Towards integrating palaeoecological and traditional knowledge to preserve the Ethiopian Ericaceous belt.

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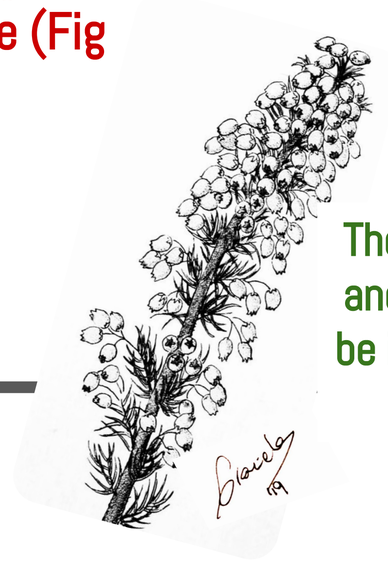
The long-term burning tipping-points controlling the Ericaceous belt (EB), in the Afromontane biome (Fig 1A), are still largely unexplored.

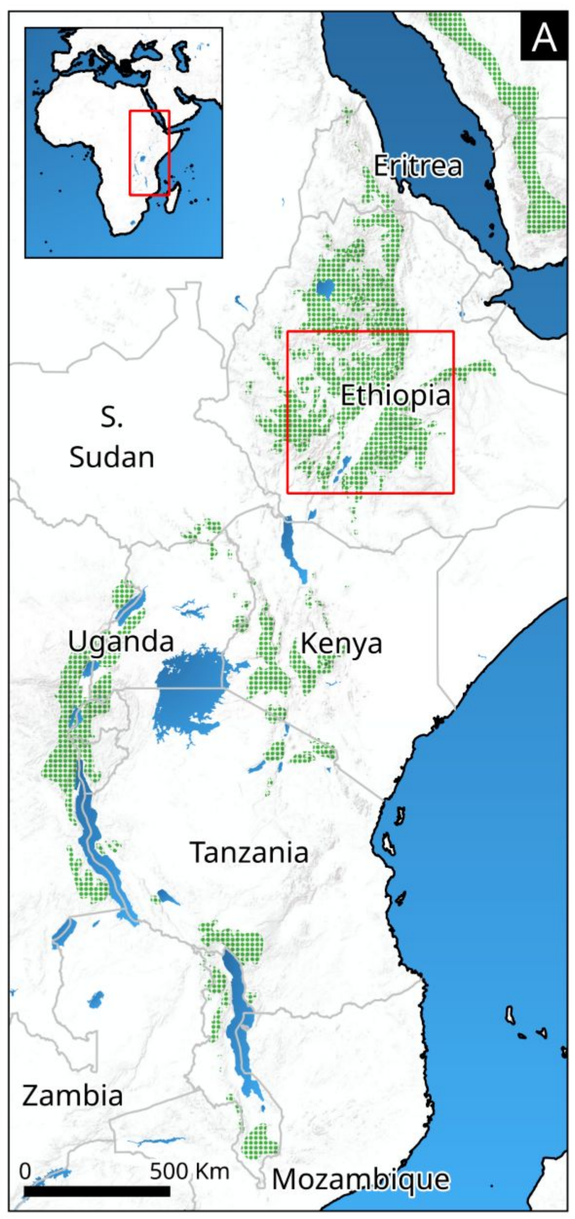
Conservation efforts in the EB have traditionally aimed to limit burning practices in protected areas. Fire has been used as an agropastoral tool on the African continent for tens of thousands of years and current research suggesting that elimination of burning may result in high-severity fires. **EB is one of the ecosystems where fire has long been used by people.**

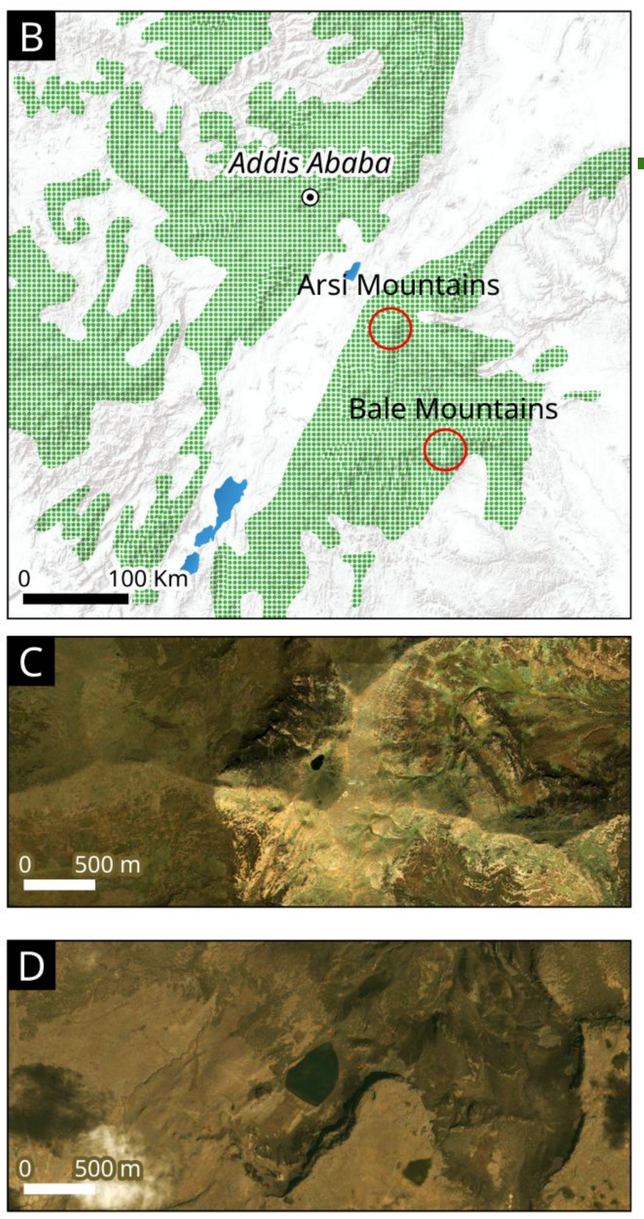


Therefore, long-term studies and local knowledge need to be integrated in conservation planning.

We combine here long-term ecosystem dynamics from the Ethiopian EB in the Bale Mountains National Park (**BMNP; Fig. 1B**) with interviews to pastoral communities of the Arsi Mountains National Park (**AMNP; Fig. 1B**). Both protected areas present similar vegetation and human activities, but AMNP receives less tourism, and traditional cattle and farming management is more widespread. We present time series of environmental variables (**Fig 2**) and preliminary results from interviews to people in the pastoral communities of the AMNP.

Figure 1: Location map of our study area (1A and 1B), Afromontane biome (green shaded); aerial photos of lake Haro Kori in AMNP (1C) and Garba Guracha in BMNP (1D). Cattle and other livestock in the AMNP (1e) and Erica heartland in the Haro Kori valley (1f). Garba Guracha lake from where most environmental variables are derived (1g) and resprouting Erica after fire in ANMP (1h)





In our environmental time series from Garba Guracha (**1D**) we found three periods of intense fire activity (**Fig 2**)[1,2,3].

- ★ I: low moisture, increasing biomass, intense fire activity.
- ★ II: fluctuating moisture and a biomass-burning lead-lag relationship.
- ★ III: Increasingly drier, less intense fire activity, probably human-dominated landscapes[4].

Along the time series we found a resilient fire response between 4 and 30 years[1] (Fig 1H)

We explored the AMNP (**Fig. 1C, E and F**), which, unlike the BMNP (**Fig. 1D and G**), does not have dense heathland areas but rather open short heathlands (**Fig. 1F and 1H**). To understand recent fire-vegetation relationships in this region, we interviewed six people (30-40 years old) from local agropastoral communities. They currently graze goats and cows and have a good knowledge of the recent burning practices in the area. Interviewees agreed that the last time the area experienced regular, large fires, aimed to produce new grass, was 10–15 years ago.

> *"We got educated and therefore most of us do not burn any longer. However, sometimes people burn to keep hyenas away or simply as a tradition, and they send the cattle and the goats to eat the new grass and also the Erica saplings."*

Since the designation of the AMNP in 2011, burning has been banned.

Interviewees explained that their parents' generation knew a very dense, impenetrable Erica landscape with remnants of Afromontane forests up to ca. 3000 m asl in AMNP. Despite the fact that burning was more frequent 20 to 30 years ago, fire was managed with return intervals of 4–5 years, which enabled the Erica heathland to become more dense.

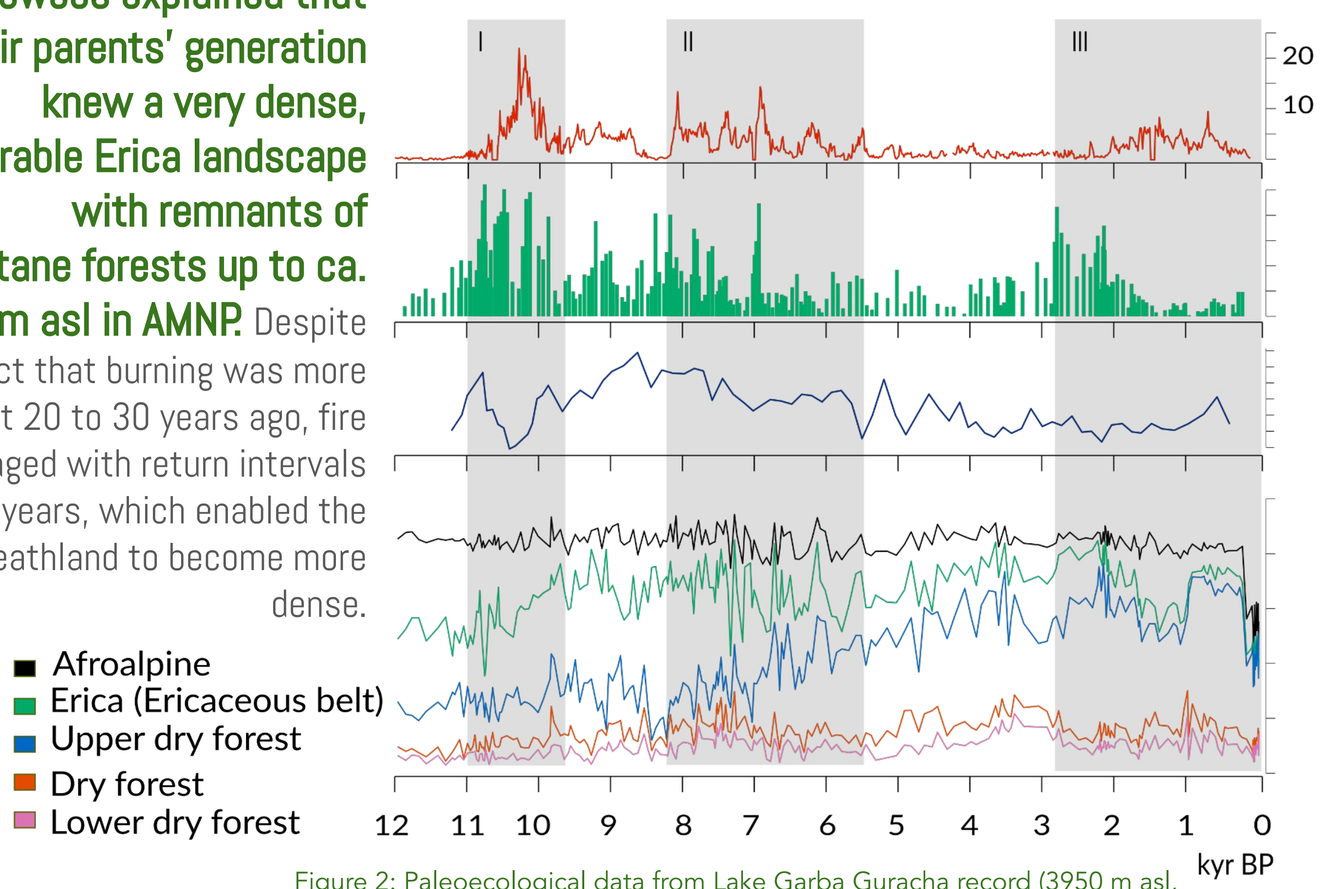


Figure 2: Paleoecological data from Lake Garba Guracha record (3950 m asl, Ethiopia). A. Fire record through charcoal accumulation rate[1], B. Erica abundance inferred from pollen accumulation rates[1], C. Precipitation/evaporation ratio based on δ18O(fucose) isotopes[2] D. Pollen abundances of the major vegetation zones in BMNP[5]. Grey areas I, II, and III reflect the most fire-active periods.

We inferred that intermediate fire return intervals, (4 to 30y), may have sustained a continuous *Erica* cover. The results suggest that a total fire ban will lead to important changes in EB structure and high-severity fires, given current increasing temperatures and population.

1.Gil-Romera et al., 2019 10.1098/rsbl.2019.0357 | 2. Bittner et al 2020 10.1007/s10933-020-00138-w | 3. Gil-Romera et al., 2021 10.22498/pages.30.1.20
4. Gil-Romera, BIttner, et al., (in prep)