

On the Origin of the Species, Danakil as the Galapagos of Pliocene East Africa

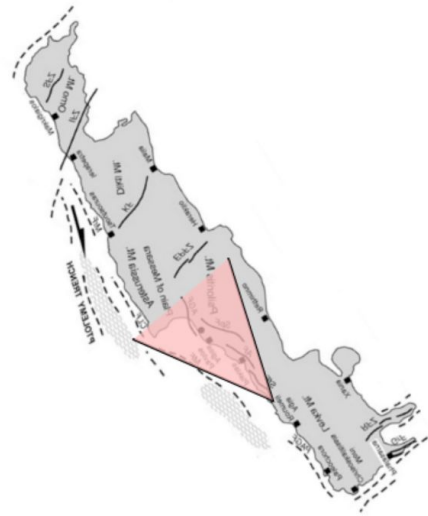
Johan Nygren



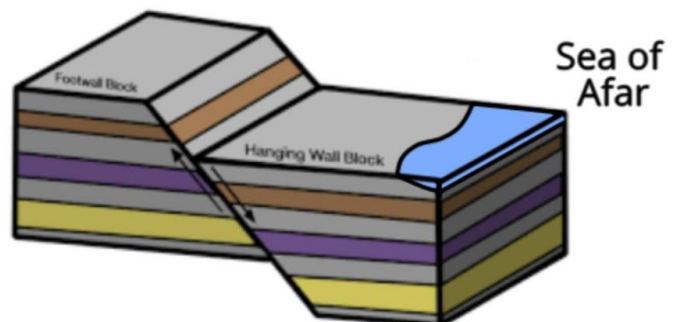
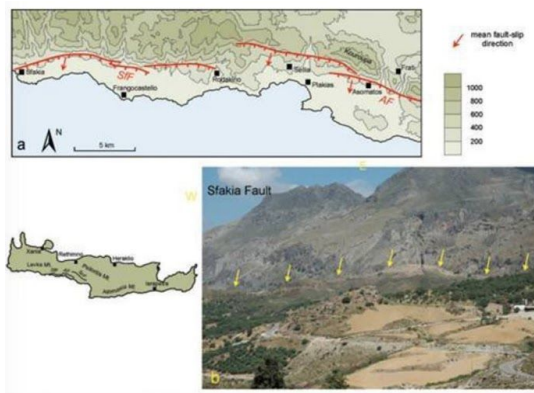
The ancestors of the human species, *Australopithecus afarensis*, evolved in an open grassland, in a region that was dominated by rainforests much like in Kongo today. How does an open grassland find a niche in a forested region, where it would easily be overgrown by arboreal vegetation?

The coast-line of Danakil as an open grasslands environment

The Danakil block separated from Ethiopia around 6 million years ago^[1, 2], and a coast line formed from faulting of the the block, much like how the coast on Crete has formed^[3], on which erosion from wind that came in from the Sea of Afar maintained a largely treeless open grasslands landscape, where grazing horses speciated^[4] as well as the waterbuck^[5] and *Australopithecus afarensis*.^[6]

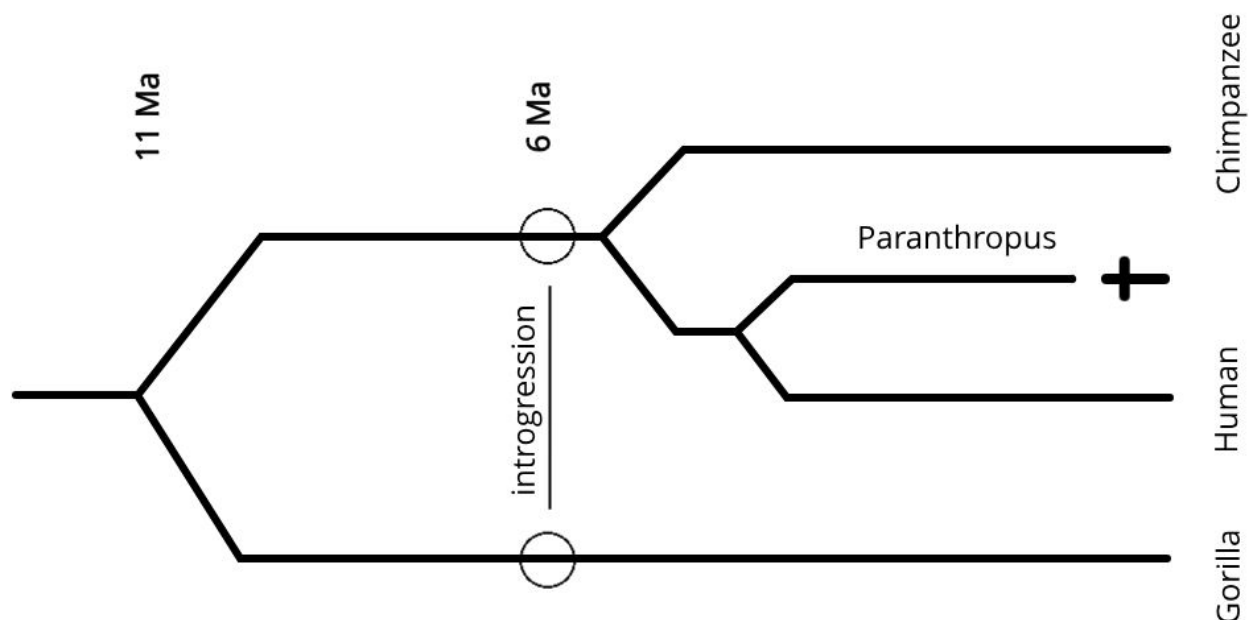


The coast east of Chora Sfakion, Sfakia, Crete, as a model for the open grassland coast on Danakil



Genetic data shows that the speciation of Homo was caused by interbreeding 6 million years ago

The interbreeding between lineages that were separated by 5 million years, that has been gradually proven with genetic data over the past decade^[7, 8], tells a story that makes it easy to get an overview of how the species within the fossil record relate to one another, and it also provides genetic evidence of geographical isolation on the island of Danakil^[2], where the small size of the region made it more probable that two species, separated by 5 million years, would interbreed.

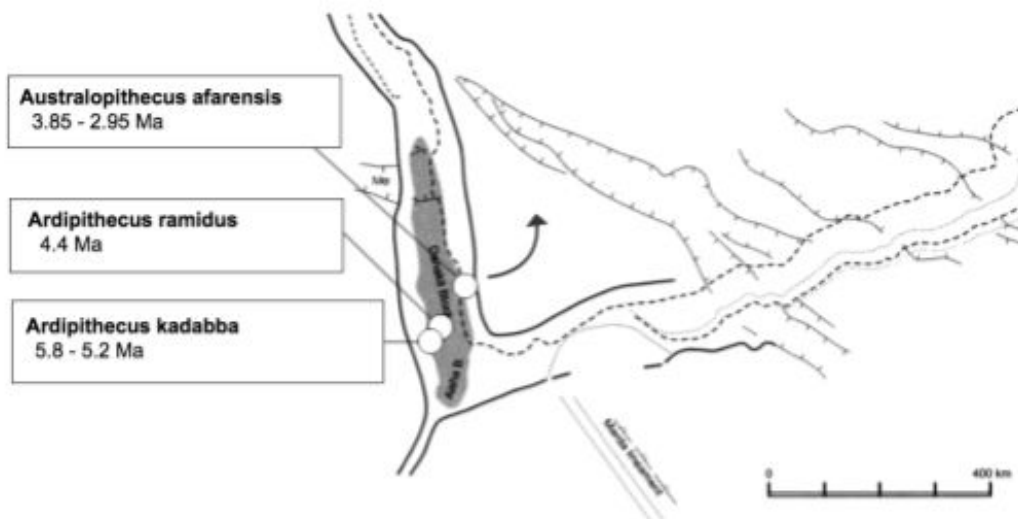


Mitochondria is inherited separately from nuclear DNA, and fragments of mitochondrial DNA are known to get inserted into nuclear DNA to form NUMTs, i.e. nuclear pseudogenes of the mtDNA. There is a NUMT sequence on chromosome 5 shared by gorillas, chimpanzees, and humans, shown from mutation rates to date back to 6 million years ago, a result of interbreeding between lineages that had diverged as much as ~4.5Myr prior to the interbreeding event.^[7]

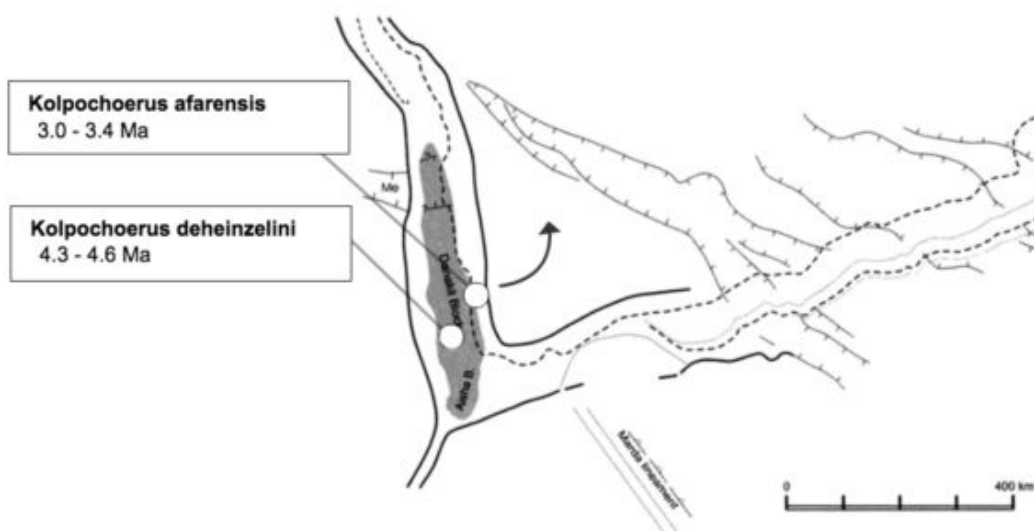
Scally et al showed that 30% of the gorilla genome exhibits lineage sorting with the human genome and chimpanzee genome^[8], with 15% of the gorilla genome being closer to human than to chimpanzee, and vice versa, that the amount of lineage sorting we see where gorillas and humans are closest together is the same as the amount where gorillas and chimpanzees are closest to each other, a result of gene transfer from the interbreeding event 6 million years ago that also transferred the NUMT on chromosome 5^[7] to all three lineages

Fossil record of a counter-clockwise rotation of Danakil

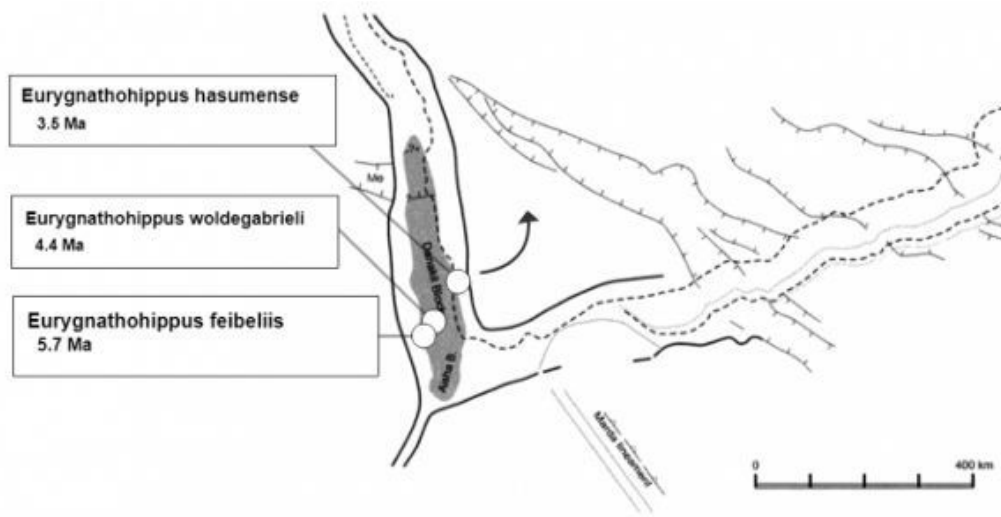
The migration of the coast-line of Danakil towards the north-east^[1], means that progressively older fossils should be found closer to the Ethiopian mainland. The fossil sites of *Ardipithecus kadabba*^[9], *Ardipithecus ramidus* (“Ardi”)^[10], and *Australopithecus afarensis* (“Lucy”)^[6], could show where the coast-line of Danakil was 5.8 million years ago, 4.4 million years ago, and 3.2 million years ago.



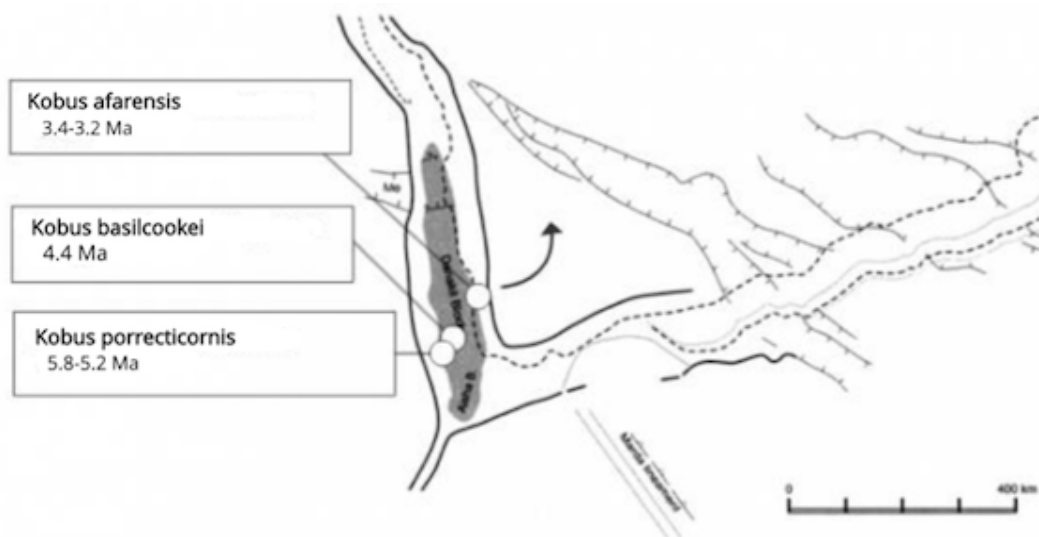
Within the Kolpochoerus lineage on Danakil, the earlier *K. deheinzellini*, is found in 4.3 to 4.6 Ma localities at the Aramis Member of Middle Awash^[11], where the “Ardi” specimen of *Ardipithecus ramidus* was found as well, dated to 4.4 Ma. The younger *K. afarensis* (3.0–3.4 Ma) is found in Hadar^[11], where the Lucy specimen of *Australopithecus afarensis* was found, dated to 3.2 Ma.



The Eurygnathohippus evolutionary lineage also maps to the counter-clockwise rotation of Danakil^[1], descendant from Miocene “forest horses”^[12] and filled a niche as a grazer on the “open grasslands” of the south-western coast-line, together with Paranthropus (*P. deyiremeda*, 3.5 Ma)^[13, 14] who also ate grass^[15] and was descendant from “forest gorillas” and a hybrid between gorilla and Ardipithecus.



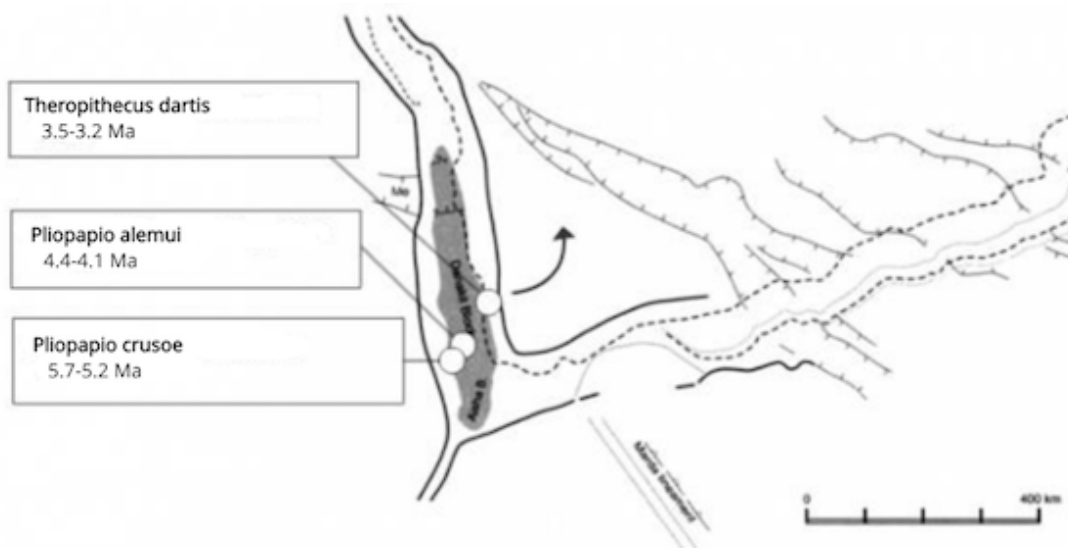
Kobus is a genus of grazing antelopes, most of which are strongly tied to permanent water^[5]. The evolutionary lineage of the kobs, lechwes and waterbuck can be traced back to the coastal environment of the Danakil block, *Kobus porrecticornis* is found at Asa koma^[16], where *Ardipithecus kadabba* is found^[9], *K. basilcookei* is seen in the fossil record at the 4.4-Ma-old strata in the Aramis Member^[5], where *Ardipithecus ramidus* is found^[10], and *Kobus afarensis* found at Hadar, 3.4-3.2 Ma^[17], where *Australopithecus afarensis* is found.^[6]





Waterbuck (*Kobus ellipsiprymnus*) in Lake Naivasha, Kenya

Pliopapio alemui found at the 4.4 million year old Aramis localities show more adaptation to terrestrial locomotion than colobines, but less than that seen in extant *Theropithecus*^[18], supporting the idea that they are ancestral to *Theropithecus dartis* found at the 3.3-3.5 million year old localities Hadar. Four isolated papionin teeth from 5.7-5.2 Ma at the Adu-Asa Formation^[18] are similar in size and morphology to the *P. alemui* material from the Aramis and Kuseralee Members, and could represent an ancestral species, tentatively classified as *Pliopapio crusoae*, having been isolated on Danakil where the coastal grasslands supported the evolution towards grass-eating papionin.



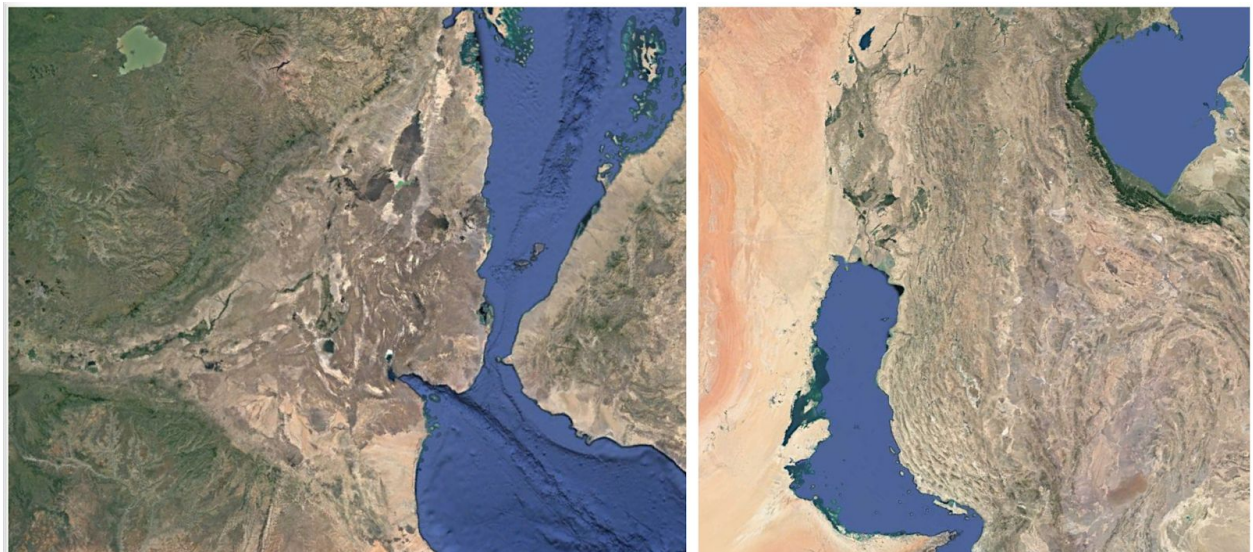


Theropithecus is a genus of primates that are terrestrial and graminivorous (grass-eating), and the only extant species is the Gelada found only in the Ethiopian Highlands. The Gelada is the only living primate that is primarily a grazer.

Geological record of the Sea of Afar in Pliocene East Africa

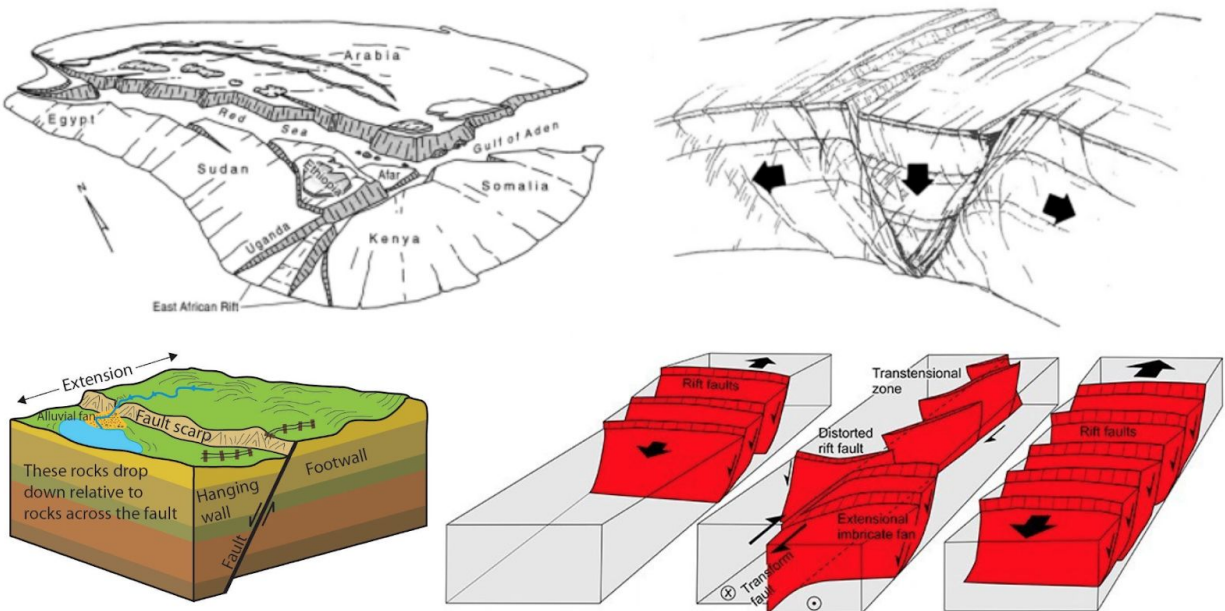
The Sea of Afar has gradually been filled with sediments, up to 1.6 km thick clay sediments^[19], over 6 million years, similar to how the northern end of the Persian gulf has been clogged with sedimentation, and for that reason, there is now dry land in Afar.

The reason Afar has been filled with sediments, while the Red Sea and the Gulf of Aden have not, is because the Sea of Afar was a "low-level energy environment" with a high rate of sedimentation, similar to a lake.^[20]



Tectonic faults on the Danakil block through the Pliocene

The Danakil block has been broken down and spread throughout Afar, coastal grasslands have shattered into smaller blocks, that have fragmented into sandstone layers, found between thicker layers of clay from the Sea of Afar^[19]. This geological record of the Danakil block can be read from Asa koma, a coastal ecosystem that existed 5 million years ago, to Aramis, 4 million years ago, to Hadar, 3 million years ago.



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