Predicting the conservation status of IUCN Data Deficient species

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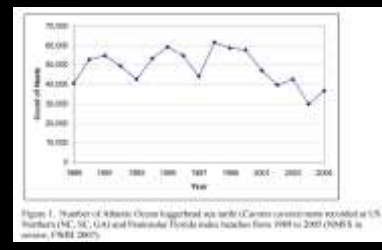
The IUCN Red List

- Extinct in the Wild (EW)
- Extinct (EX)
- Critically Endangered (CR)
- Endangered (EN)
- Vulnerable (VU)
- Near Threatened (NT)
- Least Concern (LC)
- Data Deficient (DD)

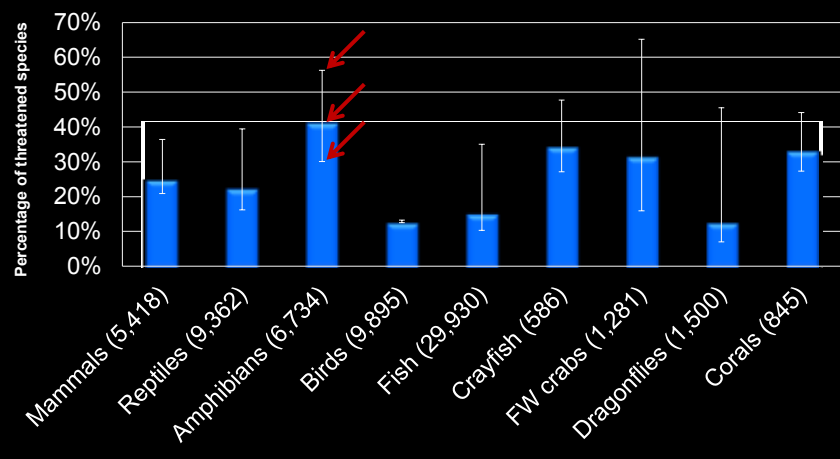
Threatened

Reasons for Data Deficiency

- Type specimens only
- Few records
- Old records (>20 years)
- Unknown provenance
- Taxonomic uncertainty
- Unknown threats
- Unknown population trends



Uncertainty in threat estimates



Study aims

- Predict the conservation status of DD species
  - ➢ Reduce uncertainty in macroecological patterns of threat
  - ➢ Prioritization for re-assessment/conservation




Machine Learning Methods

Classification Trees	Random Forests	Boosted Trees
K-Nearest Neighbours	Support Vector Machines	Neural Networks

No Free Lunch Theorem

Materials

- 4,997 exclusively terrestrial mammal species
- Response variable: IUCN Red List status coded as a binary variable
- Explanatory variables: ~40
  - Life history and ecological (e.g. Body Mass, Litter Size...)
  - Environmental (e.g. PET, Temperature...)
  - Human Impact (e.g. HPD...)
  - Taxonomy
- 5 datasets: Global, Primates, Carnivores, Bats, Rodents

Results - Species

Dataset	Best Model Type	No. of predictors	No. of non-DD species	Proportion threatened sp.	Accuracy	Specificity	Sensitivity
Global	Random Forest	35	3,967	22.1%	0.898	0.887	0.935
Rodents	Random Forest	29	1,666	17%	0.918	0.933	0.843
Primates	Support Vector Machine	32	304	56.7%	0.803	0.727	0.861
Carnivores	Neural Network	36	188	23.2%	0.913	0.917	0.900
Bats	Boosted Trees	36	828	17%	0.854	0.842	0.914

Results - Assemblages

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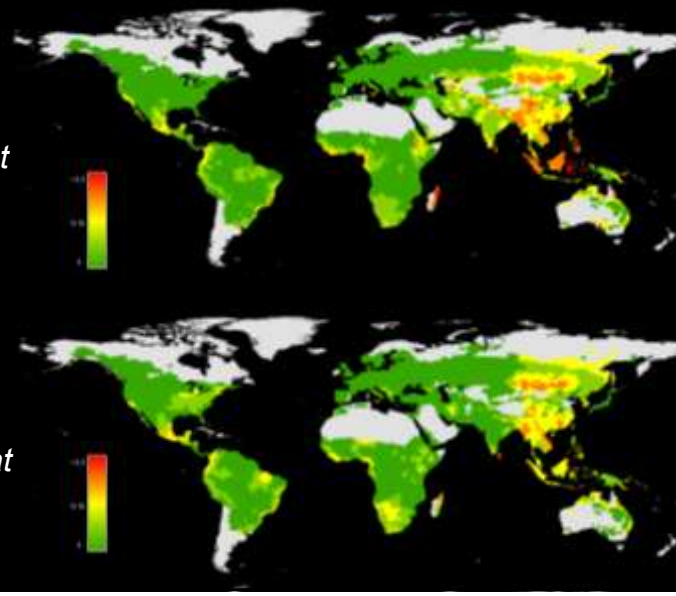
Predicted threat

Observed threat



Predictions for DD species

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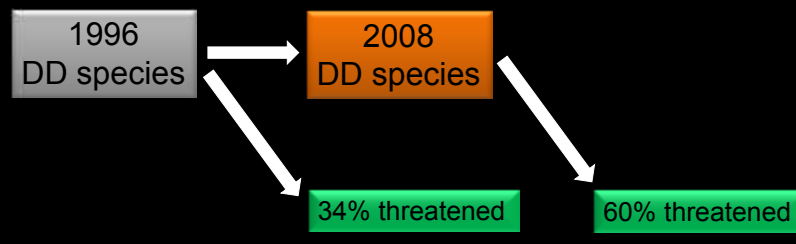
- 313 out of 493 DD species (64%) predicted to be at threat
- 27% of mammals would be at threat globally (currently 22%)
- Poorly-known DD species most at threat



Hotspots of threat

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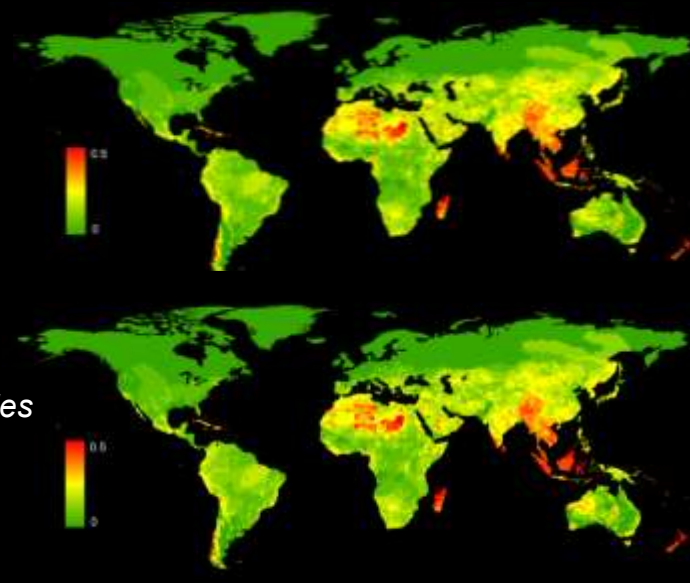
Excluding DD species

With DD species predictions



Undescribed plant species

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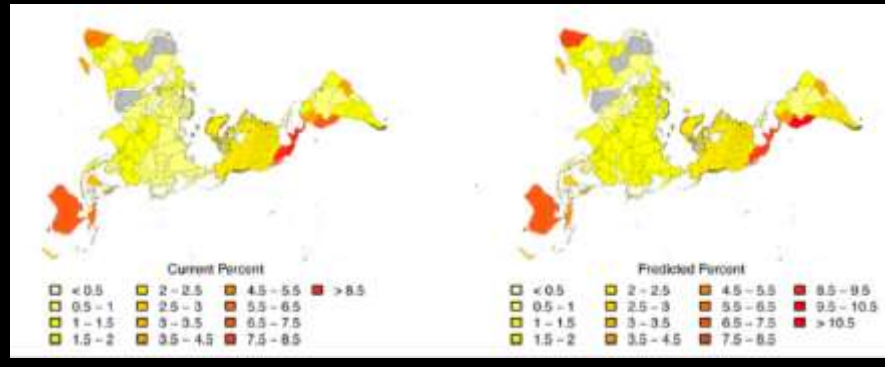
Observed species richness

With undescribed species



Joppa et al. (2011) *PNAS*

Conclusions

- ML methods show high predictive power for threatened species classification.
- Global conservation priorities unchanged, but species imperilment has been underestimated.
- Poorly-know species are disproportionately at threat.
- Taking into account information on DD species could help conserve the earth's poorly known biodiversity.

Current work

- Predicting species extinction risk could offer considerable economic benefits.
- Bayesian Value of Information analysis.

Thank you for listening!

And special thanks to:

Ben Collen (ZSL)
Jon Bielby (ZSL)
David Orme (Imperial College)

CEED Grant

Imperial College London

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