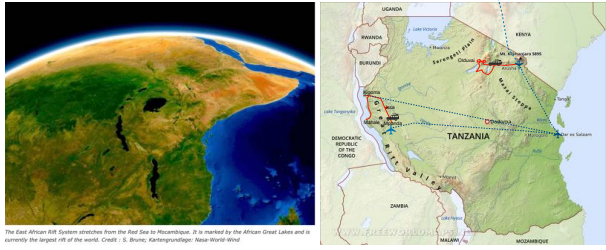


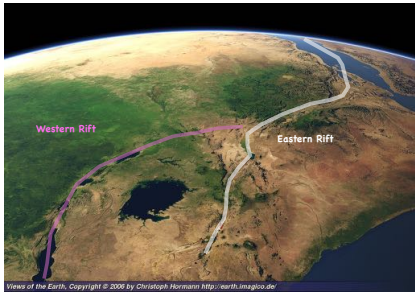
African Ecosystems



The East African Rift System stretches from the Red Sea to Mozambique. It is marked by the African Great Lakes and is currently the largest rift of the world. Credit: S. Rhone; Kartensgrundlage: NASA World Wind

The Rift Valley and Tanzania

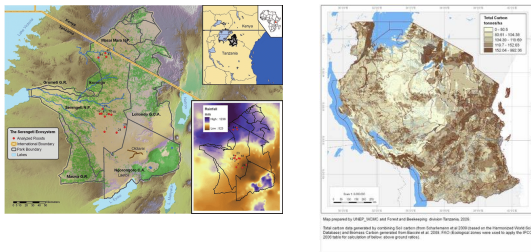
Where are the fossils and why are they found there?



Views of the Earth, Copyright © 2009 by Christoph Hoffmann <http://earth.imaggeo.de>

The rift Valley, splitting into Eastern and Western Rift in the South provides ideal conditions for regular revelation of new fossils, as continental plates separate and the rains wash out new fossils.

African Ecosystems



Map generated by Google Earth and based on data from the National Geographic Society. The map data is derived from satellite imagery and is not intended to be used for navigation or other purposes. © 2010 The National Geographic Society. All rights reserved.

Serengeti Ecosystem and Ngorongoro Conservation Area

African Ecosystems (Arusha, alpine to edible gardens..)



high elevation volcanic landscapes near Arusha: Kilimanjaro 5895 m/ 19349ft and Mount Meru 4562m/14980 ft.

Edible forests tended by Chaga people.

African Ecosystems (Rift Valley, Eastern)



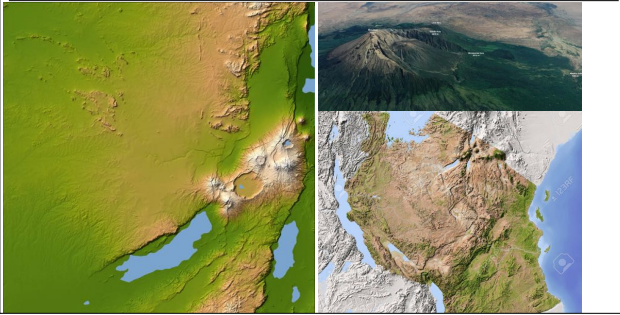
Four different views of the Eastern Rift: sunrise near Mto wa Abu, overlooking Lake Mantra, Zinnia field with the escarpment, descent from Mbulu Highlands

African Ecosystems (grassland, acacia bush, Myombo)



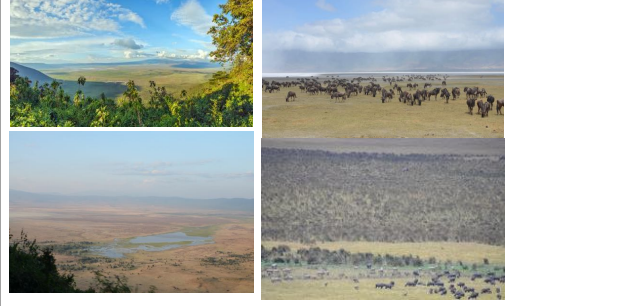
Giraffes at the edge of the Serengeti , Lake Eyasi with escarpment, Sunset over Lake Eyasi Ngotongoro Crater, Issa Valley wooded Savannah, Myombo woodlands

African Ecosystems



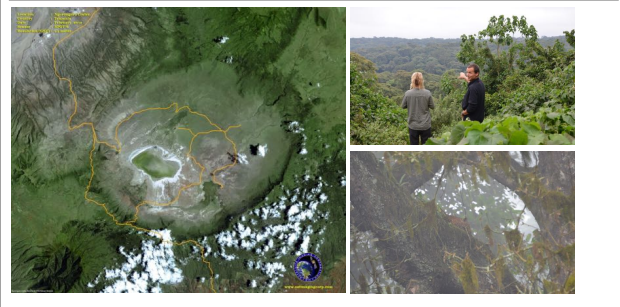
Topology of volcanic highlands in Tanzania, Mount Meru, Topology of Tanzania

African Ecosystems (Ngorongoro crater)



Ngorongoro

African Ecosystems (Ngorongoro crater)



Ngorongoro Crater, route traveled during safari, the South-Eastern side of the volcano captures much rain and has lush rain forests!

African Ecosystems



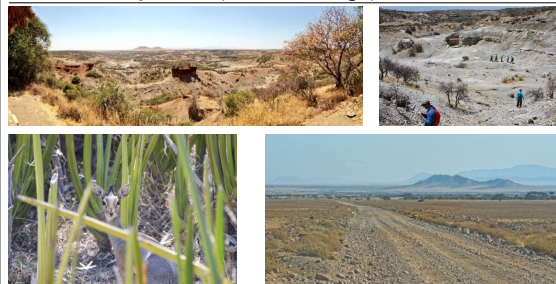
Ngorongoro Crater, about the size of the city of San Diego and holds well over 20,000 large animals

African Ecosystems (Ngorongoro crater, Simba Camp)



Camping at high altitude and low temperatures in Samba Camp on the rim of the crater. With visitors.....
Sunset with moisture flowing into the crater.

African Ecosystems (Olduvai Gorge)



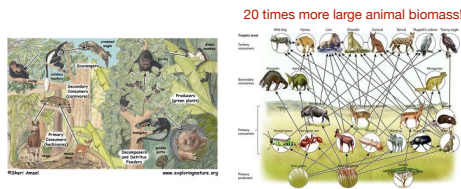
Olduvai Gorge, named after the plant *Sansevieria ehnbergii* , “oldupai” in Maasai.

African Ecosystems (Serengti)



Acacia woodland. Serengeti grassland, wandering dune (barkan from heavy volcanic sand from Oldonyo Lingai Volacano)

Trophic levels and megafauna biomass



African Forests <<<<<<< African Savannah
1000 kg/km² 20,000 kg/km²

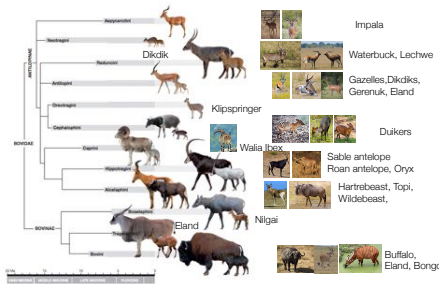
Landscapes with different plants carry very different densities of animals: tropical forests have much lower animal densities than savannas.

Grass, oh grass!!



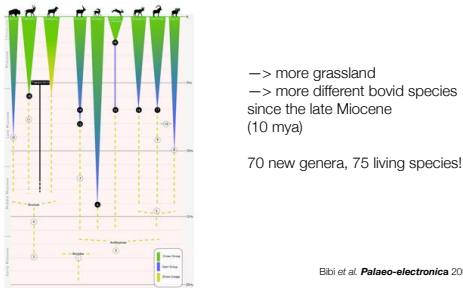
Wildebeast and African buffalo in Tanzania: rich grassland and even richer ruminant megafauna

Bovids, key ruminants for human diet



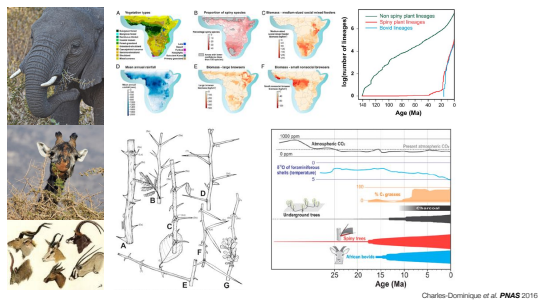
Systematic classification of the family Bovidae: Phylogenetic diagram charting the evolution of the major Bovid clades: the subfamily Antilopinae is very diverse, and its tribes are very distinct from one another, ranging from the smallest to medium and large-sized forms, usually smaller and more lightly built than many of the Bovinae; its horns are transversely ringed, and there are almost always prominent glands in front of the eye and in the forefeet. Most of them, except Cephalophini and Neotragini, live in open country or light cover. The subfamily Bovinae includes three well-distinguished tribes, with medium to very large species, usually heavily built and thick legged, with horns lightly or strongly spiraled, not ringed as in Antilopinae, and pelage with less contrast in color. They are usually adapted to heavy cover or deep forest. To the same scale. Modified from Bibi, Bukhsianidze, Gentry, Geraads, Kostopoulos, and Vrba, 2009.

Evolution of African Bovid Diversity



Diversification of bovid species in Africa over the last 10 million years. Over 75 species of bovinds are alive in Africa (most of them are antelopes). They form the result of a radiation of species, adapted to growing grasslands.

Plants react: Bovids and Spiny plants



Unlike bovinds, elephants, rhinos, zebra and giraffes are less bothered by spines. The number of spiny plants and bovid species in Africa have increased in parallel.

Water holes are dangerous



At a bend along Kruger National Park's Sweni River, a Nile crocodile (*Crocodylus niloticus*) lies in wait, hidden beneath the placid surface of the shallower-than-usual water. It's the spring of 2016, and the park's herbivores are suffering through the worst drought since official record-keeping began in 1904. Kruger's predators aren't having any trouble finding food, however. Emaciated, easy-to-catch prey abound, and the haggard animals are forced to congregate around the park's few remaining watering holes. It's with these circumstances in mind that photographer John Mullineux has trained his camera on the river bend, waiting with anticipation as a group of impala (*Aepyceros melampus*) approach to drink.

Water holes are dangerous



Large land predators also use water holes and are aware of the many opportunities for hunting there.

Confrontational scavenging?



Homo erectus/ergaster scavenging and chasing a vulture and a jackal, diorama at the American Museum of Natural History, New York

Competition



Other carnivores and scavengers such as spotted hyenas are very quick to rush to any kill site. These strong and dangerous animals will steal kills from lions if they are in a big enough group.

Competition from other carnivores



Imagine having to walk past such a lion on the way to the wildebeest in the back! The spotted hyenas came up to about 15 feet from our camp fire.....

Competition from land and air



Two cheetah brothers eating a grant's gazelle. They take turns eating as they need to keep an eye out for incoming thieves..... hyenas and vultures, lions will also steal their kill.

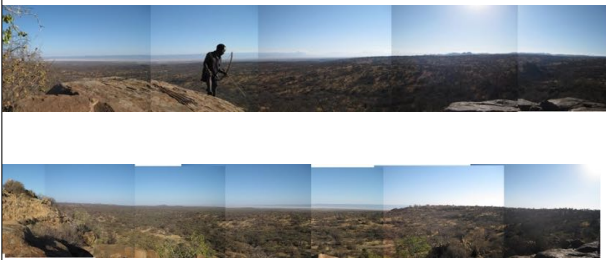
African Ecosystems (Bush: acacia brush & baobabs)



Hadza country!

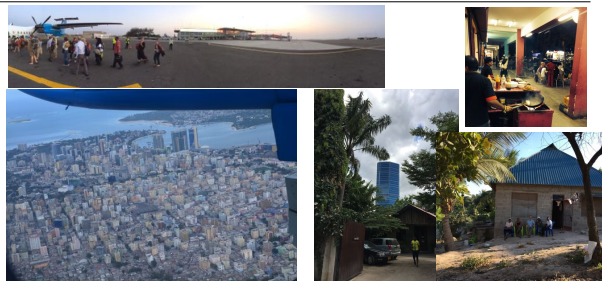
Like a "little Prince" landscape with lots of purplish baobab trees, many of them over 1000 years old.

African Ecosystems (Bush: acacia brush & baobabs)



Mbugoshi overlooking the landscape from a rocky outcrop, with Ngorongoro volcanoes in the distance

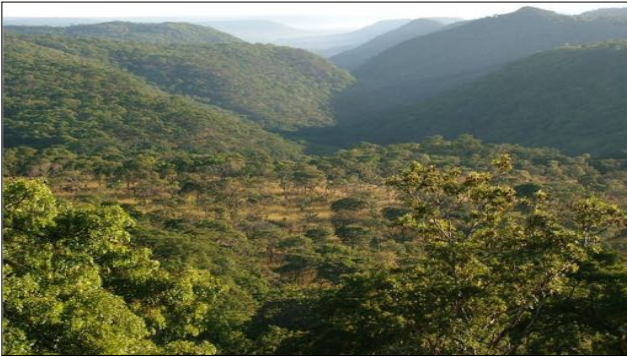
Dar Es Salam



African Ecosystems: Issa, myombo wooded savanna



Issa valley, high wood savannah on sand stone



Issa Valley flowing North towards the Malagarasi River

Lake Tanganyika : 16% of the worlds fresh water



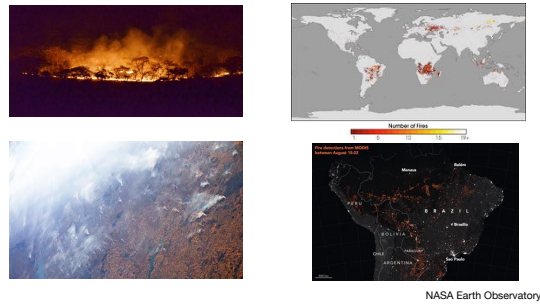
1,471m deep, almost 5000 feet.
Holds over 250 species of cichlid fish.

African Ecosystems (Kigoma, Tanganyika & Gombe)



Lake Tanganyika feeds over 10 million people

Global fire



Fire

Honey guide evolution as a clue to age of human fire use?



Wrangham and Machanda 2013: "A review of the mutualistic interaction of foragers with greater honeyguides, Indicator indicator, "indicates" that honeyguides have an innate propensity to lead humans to honey, that hominids are the most likely species responsible for the evolution of this habit, and that the habit depended on ancient human control of fire."

Mitochondrial and nuclear DNA relationships among honeyguides using different host species. (A) Mitochondrial phylogeny based on partial 12SrRNA gene sequences. Genetic divergence for the ND2 gene was measured for a representative sample of individuals with divergent 12S sequences. The lineages that interact with humans diverged from those not interacting about 2 million years ago. Interaction with humans is contingent on humans using fire to harvest bee hives.....does this indicate that human fire use is 2 million years old?

Use of fire for landscape management



Burnt landscape are much easier to travel through.

Bush Fires



Many bush fires travel rapidly and do not burn most of the mature trees.

Use of fire by pastoralists



Burning pasture can fertilize the ground and cause fresh new grass to sprout.

African Ecosystems



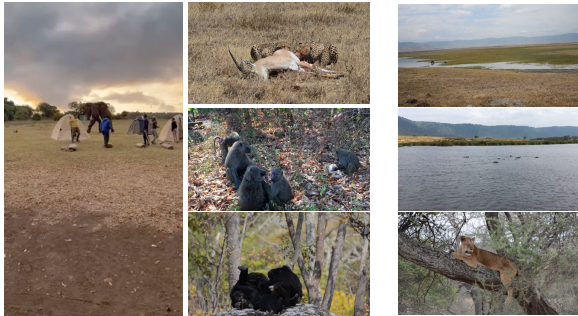
walking through grass like an ape or like Lucy

African Food



African food: starches: Ugali, Rice (wali), banana (ndizi), cassava (muhogo), wheat (chapati/mkate).

African Animals



African Animals: snakes and lizards



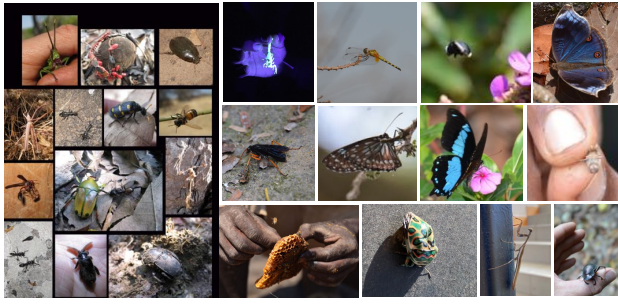
African Birds



African Birds



African Insects and invertebrates

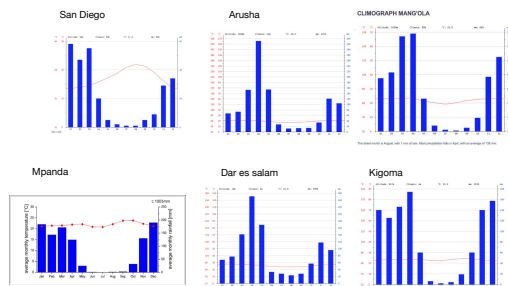


African Primates

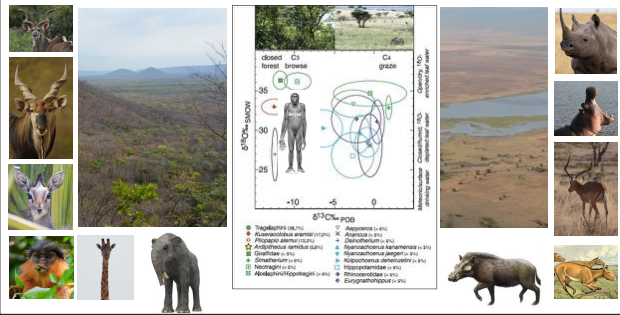


Galago (bush baby), Chimpanzees, Olive Baboons, Yellow Baboons, Vervet, red tailed monkeys, Red colobus monkeys.

Climates



Stable Isotopes (carbon and oxygen) & paleoecology



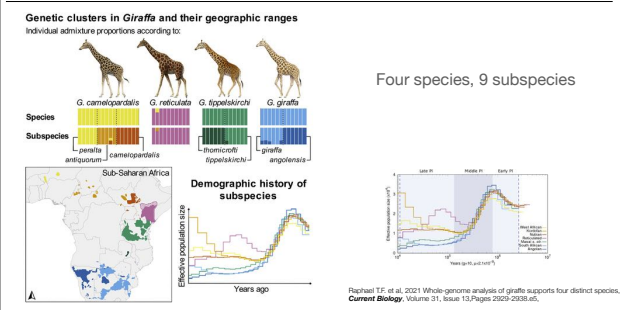
The stable isotope profile of *Ardipithecus ramidus*, 4.6 million year old hominin from Ethiopia. Oxygen and carbon stable isotopes indicate that this short bipedal hominin fed on mostly C3 plants, or animals that consumed C3 plants, unlike later hominins, where one sees a shift to C4, probably due to the consumption of grazing antelopes.

Wooded Savannah Ugalla, Tanzania



Wooded savanna in Tanzania, a present day landscape where chimpanzees live, that is not unlike the paleolandscape reconstructed for *Ardipithecus ramidus*.

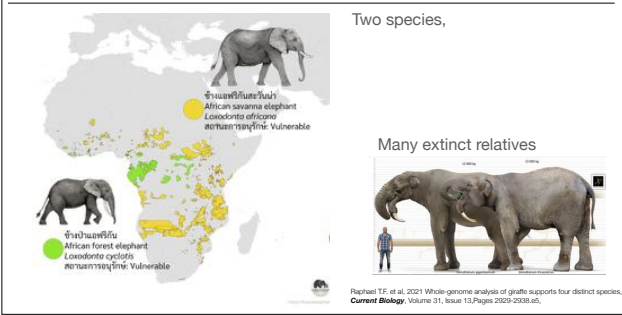
Zoogeography: Giraffes



Range of the four living giraffe species

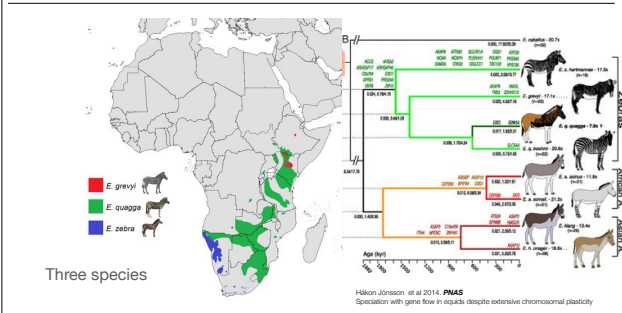
Ripstein TF, et al. 2021 Whole genome analysis of giraffe supports four distinct species. *Current Biology*, Volume 31, Issue 12, Pages 2020-2035.e5.

Zoogeography: Elephants



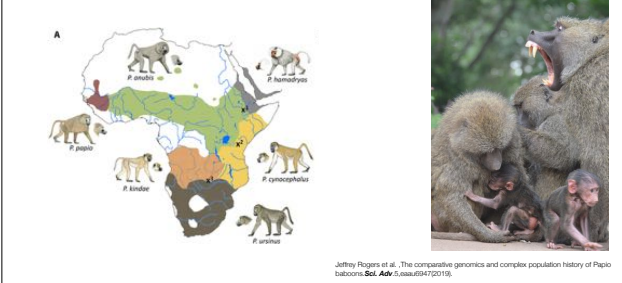
Range of the two surviving elephant species.

Zoogeography: Equids



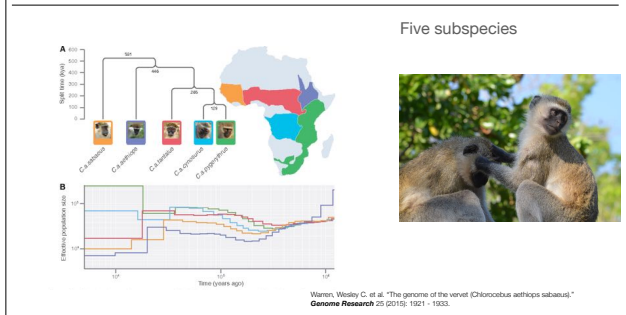
Zoogeography: baboons

Six species, two stable hybrid zones



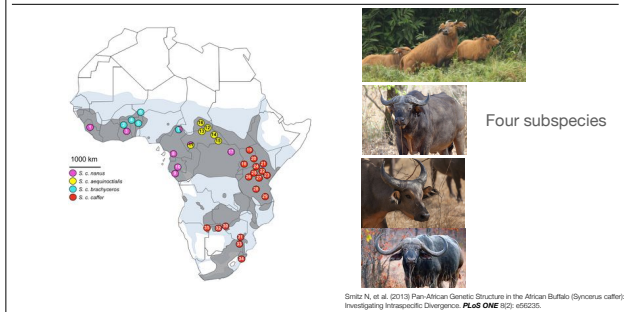
(A) The appearance and current distribution of each baboon species, and the locations of three well-documented active hybrid zones are also shown. x1: hybrid zone between *P. hamadryas* and *P. anubis* (19, 28), x2: hybrid zone between *P. cynocephalus* and *P. anubis* (17, 26), x3: hybrid zone between *P. kindae* and *P. ursinus* (18). Drawings of each species by S. Nash. (B) Distinguishing features of Papio species. Body mass data from (16, 59) and unpublished data from J.P.-C., J.R., and C.J.J.

Zoogeography: vervet monkeys



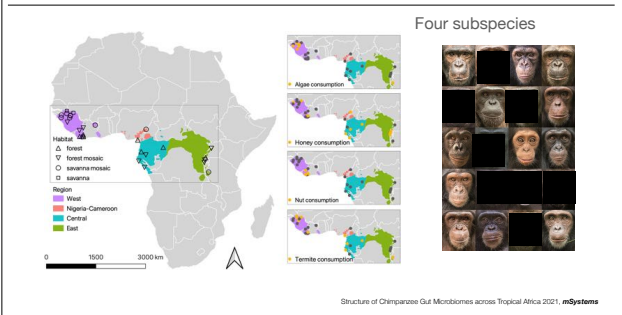
The phylogenetic tree, geographical distribution, and population history of vervet subspecies. (A) Subspecies relationships were obtained by applying a clustering algorithm to the pairwise distance matrix. The tree is rooted using rhesus macaque as an outgroup, and the estimated geographical distribution of each subspecies based on previous field studies used to characterize endangered species (www.iucnredlist.org) is displayed to the right. (B) The inferred effective population size across time (both on log-scale) for each subspecies sample inferred with the multiple sequentially Markovian coalescent (MSMC) software in two-haplotype mode (Schiffels and Durbin 2014).

Zoogeography: buffaloes



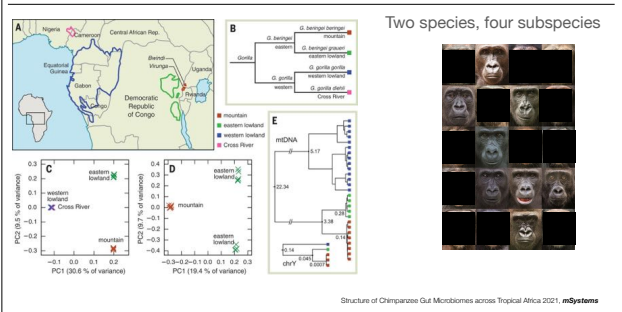
Past distribution of the African buffalo is represented in blue (after Furstenburg, personal field notes 1970–2008- unpublished), with an overlapping shape of the actual distribution represented in grey (after the distribution map of the IUCN's Antelope Specialist Group, 2008). The four subspecies currently recognized based on morphological characteristics were sampled, with the *S. c. nanus* subspecies represented in pink, *S. c. aequinoctialis* in yellow, *S. c. barchyceros* in turquoise, and *S. c. caffer* in red. At locality number 7 and 11, morphological characteristics were intermediate between the *S. c. nanus* and the *S. c. barchyceros*/*S. c. aequinoctialis* subspecies respectively, represented by both color. 1. Gola Forest; 2. Mole; 3. Kpetsu; 4. Arly, Pama, Singou; 5. Pendjari; 6. W; 7. Benoue; 8. Campo ma'an; 9. Gamba; 10. Lope; 11. Ngoto Forest; 12. St-Floris; 13. Bangoran, Koukourou, Sangha; 14. Ouadda, Bria, Ndji River; 15. Mbari; 16. Zakouma; 17. Garamba; 18. Queen Elizabeth, Lake Mburo, Muchison Falls; 19. Kidepo Valley; 20. Mount Elgon; 21. Laikipia; 22. Amboseli, Nairobi; 23. Tsavo; 24. Masai Mara, Nakuru; 25. Serengeti, 26. Maswa; 27. Arusha; 28. Kizigo; 29. Selous; 30. Hwange; 31. Gonarezhou; 32. Chobe; 33. Kruger; 34. Hluhluwe-Imfolozi; 35. Namibia unknown origin.

Zoogeography: Chimpanzees



Map (from <https://open.africa/>) of the 29 sites included in this study, showing either forest, forest mosaic, savanna mosaic, or savanna habitat types and the ranges of the four main geographic regions of chimpanzees (from reference 133). Insets show the variation among sites (points) in consumption of algae, honey, nuts (hard-shelled drupes), and termites (orange = consumed, gray = not consumed). In many cases, these items are accessed using tools (algae [6 of 7 sites], honey [10 of 13 sites], nuts [5 of 5 sites], termites [9 of 12 sites]).

Zoogeography: Gorillas



Geography, taxonomy and genetic structure of gorilla species.

(A) Distribution of gorilla subspecies (2). (B) Gorilla taxonomy. (C) PCA plot of SNP data for all four gorilla subspecies. (D) PCA plot of SNP data from mountain and eastern lowland gorilla samples only. (E) mtDNA and Y-chromosomal phylogenies. Node heights are in units of substitutions per base pair; each tree is drawn to a separate scale.