Biodiversity & Ecosystems:
Wildlife in a changing world

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August 2016
Some of the greatest challenges for biological science...
...changes to biological systems
Global commitment to biodiversity

- As signatories to the Convention on Biological Diversity, 190 nations committed themselves to actions to:
  “... achieve, by 2010, a significant reduction of the current rate of biodiversity loss”

- Replaced with 20 Aichi Targets and Strategic plan (2020)

Do we have the information with which to make robust decisions?
Understanding global biodiversity change

**Modelling**
- Historic change
  - Limited data

**Monitoring**
- e.g. change in abundance

**Predicting**
- e.g. policy & management

- **A**
- **B**
- **C**
- **D**

Metric of biodiversity
- e.g. population size

Baseline year

Confidence
Understanding wildlife population change

1. Forest: Liberia, west Africa
2. Polar regions: Antarctica
3. Marine: Chagos, Indian Ocean
Change in forest ecosystems
Pygmy hippo (*Choeropsis liberiensis*)
West Africa
Liberia
Pygmy hippo range
Sapo National Park
Largest block of remaining upper guinea forest – i.e. 40%
Threats
Aims of the research project

- Establish a monitoring programme in Sapo National Park in order to monitor terrestrial forest species

- Train local Park Rangers in camera trapping methods, building capacity for biomonitoring

- Try to obtain the first photographic records of rare and cryptic species in Sapo, in particular, the pygmy hippo
### Methods

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- 32 camera grid
- Deployed for 35 nights
- 1120 trap nights
- 60 – 80 km²
The team
Deployment

• Training
  – camera trap deployment in the field
First record of pygmy hippo in Liberia
Repeat surveys

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Using the information

- **Evaluate the symptoms of risk**
  - Reflect the likelihood of extinction under prevailing circumstances

- **Extinction risk greatest when:**
  - Population size is small
  - Decline rate is high
  - Fluctuations in size > growth
  - Very small populations susceptible (genetic, demographic, environment)

**CRITERIA**

A Population reduction
B Geographic range size
C Small population size & decline
D Very small or restricted population
E Quantitative analysis

Mace & Lande 1991; Mace et al. 2008 Conservation Biology
New IUCN Red List Assessment

Endangered

- ~20% loss in two generations inferred from forest cover decline
- Population size <2500 individuals

CRITERIA

C  Small population size & decline

Although we have not completed a national analysis of Côte d’Ivoire, we mapped deforestation for the portion that was within the view of the Landsat images used for this study, which extended as much as 65 km from the Liberian border. We observed a forest cover of 0.96 Mha in this border area in 1986, over half of which was within Tai National Forest. The rate of deforestation was 20% over the 14-year period, i.e. much higher than in Liberia. Validation with aerial photography yielded an estimated average accuracy of 83% for forest cover in ~2000. We believe that the majority of the errors are in areas of secondary or degraded forest in central Liberia. The error estimate also includes that caused by imperfect co-registration between the aerial survey data and satellite images, and thus we believe this to be a conservative estimate of classification accuracy for the country-wide estimate.

Fig. 1  Distribution of forest and forest clearance in Liberia from 1986 to 2000. Deforestation in Liberia 541
ª 2007 FFI, Oryx, 41(4), 539–543
http://journals.cambridge.org Downloaded: 30 Jun 2015 IP address: 128.40.94.125
Species response to changing threats
What are the dynamics of ecological change in Antarctica?
Antarctica’s changing temperature
Larsen B ice-shelf collapse 2002

31\textsuperscript{st} January 2002

5\textsuperscript{th} March 2002
Antarctica’s changing sea ice

Data for the Antarctic peninsula
Fisheries pressure & prey availability
Collating existing abundance data

**Abundance**: sensitive to change, meaningful for function, loss is a prelude to species extinction, variability and quantity important

**Sources and types** of penguin abundance trend data:
- total population size estimates
- no. breeding pairs
- nests

Collected primarily from journals, also NGO networks, grey literature, etc...

**Emperor penguin** (*Aptenodytes forsteri*)

**King penguin** (*Aptenodytes patagonicus*)

**Gentoo penguin** (*Pygoscelis papua*)
Creating an index

Overall Index

Further balance e.g. balance regions

Species

- Sp. A: equal weighting
- Sp. B
- Sp. C: geometric mean

Population

- equal weighting
- weight by pop size
Index of population change: Antarctic

East: 30% increase in abundance
West: 56% decline in abundance
Index of population change: Antarctic

East: 30% increase in abundance
West: 56% decline in abundance

Warming

Cool/stasis
Population trends in different regions

Peninsula

Ross sea

East
Mixed fortunes: where you live

Broad differences among regions consistent between species

Adélie

Emperor

Sea ice concentration
Changing dynamics in abundance & distribution
How to enhance ecological monitoring in Antarctica?

64 bases in Antarctica:
- 27 seasonal, 37 year round
Adapting new technology
Working with the tourist industry
Time-lapse monitoring

Phenological change, e.g.
• 1st arrival
• 1st breeding
• Departure
• Chick fledging
Tracking species in the ocean
More than 90% of all top marine predators have disappeared from the oceans

Myers et al. 2007; MacKenzie et al. 2009
The Chagos MPA

- UK Overseas Territory
- Established in April 2010
- 640,000km²
- All commercial fishing activity prohibited
- Could it help protect commercially important species?
How do you count animals in this?
Open ocean monitoring

• Spatial movement of pelagic animals

• Attach pop-up satellite tags
  – Residence in MPA
  – Site fidelity
  – Habitat use

• Data gathered
  – Location
  – °C
  – depth
More information through technology

[Kays et al. 2015 Science]
More information through technology

~ 150 sharks have been tagged
~ 25 manta rays
How do you tag?
Some sharks are more scary than others...
Early results... big differences in movement
Tracking different species
Environmental drivers of movement

Block et al. 2011 Nature
Understanding global biodiversity change

Past | Present | Future
---|---|---

**Modelling**
- Historic change
- Limited data
- Patent year

**Monitoring**
- e.g. change in abundance

**Predicting**
- e.g. policy & management

Metric of biodiversity: e.g. population size

Change in global biodiversity e.g. policy & management
Questions?

Collaborators:
**Liberia:** Zoological Society of London, Fauna & Flora International, Liberian Forest Development Authority
**Antarctic:** Penguin Lifelines, University of Oxford
**Chagos:** David Curnick, Zoological Society of London

Funding:
Rufford Foundation, NERC, UNEP-WCMC, Esmée Fairbairn Foundation, WWF, CAFF, Darwin

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