Terrestrial vertebrates and climate change in East Africa

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How does biodiversity matter?

- Ecosystem services
- Goods
- Aesthetic value

- Global extinctions are irreversible - ethical duty to prevent

- Endemic (geographically restricted) biodiversity: Fate/responsibility is with the nations that harbor it
Terrestrial vertebrates

Total: 28,097

Species

Birds
9,754

Mammals
5,067

Amphibians
5,743

Reptiles
7,533
Vertebrate species in East Africa

~ 2,700 species of terrestrial vertebrates

Sources: W. Jetz, IUCN, S. Spawls
Globally unique (endemic) vertebrate species in East Africa

Ca. 550 species of endemic terrestrial vertebrates
Functional Diversity

Birds

9,749 Bird Species

Specialists

Oilbird

GENERALISTS

902 Fruit-eaters

318 Seed

81 Nectar specialists

1,229 Fruit-eaters

83 Nectar specialists

582 Freshwater

570 Ground

816 Nocturnal

INSECTIVORES

1,206 Understory feeders

317 Low

690 High trees
Functional Diversity
Global pattern

Jetz et al in prep.
The (differing) uniqueness of biodiversity

These three species alone combine 250 million years of unique evolutionary history!
Phylogenetic endemism

Birds

Jetz et al in prep.
Chestnut Wattle-eye (
*Platysteira castanea*)

Habitat: Humid Forest

Refining expert range maps...

Del Hoyo et al. 1997
*HBW*
... using land cover information...

Global Land Cover Classification (IGBP) (1 km² resolution)
... to estimate actually occupied area
Birds: 1,558 species
Amphibians: 208 species
Mammals: 532 species
Reptiles: 400 species
Species richness
All vertebrates

2698 species
Richness of regionally endemic species

Birds

Mammals

Amphibians

Richness
High: 81
Low: 3

Richness
High: 50
Low: 3

Richness
High: 26
Low: 0

Richness
High: 13
Low: 0
Climate change

Panel on Climate Change (IPCC) Special Report on Emissions Scenarios (SRES)
Projected climate change

1981-2000 to 2081-2100

Individual variables

The climate projections are based on the REMO ECHAM5 model. Anomalies were calculated for the control and A1B emission scenario and the time periods 1981-2000 and 2081-2100, respectively.
Projected climate change

1981-2000 to 2081-2100

All for variables combined

The climate projections are based on the REMO ECHAM5 model. Anomalies were calculated for the control and A1B emission scenario and the time periods 1981-2000 and 2081-2100, respectively.
Montane specialists

Bird species restricted to >1000m elevation

La Sorte & Jetz
PRSB 2010
Levaillant’s Cisticola
African Long-eared Owl

Asio abyssinicus
2800-3350m a.s.l.

Area of occupancy
Scenario 1
Scenario 2
Hamerkop

1990 vs. 2090

65MY unique evolutionary history…
Shoebill

1990 vs. 2090

65MY unique evolutionary history...
Kinangop River Frog

1990 vs. 2090
Taita Shrew

1990 vs. 2090

Suncus spec.
Average projected exposure to climate change

2698 species

1981-2000 to 2081-2100

All for variables combined

Average least change from today’s climatic niche species in a grid cell are projected to experience
Coarse resolution of data, non-validated success of ‘refinement’ impede interpretation and reliability of results. Dire need for more, better data.
Unrefined range maps
(accurate at ca. 150km)

Habitat preference information

Land-cover maps

Refined range maps
(accurate at ca. 25km)

Point data

Survey data

Species distribution models

Climate change projections

Land use change projections

Predict future species distributions
(accurate at ca. 25km)
Survey/inventory data

E.g. Kakamega Forest:

CHECKLIST OF BIRDS OF THE KAKAMEGA FOREST AND NATIONAL RESERVE
(C) 1989 Udo M. Savalli

KEYS:
ABUNDANCE:
com. = common; fcom. = fairly common; etc.
simp. = simple occurrence; st. = stigma
* = potential breeding; ** = confirmed breeding
HABITAT:
S = shrub & thickets; F = forest; Fe = forest edge; G = grassland;
W = woodland; R = riverine; V = villages & towns

PELECANIDAE, Pelicans
Pelicanotus occidentalis africana – vagrant R.

ARDEIDAE, Herons
Grey Heron Ardea cinerea – uncom. R.
Black-headed Heron Ardea melanocephala – com. ** G
Green-backed Heron Ardea chloropterus – uncom. R.

SOKIDAE, Storks
Abdim’s Stork Ciconia abdimii – uncom.? ** G
Wattie Spoonbill C. cerroa – com. ± W G
Mandrill Leptoptilos crumeniferus – uncom. V.

TERGOSLINIDAE, Ibises
Hadeda Ibis Eudocimus hadorami – com. ** R.

ANATIDAE, Ducks
African Black Duck anas nyroca – uncom. ** R.

ACCIPTIDAE, Birds of Prey
Monteiro’s Harrier Circus pyrrhopus – uncom. V
Rufous Marsh Harrier Circus aeruginosus – rare m G
Paddy Harrier Circus aeruginosus – rare m G
Harter Harrier Falco beriguardi – uncom. * W
Black-bellied Sea Eagle Aquila diastema – rare m. W G.
Brown Snake Eagle C. cinerascens – rare m. W G.
Bank Swallow Riparia riparia – vagrant G
Shiwa’s Accipiter Bottae – rare W.
Great Grey Shrike Lanius excubitor – com. * F W
Little Grey Shrike Lanius nubicus – uncom. ? W
African Cuckoo Clamator gisera – uncom. W F
Steppe Eagle Aquila nipalensis – rare m. W.
Wattie’s Eagle A. wattii – rare m. WB
Augur Buzzard Buteo augur – uncom. * W
Common Buzzard B. buteo – com. m. W
Mountain Buzzard B. rufiventris – rare F
Augur Buzzard B. rufoides – rare m. W
Rufous Buzzard B. rufinus – rare m. W
Bioinventory data for all four vertebrate taxa

• In Kenya accurate species lists for most vertebrates available for only for very few locations

• For all but a handful national parks no species lists beyond large mammals (and sometimes birds) are available

• US (country with Marines …): ongoing vertebrate surveys of national parks. Exhaustive species lists for every reserve downloadable from internet
National priority areas for future conservation ...?

Identification (GAP analysis) requires knowledge about which species are already protected by reserves! **Currently lacking for all but large mammals.**
Point/specimen data

E.g. from museums:

African Banana Bat
(Pipistrellus nanus)

Data from GBIF
www.gbif.org
Point/specimen data for Terrestrial Vertebrates
East Africa

GBIF (304,162 records)
HerpNET (24,997 records)
ORNIS (39,886 records)

~ 333,000 digitized records. Almost all from museums outside East Africa (British, American)

At National Museums Kenya:

~ 120,000 records
To date less than 20% digitized
Towards a national conservation strategy

• **Global extinctions** are **irreversible**, prevention may be considered a national duty
• Also applies to small, non-charismatic species
• Successful conservation management in the face of environmental change requires **science**
  • Science requires **tools** and **data**
  • No shortage of tools, methods
• But **no knowledge** without data
Towards a national conservation strategy

• Biodiversity data **is** knowledge
• The collection, mobilization, online publication of data:
  • is critical to successful conservation
  • Is equally (more!) important than analysis, report-writing
  • shows that new informatics mechanisms for attribution, citation desirable
  • should not distract that collecting, serving data is service to society
• Important national and global role for NMK, KWS, many other institutions
Thank you
Richness of vertebrates with global range < 50,000km$^2$

Amphibians: 39 species
Birds: 10 species
Mammals: 38 species