

Global biodiversity indicators from heterogeneous re-purposed data: the PREDICTS project

Andy Purvis, Tim Newbold, Adriana De Palma, Sara Contu, Samantha Hill, Lawrence Hudson and many others









What is the trend in local biodiversity?

BioTime: No trend in species richness

Living Planet Index: 58% fall since 1970



Dornelas et al. 2014 Science

Living Planet Report 2016

What will happen next?



Need data linking diversity to pressure



Normalized Difference Vegetation Index

0	0.2	0.4	0.6	0.8

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Normalized Difference Vegetation Index

0	0.2	0.4	0.6	0.8

Many kinds of study design

• = sampling event; --- = treatment imposed; treatment site; control site



Control-Impact = space-for-time substitution



Time series = space-for-space substitution...



Fig. 1. Distribution of the survey sites included in our analysis. Data sets are color-coded to reflect their climatic region: pink, global; royal blue, polar; turquoise, polar-temperate; green, temperate; gold, temperate-tropical; red, tropical. See table S1 for details and sources of the data sets.

Dornelas et al. 2014 Science

Time series = time-for-time substitution too



http://forwarn.forestthreats.org/

'PREDICTS1': control-impact comparisons

Google 2 kn

Land use Land-use intensity Human population density Proximity to roads Accessibility from cities Time since 30% conversion

Biomes Biomes legend Map

Satellite

X Climate change X Invasive species X Overexploitation

Imagery ©2013 TerraMetrics - Terms of Use Report a map error



Data quality issues

- **Provenance** published studies only
- Consistency land use and use intensity of all sites classified using same framework
 - Repeatability assessed formally
 - Data provided in countless different formats
 - Curation cost MUCH more time & effort than expected!
- Representativeness geographic, taxonomic, ecological
- Transparency making the data freely available

Land use x Intensity matrix

Land use class	Minimal use	Light use	Intense use
Primary vegetation (composed of native vegetation, which is not known to have been destroyed during historical times)	Any threats identified are very minor (e.g., very light use) or very limited in the scope of their effect (e.g., hunting of a particular species of limted ecological importance).	One or more threats of moderate intensity (e.g., selective logging) or breadth of impact (e.g., bushmeat extraction), which are not severe enough to markedly change the nature of the ecosystem.	One or more threats that is severe enough to markedly change the nature of the ecosystem (e.g., clear-felling).
Mature Secondary Veg			
Intermediate Secondary Veg			
Young Secondary Veg			
Plantation forest			
Cropland (land people have planted with herbaceous crops)	Low-intensity farms, typically with small fields, mixed crops, crop rotation; little or none of the following – inorganic fertilizer, pesticide, ploughing, irrigation, mechanization.	Medium-intensity farming typically showing some but not many of: large fields, annual ploughing, inorganic fertilizer, irrigation, fixed crops, mechanisation, monoculture.	High-intensity monoculture farming, typically with many of: large fields, annual ploughing, inorganic fertilizer, pesticide, irrigation, fixed crops, mechanisation, monoculture.
Pasture			
Urban			

Database described in Hudson, Newbold et al. 2014 Ecol & Evol

Database has 767 studies, 32,078 sites, 98 countries, > 300 ecoregions



Database described in Hudson, Newbold et al. 2014 Ecol & Evol

Taxonomic coverage of 51,000 species

Names curated to Catalogue of Life 2013 so can link out to, e.g., GBIF, TRY



Open Access

The PREDICTS database: a global database of how local terrestrial biodiversity responds to human impacts

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Local richness, land use & intensity



Newbold, Hudson et al. 2015 Nature 520:45-50

'Hockey-stick curves' for richness



Newbold, Hudson et al. 2015 Nature 520:45-50

Is biodiversity within safe limits?



Steffen et al. 2015 Science

Biodiversity Intactness Index

BII = average abundance of species, relative to an unimpacted baseline... across many taxonomic groups... averaged across all land uses... excluding novel species

Scholes & Biggs 2005 Nature

Modelled Biodiversity Intactness Index for 2005



Global average = 84.6% (Planetary Boundary = 90%)

Newbold et al. 2016, Science 353:288-291.

UK State of Nature Report

BII may be overestimated because:

- island biotas more sensitive?
- much UK land conversion is old
- map use in projection does not have plantation forest
- little/no chance for influx from nearby primary vegetation
- models do not (yet) consider fragmentation



Work in progress: annual estimates of BII



Bll increases & decreases 2001-2012: very preliminary



De Palma, Hoskins et al., in prep.

Conclusions

- Linking biodiversity data to pressure data allows more powerful modelling
- Control-Impact studies are most common
 - Assume space-for-time, but not space-for-space or time-for-time, as time series data do
- Land use has reduced average biodiversity
 - Species-richness down by 13.6%
 - Biodiversity Intactness Index (BII) down by 15.4%
 - 58.4% of land surface below "planetary boundary"
- Annual BII ready soon
 - Feeding into policy processes and documents

'PREDICTS2': dynamics



Normalized Difference Vegetation Index

0	0.2	0.4	0.6	0.8

'PREDICTS2': dynamics



Normalized Difference Vegetation Index

0	0.2	0.4	0.6	0.8

Please share your data with us!



- Known time of land-use/intensity/pressure change
 - e.g., logging, fire, urban expansion, conversion to organic farm, start of restoration...
- Published study (data can go beyond latest paper)
- BACI is ideal
 - then "After-Control-Impact" and "Before-After"; then "Reference-After"; then "After"
- Will publish Open-Access database paper; data will be at data.nhm.ac.uk

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Measuring site-level biodiversity









