Changes in Mammal Community Structure in Kenya over the Last 100 years

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Climate change and anthropogenic activity have substantially altered habitats and ecosystems all over the world. Habitat loss, invasive species, and overexploitation are threatening biodiversity. To protect their historical biodiversity and species richness, many countries, such as Kenya, have set aside National Parks. Here we compare mammal communities sampled by museum expeditions in the early 1900s to modern surveys in the same areas to test how these parks are preserving the biological integrity and diversity of historical ecosystems.

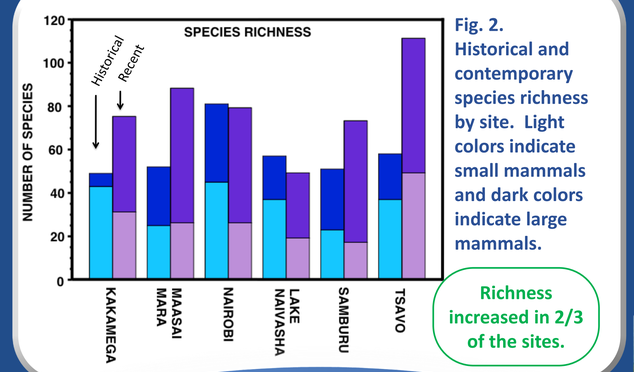
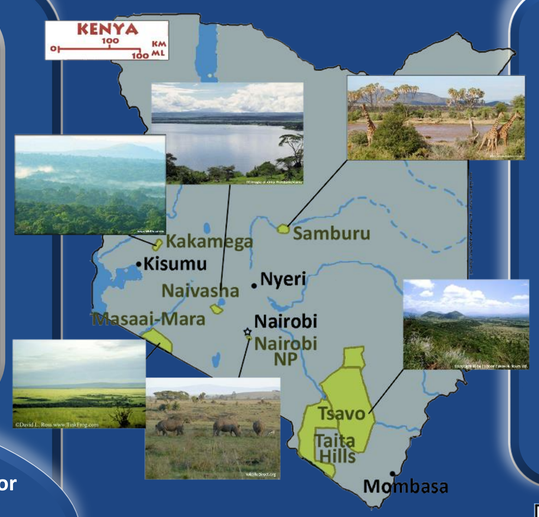


Fig. 2. Historical and contemporary species richness by site. Light colors indicate small mammals and dark colors indicate large mammals.

Richness increased in 2/3 of the sites.



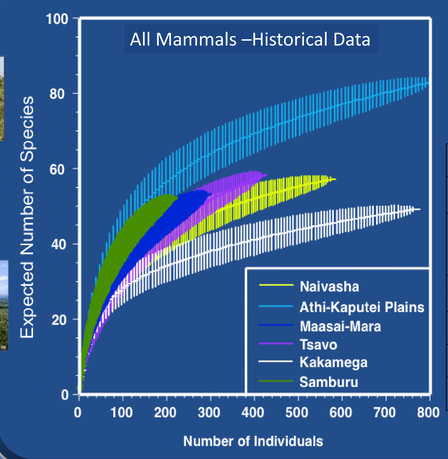


Fig. 1. Rarefaction analysis and Chao-1 calculates expected species richness based on sampling. Table shows observed richness and Chao-1.

Site	Richness	Chao-1:
Naivasha	57	64.682
Athi-Kaputei Plains	83	110.562
Maasai-Mara	53	67.062
Tsavo	58	76.05
Kakamega	49	63.083
Samburu	52	60.167

Questions:

1. Was historical sampling of Kenyan mammal faunas adequate for comparative and analytical purposes?
2. Have mammal communities in Kenya changed with respect to:
   a. Species richness?
   b. Species composition?
   c. Body size distributions?
   d. Trophic structure?

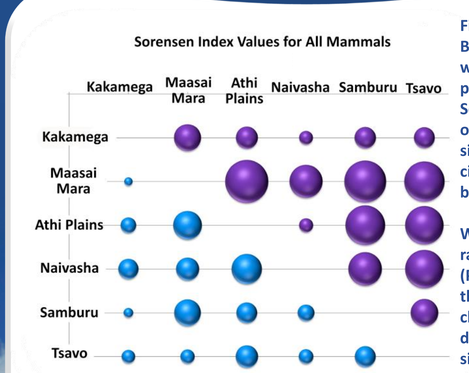


Fig. 3. Beta diversity within each time period using the Sorensen index on all pairs of sites. Larger circles = lower beta diversity.

Wilcoxon sign ranked test (P=0.004) shows that the overall change in beta diversity is significant.

Beta diversity decreased in modern (post-1975) sites.

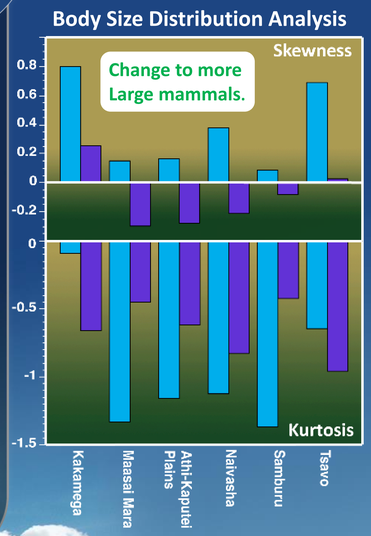
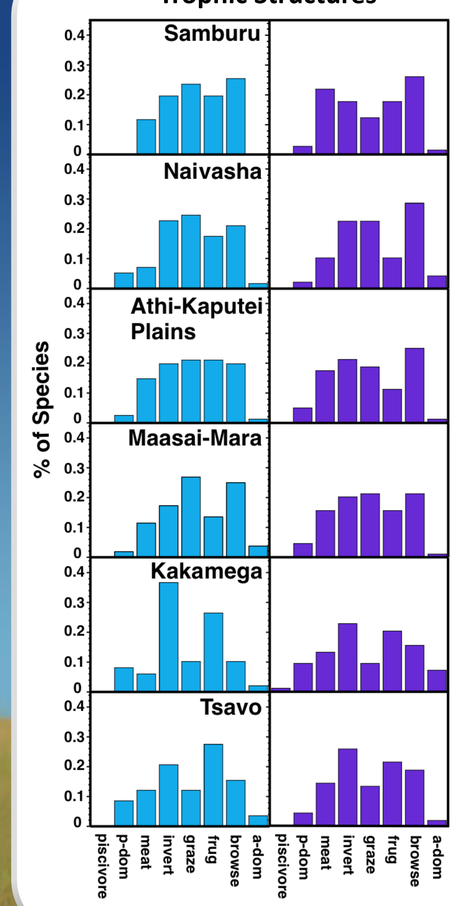


Fig. 4. Moments of the historical and community body size distributions.
Skewness: Positive values indicate Right skew (more small mammals); Negative values indicate Left skew (more large mammals).
Kurtosis: Values around zero indicate a simple normal distribution, from 0 to -1 indicates uniform distribution. < -1 indicates a bimodal distribution.

All sites have moved toward more uniform body size distributions.

Fig. 5. Trophic distributions of historic and modern site faunas. Historic faunas show more inter-site variation than the same sites ~100 years later. Post-1975 faunal data from Naivasha, the Athi-Kaputei Plains, and Maasai-Mara approach similar trophic structures, as do Kakamega and Tsavo. →



Conclusions

- Sampling of historical sites was adequate for analysis (Fig. 1)
- Species richness increased (Fig. 2) - mainly due to large mammals
- Beta (inter-site) diversity decreased significantly (Fig. 3)
- Body size distributions changed (Fig. 4)
  - from right skew to left skew
  - from a variety of distributions toward a more uniform distribution.
  - Significant changes in Kakamega, the Athi-Kaputei Plains, and Tsavo
- Trophic distributions became more similar across sites (Fig. 5)
  - Naivasha, the Athi-Kaputei Plains, and Maasai-Mara became more similar to each other
  - Kakamega and Tsavo became more similar to each other
- Suggests National Parks are preserving overall mammal diversity in Kenya.

Overall, however, the data show *loss in community uniqueness* across all sites in the past century

Methods

We examined mammal assemblages at six sites in Kenya (see Map). These sites comprise several different habitat types including high elevation rainforest (Kakamega), grassland (Maasai Mara), savanna (Athi Plains, Samburu), wetland (Naivasha), and woodland (Tsavo). The sites were compared at 1896-1913 and post-1975. We obtained historical data from faunal lists and specimen counts from the Smithsonian African Expedition of 1909 and from the Field Museum of Natural History. We compiled contemporary (post 1975) species lists for each site from field surveys and various literature (e.g., Williams, 1976) and Internet sources. Taxonomy was updated and standardized according to Wilson and Reeder (2005). Body sizes and trophic information were taken from an updated version of Smith et al. (2003).

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