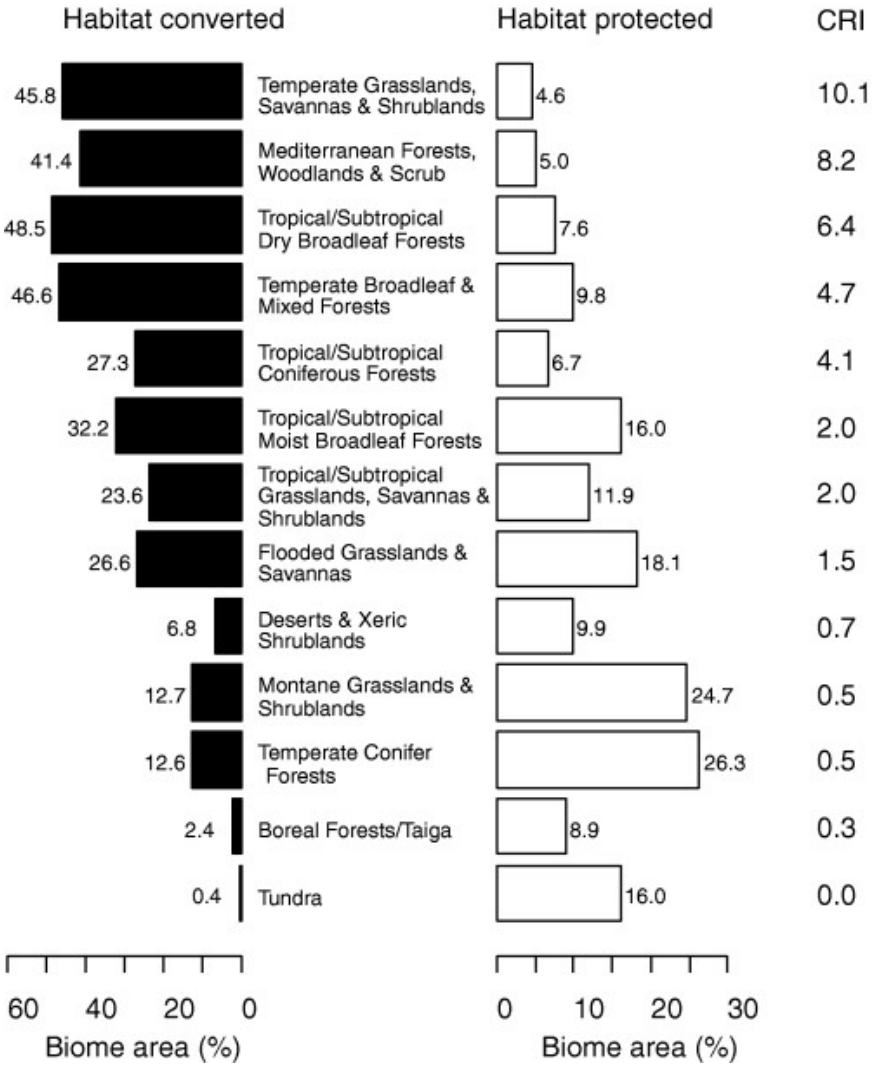
3. Remnant natural areas are also those where most conservation efforts (including the creation of protected areas) are directed

Protection level of main biomes



Jenkins & Joppa (2009) *Biol Conserv* 142:2166

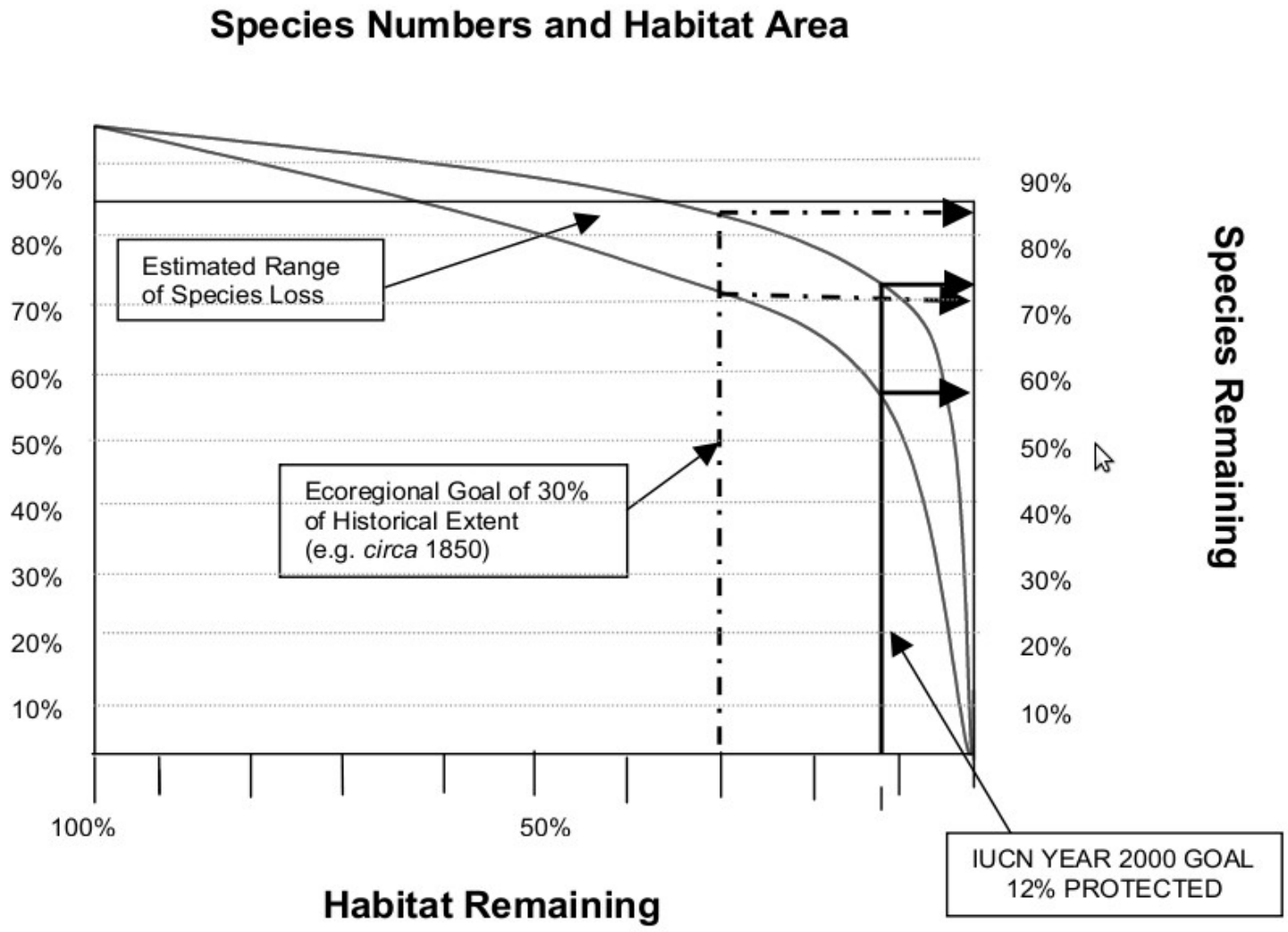
Protection level of main biomes



Hoekstra et al. (2005) *Ecol Lett* 8:23

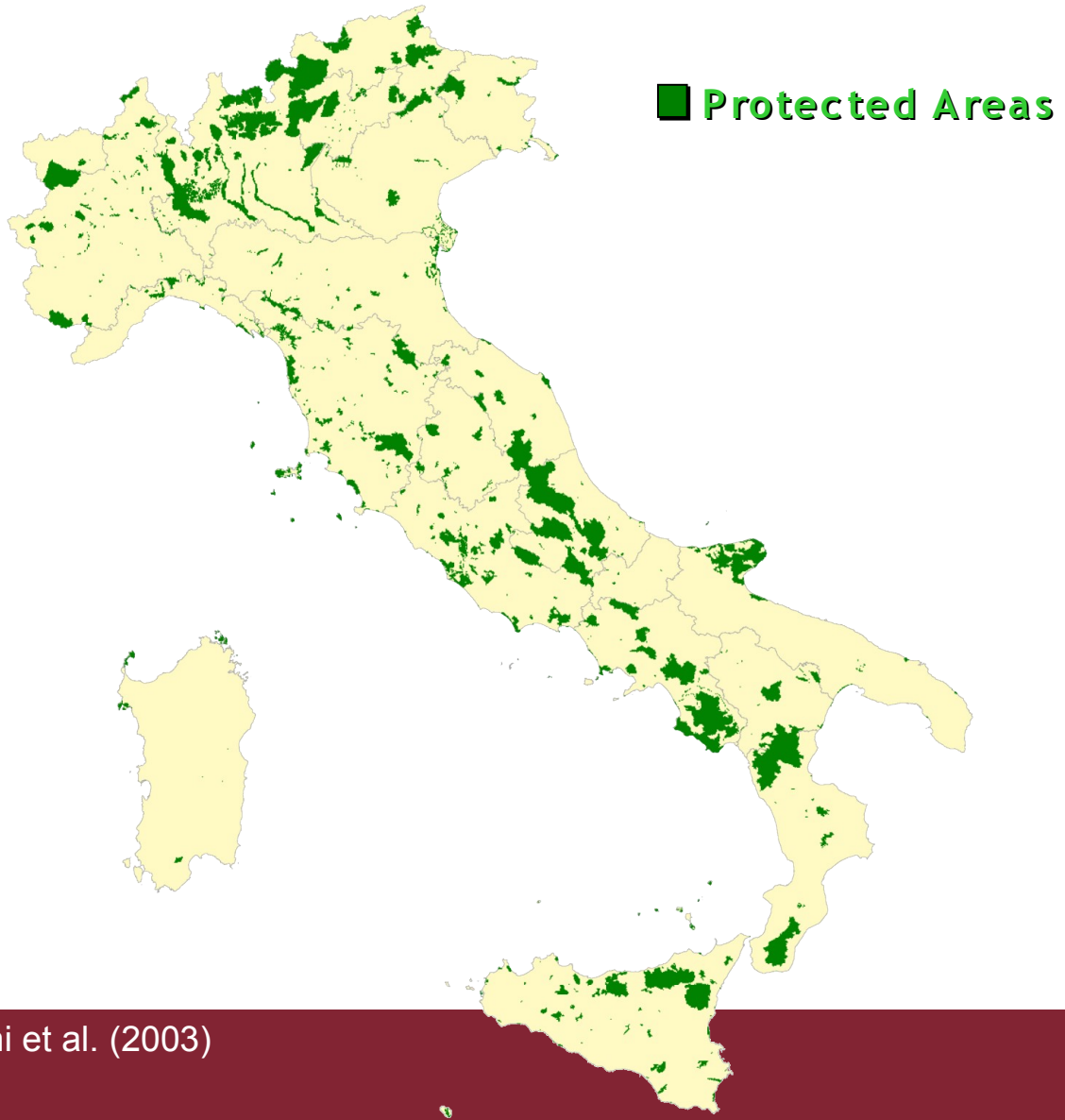
4. Unfortunately it is demonstrated that protecting only intact natural areas is not enough to conserve biodiversity

Species represented in remaining habitat



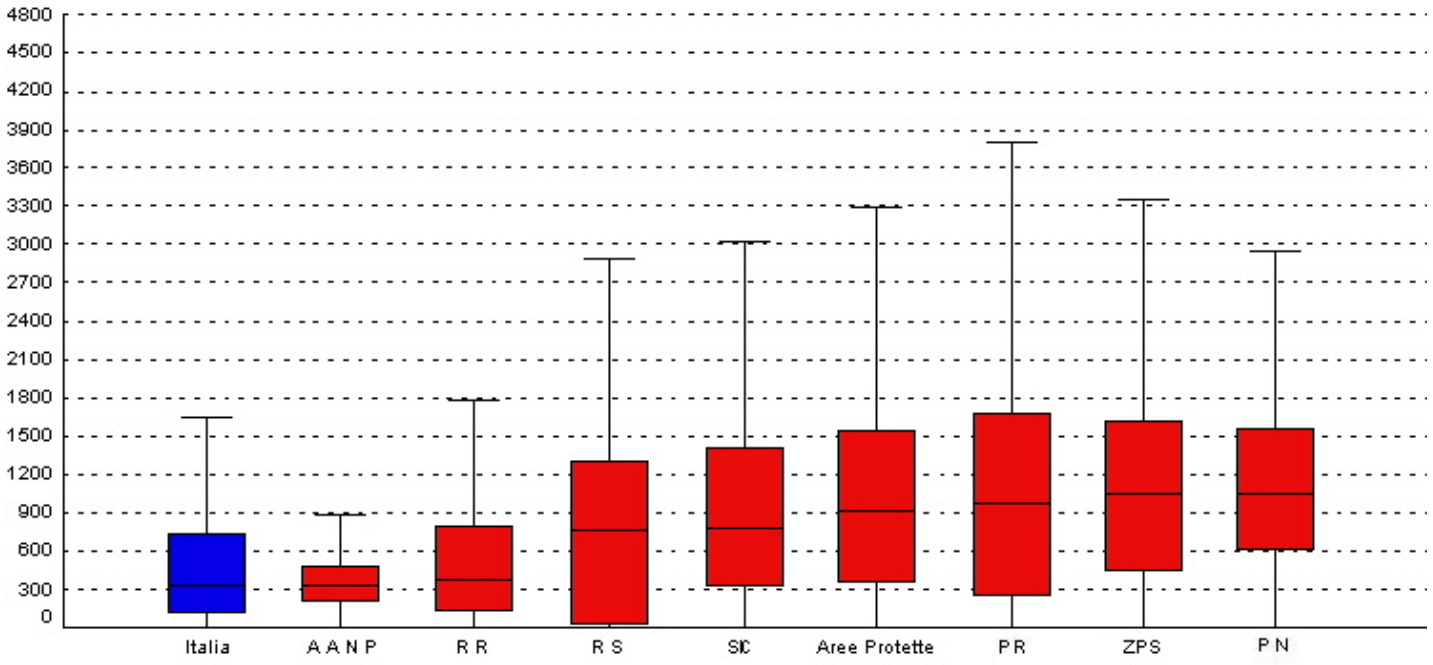
McNeely et al. (2001)

Italian protected areas



Boitani et al. (2003)

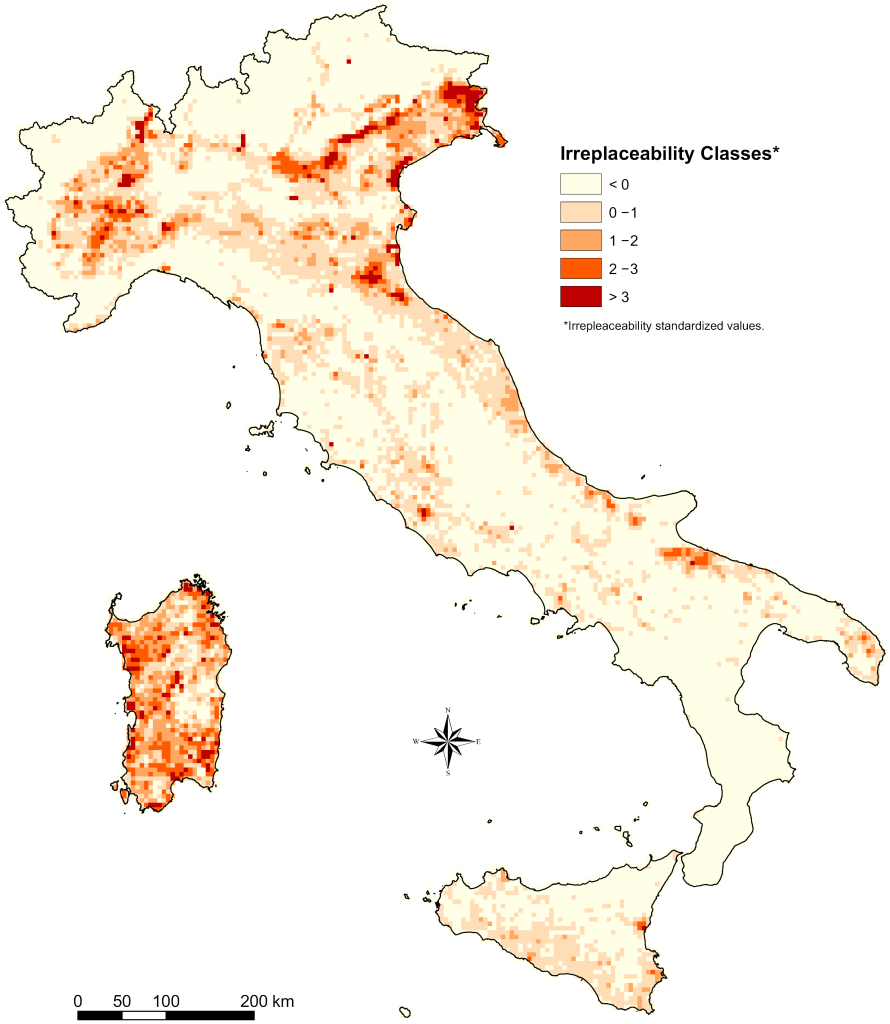
Elevation of Italian protected areas



High elevation == low economic value

Boitani et al. (2003)

What else should be protected in Italy to conserve vertebrates



Boitani et al. (2003)

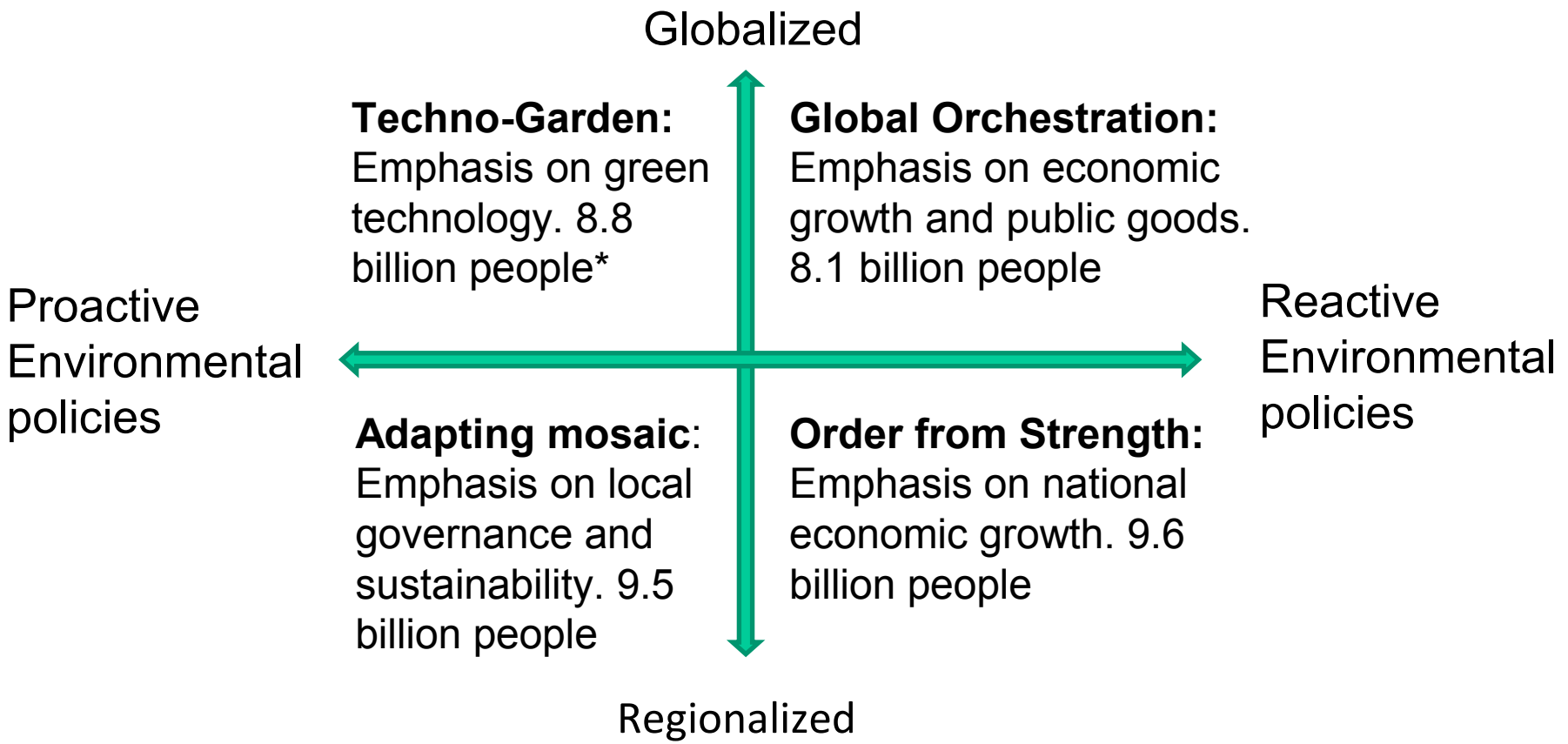
5. The scenarios of socio-economic development (including the most optimistic) predict an increase rather than a decrease of anthropogenic pressure in the next 40 years, with further habitat loss for species

Global models of socio-economic development

- Scenarios
  - Millennium Ecosystem Assessment (MEA 2005)
- Amount of land converted
  - IMAGE (Alkemade et al. 2009)
- Spatial allocation
  - Globio (Alkemade et al. 2009)

Visconti, Rondinini et al. (2011) Future hotspots of terrestrial mammal loss *Phil Trans R Soc B* in press

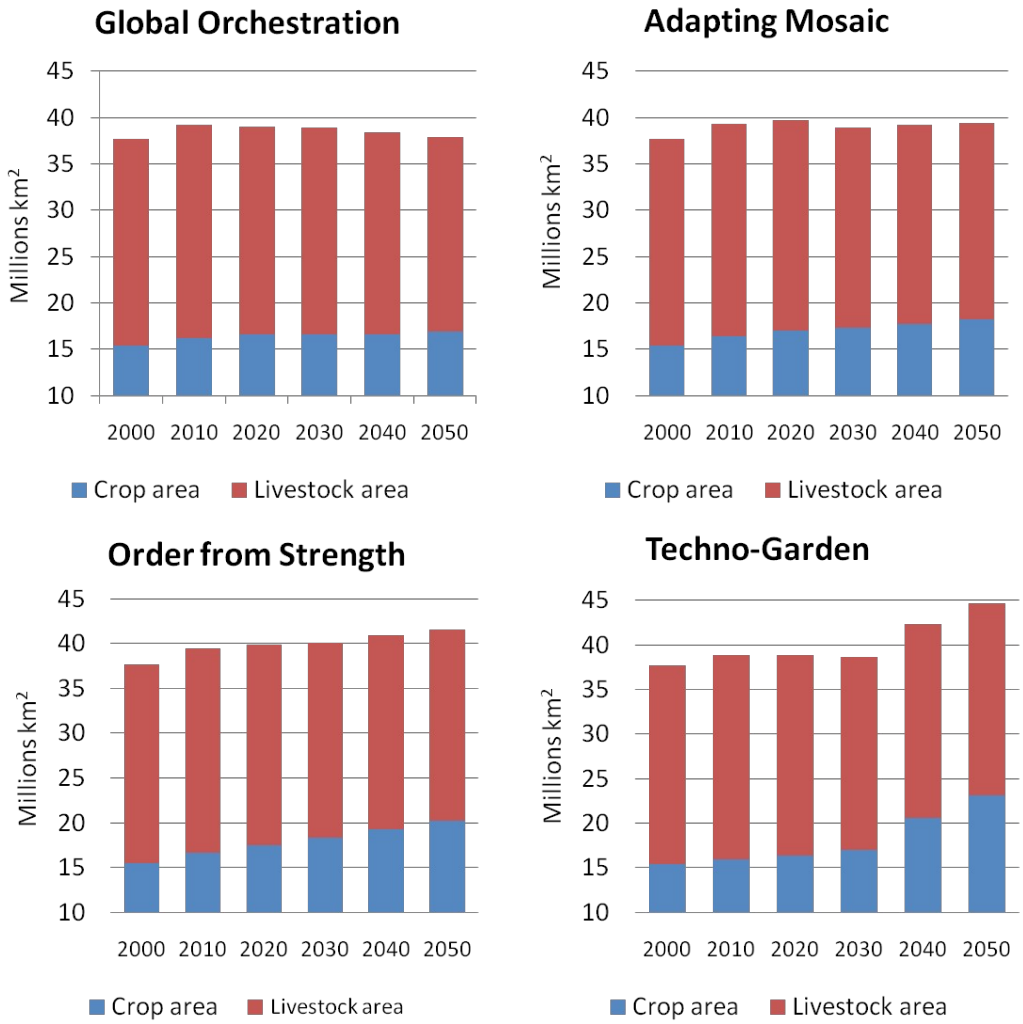
The four scenarios



*Global population in 2050

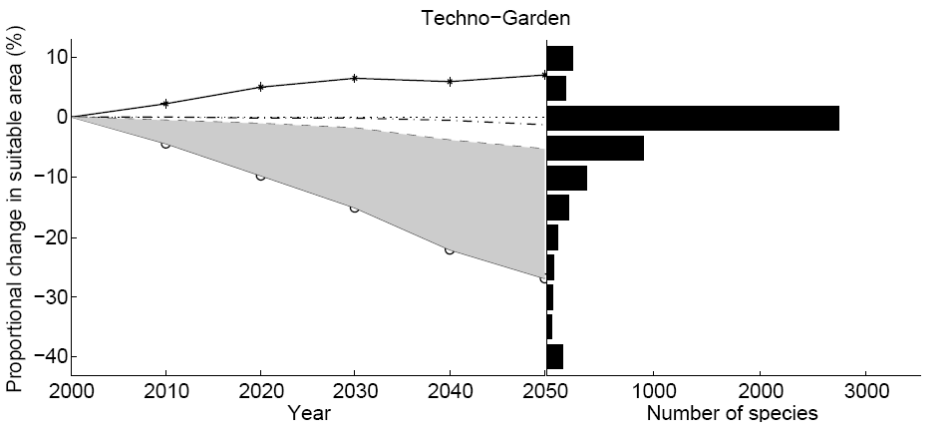
Visconti, Rondinini et al. (2011) Future hotspots of terrestrial mammal loss *Phil Trans R Soc B* in press

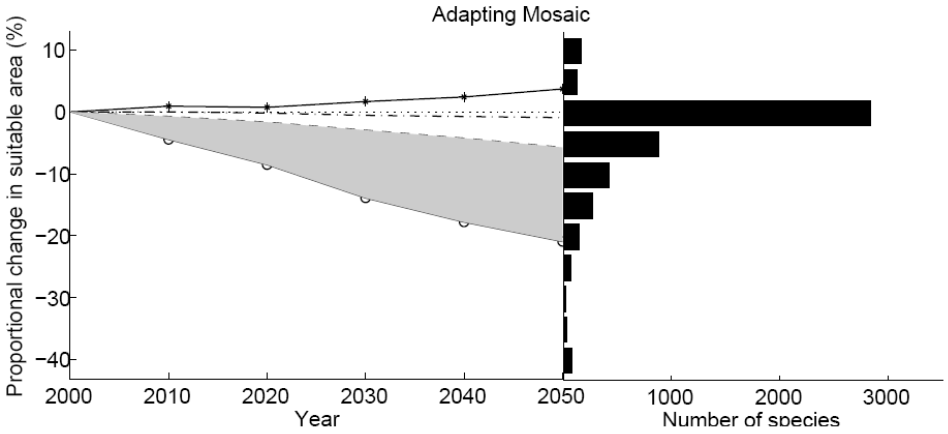
Projected increase in conversion of natural habitat

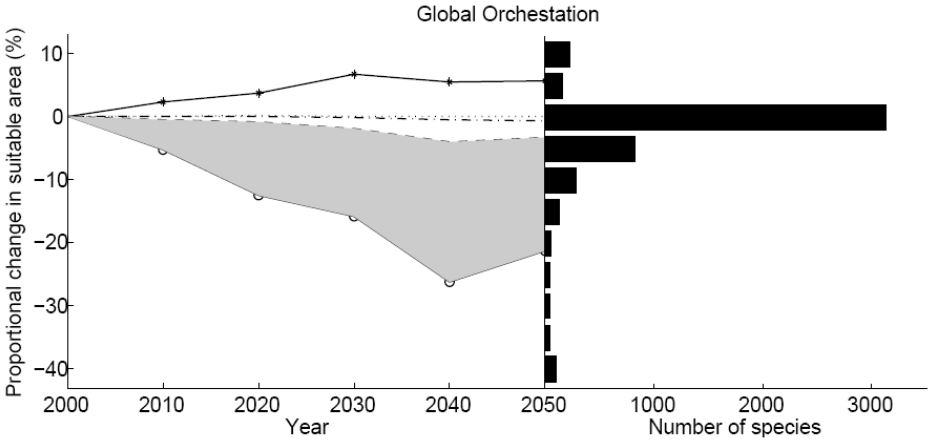


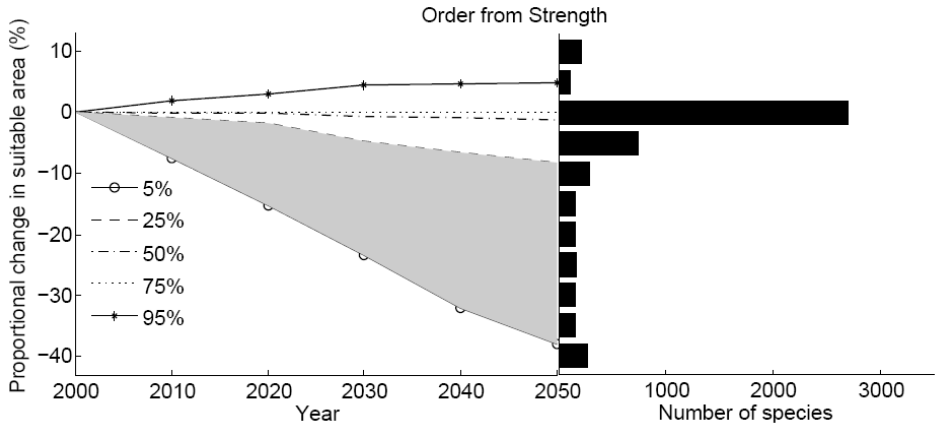
Visconti, Rondinini et al. (2011) Future hotspots of terrestrial mammal loss *Phil Trans R Soc B* in press

Projected global habitat loss for mammals to 2050 as compared to 2000









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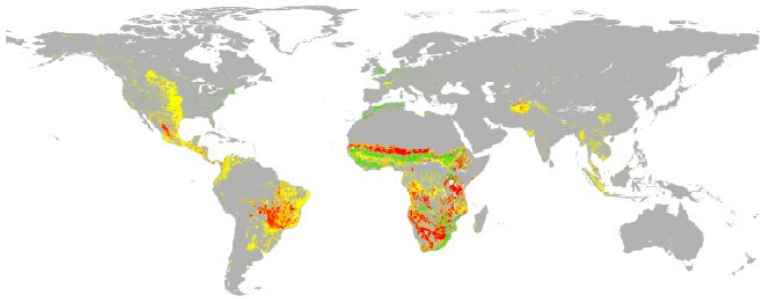
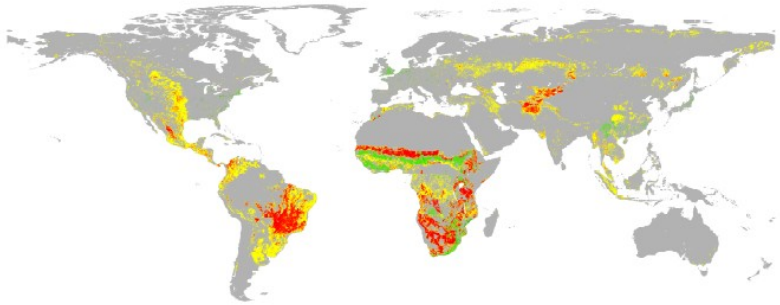
Projected global habitat loss for mammals to 2050 as compared to 2000

Global Orchestration



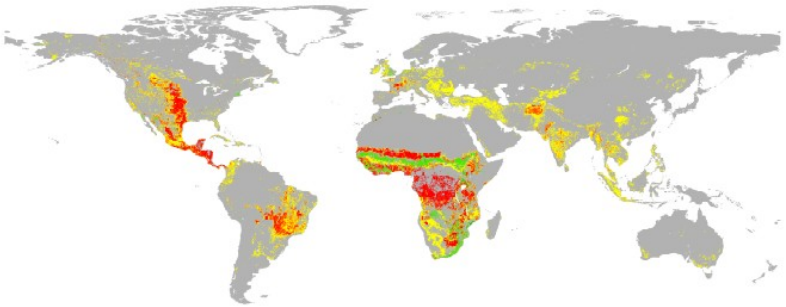
TechnoGarden



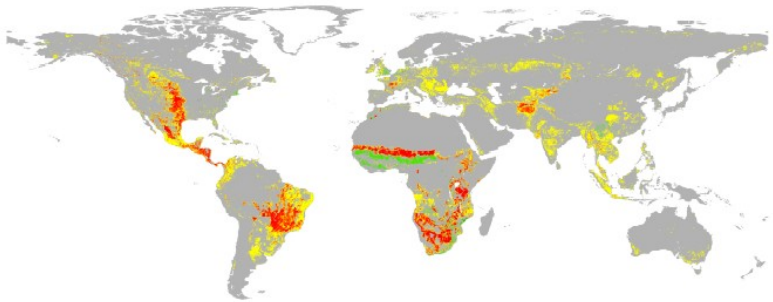
Change in suitable habitat
(1000* Kmsq*Species)

-13.7 - -1.5 -1.5 - -0.2 -0.2 - 0.2 0.2 - 0.8 0.8 - 1.2 1.2 - 12.8

Order from Strength



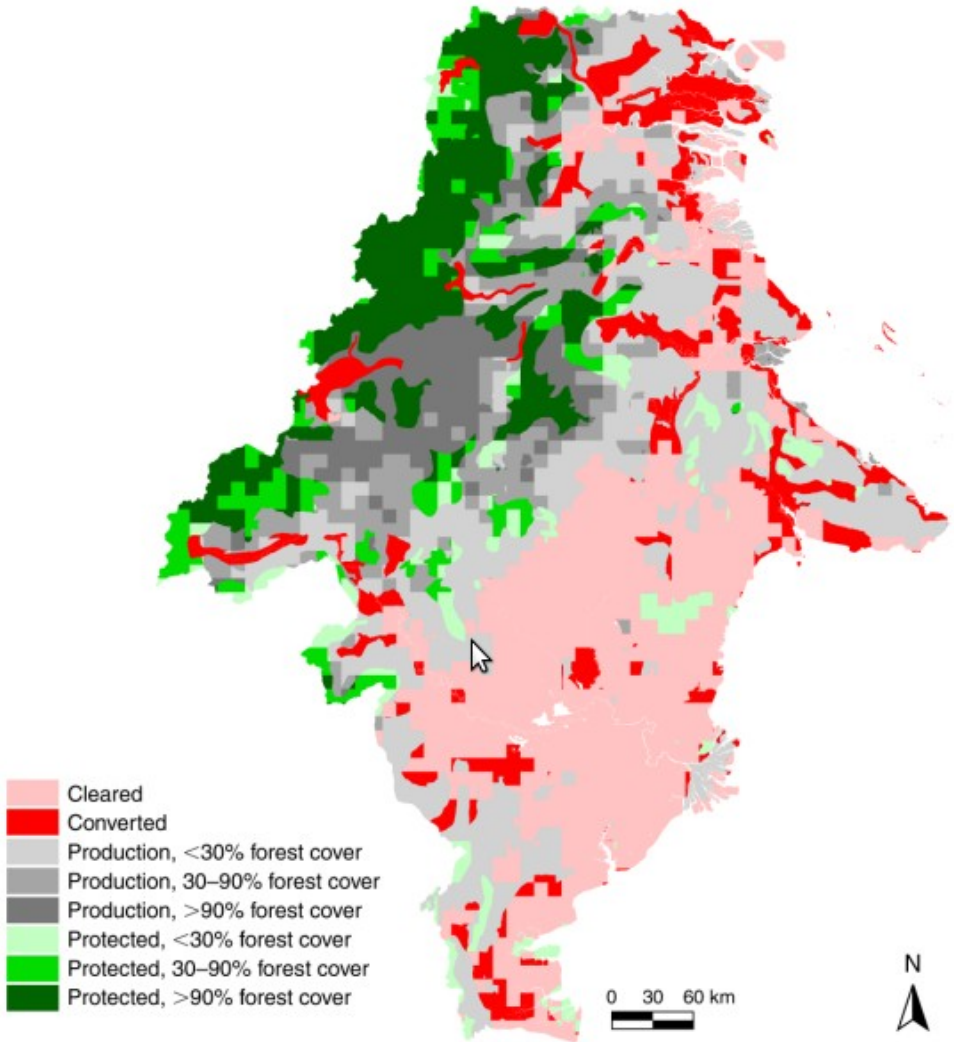
Adapting Mosaic



Visconti, Rondinini et al. (2011) Future hotspots of terrestrial mammal loss *Phil Trans R Soc B* in press

6. The planning and management tools that allow the coexistence between production and conservation now exist

Forest use in East Kalimantan, Borneo



Wilson, ... , Rondinini et al. (2010) Conserving biodiversity in production landscapes. *Ecol Appl* 20:1721

Contribution of different forest uses to mammal conservation in East Kalimantan

Land use	Percentage of target contribution		
	Plantain squirrel (low sensitivity)	Lesser mouse-deer (medium sensitivity)	Bornean gibbon (high sensitivity)
Cleared	0	0	0
Converted	0.1	0	0
Production, <30% forest cover	0.1 (0.25)	0	0
Improved production, <30% forest cover	0.1 (0.25)	0	0
Production, between 30 and 90% forest cover	0.1 (0.5)	0	0
Improved production, between 30 and 90% forest cover	0.25 (0.5)	0	0
Production, >90% forest cover	0.25 (1)	0.25 (1)	0.25 (1)
Improved production, >90% forest cover	0.5 (1)	0.5 (1)	0.5 (1)
Protected, <30% forest cover	0.1 (0.25)	0	0
Improved protection, <30% forest cover	0.25 (0.25)	0	0
Protected, between 30 and 90% forest cover	0.25 (0.5)	0.25 (0.5)	0
Improved protection, between 30 and 90% forest cover	0.5 (0.5)	0.5 (0.5)	0
Protected, >90% forest cover	0.5 (1)	0.5 (1)	0.5 (1)
Improved protection, >90% forest cover	1 (1)	1 (1)	1 (1)

Notes: The values in parentheses indicate the maximum possible zone contribution given the allowable zone transitions, which was used to calculate the contributing area of occupancy for each species. The plantain squirrel (*Callosciurus notatus*) has low sensitivity to forest degradation; the lesser mouse-deer, also known as the lesser Indo-Malayan chevrotain (*Tragulus kanchil*), has medium sensitivity; and the Bornean gibbon (*Hylobates muelleri*) has high sensitivity.

Wilson, ... , Rondinini et al. (2010) Conserving biodiversity in production landscapes. *Ecol Appl* 20:1721

Cost of different conservation strategies in East Kalimantan

Cost component	Establishment of new protected areas	Improved management of production forest	Improved management of protected areas
Start up costs	50	60	
Management costs	163		163
Opportunity costs	2634		
Total	2847	60	163

Wilson, ... , Rondinini et al. (2010) Conserving biodiversity in production landscapes. *Ecol Appl* 20:1721

Cost minimisation analysis

- Mammal distribution from HSM
- Species-specific persistence target
- Cost minimisation through software MarZone (UQ)
    - Simulated annealing

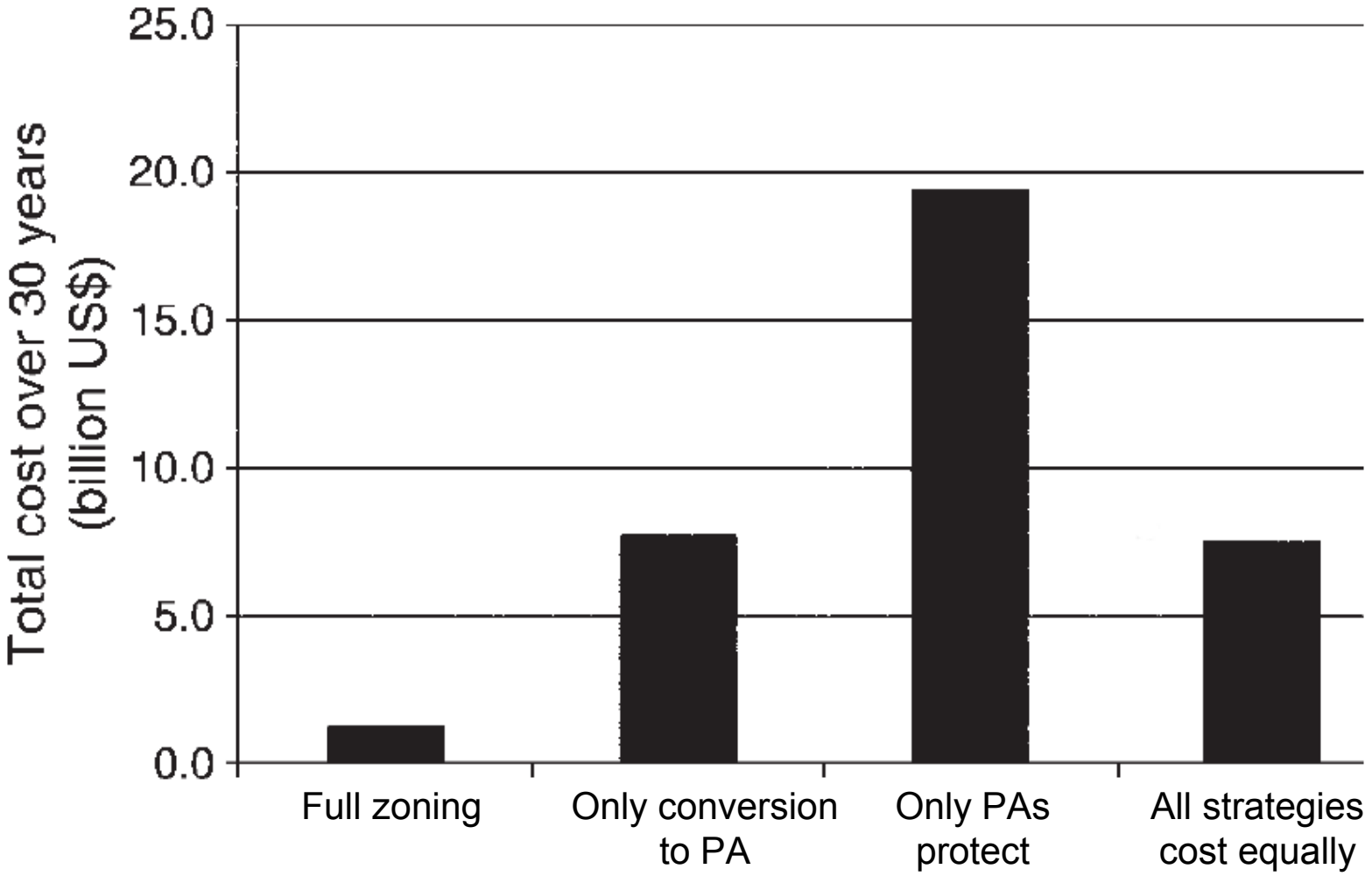
Wilson, ... , Rondinini et al. (2010) Conserving biodiversity in production landscapes. *Ecol Appl* 20:1721

Recommended management changes in East Kalimantan to optimise mammal conservation

Land use zones	Current area of each land use (ha)	Recommended area under the full zoning analysis (ha)
Cleared	5 714 366	5 714 366
Converted	2 105 111	2 105 111
Production, with less than 30% forest cover remaining	4 469 618	4 429 808
Improved production, with less than 30% forest cover remaining	0	0
Production, with between 30 and 90% forest cover remaining	918 610	33 620
Improved production, with between 30 and 90% forest cover remaining	0	872 641
Production, with greater than 90% forest cover	2 278 120	137
Improved production, with greater than 90% forest cover	0	2 186 951
Protected, with less than 30% forest cover remaining	835 808	182 190
Improved protection, with less than 30% forest cover remaining	0	693 429
Protected, with between 30 and 90% forest cover remaining	710 865	15 025
Improved protection, with between 30 and 90% forest cover remaining	0	708 188
Protected, with greater than 90% forest cover	2 513 334	0
Improved protection, with greater than 90% forest cover	0	2 604 365
Total area	19 545 832	19 545 832

Wilson, ... , Rondinini et al. (2010) Conserving biodiversity in production landscapes. *Ecol Appl* 20:1721

Scenario comparison for East Kalimantan



Wilson, ... , Rondinini et al. (2010) Conserving biodiversity in production landscapes. Ecol Appl 20:1721

Conclusion

To slow down or reverse decline, biodiversity must be conserved also in (partly) converted areas, including agroecosystems, by applying planning and management techniques that allow the coexistence between production and conservation

This is doable

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