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The Field Guide to Mixing Social and Biophysical Methods in Environmental Research

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13. Revealing the social histories of ancient savannas and intact forests using a historical ecology approach in Central Africa

Gretchen Walters, Olivier Hymas, Stevens Touladjan, and Kevin Ndong

Ecosystem histories: from received wisdom to testing assumptions

The state of ecosystems and people's impact on them raise instant questions, and lots of assumptions. I (GW) was consulting aerial photographs in Paris in 2006, at the Institut Géographique National (IGN). A series of black and white images from the 1950s of Gabon's forest-savanna mosaic sat in front of me. A staff member looked at them and raised a seemingly innocent question, "What happened to all the forest?" Their question was based on a stereotype of savanna, assuming that the whole area had once been entirely forested and that the savanna was the result of relatively recent anthropogenic degradation. In reality, these are ancient savannas that have been kept open by customary fire use, as we will see later. These are some of the most ancient savannas in sub-Saharan Africa, with thriving human and ecological communities. So, why do people suppose they are not only anthropogenic, but degraded?

These persistent, misleading stories about ecosystems are "received wisdom", permitting researchers, decision-makers, NGOs and many others, to leave histories of ecosystems unquestioned. Well-known examples include unsupported national deforestation statistics (Fairhead and Leach 1998), assuming that tropical savannas

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were previously forest and are degraded by fire (Fairhead and Leach 1996a; Bond 2016a), or that intact forests have little human influence, being an "unbroken expanse of natural ecosystems" (Heino et al. 2015).

To move beyond assumptions about ecosystems (Kelley, Chapter 19), it becomes important to look below the canopy of these forests (Haurez et al. 2017), where the legacy of past and present societies becomes visible (Biwolé et al. 2015; Morin-Rivat et al. 2017; Roberts 2019). When researchers use interdisciplinary methods, they discover exciting things, such as combining land use and archaeological evidence to understand that most of the Earth has been inhabited by humans for over 12,000 years (Ellis 2021). To understand ecosystems, one must ask questions beyond disciplinary boundaries, and overcome assumption drag (see Lane and Lave, Chapter 3; Ascher 1979). Why is this particular ecosystem here? How has it been shaped over time by people? Without asking these questions, we risk "misreading" the landscape and encouraging erroneous policy pathways supported by degradation narratives about the West African forest-savanna mosaic (Fairhead and Leach 1996b), Sami herding practices in the Arctic (Benjaminsen et al. 2015), or desertification in North Africa (Davis 2007). Understanding the history of landscapes is one of the "Grand Challenges" for conservation in the 21st century (Gillson et al. 2020). Addressing this challenge requires understanding both ecological and social "keystone processes" (Marcucci 2000: 72) that shape landscapes over time, such as those impacting intact forest and ancient savanna.

Intact forests and ancient savannas have a descriptor ("intact" and "ancient") in their titles, potentially presupposing little human history. Such assumptions come from the colonial period. In the case of savannas, fire use was seen as destructive (Kull 2004; Laris and Wardell 2006) despite being necessary for fire-dependent species. Over time, debates have shifted from viewing savannas as degraded ex-forest to insisting that many are old-growth or ancient and maintained by anthropogenic fire (Bond 2016b). Old-growth savannas are defined as "ancient ecosystems characterized by high herbaceous species richness, high endemism, and unique species compositions" (Veldman et al.

2015). However, many of these old-growth savannas are regularly burned by people (Walters et al. 2022), and thus anthropogenic. Such smallholder fire use is rarely reported, yet remains an important part of these ecosystems (Smith et al. 2022). So, what does fire use look like in an ancient grassland?

Extensive tropical forests suffer from a different issue: in many African countries, colonial policies emptied forests of people (Cinnamon 2003; 2010) and claimed that empty spaces were uninhabited or pristine (Hymas et al. 2021a). Many of these forests are now called "intact". These intact forest landscapes (IFL) are defined as "a seamless mosaic of forest and naturally treeless ecosystems with no remotely detected signs of human activity and a minimum area of 500 km^2" (Potapov et al. 2017), and are often associated with an absence of roads (Kleinschroth et al. 2017). IFLs are identified by remote sensing methods (see Braun, Chapter 39), but such methods can only detect limited kinds of activity and will likely lack a long-term, historical view. These views from above miss the fact that forests have histories, linked to the societies that inhabit them (Walters et al. 2019).

What methods can we use to test our assumptions about the occupation and histories of these ecosystems? In the past, problems were successfully confronted in a stepwise fashion where a single problem was investigated with a single set of methodologies through the prism of one academic discipline, heavily influenced by the assumptions of one's culture, resulting in a single solution that could be applied globally and at any time. However, with the current multi-faceted global crises such as climate change or changing forest extent, this stepwise process no longer works. Furthermore, unlike Newton's apple that would fall in exactly the same way, regardless of where you are in space and time, studying the current multi-faceted crises with a stepwise, recipe-like methodology results in different outcomes in both space and time (Reiners and Lockwood 2010; Reiners et al. 2019). Instead, today's researchers facing multi-faceted problems need to move beyond a siloed approach and (Tett 2015) a) take a case-by-case approach, b) be agile in their methodology, and c) be open to other scientific disciplines (Fig. 13.1a and b).

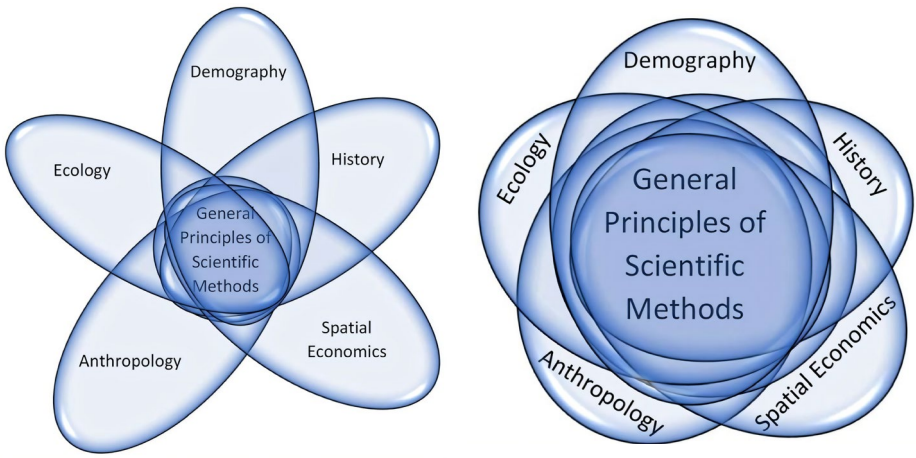

Fig. 13.1 Gretchen Walters. Example of disciples used in Case 1. A. Siloed approach used to study simple problems, where there is little need to integrate other silos. B. Approach needed when investigating multi-faceted problems, where we need to expand our general principles of scientific methods to other disciplines. Note however, we will always have biases towards certain disciplines and there will always be methods that are very specific. Inspired from (Gauch Jr 2002)

Mixed methods have become essential to understanding ecosystems, producing works which have become standard references in the field, such as the high-impact research by anthropologists James Fairhead and Melissa Leach who went to study the forest islands in the tropical savannas of Guinea Conakry. They had originally assumed that they were studying degraded tropical savannas. Only by setting aside their cultural and methodological assumptions, by working with local knowledge-holders about landscape history, and by consulting archival information and aerial photos were they able to understand that these forest islands had been created by people rather than being forest remnants within degraded savannas (Fairhead and Leach 1996). What they were seeing was not deforestation, but reforestation. Although such a combination of methods has since become more common, it remains marginalised in the face of more traditional methods of studying ecosystems. Such work across disciplines requires moving beyond disciplinary boundaries and cultures (Táíwò 2019) and understanding the "conceptual worlds of our colleagues"(Darbellay 2015: 167).

Historical ecology methods: what and why

In the early 2000s, many ecologists believed that societies had not greatly shaped ecosystems (Foster et al. 2003).[1] The long-term impact of historical human disturbance on forests is now more accepted (Ellis et al. 2013) thanks to ground-breaking work in environmental anthropology, geography, and historical ecology (Denevan 1992; Fairhead and Leach 1996a; Balée and Erickson 2006) that considered the influences of humans on forests.

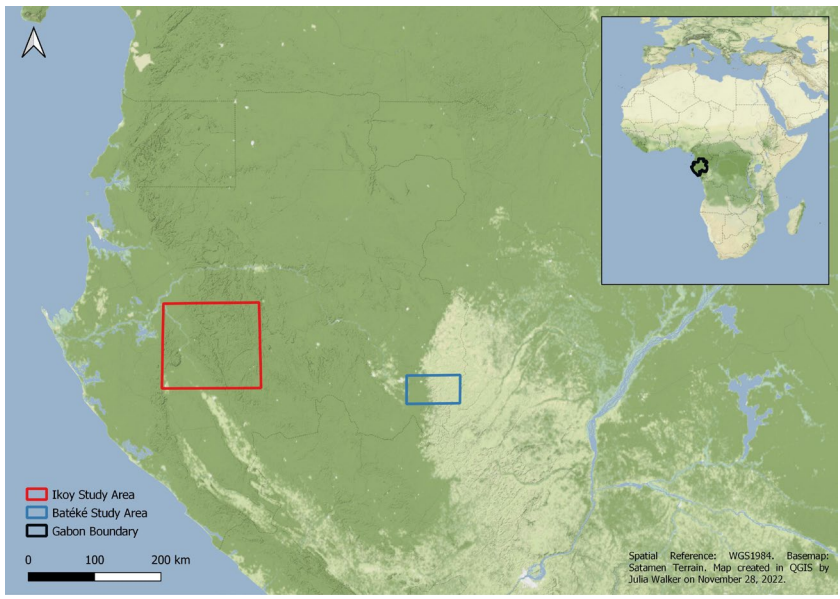

Fig. 13.2 Gretchen Walters. The Ikoy study area in red in an Intact Forest Landscape and the Batéké study area in blue in an ancient savanna

Historical ecology (see Davis, Chapter 29) is an interdisciplinary approach that can be used to unravel the interaction between humans and the environment at different spatio-temporal scales (Szabó 2015), bringing together the ecological and social sciences (see Davis, Chapter 29; Balée 2018). It places people at the centre of investigation, as a "keystone species" (Erickson 2021) having an impact at the landscape scale (Dodaro and Reuther 2016). Historical ecology research has been conducted in Amazonia

1 There are exceptions, e.g., Leopold (Leopold 2013: 375).

(Balée and Erickson 2006) since the 1980s, but has only recently become more common in Central Africa (de Saulieu et al. 2016), where research suggests that forests have been heavily impacted by past anthropogenic disturbances (Oslisly et al. 2013; Garcin et al. 2018). Historical ecology comprises many methods, with a 2021 manual proposing 17 (Odonne and Molino 2020), and can be summed up as requiring the analysis of "two types of archives: ecological....and human" (Decocq 2022: 3). Here, we focus on methods that help discern how intact forests and ancient savannas have been created by societies over time. We look at migration patterns, the history of settlements as derived from oral and archival sources (see Cope, Chapter 22; Chakov et al., Chapter 33; Grenand and Davy 2021), and customary fire use and indicator species derived from botanical data and interviews (Ekblom et al. 2019). We focus on cases from the Ikoy forest and the Batéké savanna of Gabon (Fig. 13.2).

Case 1: The intact forest of the Upper Ikoy

The Upper Ikoy Valley of Gabon is classified as an Intact Forest Landscape (IFL) (Potapov et al. 2017). These forests are called "seamless". But are they? The vegetation suggests that previous agricultural fields and village settlements have been resettled by a pioneer tree species, while two palm species suggest opposing landscape histories of presence and absence of people. What is happening under the canopy of this IFL? Who were the inhabitants over time? How was the forest composition and its people impacted by colonisation, disease, and trade? To answer these questions, one must combine several methods from the social, historical, and ecological sciences.

In this study we bring together oral histories (Chakov et al., Chapter 33) and two frameworks to understand the historical events that affected the people and the environment of this area: one from trade and the other from disease. The first framework focuses on trade in the colonial era (Chamberlin 1977). The second framework focuses on the spread of disease (Headrick 1994) (Hymas et al. 2021b). Using these two frameworks and oral histories we explore how the spread of disease and trade impacted this IFL (Fig. 13.3).

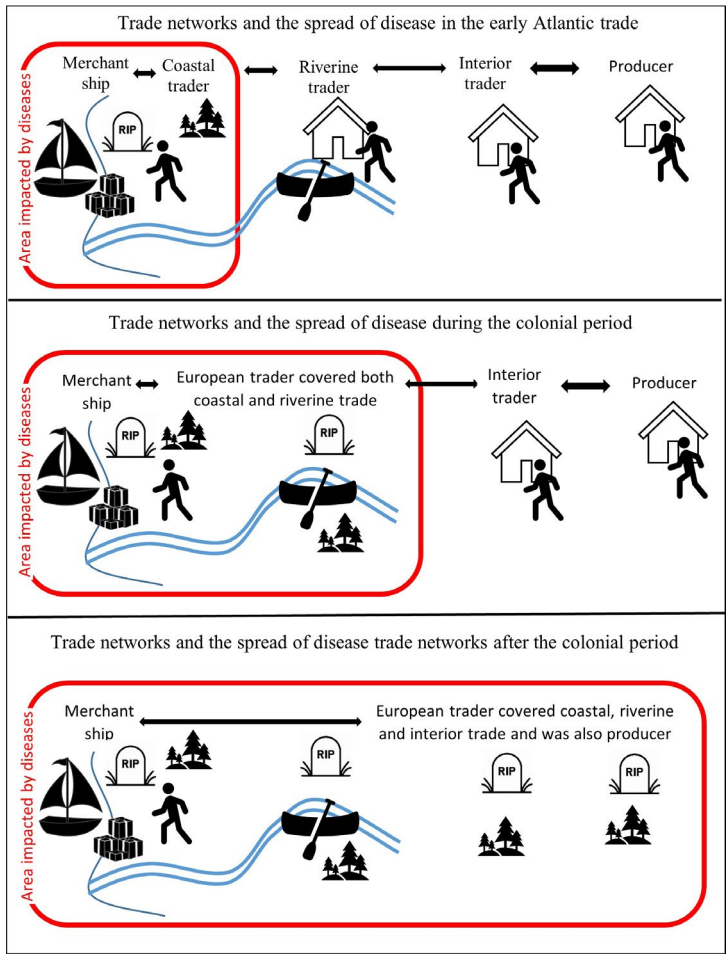

Fig. 13.3 European traders appropriated local trade networks while also aiding the spread of disease. Traders are split into three tiers: first tier traders dealt directly with merchant ships, second tier traders were middlemen, and third tier traders operated the stages between the producers and second tier middlemen (based on Chamberlin 1977: 6–7)

The upper Ikoy study area and methods

In order to understand the forest ecology of the Ikoy, one must move beyond a more traditional method of using forest plots or transects (and so limiting oneself to only biological information) (Walters et al. 2019) or only using interviews, and so limiting one's understanding to what is remembered. In using an ethnographic approach (Sayre, Chapter 34) to unravel migration stories in combination with archival photos and

maps, one gains a historic depth to the research and a view of what has happened under the canopy of an intact forest landscape over time.

The upper Ikoy study area is located in Gabon's Du Chaillu Massif (Fig. 13.2) and contains a road that runs up the Ikoy valley along which there are villages populated by Bantu-speaking Mitsogho and Akele peoples. The other villages are mostly populated by the Babongo, a hunter-gatherer group.

We developed our understanding of the historical and epidemiological impacts of the Atlantic trade period mainly from authoritative secondary sources and trading accounts dating from this time. We also used online archives (Cope, Chapter 22) such as the Internet Archive (www.archive.org), the British Library (www.bl.uk), the British Newspaper Archive (www.britishnewspaperarchive.co.uk), Bibliothèque Nationale de France (gallica.bnf.fr), Persée (www.persee.fr), and Horizon Pleins Textes (horizon.documentation.ird.fr).

To place the findings in the local context, we recorded anonymised village histories. Due to the small size of Gabonese villages no sampling strategy was used. The oral migration histories were recorded first with a group of adults and elders and then in separate smaller groups, some of which were based on ethnicity. In each of the group oral history interviews we drew a map on the ground consisting of the villages that people had created during their migration. Then, we asked open-ended questions about each of the villages mentioned, including why they left the previous village, why they moved to the village in question and the routes they used. This information was supplemented with the current locations of named places and a local event calendar we constructed from dates of major, local, historically salient events.

These village oral histories (Chakov et al., Chapter 33) were carried out in French and Mitsogho. We triangulated this information with oral histories from other villages, foresters' accounts, and historical accounts. The University College London's ethics committee reviewed and approved the methods used. Oral consent was requested from study participants, with the understanding that all oral histories would be anonymised. The study was carried out using the Free, Prior and Informed Consent (FPIC) process.

Care was taken not to conduct oral history interviews during busy parts of the year, i.e., when people are in their plantations[2] To encourage participation and to compensate participants for their time in a locally meaningful way, we distributed locally purchased drinks and food items.

2 Plantations are large forest gardens created using slash and burn agriculture to cultivate large crops of manioc or plantains; typically, each adult married woman

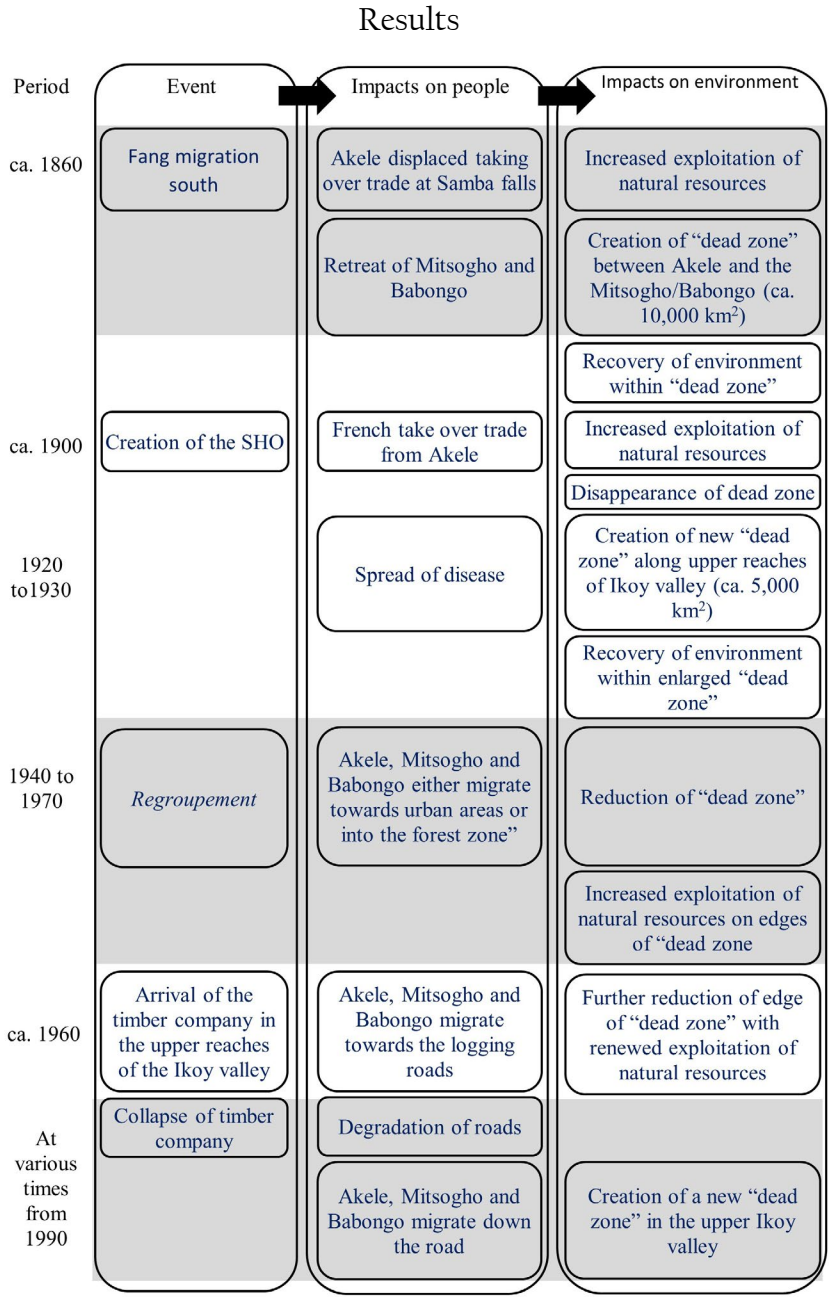

Fig. 13.4 Gretchen Walters. Summary of events and the impact that they had on both the people and the environment of the villages of the Ikoy area

in a household will have her own plantation. These plantations are rotated over time, allowing the forest to recover in between plantings.

To understand the migration of people into the Ikoy area, multiple strands of information must be brought together. This account starts with the European migration from the coast into the interior of Gabon. It continues with how this migration brought disease and, with resettlement policy[3], resulted in the depopulation of the Ikoy area. We then describe the migration histories of the three ethnicities currently living in the area (Fig. 13.4) and discuss how these events influenced the landscape of the area.

Colonisation and migration history

National context

During the 1470s the Portuguese were the first Europeans to enter into contact with the Mpongwe coastal people (Patterson 1975; Aicardi de Saint-Paul 1987: 6; Gaulme 1988: 63; Merlet 1990: 19; Knight 2003; Gardinier and Yates 2006). The Atlantic trade of Gabonese natural resources started around the mid-16th century (Patterson 1975: 8; Merlet 1990: 20–21; Pourtier 2010: 2). Trade of forest products and slaves ensued in the 16th century, with a history too detailed to recount here (Rondet-Saint 1911: 101; Sautter 1966: 729; Martin 1972; Patterson 1975; Chamberlin 1977; Vansina 1990; Gray 2002; Gardinier and Yates 2006; Pourtier 2010: 2).

The ensuing surge in coastal trade drew people from the interior towards these new coastal markets (Sautter 1966: 752; Vansina 1990: 234) bringing the Gabonese second- and third-tier traders into contact with the first-tier traders (Patterson 1975; Chamberlin 1977; Gaulme 1988: 58; Vansina 1990; Gray 2002: 26). To strengthen their position in the tier system the French created a concession system and trading routes that favoured French companies (Cuvillier-Fleury 1904: 80; Gaulme 1991: 85; Coquery-Vidrovitch 2001). These French companies covered 70% of Gabon (Vande weghe 2011: 61).

Ikoy area context

In 1893 the Minister of the Colonies awarded Daumas the first commercial concession, which included the Ikoy River valley (Coquery-Vidrovitch

3 Colonial and postcolonial policy of regrouping, sometimes forcibly, villages together. In Gabon this usually meant along roads (Sautter 1966).

2001: 380). It comprised eleven million hectares of forest (four times the size of Belgium), and became the Société Commerciale Industrielle et Agricole du Haut-Ogooué (SHO)[4] (Cuvillier-Fleury 1904: 92–93; Rouget 1906: 610–611; Coquery-Vidrovitch 2001: 14, 44). By 1928, the area was crisscrossed with SHO trading posts (Fig. 13.5), caravan routes, and villages (Journal Officiel de L'Afrique Equatoriale Française 1910: 515).

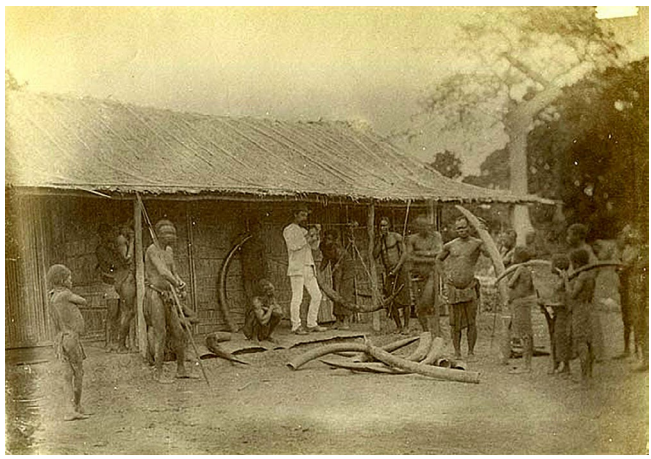

Fig. 13.5 Elephant tusks outside a SHO warehouse, circa 1910 from Moutangou (2013: 95), public domain

The thirty-year monopoly of the SHO in Gabon ended in 1923 (Moutangou 2013: 216–217) by which time the SHO had already left the Ikoy area (Suret-Canale 1987: 130; Gaulme 1988: 116; Coquery-Vidrovitch 2001: 388). Just before independence, in 1960, 100,000 ha of the SHO concession was bought by la Société d'Okoumé de la N'gounié (SONG) (Simon 1953: 26, see maps in Sautter 1966: 762; and Suret-Canale 1987: 235; Lepemangoye-Mouléka 2009), which operated in the Ikoy area for over 30 years (1956–1990s) (Charbonnier 1957; Lepemangoye-Mouléka 2009). By controlling the production of timber, Europeans took over the last tier. La SONG established the modern-day town of Ikobey, where they set up their base and created the area's present-day roads.

4 A company which still exists today under the name Tractafric.

Disease and "dead zones"

Disease-related depopulation has a long history in Gabon (Oslisly 2001: 112–113; Spinage 2012: 1194). By breaking down trade barriers, Europeans increased disease transmission and brought diseases previously unknown in Gabon (Sautter 1966: 798). The introduction of quinine[5] helped Europeans to become first-tier traders and to move away from the coast, leading to further disease spread (Gray 2002: 95) from around 1880 until the First World War (Debusman 1993: 40). This was a time when early explorers and traders, such as du Chaillu and de Brazza (Marche 1879: 327–328), were exploring the interior of Gabon (Headrick 1994: 8) and brought coastal diseases such as venereal disease and smallpox (du Chaillu 1867) into places where they were unknown (Spinage 1973: 966). The final phase of disease spread occurred after the First World War with Europeans taking over the second and third trading tiers. The timber concessions and the development of transport infrastructure created a large demand for labour in a country that had already been depopulated by disease. The resulting mixing of people from all over the country in timber camps and administration posts fostered the spread of diseases including during the 1918 influenza pandemic (Headrick 1994: 125, 128; Coquery-Vidrovitch 2001: 456; Hymas 2015a; Hymas et al. 2021b). While French foresters and the colonial administration fought each other over access to labour (Pourtier 1989: 173; Gray and Ngolet 1999; Coquery-Vidrovitch 2001: 455; Rich 2005) villages became depopulated. A forester wrote in 1918:

> In all the exploitable areas of the Gabonese forest, it is becoming more and more rare to find villages in the middle of the forest. Sleeping sickness, alcoholism, venereal diseases have resulted in the disappearance of a large part of the population and the rest, decimated, have slowly come closer to places where they can get easy access to European factories (Quilliard 1920: 645).

Europeans were moving into remote parts of Gabon away from the principal trade routes in search of resources. The SHO's porters from surrounding areas (Martrou 1923; Moutangou 2013: 230) (Fig. 13.6) brought people into contact with new coastal diseases (Hartwig and Patterson 1978: 9–10; Headrick 1994: 42).

5 Quinine was one of the earliest treatments for malaria. Malaria was a deadly disease for Europeans who had not previously encountered it.

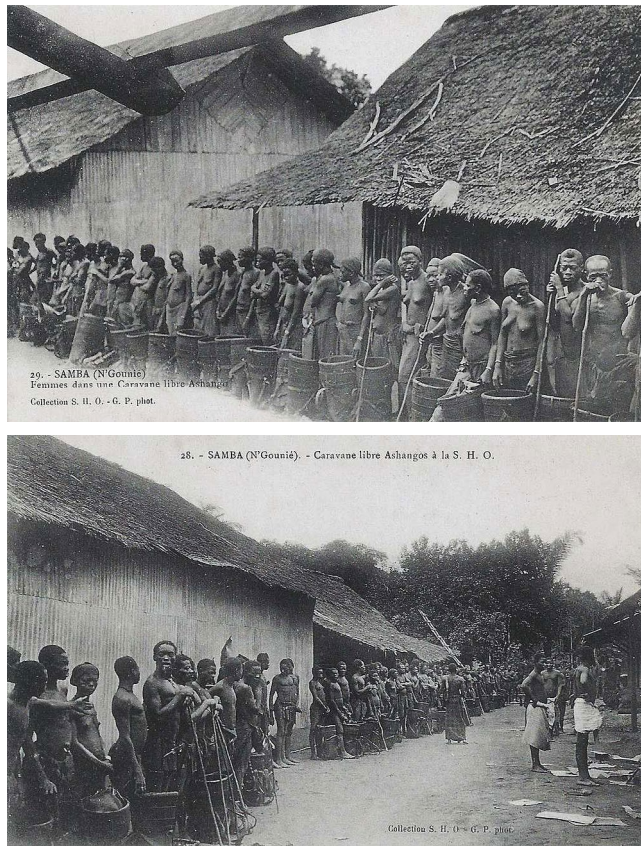

Fig. 13.6 Porters near Samba falls circa 1923 from Moutangou (2013: 227–228), public domain

Road building was also carried out through the resettlement policy which exacerbated disease spread. People fled as famine and disease spread. During the 1918 Influenza pandemic there was a 16.6% mortality rate in Sindara (Bruel 1935: 338). By the early 1930s, disease and famine resulted in the abandonment of trade routes and the loss of the SHO concession; the depopulation of the area led to it becoming a "dead zone" (Gray 2002: 160; Hymas 2015b).

For around thirty years the area was devoid of people, resulting in the growth of *Okoumé* (*Aucoumea klaineana*), a successional forest tree species, and an increase in animal populations that had previously been hunted (Hymas 2015b). The arrival of La SONG timber company in the late 1960s encouraged people to return. The company entered the dead zone, finding stands of *Okoumé* that had grown in the abandoned village

and trade plantations. With the arrival of La SONG and the creation of the town of Ikobey, migration into the area increased (Abitsi and Lepemangoye-Mouleka 2009), finding only forest. One informant noted that "here everything was forest, all that was forest, Nyoe I and Nyoe II, it was La SONG that opened it up" (Makoko, Babongo Ghebondgi 24/02/10), while another said that "there were no old villages" (Nyoe II, Akele 22/05/10). The migration of people into the area culminated in 2000 when a group of Babongo hunter-gatherers from Mount Iboundji followed the Ikoy River downstream. It was in this area that the different ethnicities started to live together. In the next section, we recount three migration histories, using oral history methods, in order to show the complexity of migration into the landscape.

Akele migration history

The Akele migration into the area started in the 1840s due to competition with the Fang traders (du Chaillu 1861: 121; Walker 1870: 142; Sautter 1966: 745; Chamberlin 1977; Cinnamon 1998; Gray 2002).[6] By the 1870s, the Akele took over an important part of the riverine trade at Samba Falls (Gray and Ngolet 1999) and become second-tier traders (Chamberlin 1977), which put them in competition with the Mitsogho and the French. Migration occurred in two directions: one used during the first Akele migration along the Ngounié and along the Ogooué Rivers (Avelot 1905; Gray 2002; Ngolet 2003), and a second (Map 2) along the old trade routes that surround Mimongo and Eteke, villages created by the resettlement policy (1950s–1960s).

During resettlement, a Prefect of the Fang ethnicity named Ekoga asked the Akele, Mitsogho, and Babongo peoples to move towards Mimongo. Some agreed while others refused and went into the forest. Those who refused used the old caravan routes and the Ikoy. As they went down the river they found no villages or signs of old villages. Some of the first villages settled were along the Idemba River, where they met La SONG. By this time, disease and migration had once again decimated populations. Overall, the Akele migrated 40 km through the forest.

6 The migration of the Fang from Cameroon triggered the displacement of people throughout northern and central Gabon (Avelot 1905; Gray 2002), including the Akele (Sautter 1966: p. 743; Van der Veen 1991).

Mitsogho migration history

The Mitsogho used two different migration routes to return to the Ikobey area, a migration of approximately 90 km. The migration from Mimongo village also started with the resettlement policy implemented by the Prefect Ekoga. Some accepted, while others refused and started their migration towards Ikobey:

> Since Ngoassa, there was a chief [Prefet], a joker, Ekoga, who asked our parents to leave—at our old village—leave there, go back, go back home, go back home, over there. They said we will not go over there. Ekoga, what did he do, he took all the chiefs, there were six villages...and said 'ok you are being arrogant, it's you who makes it that the population does not go over there, so I will take you, let's go! ....he took them, beat them well. So they got hit, it was the commander Ekoga who took them. But they, when they saw how things were, they said 'as we were hit, we are obliged to go down, we will no longer go to Mimongo, he should not have hit us'. And that is why they went down. Some went down one side of the Oumba River, that was us [people of Nyoe I]. Those who went down the other side of the Oumba River, were the ones who accepted Ekoga's beatings, but after a time they came back, saying that the others, on the other side of the Oumba River, reacted better than we did. Nyoe I, Mitsogho 09/05/10 [recording DS400093].

They first descended the rivers using the colonial trade routes and then followed the Bakounga River, and eventually found La SONG's forestry roads. One informant noted that "it was the road where our parents passed, with the tipoi, they followed it ... and then at rivers we cut trees to cross". Nyoe II, Mitsogho 23/04/10 [*recording DS400080*] (Fig. 13.7).

Fig. 13.7 Tipoi being used during the colonial period in Gabon reproduced from Meyo-Bibang (1975: 51), public domain

Once on the La SONG road, they followed the timber companies, setting up villages in anticipation of the road. As with the other ethnicities in the area, they moved slowly away from badly degraded roads.

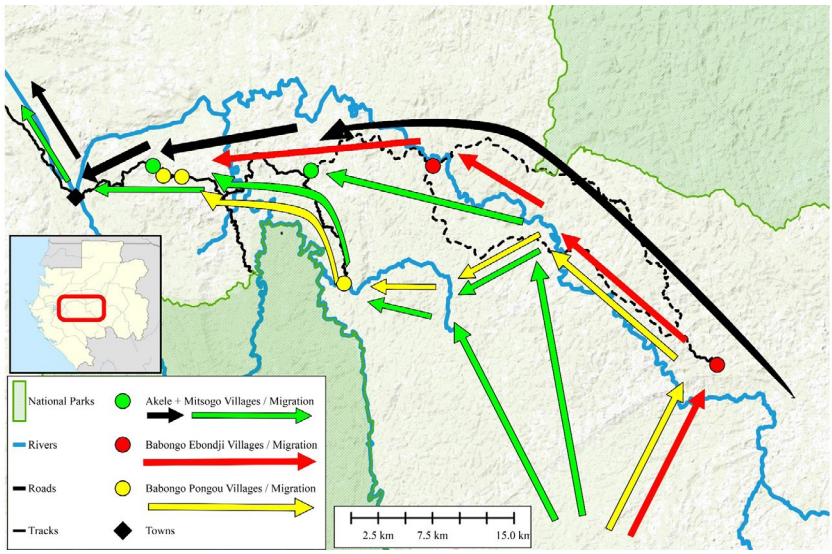

Fig. 13.8 Current villages in the upper Ikoy area with the migration routes of the Akele, Mitsogho and Babongo. Based on the following sources: Basemap (ESRI 2021), park boundaries(Institut Geographique National 2008)

Babongo migration history

As with the Mitsogho and Akele, the Babongo hunter-gatherers were also impacted by resettlement. The same prefect asked them to move towards Mimongo town. Once again some refused and went into the forest. This migration also split into two groups: the Babongo Pongue and the Babongo Ghebondgi.

The Babongo Pongue originally migrated from the village of Pongou to the Oumba River (Fig. 13.8). Currently they live along the road, claiming a common village of origin: Pongou, approximately 130 km away. After refusing to be resettled, they continued their migration down the Ikoy River, sometimes using old trade routes. It was around today's villages of Motombi/Mimongo II where the Babongo Pongue came into contact with La SONG's road. Currently, they are continuing their migration depending on the state of the road and the elephants [recording DS400084]. The second group followed the Ikoy downstream

and currently live in the roadless villages of Makoko and Ngondet. They migrated later, having originated from the village of Ebondji. It was at the village of Indamba that the Babongo Ghebondgi came into contact with La SONG's road.

For the Babongo, resettlement is still occurring, with local administrators still asking them to move closer to the road. In 2010, the Babongo Ghebondgi of Makoko and Ngondet were asked to leave the village of Massika and go back towards Mimongo. Instead, some went to Ngondet and others used the old La SONG road to migrate to Makoko or Ossimba.

In 2010, a Chinese logging company, SUNNLY, re-opened part of the La SONG road to a river where one of their old hunting camps was located, and some of the people of Makoko migrated towards this site. By 2014 the village of Makoko had been abandoned with everyone moving down the road towards Nyoe II.

Trade and Okoumé trees of the upper Ikoy

The competition for natural resources, the creation of colonial concessions, and resettlement policy facilitated disease spread. These keystone processes (Marcucci 2000) are "crucial to ensuring we understand the ecological character and effects of long-term human influence" (Gillson et al. 2020: 2) in the Ikoy area. These factors resulted in periods of in- and outmigration, causing a patchwork of forest succession after plantations were abandoned.

The 1930s closure of the SHO in the area meant that large plantations for feeding labourers were abandoned. Combined with disease which created dead zones, the environment was released from anthropogenic disturbance. This resulted in a succession from old plantations to a forest with a high density of *Okoumé* trees, leaving legacies of former land use. The presence of old fruit trees in abandoned villages further contributed to an increase in globally endangered species of animals such as gorillas and chimpanzees and the recovery of elephants that had previously disappeared from the area in the late 1800s (Berton 1895: 214).

The return of logging companies to the Ikoy area in the 1960s resulted in the forest being once more exploited for its natural resources. Ecological surveys undertaken just after the creation of Waka national

park indicate a high biodiversity. Maisels et al. (2008) estimated 744–2330 elephants and 2000 great apes in the Lopé-Waka corridor.

The vegetation survey of Balinga et al. (2006) concluded that there was an abundance of large diameter trees and the relatively high number of species made Waka "amongst the most biodiversity-rich of all the Smithsonian Institution's Biodiversity Plot sites" (Balinga et al. 2006: 1, 20). However, they were surprised to find two palm genera species, *Podococus* and *Sclerosperma*, as they usually indicate opposing natural histories: *Podococcus*, "an indicator of long term stability of a habitat" and *Sclerosperma*, "supposedly characteristic of disturbed habitats" (Balinga et al. 2006: 19). While they attributed this contradiction to "unique climatic and topographic features of this landscape" (Balinga et al. 2006: 19), it could also be explained by the history of the area, with waves of settlement and abandonment leaving both deliberately cultivated and successional tree species.

Overall, using the oral history methods and archival work enabled us to understand that the Upper Ikoy forest has been inhabited for a long time, but with substantial impacts from trade and disease brought by colonisation. Using migration histories, we learned the history of this supposedly intact forest landscape and how this history created *Aucoumea* forests, showing how the social history and its vegetation are intertwined. If this case study had been undertaken with a disciplinary approach, we would have ended up with an incomplete history, heavily influenced by assumptions based on the cultural baggage of the researcher, which in turn is susceptible to, among other things, colonial ideologies (Trisos et al. 2021). These mistaken assumptions can have important consequences. Conservation projects have been designed using previous studies of the history of the area that were based on assumption drag and a single methodological approach that resulted in project failure, including misunderstanding which peoples were Indigenous inhabitants of the forest.

Case 2: Fire use in ancient savanna of the Plateaux Batéké

The savannas of the Batéké Plateaux were often considered to be degraded or secondary by colonial-era foresters and botanists (Aubréville 1949; White 1983) and thus of little interest for biodiversity. However, their "underground forests" tell a different story: shrub species have large,

often woody root systems, but comparatively little above-ground biomass, which is burned back every year and so resembles herbs (Bond and Zaloumis 2016). Recent work shows that these endemic species are fire-dependent and are an indicator of the ancient status of these savannas (Walters et al. 2022), which are estimated to be at least 30,000 years old (Giresse 1978). Located in the forest-savanna mosaic transition zone of the Guineo-Congolian forest (White 1983), the savannas sit on the Kalahari sands, one of the deepest sand deposits in the world (Haddon 2000). These savannas are part of the greater Batéké Plateaux, spanning more than 120,000 sq. km across south-eastern Gabon, central Republic of Congo, and southwestern Democratic Republic of Congo.

Local fire use plays a role in keeping these ancient savannas open. However, the old-growth definitions say little about the human dimensions of these ancient landscapes. Returning to the savannas we encountered in the aerial photographs of the introduction, where a photographer assumed that the savannas were degraded rather than ancient, we ask: what does fire use look like in an ancient savanna? And what is the link with species diversity? Employing a historical ecology approach, we use interviews and archival research to unravel the history of fire use in this ancient tropical habitat and its links to some savanna species. Using a combination of methods is critical for understanding ecosystem change over time and how people have shaped these landscapes.

Methods and study area

We conducted fieldwork in Gabon's Plateaux Batéké over 19 months (2006–2010, 2022). We triangulated the historical literature with oral histories of elder men and women. We collected site-based information on current fire use via participant observation and semi-structured interviews (see Johnston and Longhurst, Chapter 32; Sayre, Chapter 34). The first and third authors lived in the community, participating in gathering, fishing, agricultural, and ceremonial activities, and helping the community with medical care, education, and transport. Formal, semi-structured, recorded oral history (see Chakov et al., Chapter 33) interviews were conducted with 38 elders. Interviews were conducted in French or Batéké, the latter with the help of a translator.

All informants' names have been changed. A survey on savanna fire use, hunting and gathering was conducted with 122 people in four villages (see Winata and McLafferty, Chapter 43). Botanical specimens were collected, identified, and deposited in the Herbier National du Gabon, the Missouri Botanical Garden, and other herbaria. Samples of the insects and plants were identified by specialists. In the case of birds and mammals, no samples were taken, but the species was identified by biologists who worked in the study area.

Fire use in the pre-colonial and colonial eras

Anthropogenic savanna fires in the Plateaux Batéké have occurred since at least 2,100 years BP (Schwartz 1988b), with lightning fires having occurred for much longer. Early large-scale Bantu migrations into the Plateaux Batéké ended around 1,000 AD; smaller migrations continued, influenced by politics and natural resources (Vansina 1990; Dupré and Pinçon 1997). The Batéké-Alima people who currently live in these savannas have occupied them for hundreds of years (Papy 1949). The savannas were once governed by supreme land chiefs, who used fire largely for communal hunting in the long dry season. Remnants of this system remain today, influencing the ecosystem structure and diversity (Walters 2012; Walters et al. 2014).

Fire use was frequently observed by European explorers in the late 1800s, showing the utility of fire for hunting and gathering (which we call fire foraging). In de Brazza's dry-season crossing of the plateaus in 1880, he repeatedly noted fire use (Brunschwig 1972). These accounts are summarised elsewhere (Walters et al. 2014), but here we provide some examples. Guiral, one of de Brazza's travel companions, observed how fire was used in the hunt,

> Towards the month of September, when the prairies are dried by the sun, they burn all the grass, letting the wind carry the flames forward. In a small space, they install their nets, supported every so often by stakes in the earth. A group of small rodents who live in the prairies, flushed out by the fire, find themselves in the area of the nets.
>
> Guiral 1889: 154

These ancient savannas were governed by people. The Batéké territories, or *ntsé*, were governed by a land-chief (Ebouli 2001), who amongst

other duties, was responsible for organising the annual collective fire drive. *Ntsé* were subdivided into permanent burn units called *ewa*. After rituals for a productive hunt, the fire specialists (*otiugui*) would burn fires towards nets, which extended for kilometres (Dusseljé 1910), with some 50 hunters joining their nets end to end. Animals were driven by the fire into the nets. Women would follow, gathering small animals that had been killed. This hunt is further detailed elsewhere (Walters et al. 2014). These ancient savannas were also important for the gathering of many species of caterpillar and insects. Guiral talks about the savanna foods, as well as the link of the *nkieli* caterpillars harvested on the *ololo* tree (a dominant savanna shrub, Annona senegalensis):

> ... the Batéké were extremely fond of these foods. Thus, they eat with gusto grilled rats..., toads that were smoked alive, sun-dried grasshoppers, and fat yellow caterpillars that they abundantly gather on a special tree...
>
> Guiral: 160

Based on these historic sources, we see that fire use was important for livelihoods, but also linked to species, which we will explore in the next section.

In 1960 the Gabonese state gained independence from France. New state laws removed land tenure and burning privileges from the local people and customary authorities. At the same time, gun possession increased, and a rural exodus caused a reduction in communal hunting. Today, communal fire drives are non-existent and land fertility rituals are becoming increasingly rare. Hunters set fires that cross former hunting territory boundaries; these fires are set to attract game to pasture later, rather than using fire to actively drive animals to nets (Walters 2015).

Post-colonial fire use in the ancient savannas

Today, fire foraging continues in these ancient savannas. In our 2007 survey about present day and past fire practices, almost all respondents indicated that they still burn the savanna today. Reasons for burning can be categorised into subsistence activities, safety (visibility, reptile habitat removal, path clearing), and for pleasure (Table 13.1). Answers related to subsistence comprise more than half of the reasons for pre-independence burning and today. As stated by Tricia, "If the savanna is

burned, we can easily find *olu*, caterpillars or grasshoppers" (Tricia, Age 55). Many respondents indicated that burning and foraging were linked, particularly in the past. Gorgie noted, "In the past, the women would burn the savanna to look for grasshoppers and the men for the hunt. After the grasshoppers, the new grass shoots would call the *ntsienstiele* caterpillar" (Georgie, age 67). This quote demonstrates the link between fire and the creation of new shoots needed by caterpillars for food.

Table 13.1 Reasons, in order of importance, for past and present savanna burning.

Pre-independence burning (respondents born pre-1960)	Current burning (all respondents)
1. Grasshopper gathering	1. Clearing paths
2. Hunting (fire drive)	2. In disorder (negative)
3. Savanna plantation	3. Hunting (creating pasture)
4. Rodent gathering	4. Grasshopper gathering
5. Clearing paths	5. Savanna regeneration
6. To eat	6. Savanna plantation
7. Caterpillar gathering	7. To eat
8. Bird hunting	8. Caterpillar gathering
	9. Visibility
	10. Fun
	11. Protection from reptiles
	12. Mushroom gathering
	13. Dead grass removal
	14. Rodent gathering
	15. Bird hunting

A major portion of Batéké rural livelihoods is derived from savanna resources. According to our survey, the list included more than 25 items.[7] These responses ranged from bush meat to insects and fruits, representing a range of seasons and fire-foraging methods (Table 13.2).

7 More than 25 species are represented, with "bushmeat" representing several species. Spellings correspond to a Batéké-Alima lexicon where possible (Linton 2009).

Table 13.2. A list of savanna derived foods in order of importance. The letter "I" denotes fire used indirectly to obtain food; "D-I" means "direct-immediate"; "D-D" means "direct-delayed".

Category	Lateghe name	scientific name (or order/family)	Direct or indirect burning	Number of respondents (N = 122)
Insect-larva	*enkele*	*Bunaeopsis licharbas* (Saturniidae)	D-D	99
Insect-juvenile/ adults	*ampari*	Several species	D-I	98
Insect-larva	***Ntsienstiele ntsintsili***	*Spodoptera exempta* (Noctuidae)	D-D	62
Insect-adults	*enginiña*	Cetoine (Phoenomeanidae)	I	56
Insect-larva	*evura*	*Anthuea insignata* (Notodontidae)	I	42
insect	***akuraku***	*Antheua* sp. (Notodontidae)	I	17
fungi	***tutsa***	*Termitomyces striatus* (Tricholomataceae)	I	15
plant	*olu*	*Albizia adianthifolia* (Fabaceae)	D-D, I	15
plant	*kura*	*Hymenocardia acida* (Phyllanthaceae)	D-D	6
insect	*evatu*	Unknown (Coleoptera)	I	5
animal	rats	Several species	D-I	4
animal	*nyama*	Several species	I	4
plant	*eburi/ mfulugu*	*Landolphia owariensis* (Apocynaceae)	I	3
Animal (bird)	*ankumbi*	*Ciconia abdimii* (Ciconiidae)	D-I	3
Insect-adults	*kayie*	Unknown (Homoptera)	I	3
Insect-larva	*entsaaba*	Unknown (Psychidae)	I	3

Insect-adults	*antsama*	*Macrotermes bellicosus* (Termitidae)	I	3
plant	*mbaama*	*Cogniauxia podolaena* (Cucurbitaceae)	I	2
plant	*bli ntsa*	*Parinari capensis* (Chrysobalanaceae)	I	2
plant	*ntunu e ntsege*	*Afromomum alboviolaceum* (Zingiberaceae)	I	1
Insect-juvenile/ adults	*eŋeye*	*Ruspolia differens* (Tettigoniidae)	I	1
plant	*mfuu*	*Anisophyllea quangensis* (Anisophyllaceae)	I	1
other			I	4

Eighty-five percent of the respondents spoke directly of or implied links between foraging and fire. For these foods, foraging and fire are linked in three ways according to the application of fire and the timing of the resource's harvest post-fire:[8]

- *Direct-immediate benefits of burning*: fire is intentionally applied to acquire a resource the same day. Examples: the historic *ntsa* fire drive, attracting Abdim's stork with smoke and singed grasshoppers, attraction of game to cinders, and grasshopper gathering. 12% of the savanna resources are in this category.
- *Direct-delayed benefits of burning*: fire is intentionally applied to gain a resource that appears weeks or months after application. Examples: creation of forage for caterpillar species several months post-fire; creation of forage for grazers days and weeks post-fire. 15% of the savanna resources are in this category.
- *Indirect benefits of burning*: fire maintains the savanna habitat in which many gathered and hunted organisms are found. 73% of the foods listed are in this category. During the survey, fire was never stated as a tool to harvest these species.

8 Categories were determined by GW, not by informants and so do not reflect folk taxonomy.

Here we see that fire's relation to livelihoods in this ancient savanna is linked to maintaining an open habitat, but also to the life cycles of some species.

Direct-immediate benefits of burning: Grasshopper gathering

In the mid-2000s, every long dry season, when the stands of dry grass are full of nymph grasshoppers, Batéké women would burn small patches of the savanna to gather grasshoppers. This form of gathering was done historically either during the communal *ntsa* hunt or in peri-village savannas. Women limit the fire surface area with the idea of conserving a grasshopper-rich spot of savanna for the following day's gathering. Groups of women depart early in the morning to an area where they have recently estimated high grasshopper abundance. Once the conditions are judged right for burning (low humidity, low wind), *ntseli* (long stems of dry grass to use as an ignition torch) are gathered. Lighting is performed by two or more people, either walking along the perimeter of the burn or walking up the middle of the area to be burned (this latter burn type is called *onya*). As the wind takes the fire away from the ignition point in a head-fire (*mba ya olumi*), leafy branches of *ongalaga* (*Hymenocardia acida*) trees are used to beat out the advancing flames. Once the flames are extinguished, the women gather the dead nymph-stage grasshoppers. There are several varieties in Batéké terminology such as *tsara*, *ngokolo*, *kadula*, *jele*, *oyara*, *ambali*, *kafuuyi*, and *anai* according to one informant (interviewed 25 September 2007).

Direct-delayed burning: Caterpillar gathering

The Batéké gather several caterpillars, but here we will focus on the main savanna one: *kankele*. For years a fire specialist, Antoine Mbia, lit savannas in July for *kankele* gathering in November, something that he was taught by his father. Even though fires no longer have a controlled calendar, many people surveyed in 2007 indicated that burning was essential in order to gather *kankele*. *Kankele* is a Saturniidae family African emperor type moth whose major food plant at the larval stage is *ololo* (*Annona senegalensis*). *Ololo* is a co-dominant, fire-resistant savanna shrub. Not a dense wood, these shrubs are not used for firewood. Batéké view them

primarily as the host plant for *kankele*; when burned, the shrub resprouts tender leaves which the larvae consume.

In order to gather *kankele*, groups of women leave on all-day expeditions. Some women return to the places where they have gathered since they were young, near former village sites. Hunters discover *kankele* sites. After gathering, upon return to the village, some women begin the time-consuming task of cleaning, cooking, and smoking *kankele*. They can be stored for months and can also be sold in nearby markets.

Caterpillars were proposed as a cash crop in the 1950s (Merle 1958). When the declining abundance of some species was noted in the Kwango area of the Democratic Republic of Congo, investigators linked this to the demise of the traditional authorities who once controlled fires (Leleup and Daems: 19). Unseasonal fires were thought to injure the subterranean larvae of the Saturniidae in the Kwango area, as well as failing to provide tender leaf forage at the right time, linking fire, tender leaf production, and feeding of Saturniidae species (Leleup and Daems 1969).

Indirect burning and ancient savanna indicator species

Another contribution that fire makes to Batéké gathering is through enhancing the growth of gathered fruits and leaves. *Olu* (*Albizia adianthifolia*) is a widespread fire-resistant savanna tree used for medicine, subsistence, and as a host plant of edible caterpillars (Latham 2004: 20). The leaves of *olu* contain as much as 10.81 g of protein per 100 g; this is twice that of *Gnetum africanum*, the most commonly consumed wild leaf in the study area (Mbemba and Remacle 1992: 23) and one of the most common leaf dishes in several Central African countries. Gathering of *olu* occurs primarily after fire, when leaves are resprouting.

Several species are indicator species of ancient savannas, which form underground forests of roots due to the repeated passage of fire that favours constant resprouting (Bond and Zaloumis 2016). Several of the taxa in the survey comprise these indicator species, notably *mufulugu* (*Landolphia owariensis*), *mfuu* (*Anisophyllea quangensis*), and *Parinari capensis*. *P. capensis* is primarily consumed by the *ntsa* (*Sylvicapra grimmia*), the prey of the fire drive and the object of conservation concern, requiring regular burning, which in this case comes largely from customary fire use.

In these examples, we see that fire use in this ancient savanna is diversified and has changed over time. Burning remains a central strategy for obtaining savanna foods, many of which are fire-dependent. When these historic and modern accounts of fire use are taken into account, we see that endemic, fire-dependent species of these ancient savannas co-exist with customary fire use. If we had only applied botanical methods, we would have understood plant diversity, but not its linkages with livelihoods and fire regimes. If we had only applied ethnographic methods, we would have understood fire use but not its connection to the vegetation. Bringing these methods together, we can understand the ties between vegetation, fire use, and local livelihoods.

Discussion and conclusion

These case studies use historical ecology methods (see Davis, Chapter 29) to test assumptions about two ecosystems: intact forests and ancient savannas. In our analysis, we show that the processes behind these landscapes are complex. Bringing together a variety of methods, we are able to understand that in the first case, intact forest landscapes may appear to be "seamless" when viewed from the canopy today, but in the past, the area was crossed with colonial trading routes and impacted by disease and village resettlement politics. The tree canopy bears legacies of these movements through its present day *Aucoumea* populations, which are testimonies of past disturbance (sensu Morin-Rivat et al. 2017). Furthermore, the presence of fruit trees in the abandoned village sites attracts elephants. The curious mixture of a successional timber species and a threatened animal drew the interest of both loggers and conservationists to the area. In the second case, we look at how species and people are linked in hunting and gathering traditions where fire is used as a primary tool for livelihoods but is also necessary for maintaining the biodiversity of species and habitats.

When the first and second authors were university students working on our bachelor's and master's degrees in biology (United Kingdom) and botany (United States) in the 1990s, our courses were siloed by discipline. However, our interdisciplinary doctoral programme in environmental anthropology in the late 2000s allowed us to combine environmental anthropology with ecology to understand complex environmental problems. Such training has helped us to research and

understand ecosystems through different angles and to work with other disciplines and forms of data.

Using a historical ecology approach in both cases permitted us to explore the histories of an intact forest landscape and an ancient savanna, using archival work, interviews, and participant observation, but in light of ecological data on species ecology and diversity. Integrating data from multiple disciplines brings these landscapes alive, providing insight into the complex processes that create them and understanding the legacy effects of former land uses (Bürgi et al. 2017). By putting people at the centre of inquiry, historical ecology enables us to analyse how people have historically crafted landscapes. This requires asking social questions of habitats and ecosystems.

Working with diverse types of data can be challenging. We may not have enough time to conduct all the work necessary to answer a question with statistical satisfaction. We may have to translate historical documents, oral histories (see Chakov et al., Chapter 33), and maps into workable data, which requires us to develop different skillsets or collaborate with colleagues from other disciplines. Combining different disciplines that use diverse lexicons, timeframes, epistemologies and methodologies is one of the biggest challenges of conducting interdisciplinary research (Lele and Kurien 2011). Another is publishing such interdisciplinary work, which requires a review process that values the contributions of different disciplines (Campbell 2005).

Intact forest and ancient savannas form parts of scientific and policy debates in different ways. On the one hand, intact forest extent was first defined through satellite imagery without factoring in what was happening under the forest canopy or its history (Potapov et al. 2008; 2017). Later research challenged this, showing the importance of such areas for Indigenous peoples (Fa et al. 2020). However, intact forests form part of forestry policy in some countries (Brouwer 2021) and so understanding how these forests are influenced by societies over time, how this impacts timber stocks species such as *Aucoumea* (Walters et al. 2019), and how local people claim these forest territories (Evine-Binet 2022) should inform policies that recognise that people created these valued forests and in many cases may protect them (Zanjani et al. 2023). On the other hand, ancient savannas are also part of policy debates which focus on the extent to which forests have been favoured over open habitats,

like in large-scale restoration (Veldman et al. 2015a, b) fire suppression, and exclusion of megafaunal herbivores (native or domestic. It has been argued that there is a predisposition for forests over savanna leading to "Biome Awareness Disparity" (Silveira et al. 2021). Although an ancient savanna classification is better than an assumption of a savanna being degraded, understanding how ancient savannas are influenced over time by practices such as fire use is often not at the forefront of debates. If we want to ensure that such ecosystems remain functional, we should also ensure that the practices influencing their biodiversity, such as customary fire management, are supported (Walters et al. 2014; 2022).

When considering the state of ecosystems, we should always test our assumptions and look what is going on underneath the canopy (Nguyen 2022; Kelley, Chapter 19) including understanding resource politics, societal change, and how this relates to species in the landscape. The approach we show here is but one way to challenge assumptions about tropical ecosystems. Our best chance of understanding these complex systems is by combining diverse methods and working in interdisciplinary teams to raise critical questions when tropical ecosystems are presented without a historical or social context.

Research and writing process and credits

GW conceived the chapter and lead the writing process. OH, KN, and TS contributed the Ikoy case study. GW and TS contributed the Batéké case study.

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