Effectiveness of African protected areas for the conservation of large mammals
Increase of large mammal extinction risk 1975-2008

Change in large mammal extinction risk 1975-2008

African large mammals moving towards extinction


Hirola (*Beatragus hunteri*)
African large mammals moving towards extinction


Ader's duiker (*Cephalophus adersi*)

NT (1975) → CR (2008)

Hirola (*Beatragus hunteri*)

African large mammals moving towards extinction


Hirola (*Beatragus hunteri*)

Ader's duiker (*Cephalophus adersi*)
NT (1975) → CR (2008)

Dama gazelle (*Nanger dama*)
African large mammals moving towards extinction


- **Hirola** (*Beatragus hunteri*): LC (1975) → CR (2008)
- **Ader’s duiker** (*Cephalophus adersi*): NT (1975) → CR (2008)
- **Caracal** (*Caracal caracal*): LC (1975) → NT (2008)
- **Dama gazelle** (*Nanger dama*): VU (1975) → CR (2008)
African large mammals moving towards extinction

Ader's duiker (Cephalophus adersi)
NT (1975) → CR (2008)

Hirola (Beatragus hunteri)

Caracal (Caracal caracal)
LC (1975) → NT (2008)

Dama gazelle (Nanger dama)

Leopard (Panthera pardus)
LC (1975) → NT (2008)

African large mammals moving away from extinction

Arabian oryx (*Oryx leucoryx*)
CR (1975) $\rightarrow$ VU (2008)

African large mammals moving away from extinction


**Arabian oryx (Oryx leucoryx)**

**Mountain zebra (Equus zebra)**
EN (1975) → VU (2008)
African large mammals moving away from extinction

Decline of large mammals in African protected areas

Natural land cover loss is slowed down inside African protected areas

... but with leakage

Beresford et al. (2013) Protection reduces loss of natural land-cover at sites of conservation importance across Africa. PLoS One 8:e65370
What is the role of African protected areas for large mammals' conservation?
Drivers of extinction risk in African mammals: the interplay of distribution state, human pressure, conservation response and species biology

Moreno Di Marco¹, Graeme M. Buchanan², Zoltan Szanto³, Milena Holmgren⁴, Gabriele Grottolo Marasini¹, Dorit Gross³,⁴, Sandra Tranquilli⁵, Luigi Boitani¹ and Carlo Rondinini¹

¹Global Mammal Assessment Program, Department of Biology and Biotechnologies, Sapienza Università di Roma, Viale dell’Università 32, 00185 Rome, Italy
²Conservation Science, RSPB, 2 Lochside View, Edinburgh EH12 9DH, UK
³European Commission’s Joint Research Centre, Land Resource Management Unit, Institute for Environment and Sustainability, Via Enrico Fermi 2749, Ispra 21027, Italy
⁴Resource Ecology Group, Wageningen University, PO Box 47, 6700 AA Wageningen, The Netherlands
⁵Department of Biological Anthropology, University College London, 14 Taviton Street, London WC1H 0BW, UK

Although conservation intervention has reversed the decline of some species, our success is outweighed by a much larger number of species moving towards extinction. Extinction risk modelling can identify correlates of risk and prioritise species for conservation action.

Extinction risk analysis: design

Four components:
- Species distribution state
- Human pressures
- Conservation responses
- Species biology

First time satellites in extinction risk analysis
- Multi-resolution (NDVI, MODIS 250m; Landsat 5, 7 30m)

Extinction risk analysis: Random Forest model

500 Classification Trees

<table>
<thead>
<tr>
<th>parameter</th>
<th>all variables</th>
<th>RangeSize removed</th>
</tr>
</thead>
<tbody>
<tr>
<td>no. species</td>
<td>1044</td>
<td>1044</td>
</tr>
<tr>
<td>proportion correctly classified</td>
<td>0.927</td>
<td>0.900</td>
</tr>
<tr>
<td>sensitivity</td>
<td>0.803</td>
<td>0.682</td>
</tr>
<tr>
<td>specificity</td>
<td>0.964</td>
<td>0.965</td>
</tr>
<tr>
<td>true skill statistic</td>
<td>0.767</td>
<td>0.647</td>
</tr>
<tr>
<td>$K$ statistic</td>
<td>0.788</td>
<td>0.696</td>
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</table>

Drivers of extinction risk in African mammals

<table>
<thead>
<tr>
<th>class</th>
<th>variable</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>extinction risk</td>
<td>RIThreat</td>
<td>the response variable, binary species threat status (threatened versus non-threatened in the IUCN Red List)</td>
</tr>
<tr>
<td>distribution state</td>
<td>RangeSize</td>
<td>size of species geographical ranges</td>
</tr>
<tr>
<td></td>
<td>NDVI2010</td>
<td>mean NDVI value within a species' range in 2010</td>
</tr>
<tr>
<td></td>
<td>SuitPrev</td>
<td>proportion of suitable habitat within a species' range</td>
</tr>
<tr>
<td>human pressure</td>
<td>SuitLossa</td>
<td>net change in the proportion of suitable habitat within a species' range, between 1970 and 2010</td>
</tr>
<tr>
<td></td>
<td>NDVIlossa</td>
<td>net change in NDVI value within a species' range, between 2000 and 2010.</td>
</tr>
<tr>
<td></td>
<td>Treecovlossta</td>
<td>net change in tree cover percentage within a species' range, between 2000 and 2010</td>
</tr>
<tr>
<td></td>
<td>HIL5</td>
<td>proportion of a species’ range overlapping with areas having an HII &gt; 5</td>
</tr>
<tr>
<td></td>
<td>HIL10</td>
<td>proportion of a species’ range overlapping with areas having an HII &gt; 10</td>
</tr>
<tr>
<td>conservation response</td>
<td>AvgCons</td>
<td>average amount of conservation actions measured in PAs established within a species’ range</td>
</tr>
<tr>
<td></td>
<td>RangeProt</td>
<td>proportion of a species’ range overlapping with PAs</td>
</tr>
<tr>
<td></td>
<td>SuitProt</td>
<td>proportion of a species’ suitable habitat overlapping with PAs</td>
</tr>
<tr>
<td>species biology</td>
<td>Order</td>
<td>taxonomical order</td>
</tr>
<tr>
<td></td>
<td>DietBreadth</td>
<td>number of dietary categories eaten by a species</td>
</tr>
<tr>
<td></td>
<td>HabitatBreadth</td>
<td>number of habitat layers used by a species</td>
</tr>
<tr>
<td></td>
<td>AdultBM</td>
<td>adult body mass</td>
</tr>
<tr>
<td></td>
<td>LitterSize</td>
<td>number of offspring born per litter per female</td>
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<tr>
<td></td>
<td>NeonateBM</td>
<td>neonatal body mass</td>
</tr>
<tr>
<td></td>
<td>WeaningAge</td>
<td>age when primary nutritional dependency on the mother ends</td>
</tr>
</tbody>
</table>

*aThe acronym 'Loss' was used to indicate the rationale of the variable, even if the net change in variable values over time was measured (i.e. including losses and gains).*

Drivers of extinction risk in African mammals

The vortex of extinction?

MDS on RF classification proximity

Lessons from the extinction risk analysis

Potential of satellite imagery to monitor pressures at continental scale

PAs have a measurable effect on the conservation of mammals in Africa

Role of African protected areas in maintaining connectivity for large mammals

Martin Wegmann¹, Luca Santini², Benjamin Leutner¹, Kamran Safi³, Duccio Rocchini⁵, Mirjana Bevanda⁶, Hooman Latifi¹, Stefan Dech¹,⁷ and Carlo Rondinini²

¹Department of Remote Sensing, Remote Sensing and Biodiversity Research group, University of Wuerzburg, Wuerzburg, Germany
²Global Mammal Assessment Program, Department of Biology and Biotechnologies, Sapienza University of Rome, Rome, Italy
³Department of Migration and Immuno-ecology, Max Planck Institute for Ornithology, Radolfzell, Germany
⁴Department of Biology, University of Konstanz, Konstanz, Germany
⁵Department of Biodiversity and Molecular Ecology, GIS and Remote Sensing Unit, Fondazione Edmund Mach, Research and Innovation Centre, San Michele all’Adige, Trentino, Italy
⁶Biogeographical Modelling, BayCEER, University of Bayreuth, Bayreuth, Germany
⁷German Aerospace Center, Earth Observation Center, DLR-DFD, Oberpfaffenhofen, Germany

The African Protected Area (PA) network has the potential to act as a set of functionally interconnected patches that conserve meta-populations of
Connectivity analysis: design

469 African PAs overlapping with the ranges of 76 species of carnivores and ungulates

Individual-based models simulating dispersal among PAs
Habitat suitability influenced dispersal cost
Steps proportional to allometric dispersal distance

Search time to each PA calculated

Irreplaceability of each PA measured as average distance in search time with and without that PA

Vulnerability measured as photosynthetic activity (NDVI) long-term trend

Irreplaceability for connectivity

Irreplaceability and vulnerability (NDVI trend)

Lessons from the connectivity analysis

Satellite imagery enables continental-scale assessments of connectivity

PAs can play a key role in maintaining connectivity for area-demanding species like the African large mammals

Effective action is needed to prevent degradation and loss of the natural habitats inside and surrounding

Conclusions

PAs alone are insufficient to stop population declines and the race towards extinction

Measurable effect of PAs on the conservation of large mammals in Africa

Key role in maintaining connectivity for the African large mammals, but leakage to be kept under control
Special thanks to collaborators and friends

The coauthors of the papers presented and in particular Martin Wegmann and Moreno Di Marco

The Global Mammal Assessment lab at Sapienza University, including Luca Santini, Michela Pacifici, Daniele Baisero, Federica Chiozza, Alessia Battistoni

The IUCN SSC and the 5000+ individuals involved in the mammal Red List

Several collaborating institutions including IUCN, BirdLife, German Aerospace Centre, JRC, Microsoft Research, UCL, U Wageningen, U Wuerzburg

http://globalmammal.org
Interplay of drivers of extinction risk