

ERTH 484 - Research Briefs
African Humid Period: Human-Environment Interaction
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Introduction:

The African Humid Period, otherwise known as AHP, occurred in the mid-Holocene from approximately 11.7 ka to 4.2 ka synchronously to a wetter climate in other parts of the World (Claussen, Dallmeyer, and Bader 2017). It most prominently had effects on the Northern portion of the African continent, from the equator to the Mediterranean Sea. The most commonly cited causes are changes in insolation from Milankovitch cycles, and albedo, combining to cross a threshold that led to the subsequent northward movement of the ITCZ and strengthening of the West African Monsoon (Burrough and Thomas 2013). This led to increased precipitation and expansion of vegetation and species northward, the growth of lakes, rivers, and glaciers across the continent, and the dispersal and movement patterns of native peoples. The moisture from the AHP was sustained by feedback loops coming from a variety of systems, including vegetation, soil, and lake systems. According to a paper published in Geophysical Research Letter, these combined feedbacks could have increased precipitation in the present-day Sahel by 800mm (Chandan and Peltier 2020). For how well documented the evidence is of the forcings that brought on the AHP, the forcings behind termination and the potential involvement of humans in this change is much more hotly contested.



Figure 1: Graphical representation of Paleoclimate lakes and ecological regions during the African Humid Period (Editorial Team 2021)

There has been a historical human record of the region obtained through petroglyphs and archeological sites. The “Cave of Swimmers” is a petroglyph that was re-discovered in 1933 in the present-day Libyan desert, and documents people swimming. This petroglyph has been dated to ~10 kya and is located in a region that would be nearly impossible for nomadic peoples’ to access water to swim in, had the climate not been extremely wetter. These petroglyphs’ have been referenced in the literature that states changing climate may have been a potential influence on the development of the great Egyptian civilization. As people would have been forced out of the Sahara

and Sahel regions due to increasing aridity, population density become more centralized along the Nile River, due to its fertility and comparative abundance of water (Bárta and Frouz 2010). The delicate threshold between fertile land and arid desert in this region, as well as the mobile lifestyles of many human inhabitants from this region, exasperated the effect climate had on the movement of people. When the land was no longer habitable, people began to move, gradually out of the Sahara and the Sahel. But the human influence on these regions could have been a driver in this climate change, just as much as populations were subsequently affected by it.

The traditional view of the termination of the AHP, acknowledges that orbitally caused weakening of the monsoon season, and a southerly shift of the ITCZ, increased albedo, dust storms, and entrainment, and spurred on a feedback loop that reduced precipitation across the continent (Gasse 2000) (Kutzbach et al. 1996) (Prentice and Jolly 2000). Although there has been much debate in the last several years, in the involvement of humans as agents of change in this termination.

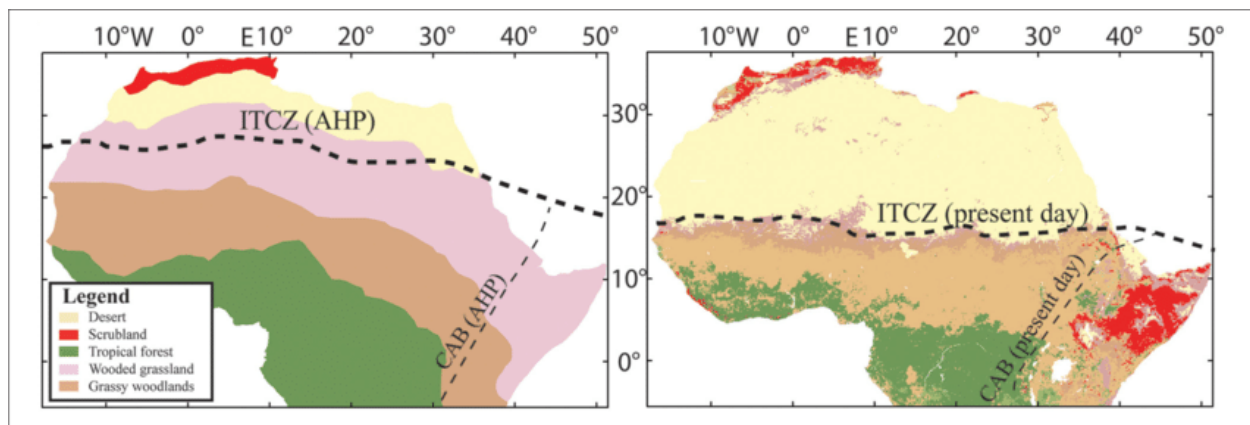


Figure 2: African biomes. Left: Reconstructed African Humid Period (AHP biomes based Larrasoaña et al., 2013). Average summer position of the Intertropical Convergence Zone (ITCZ) and Congo Air Boundary based on Junginger et al. (2014). Right: Present-day biomes created from data downloaded from the Atlas of the Biosphere (<http://nelson.wisc.edu/>) originally digitized from Ramankutty and Foley (1999). Figure from (Wright 2017)

Question / Hypothesis:

Some of the major questions still in debate surrounding this topic include the timing and magnitude of when the African Human Period was terminated. As well as hypotheses around humans being the potential drivers of this termination. Because archeological evidence is sometimes fuzzy, two camps have developed around this human-environment interaction argument. One that believes humans were agents of change that pushed Northern Africa out of the AHP, and into a drier climate, and another camp that believes human pastoralism stalled the termination of the AHP and prolonged a “greener” Sahara. In addition, as cited in (Wright 2017), some proxies that documented the termination of the AHP indicate a rapid transition, with others express conflicting evidence that shows gradual cooling. The hypothesis behind humans being a potential driver in this termination does not credit them as the only driver, but rather in coincident time with orbital forcings, and the shifting of the ITCZ in a fashion that was able to tip

ecological thresholds. As seen in **Figure 3**, the domestication of livestock had been occurring in the Sahara / Sahel regions for over ten thousand years before the present, and these geographic relationships between grazing period and latitude are in direct association. (Wright 2017) argues that because there is great spatial variability of termination of the AHP, there had to be variables contributing to this phenomena besides orbital forcings, which would likely have presented themselves in a spatially consistent way.

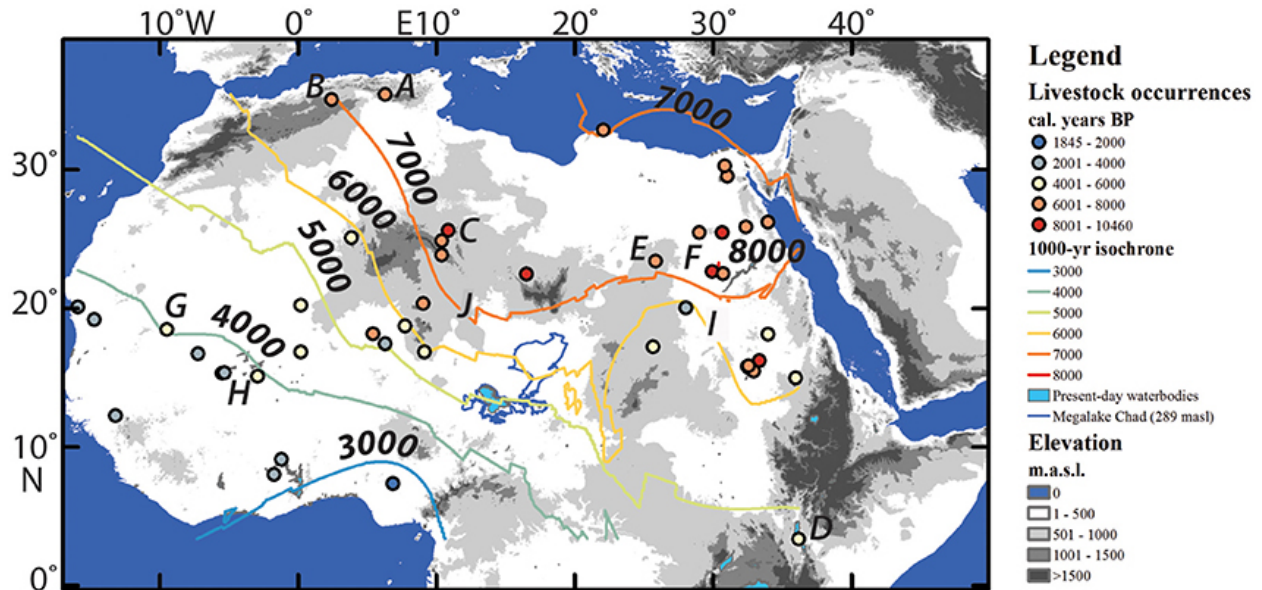


Figure 3: Locations of early occurrences of domesticated livestock in Africa. Data points were largely drawn from published archeological literature (e.g., Gifford-Gonzalez, 2005; Fuller et al., 2011; di Lernia, 2013; Linseele et al., 2014; Ozainne, 2014; Gatto and Zerboni, 2015). The 1000-year isochrone was digitized as contour lines from an ordinary kriged spherical semivariogram model (created in ArcGIS 10.1) of the distribution of early livestock occurrences. Archaeological sites mentioned in the text: **(A)** Ifri Oudadane, **(B)** Ifri n'Etsedda, **(C)** Tin-a-Hanakaten/Uan Afuda, **(D)** Lake Turkana, **(E)** Nabta Playa, **(F)** Fayum depression, **(G)** Hodh depression/Dhar Tichitt, **(H)** Ounjougou, **(I)** Selima Oasis, **(J)** Segedim depression. From (Wright 2017)

On the other hand of this debate, a recent article published in Nature in 2018, points to subsistence pastoralism actually prolonging a “greener” Sahara. They published a figure that explains both arguments. Their research also draws to light the fact that pastoralism had co-evolved in a productive and largely beneficial way in the Sahel, and the question of if pastoralism had been destructive, why had there been no evidence of this “destruction” on the African Continent happening earlier (Brierley, Manning, and Maslin, n.d.).

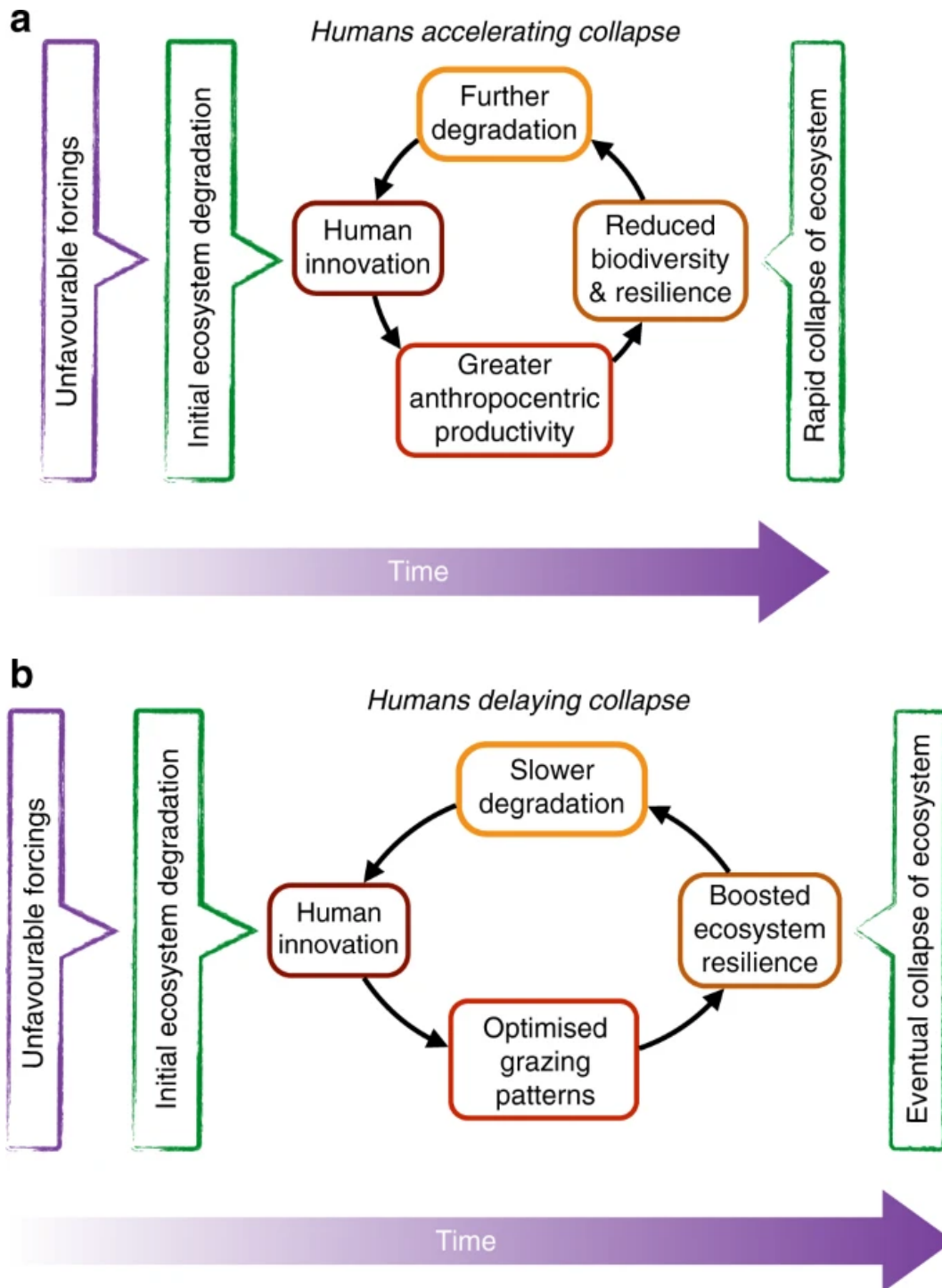


Figure 4: Pastoralist–environment interactions. *a* Schematic of a human population expansion beyond the carrying capacity of the region exacerbating aridification². *b* Schematic of how the technological and cultural advances associated with sustainable pastoralism could help buffer changes to a fragile ecosystem from (Brierley et al. 2018)

Methods and Approach:

Much of the work around the topic of human-environment interactions and feedback in the AHP has come in the form of archeological evidence, with a mixed model-based approach that also

incorporates other data sources and proxies. Wright, conducted a review of already existing datasets, with archeological evidence of domesticated livestock and pastoralism as supporting evidence of his claims (Wright 2017). On the other hand, (Brierley, Manning, and Maslin, n.d.) took a more data-driven approach, and created two models that were run in accordance with vegetation and rainfall feedbacks and thresholds, with and without anthropogenic forcings. (Phelps et al. 2020) used a pollen driven model to map vegetation changes to possibly try and resolve these conflicting hypotheses in geographic space, as seen in Figure 5

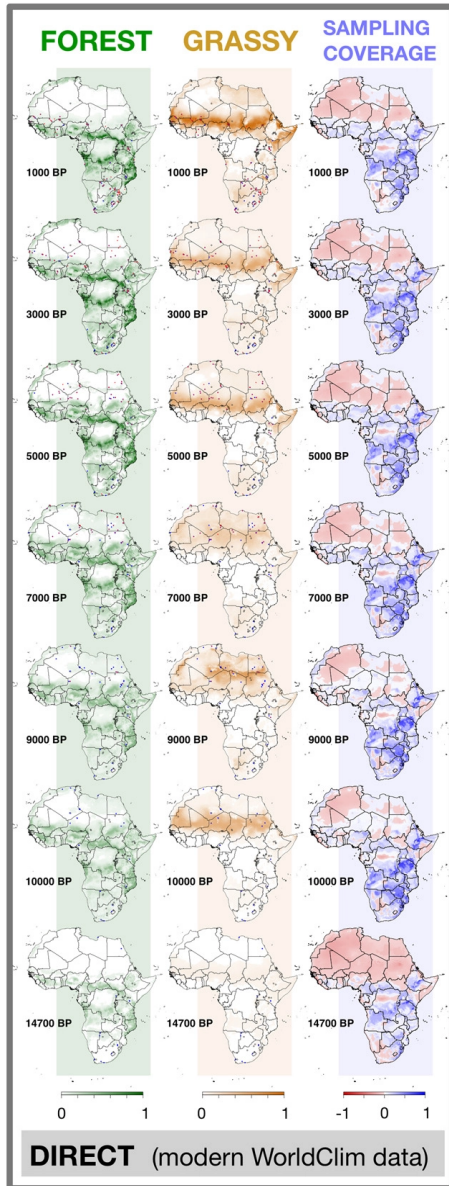


Figure 5: The climatic envelope of forest projected into geographic space (left); the climatic envelope of grassy biomes (savanna and steppe) projected into geographic space (center); sampling coverage, determined using multivariate environmental similarity surface (MESS) analysis (right). For all maps, the direct methodology and repeated modern-day WorldClim data were utilized (for further time intervals see Supplementary material Movies and Fig. A6). For MESS analyses (–1 to 1), negative (red) values indicate a dissimilar sample area to the overall climate space, i.e. poor sampling coverage, and positive values (blue) indicate climate similarity, i.e. good sampling coverage. From Phelps et al. 2020.

Results and Evidence

(Brierley, Manning, and Maslin, n.d.) concluded that without anthropogenic forcings brought on by pastoralism, the AHP should have terminated 500 years before what is observed in the climate record. This is in direct opposition to the evidence posed by the “Desertification” hypothesis, in which pastoralists are cited as “catalysts in accelerating the pace of de-vegetation in the Sahara” (Wright 2017). (Phelps et al. 2020) supported one of their hypotheses that animal production and herding, could have led to a preferential bias toward the expansion of grasslands. Buying into the hypothesis proposed by (Wright 2017) would further provide evidence for a “long Anthropocene” in which humans have had astounding effects on the natural environment since long before the industrial revolution (Fuller et al. 2011) (Ellis et al. 2021)

The conclusions for both sides of this debate, seem to be in near-direct opposition to each other. However, if humans were to be a compounding variable in the termination of the AHP as (Wright 2017) suggests, is it possible that pastoralism was able to both delay the process of the termination AND, worsen it after the termination began? Both sides of the argument are correct in their own space and ways, but can also be concluded in conjunction, with a shift in perspective. The conclusions drawn by (Phelps et al. 2020) make it possible to see both an increased “greening” and

subsequent collapse of grasslands in which humans were a potential agent of change, leading to the possible belief that both of these hypotheses could be true in ways that balance each other out.

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