

Interactions in a Border Zone: Conflict and Cooperation in the Northeastern Kalahari, 1849-2021

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Abstract

The northeastern Kalahari (also called Kgalagadi) border zone between the Bangwato and the Ndebele in northern Botswana and western Zimbabwe was the scene of intense interactions among a variety of different groups, including pastoralists, farmers, and hunter-gatherers. The border area saw conflicts, cooperation, cattle raiding, trade (for example, of salt from the Nata River Delta), exchanges of wild animal meat for ceramics, domestic foods, and iron tools, and shifting alliances in late prehistoric and early historic times. There was competition in the area over grazing land, livestock, high value plants, salt, iron, and copper. There were also struggles over rights to utilize the services of people, including the Tshwa San in the region who the Bangwato and Ndebele defined as ‘servants’ (*bolata, izinceku, isisebenzi*) in a system of hereditary servitude that lasted until well into the 20th century. We draw on archaeological, ethnoarchaeological, and ethnohistoric data in order to assess the evidence relating to the complex socioeconomic interactions among the various people who resided in this heterogeneous landscape.

Key Words: border; conflict; cooperation; exchange; exploitation; frontier; northeastern Kalahari Desert; Nata (Manzanyama) River; struggles; Bangwato; Kalanga; Ndebele; Tshwa.

Introduction

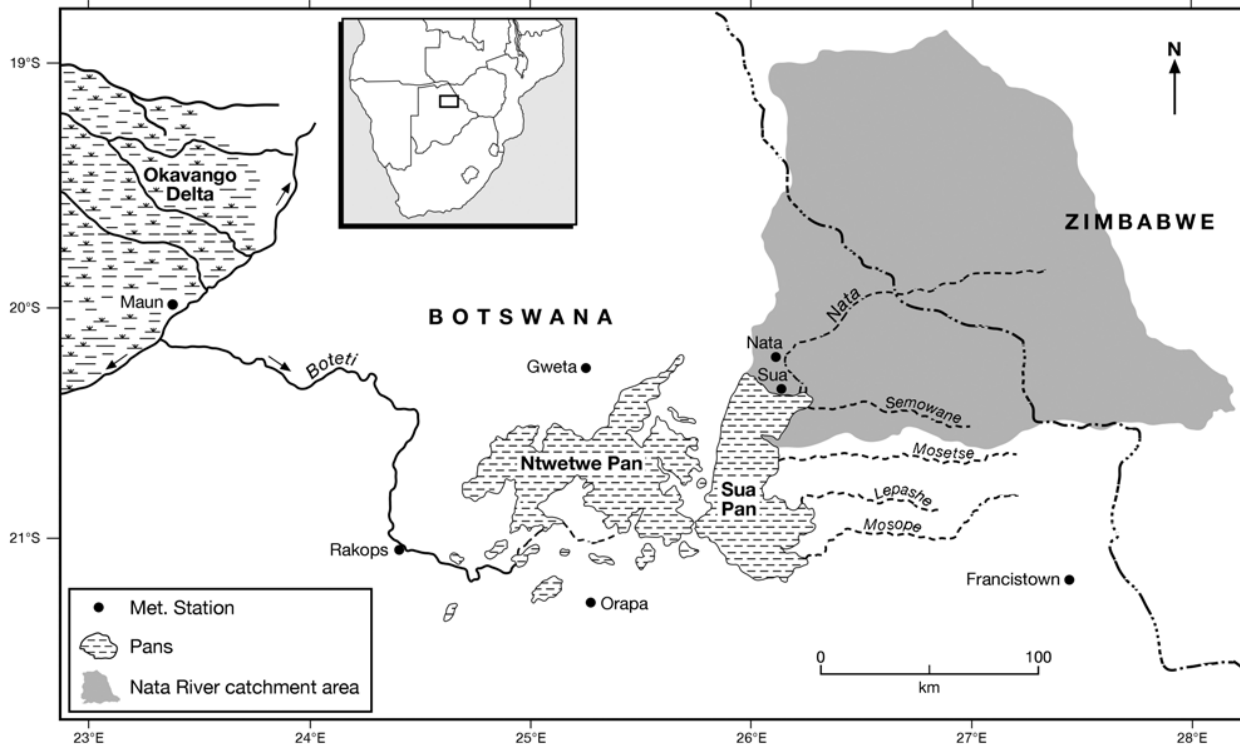
The work of Fred Morton (2009 and 2018) on the history of the Bakgatla-ba-Kgafela and their neighbours in southern Botswana and South Africa is ground-breaking in its use of archival, archaeological, historic, ethnographic, and interview information to address issues that faced a Tswana population in a border zone. His work fits firmly in the rapidly developing field of border studies as well as in the historiography of African societies. Building on the work of Fred Morton, we examine borderland interactions among various groups that occurred in the northern part of what is now Botswana and western Zimbabwe. Our findings are based on a set of archaeological and ethnographic surveys undertaken in 1975-1976, combined with more recent work in the region in 2013, 2014, 2015 and 2019. Documented history in the northeastern Kalahari region dates to the 1840s, when missionaries, hunters, and travelers began interacting with the Ndebele and Bangwato and other groups in the area (Moffatt 1842; Livingstone 1857; Baldwin 1863; Chapman 1868). Early travellers recorded the complex interactions that occurred among the resident populations in the area, ranging from conflict over animal, plant, and other resources and the services of the people residing there, to cooperative hunts of wild animals, including elephants (*Loxodonta africana*) and lions (*Panthera leo*).

The University of New Mexico Kalahari Project team undertook archaeological surveys in the northeastern and eastern Kalahari which recorded over 100 sites ranging from Early Stone Age to Late Iron Age and historic. The research area in the northeastern Kalahari region includes the Makgadikgadi Pans, particularly Sua Pan and adjacent areas, the Nata River catchment in northeastern Botswana and western Zimbabwe, and the escarpment along the eastern side of Sua Pan (See Map 1).

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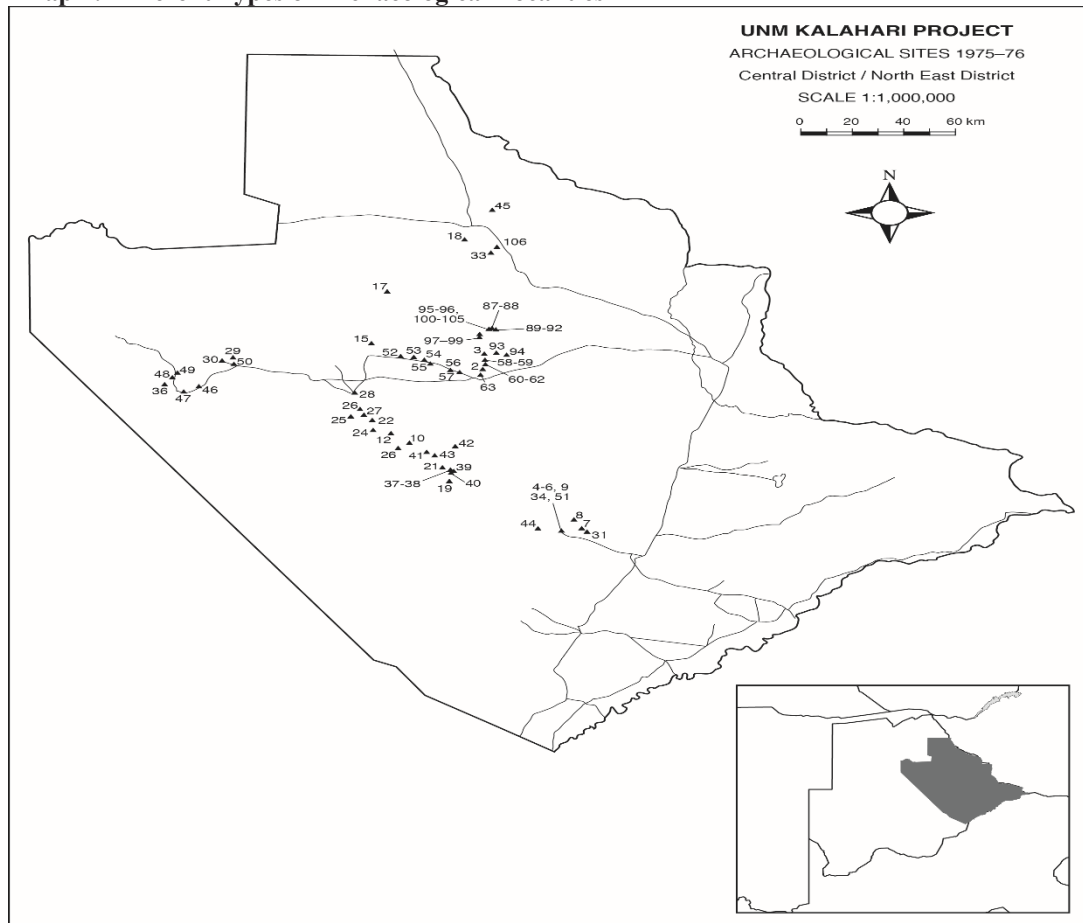
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Map 1: Research Area in the Makgadikgadi Pans and Nata River Catchment



Source: adapted from Bryant *et al.*, (2007:2)

Several different types of archaeological localities were identified during the University of New Mexico Project 1975-76 archaeological surveys (see Map 2). These included the following: 1) open areas containing Stone Age materials, mainly lithics and debitage, and in a few cases, ostrich eggshell pieces and ostrich eggshell beads; 2) Iron Age localities that contained ceramics, metal, ostrich eggshell beads, and, in some cases, faunal remains; 3) specialised localities such as salt collecting places along with short-term camps in the Nata River Delta; 4) quarries, where lithic materials were obtained; 5) ambush hunting sites (hunting blinds) around pans such as Mumpswe, Naishini, and Gutsha in the Makgadikgadi Pans region and at Jimakando Tcaitsumtsaa on the Nata River; 6) fishing sites, such as ones around Dzivanini (Tsebanana) Pan, close to the Botswana-Zimbabwe border; 7) small rock shelters in the hills along the edge of Sua Pan and in some of the granite kopjes to the east of Mosetse, some of which contain rock art, mainly paintings and a few engravings; 8) shrines, some of them in rock shelters, and a few of them in open areas (for example, in the hills east and south of Sua Pan; 9) possible initiation sites, such as those on Lekubu Island between Sua and Ntwetwe Pans (Alec Campbell, Tom Huffman, personal communications, 1982); 10) cattle posts, where cattle owners kept their livestock either in the past or recently; 11) agricultural sites, where food production and processing took place; and 12) recent residential localities that were occupied by Tshwa San, Kalanga farmers, and Bangwato agropastoralists.

Map 2: Different Types of Archaeological Localities

Source: Map drawn by Marieka Brouwer-Burg, University of Vermont, for the Kalahari Peoples Fund

Many of the latter localities contained evidence of a mixed economy, including wild and domestic species of fauna and flora and items such as tools and facilities (the remains of huts, storage structures, fences, ash heaps, and kraals or corrals). Some sites were multi-component, as was the case, for example, with residential locations and cattle posts in the Northern Crown Lands which had recent materials and Late Stone Age materials on the surface. Table 1 presents a list of the sites found by the UNM Archaeological Project. For additional discussions of the sites in this area, see Bond and Summers (1954), Cooke (1967 and 1979), Hitchcock (1982b), Campbell (1998), Walker (1991 and 1998); Huffman (1997), Main (2008), Burrough, Thomas, and Bailey (2009); Main and Huffman (2021), Daggett (2018), and Wilkins (2021). Archaeological surveys continue in the northeastern Kalahari in 2021, though some of the work has been affected by COVID-19 movement and meeting restrictions of the government of Botswana.

Table 1. Makgadikgadi Pans and Nata River Region Archaeological Sites

Makgadikgadi Pans	Location	Location
Tshwaane Game Trap	Tshwaane, Eastern Sua Pan area	20° 39' 16" S 26° 09' 04" E
Manxotae, Late Stone Age lithic scatter	Middle section of Nata River	20° 06' 54.23" S 26° 24' 02.91" E
Sa/a (Saxa) Late Stone Age lithic scatter	Middle section of Nata River	20° 00' 48" S 26° 27' 26" E
Gutsa Pan, hunting blinds, Late Stone Age lithics scatter	Greens Baobab, Central Makgadikgadi	20° 25' 29" S 25° 13' 53" E
Gabasadi Island, Middle and Late Stone Age lithics scatter	Central Makgadikgadi	20° 25' 29" S 25° 13' 53" E
Chapman's Baobab, hunting blinds, Late Stone Age lithics scatter	Central Makgadikgadi	20° 29' 21" S 25° 13' 53" E
Chai Gate Site, Late Stone Age lithics scatter	Central Makgadikgadi	20° 43' 41" S 25° 12' 17" E
South Boteti River Site, Middle and Late Stone Age lithic scatter	Central Makgadikgadi	21° 01' 24" S 25° 14' 29" E
Kedia Hill Site, Middle and Late Stone Age lithic scatters, Ostrich Eggshell beads (OES)	Eastern Makgadikgadi	21° 21' 51" S 24° 43' 50" E
Moreamaoto Sand Ridge Site, Middle and Late Stone Age lithic scatters, OES beads	Eastern Makgadikgadi	20° 16' 15" S 24° 15' 36" E
Motopi Site on Botetle River, Middle and Late Stone Age lithic scatter	Eastern Makgadikgadi	20° 12' 41" S 24° 07' 42" E
Njare Pan Site, Middle and Late Stone Age lithic scatter	Central Makgadikgadi	21° 17' 13" S 25° 06' 39" E
Tshwagong Site, Middle and Late Stone Age lithic scatter	Central Makgadikgadi	20° 48' 02" S 25° 43' 37" E
Njuca Hills Site, Middle and Late Stone Age lithic scatter	Eastern Makgadikgadi	20° 25' 48" S 24° 52' 24" E
Toromoja, Middle and Late Stone Age lithic scatters, OES beads	Eastern Makgadikgadi	21° 06' 68" S 24° 56' 90" E
Lake Xau, Middle and Late Stone Age lithic scatters, OES beads	Eastern Makgadikgadi	21° 25' 00" S 24° 66' 07" E
Lekubu Island, Middle and Late Stone Age and Iron Age materials, ostrich eggshell beads, ceramics	Central Makgadikgadi	20° 53' 23" S 25° 49' 41" E
Nata Village (site at bridge), Middle and Late Stone Age artifacts, historic materials	Eastern Sua Pan Area	20° 21' 67" S 26° 18' 33" E
Tlapane – Iron Age (Leopard's Kopje) Site, ceramics, ostrich eggshell beads, iron slag, iron tools, domestic remains of fauna	Eastern Sua Pan Area	21° 06' 34" S 26° 15' 53" E
Tora Nju Site, Iron Age, ceramics, ostrich eggshell beads, iron slag, iron tools, domestic remains of fauna	Eastern Sua Pan Area	20° 42' 48" S 26° 11' 01" E
Mosu, Leopard's Kopje, Late Iron Age site, ceramics, ostrich eggshell beads, iron slag, iron tools, domestic remains of fauna	Southern Sua Pan Area	21° 18' 75" S 25° 95' 17" E
21 archaeological sites		

The primary features of the northeastern Kalahari region where remains of human activities were found include the Makgadikgadi Pans, the rivers that drain into Sua Pan (the Nata, Mosetse, Lepasha and Semowane), the undulating plains to the north of the Makgadikgadi Pans, which were designated as the Northern Crown Lands by the Bechuanaland Protectorate (later, after Botswana independence,

the Northern State Lands (Blair Rains and McKay 1972)). This area is sometimes described as ‘the pool plateau’ (Holub 1881:83) because of the large number of pans that are found there. The northern part of the Ngwato District has a series of east-west trending *alab* sand dunes, the evidence of aeolian (wind-driven) processes in the past (Flint and Bond 1968). These dunes support mongongo trees (*Schinziophyton rautanenii*) and marula (*Sclerocarya birrea*) trees, the nuts and fruits of which local people obtain for food and the wood is used to make items such as wooden mortars (*dikika*). The Nata (Manzanyama) River today flows seasonally, and is known locally as ‘the two-way river’ because the flow goes both directions, depending on the time of the year (Hitchcock 1982a; Hitchcock and Nangati 2000 and Nkelekang Smeru, personal communication, 2015). The Nata River is 330 km in length and has a large catchment area, with 210 km² of the catchment in Zimbabwe while 120 km² is in Botswana (Mitchell 1976).

The Makgadikgadi Pans are surrounded by grasslands, but there are also mudflats and smaller pans within the Makgadikgadi region (Smithers 1971:17-18; Vanderpost and Hancock 2018). Today, the Makgadikgadi Pans region occasionally has areas that are covered by shallow bodies of saline water. This is particularly true in places near the mouths of the Boteti and Nata Rivers which flow into the basin from the west and northeast, respectively. The Nata River mouth resembles an inland delta and has contained water off and on since the latter part of 1973. A shallow lake ranging from 400-600 km² at the mouth of the Nata serves as a focal point for large numbers of flamingos (*Phoenicopterus minor* and *P. ruber*) and other waterfowl which congregate in the area in order to feed on brine shrimp and fish as well as to breed. This area today is part of the Nata Bird Sanctuary, a community-controlled protected area which covers an area of 230 km² (89 mi²). The Nata River delta is also important in that it contains two types of resources that are uncommon elsewhere in the area. In one arm of the delta, which is 15 km south of Nata Village, there are brine pools in which blocks of salt form. This salt served to attract game which could be hunted using ambush techniques while it also attracted people to the area who wished to exploit it for domestic use and trading purposes (Chapman 1868:57; Holub 1881:61 and 72; Matshetshe 2001). The other significant resource was stone. In the past, the existence of silcrete nodules and other kinds of siliceous stone was important because the material was utilized in stone tool manufacture by prehistoric peoples (Bond and Summers 1954 and Cooke 1967).

There is abundant evidence that climate oscillations have occurred over time in the Kalahari, and these fluctuations have played an important role in the evolution of landscapes in the region (Thomas and Shaw 2010). The Kalahari is a desert of long standing which has witnessed phases that were both wetter and drier than those at present. Etched onto the surface of the region are a variety of landforms, many of which are the result of a complex interaction between climatic and tectonic forces. Geomorphological features in the Kalahari include complexes of dunes, fossil drainage lines, shallow depressions (pans and playas), open sandy plains, and a series of strandlines or beach levels surrounding what was once a gigantic lake, Lake Makgadikgadi (Burrough et al., 2009). The open nature of the pans is of significance to Kalahari fauna in that antelope and other plains fauna can see long distances and can thus be relatively safe from predators. The riparian woodlands along the rivers provide more cover for antelope and other species (Smithers 1971). Humans utilized the lake and the delta as well as some of the pans to the north of Sua Pan when they contained water, exploiting fish (barbel *Clarias gariepinus* and bream, *Pharyngochromis acuticeps*), bullfrogs (*Pyxicephalus adspersus*), and birds, some of them water birds such as pelicans (*Pelecanus onocrotalus*).

Nineteenth Century and Early Twentieth Century Use of the Nata River Region

Based on ethnohistoric data, archival research, oral history, and interview data, in the mid-nineteenth century there were approximately 1,000–1,200 people occupying the region north of the Nata River. Some of these groups lived near pans part of the year, and they foraged in forests, open savanna areas, and dry

river courses called *molapo*, *mekgacha*, or *dombos* during the dry season.

Pans such as Motomomaganyane and Tamafupa had as many as five different foraging groups that claimed rights to various sides of the pan, resulting in a kind of flower petal type land use pattern. Other groups lived along the Nata River during the dry season and came out to the pans during the wet season to exploit water lilies, fish, game, and other resources. The pans in the areas north of the river were thus utilized for residential purposes by some groups and were the centres of their territories, while they also served as logistical sites (e.g., for hunting and gathering purposes) for other groups. Both shortterm and longterm residential base camps were found at these pans. In the 1860s and 1870s some of the pans were utilized as cattle posts (*meraka*) by Bangwato and Ndebele herders who engaged local Tshwa to herd for them. By the 1880s, Khama III of the Bangwato had established royal cattle posts to claim territorial rights in the buffer zone. The marauding activities of Ndebele groups in the latter part of the nineteenth century led to an abandonment of some of these cattle posts. Cattle raiding was done by the Ndebele, who took cattle and captives, often young women and children, back to the royal capital of Bulawayo in present-day Zimbabwe. The Ndebele were also known to conscript individuals from other groups into their military units (Morton 2009:14). Because of the social uncertainty in the area, the pans reverted to being utilized primarily for foraging purposes, usually by logistically organised parties of hunters from areas to the south and east who sought wild animals there. These foragers also used the pans to collect important food plants (such as water lily, *tswii*, *Nymphaea capensis*). A key resource for some groups along the Nata and in the areas to the north was *mophane* worms (*Phane*, *Imbrasia belina*). Groups of women and sometimes men would go into areas where there was *mophane* (*Colophospermum mopane*) to collect these worms which formed an important part of the seasonal diet of Tshwa (Hitchcock, Begbie-Clench and Murwira 2016).

In the 1890s officials of the British South Africa Company (BSAC) told local Bangwato that they had to leave the Nata area since, according to them, the rights to the region had been granted to the BSAC (Parsons 1973:141-154 and Chirenje 1977). Many of the chiefs in what is now Zimbabwe refused to accept the authority of the BSAC (McGregor 2009:66). Khama III did not go along with what the BSAC wanted, and he lodged a protest against their actions. The tensions between the BSAC and the Bangwato led eventually to efforts to resolve the boundary disputes between the various groups, and then to a formal border demarcation effort. Intense competition over mineral rights lay at the foundation of the 'disputed territory' between the Bangwato and the Ndebele in the 1890s (Parsons 1982:121). There were armed frontier clashes between the Bangwato and Rhodesian forces on the Nata River in 1894-1895. The BSAC claimed that they had assumed Ndebele sovereignty over the Nata area, while the Bangwato protested Rhodesian claims. The idea of the British handing over Bechuanaland to Cecil Rhodes and the BSAC, combined with pressures from South Africa, led to the decision of the Batswana *dikgosi* (chiefs), Khama III, Sebele of the Bakwena, and Bathoen of the Bangwaketse to travel to England in 1895 to seek British protection over Botswana.

The 1896-1897 rinderpest (*bolowane*) epidemic wiped out the cattle and much of the game in the northern Kalahari. The Bangwato lost an estimated 90% of their cattle herds, despite efforts by the *kgosi* (chief), the colonial government veterinary officer, and large sections of the *morafe* (tribe) (Chirenje 1977:252-253). Tshwa and other groups ranged over the area in search of meat, bones, and ivory which they scavenged or sold to traders for cash. This occurred again in the early 1970s in the Nata area because of high rates of starvation and mortality of wildlife and livestock due to a major drought (Campbell and Child 1971). There were similar die-offs of wildlife and livestock in the 1990s due to droughts.

In the early 1900s, serious droughts affected the northern Kalahari area, and many Tshwa fell back on the river, where they lived in small villages composed of extended family compounds located approximately 500m to a kilometre apart (Hitchcock 1982a; Hitchcock and Nangati 2000). During this time the pans north of the river were used primarily for ambush hunting purposes. In some cases, large

hunting trips consisting of several men (and occasionally women) were organised. These communal hunting trips often resulted in the killing of sizable numbers of large animals, including eland, hartebeest, wildebeest, and kudu. The animals were butchered at the kill sites, and the meat was cut into large strips which was then dried on drying racks to make *digwapa* (biltong). The dried meat was then carried back to the residential locations on the Nata River where it was distributed, with an eye toward ensuring that virtually all kin and often visitors were provided with meat.

Besides kill sites, there were also processing sites. In places where large numbers of animals were procured, processing was done on the spot. In these places substantial accumulations of faunal remains were found along with hearths, drying racks, and sometimes stones used for sharpening axes. The Tshwa often processed meat for storage purposes. It was hung in trees or on specially erected drying racks. The butchering system worked in various ways, depending on who was in the hunting party. Men did most of the butchering, with women sometimes participating. They often built fires to cook some of the meat. During some times of the year, particularly in the wet season, meat was smoked to preserve it. The animals were butchered in such a way that the disarticulated parts could be carried back to the residential camps. Sometimes meat was cached at the site, but this was risky since predators and scavengers came to the site, attracted by the smell of blood, while the butchering process was on-going. The animals were first eviscerated and the heart, liver, and sometimes the brains were roasted and eaten. Long bones were cracked for marrow once the muscle tissue was removed. Decisions about processing depended on the distance to the residential location, the time of the year, the number and character of the participants, and the technology available. If the prey animal was large (such as a giraffe or an elephant), people would move to the kill site to butcher the animal and eat some of the meat while they were there. After a few days, however, the people at the kill site of large body-sized prey would grow tired of the smell, and they would leave the kill and butchering site and return to their residential locations.

Some Tshwa remarked that they would move to a site where an elephant was only if the scavengers had finished their activities and the smell of the carcass was not too bad. According to oral history information, there were approximately 500-700 people in the Crown Lands region of the Bechuanaland Protectorate in the late 1920s. Some of these people were mobile foragers and others were watching over the herds of Kalanga and Bangwato cattle owners. Cattle were taken to the pans north of the Nata during the wet season for shortterm grazing purposes, and herders built temporary shelters which they occupied while watching over the livestock. In some cases, herders (*badisa*) who were living at the pans engaged in small-scale hunting, fishing, and plant collecting. Archaeologically, there were temporary shelters, piles of firewood, and remains of fish, turtles, and small mammals found in and around hearths at some of the pans. The Nata River example illustrates the way place usage can change over time. In this situation, residential bases were abandoned and later reoccupied by specialized task groups. Whereas originally sites were located to provide access to water and food resources, the primary concern of subsequent occupants was a specific target resource: game.

Criteria for site positioning thus changed over time, with an attendant shift in the settlement system; instead, the same sites were simply used for different purposes. An examination of the pans north of the Nata River reveals a jumble of remains representing complex cultural and natural formation processes. A variety of activities are represented there, ranging from shortterm residential sites and hunting sites of foragers to cattle posts, game traps, and salt collecting sites of agropastoralists. Trampling by livestock, collection of bones by Tshwa and other people, the actions of scavengers (including hyenas and jackals), and wind and water erosion have all had significant impacts on archaeological remains. When combined with a history of land use by foraging, agropastoral, and wage-earning populations, the result is a complex landscape with a wide array of cultural and other materials.

Socioeconomic Interactions among Populations in the Northern Kalahari Region

There were a number of different kinds of socioeconomic interactions occurring among the populations residing in the northeastern Kalahari in the nineteenth and early twentieth centuries. Interactions included short-term trading activities between different groups. Foragers traded wild animal meat with Bangwato, Kalanga, and Ndebele for glass beads, ceramics, and agricultural products. Tshwa made baskets of *Hyphaene petersiana* palm leaves which they traded with other groups in exchange for iron tools, pots, and other items. As previously mentioned, Tshwa collected salt in the Nata Delta which they transported on donkeys to Bokalaka and on to Tsholotsho and Bulawayo in Zimbabwe. In some cases, Ndebele would send *impis* (armed groups) to collect tribute from the Tshwa, which usually included meat, salt, and palm leaves. More complex interactions occurred in the northeastern Kalahari, as well, with Bangwato and Ndebele exploiting the labour of Tshwa, requiring them to watch over their cattle for little or no compensation. Occasionally, a Tshwa *modisa* (herder) would be provided with a bag of maize meal, or, rarely, be allowed to keep a calf after a year or two of herding work. Tshwa saw themselves as part of a complex system of labour exploitation which was sometimes described as ‘serfdom’ or ‘slavery’ (Sebolai 1978 and Gadibolae 1985). While chiefs such as Khama III declared an end to San serfdom in 1891 (Chirenje 1977:264), the practice persisted among some Bangwato until the early to mid-twentieth century. Serfdom was the subject of formal investigations and declarations by the British administration of the Bechuanaland Protectorate in the 1920s and 1930s (Miers and Crowder 1988). Tshwa were seriously concerned about the corporal punishment, kidnapping, and, in some cases, outright murder of Tshwa by members of other groups, something remarked upon by James Chapman when he visited the Nata River in 1854 (Chapman 1868:140-146). Edward Mohr, who travelled to the Nata River area in 1870, observed that ‘The Bushmen of these districts live like hunted game between the Matabeles on the north and the Bechuanas [Tswana] on the south. The former race looks upon them as outlaws, and a young warrior would think little of testing the sharpness of his spear by pinning a Bushman to the earth with it’ (Mohr 1870:156).

The Tshwa, for their part, employed a variety of strategies to deal with the Bangwato and the Ndebele. They located their camps in remote places in order to avoid contact with agropastoral groups. They deliberately hid evidence of their activities on the landscape, burying the remains of animals that they had butchered, and removing signs of their presence by covering their hearths, taking down their huts, and hiding their tools. There is relatively little evidence of outright clashes between Bushmen and other groups, with some exceptions. For example, James Chapman, a South African explorer, hunter and trader who travelled in the northern Kalahari region between 1852 and 1855, said that he witnessed 200 or 300 Bushmen who came by his camp on 26 September 1854, ‘in great haste, their utensils carried on their heads, running from a commando of Matabele’ (Chapman 1868:146). He went on to say he came upon the remnant of a Bushman family which had been massacred out on Sua Pan, whose younger members were ‘carried into captivity at Mzilikazi’ (Chapman 1868:146). Emil Holub, a Czech physician, explorer, ethnographer, and cartographer who traveled in the northern Kalahari region between 1872 and 1879, said that ‘The Bangwato king was aware of the marauding habits of these parties, but did nothing to control them, although they perpetually disarm any Bangwato they may meet, and delight in breaking the legs of the Masarwas’ (Holub 1870:61)). The Tshwa did not accept the actions of either the Bangwato or the Ndebele easily, and they resisted being incorporated into these two groups. Tshwa played the two groups off against one another, sharing information with both groups and informing one group about the whereabouts and activities of the other. It is fair to describe the interactions of the Tshwa with Bangwato, Kalanga, and Ndebele in the northeastern Kalahari as ranging from symbiotic to antagonistic, depending on how they felt that they were treated. The Tshwa appeared to have better working relationships with

the Bangwato than they did with the Ndebele. There were cases where Tshwa would seek out travelers, hunters, and missionaries who they thought might protect them more effectively than either the Bangwato or the Ndebele.

The Nata River was in some ways a ‘shatter zone’ (Parsons 1973:145), one where various groups competed with one another for grazing, livestock, cattle posts, wild resources and people they could exploit for labour. The contested border between the Bangwato and the Ndebele was seen by both groups as a crucial frontier area. As Parsons (1973:148) states:

The shatter-zone extended westward through Kalanga territory and the northern Makgadikgadi. Between 1863 and their kingdom’s demise in 1893 the Ndebele were careful not to penetrate the shatter-zone as far south as the northernmost Ngwato cattle-posts: this can be clearly seen in their raids against the Tawana which always skirted north of the Boteti where Ngwato frontier forces assembled.

While there were clashes between the two groups over territory and over Tshwa labourers and hunters, both the Bangwato and the Ndebele were careful about how far they extended their reach and how they operated in areas that were considered to belong to other groups. The preference was for cooperation rather than conflict. The capital of the Bangwato at Shoshong was on the traders’ road that extended north to the Nata area and came to be known as the ‘Hunter’s Road’ along the Botswana Zimbabwe border (Parsons 1982:118). The Bangwato capitalized on the presence of traders in their midst and were able to expand their cattle holdings and wealth from ivory, ostrich feathers, and furs. Khama III’s son Sekgoma was detained for hunting giraffes and possession of firearms in the Nata area in 1894 by agents of the BSAC, an action which he protested vigorously. The Bangwato exerted control over their ‘outer frontiers’ through trade, exchange, and the import of guns, wagons, and other goods from South Africa (Parsons 1982:119). The expansion in the numbers of weapons and the commercialisation of the hunting trade contributed to the decimation of elephants, rhinoceros, giraffes, and other animals in the last quarter of the nineteenth century (Parsons 1982:119; Morton and Hitchcock 2014). Tribute in the form of ivory, ostrich feathers, and skins was extracted by the Bangwato and the Ndebele until Khama III denounced the practice among the Bangwato after assuming the chieftainship (*bogosi*) in 1875 (Schapera 1970; Parsons 1973, 1977 and 1982:119). In the boundary area between the Bangwato and Ndebele, tensions continued to be felt. Khama III took issue with the boundary marking of the Bechuanaland Police in 1893 and 1899, saying that it infringed on his territory (Parsons 1973:156). The Bangwato were loath to give up the northern part of the Makgadikgadi Pans region to the Bechuanaland Protectorate administration in 1895, in part, according to Leapetswe Khama (personal communication, 1981) because they had royal cattle posts and Tshwa ‘clients’ in the area. The usurpation of the power of the Ndebele king Lobengula by the BSAC in 1893 and the establishment of the Bechuanaland Protectorate in 1885 resulted in significant transformations in the interactions of the Bangwato, Ndebele, and Tshwa at the end of the nineteenth century.

As railway, mining, and commercial farm developments proceeded in Southern Rhodesia (Zimbabwe), there were ‘slave raids’ across the border from the Hwange area into northern Bechuanaland to obtain Tshwa for work in the mines, colliery, and especially on the farms that had been laid out between 1903 and 1910 (McGregor 2009:94-96). White settlers in Rhodesia, including Alfred Giese, a hunter, adventurer, and later a farmer, were known to use European policemen and African constables to assist them on their armed raids of the pans in northern Bechuanaland, some of which resulted in injuries and deaths among Tshwa (McGregor 2009:96). Eventually, Giese’s actions were addressed in the Wankie magistrate court, where he was ‘charged with assault, murder, brutality, and neglect of workers’ (McGregor 2009:96).

The Tshwa, for their part, shared information with one another about potential raids and the poor working conditions that existed across the border in Rhodesia.

The establishment of Wankie Game Reserve in Rhodesia in 1927 led to removals of Tshwa from the game reserve (Davison 1983 and Haynes n.d.). Some of the Tshwa went south into what is now the Tsholotsho District in Zimbabwe, while others crossed the border into Bechuanaland, where they resumed their foraging activities. The two governments believed that some of the Tshwa in the Northern Crown Lands engaged in illegal activities, including holding up travelers and taking their goods and refusing to pay a hut tax which had been introduced in 1899. The Bechuanaland police and Bangwato *mephato* (age-regiments) in the Northern Crown Lands led periodic forays in order to exert some control over the local people residing there. Tensions rose in the Northern Crown Lands in the 1940s after the disappearance of two Royal Air Force flyers who landed their plane on Kaukaka Pan in October 1943, never to be seen again (Hitchcock et al. 2017). Subsequently, the Bechuanaland Protectorate administration and the Bangwato alleged that the two pilots were murdered by a group of Ganade Tshwa San from Gum//gabi, a pan northwest of the Nata River. Twaitwai Molele, a wellknown Tshwa traditional doctor, and seven other Tshwa were arrested for the crime and were put on trial at the High Court in Lobatse on 25 September 1944 (Botswana National Archives File S.198/2; Laverick 2015; Hitchcock et al. 2017). At the High Court trial evidence was presented by witnesses, but it was considered insufficient. The bodies of the men were never found, and the small amount of material supposedly belonging to the men that was found in the possession of the Tshwa could not be traced directly to the fliers. Therefore, the Tshwa were acquitted of the murder charge.

After the end of the trial Aubrey ForsythThompson, a Bechuanaland Protectorate government official, expressed the opinion that the acquittal could have dire consequences for those who bore witness against the defendants, and he urged that Twaitwai be re-arrested (Botswana National Archives File S.303/8/1; Hitchcock et al. 2017:559). Twaitwai was arrested on a charge of killing royal game, specifically a giraffe. He and some of his group members were relocated to Shashane, a cattle post in the central Bangwato tribal reserve which was owned by Tshekedi Khama, the Regent of the Bangwato. In 1945-1946, the Bechuanaland Protectorate Police, along with dozens of Bangwato, undertook a concerted effort to clear the Northern Crown Lands of all the Tshwa who resided there. The Tshwa were disarmed and moved to an area south of the Nata River, one of the first major resettlements of San in the country. In the 1950s, land in the northern Makgadikgadi region was allocated to the Colonial Development Corporation (now the Commonwealth Development Corporation, CDC) in a ranching scheme that eventually failed. At least one of the former CDC ranches was taken over by an enterprising individual, JG Sonk Van Gass, who hired dozens of Tshwa to work for him in a commercial forestry scheme aimed at exploiting high value Zimbabwe teak (*Baikiaea plurijuga*).

The Bechuanaland Protectorate administration engaged in numerous different development activities from 1895-1966, when Botswana became independent. These activities included the boundary demarcation between Bechuanaland and Rhodesia in the late 1890s, and the drilling of boreholes and the underwriting of cattle ranching operations in the Northern Crown Lands and other parts of the Bangwato territory in the 1930s, 1940s, and 1950s. Especially important was exploration for mineral resources, including copper, gold, and diamonds throughout the existence of the Bechuanaland Protectorate. Under colonial rule, the Botswana state was consolidated, and a relatively efficient bureaucratic system established, but the British investment in Botswana was relatively limited, and Botswana was one of the poorest countries on the planet at the time of independence. Of great value to the future state of Botswana was the peaceful transition from Protectorate to independent nation.

Developments in the Post-independence Period

The mineral exploration mentioned above culminated in the announcement of the discovery of diamonds at Orapa (Bangwato territory) in 1967, the year after Botswana achieved its independence in 1966. In the 1970s, the former CDC ranches were allocated to individuals, primarily Kalanga and Bangwato, who were given leasehold rights over what came to be known as the Nata Ranches. Another set of commercial ranches under the Tribal Grazing Land Policy of 1975 (Republic of Botswana 1975) was located at Lepasha, to the east of Sua Pan and south of the Dukwi quarantine gate. Most workers on both of these sets of ranches were Tshwa, many of whom brought their families with them. The interactions between the ranch lessees and the Tshwa workers were complicated, particularly since the Tshwa wanted higher wages and better working conditions. Some of the Tshwa later moved back to their villages along the Nata River (see Figure 3) where they established small-scale livestock and agricultural operations and engaged in entrepreneurial activities including craft production, wild resource collection, and working for other people.

Figure 3: A Group of Tshwa at a Homestead



Source: Photograph by Robert K Hitchcock, Manxotae, 14 April 1976

In some ways, what we are witnessing today in the Nata area has been shaped by what happened there in the nineteenth and early twentieth centuries. Given their resistance to outside interference in their lives, it should come as no surprise that the Tshwa of the Nata region were the first group in Botswana to seek rights over their communal land after the declaration of the government's Tribal Grazing Land Policy in 1975. The struggle over land rights continues to the present time.

Thanks to astute leadership and forward-thinking economic development policies, by the 1990s Botswana was able to establish itself as a middle-income country with extensive social protection systems. The country had achieved a great deal by the time of its founding President Sir Seretse Khama's death on 18 July 1980.

However, tensions in the Botswana-Zimbabwe border region increased during the Zimbabwean War of Liberation (1965-1980) which culminated in independence for Zimbabwe on 18 April 1980. Botswana

was subjected to military attacks and harassment by Ian Smith's government, the most serious of which was an attack on Botswana Defence Force (BDF) soldiers at Lesoma on 27 February 1978 that resulted in the deaths of 17 people, including 15 BDF soldiers (Makgala and Fisher 2009). This incident is considered one of the worst attacks in the history of the BDF which had been formed in 1977 specifically in response to the cross-border attacks in the northeastern part of Botswana.

After independence in Zimbabwe, the new government under President Robert Mugabe sent soldiers from the 5th Brigade into Matabeleland where one of the major groups of freedom fighters, the Zimbabwe People's Revolutionary Army (ZIPRA), the military wing of the Zimbabwe African Peoples Union (ZAPU), had its primary base of support. A group of former guerrillas felt that they had not been treated appropriately by the new government under Robert Mugabe, and tensions erupted into conflict in late 1980 and early 1981. Some of the former guerrillas returned to the bush and began what turned into a lowlevel insurgency. Beginning in 1981 and continuing into the late 1980s, the Zimbabwe government carried out counterinsurgency operations against those they termed 'dissidents'. These operations included military attacks on villagers, kidnappings of suspected terrorists, torture and murder of detainees, a wide range of atrocities against the civilian population, and restriction of the movement of food into the area. This period was described by the Tshwa, Ndebele, and Kalanga, as 'the time of troubles.' It was known as '*Gukurahundi*' in Shona, a term which is used to describe the early spring rains that wash away the chaff from the wheat (Catholic Commission for Justice and Peace in Zimbabwe and Legal Resources Foundation 2008). Tshwa were targeted during this time, and some Tshwa left the Tsholotsho area of Matabeleland North and moved into Botswana in order to seek safety. By 1987, a peace treaty was signed, resulting in a period of relative peace that lasted into the new millennium.

However, tensions continued along the Botswana-Zimbabwe border, and the Botswana government began building an electrified fence along the border in 2003, ostensibly to prevent the movement of cattle with Foot-and-Mouth Disease (FMD) into Botswana, but also likely to dissuade large numbers of Zimbabweans from crossing the border illegally into Botswana (see Kopiński and Polus 2011). The government of Botswana dispatched BDF soldiers and wildlife officers into the Botswana-Zimbabwe border area to prevent Zimbabweans from crossing the border and to enforce wildlife conservation laws. They helped to establish border crossing facilities along with Botswana's Ministry of Nationality, Immigration, and Gender Affairs. Many local development projects have been initiated in Manxotae, Sepako, Maposa, and other villages along the Nata River, including ones that provided direct assistance to women, children, and people with disabilities. Cross-border movements declined during the COVID-19 pandemic due to government-imposed movement restrictions in 2020 and 2021.

Conclusion

The archaeology and ethnohistory of the Makgadikgadi Pans, the Nata River region, and the border zone between Botswana and Zimbabwe reveals a complex interplay among groups employing a variety of different adaptive strategies. The archaeological record is highly variable, consisting of small scatters of stone tools and debitage indicating where hunter-gatherers lived and worked up to and including large, stone-walled villages that extended over thousands of square meters. Tshwa hunter-gatherers and their predecessors exploited the wild game and plant resources in the region for millennia, moving over the area in small groups that had kinship, marriage, exchange, friendship, and other kinds of relationships among them. The incursions of agropastoral populations some 2,000 years ago resulted in a wide range of complex interactions among a variety of different groups ranging from dependence to resistance, and from accommodation to avoidance. Land use strategies shifted in various ways over time, as did degrees of environmental degradation, depending on climatic conditions, livestock densities, grazing intensity, and the presence of plants poisonous to cattle (such as *mogau*, *Dichapetalum cymosum*). Tshwa have

engaged in the exploitation and sale of high-value plant resources such as marula (*Sclerocarya birrea*) and baobab (*Adansonia digitata*). Craft production including the making of baskets continues to be important in 2021.

In the twenty-first century, cross-border movements have continued, with Zimbabweans, a significant number as undocumented immigrants, coming into Botswana seeking employment or refuge from the Zimbabwean government and poor economic conditions. Small numbers of Botswana also cross the border into Zimbabwe to sell goods or visit relatives and friends. Clearly, the social environment of the border has fluctuated considerably over time. The people who reside in the northeastern Kalahari region have been subjected to various social, economic, political, and ecological pressures. A major outgrowth of these pressures is the desire on the part of all the peoples of the region for equitable development, social justice, and fair treatment by the nation-states of Botswana and Zimbabwe.

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References

Official documents and reports

- Blair Rains, A and McKay, AD 1968. *The Northern State Lands, Botswana. Land Resource Study No. 5. Tolworth, Surrey, England: Land Resources Division, Directorate of Overseas Surveys.*
- Catholic Commission for Justice and Peace in Zimbabwe and Legal Resources Foundation 2008. *Gukurahundi in Zimbabwe: A Report on the Disturbances in Matabeleland and the Midlands 1980-1988. New York: Columbia University Press.*
- Hitchcock, RK., Benjamin, B and Murwira. A 2016. *The San in Zimbabwe: Livelihoods, Land, and Human Rights. Report No. 22. Copenhagen: International Work Group for Indigenous Affairs and Johannesburg: Open Society Initiative for Southern Africa.*
- Mitchell, AJB 1976. *The Irrigation Potential of Soils Along the Main Rivers of Eastern Botswana: A Reconnaissance Assessment. Land Resource Study No 7. Tolworth, Surrey, United Kingdom: Directorate of Overseas Development.*
- Republic of Botswana (1975) *National Policy on Tribal Grazing Land. Government Paper No. 2. Gaborone: Government Printer.*

Secondary sources

- Baldwin, WC 1863. *African Hunting from Natal to the Zambesi, including Lake Ngami, the Kalahari Desert, etc. from 1852 to 1860*. London: Richard Bentley.
- Bond, G and Summers, R 1957. *A Late Stillbay Hunting-Camp Site on the Nata River; Bechuanaland Protectorate*. *South African Archaeological Bulletin*, pp.89-95.
- Burrough, SL, Thomas, DSG and Bailey RM 2009. *Mega-Lake in the Kalahari: A Late Pleistocene record of the Palaeolake Makgadikgadi system*. *Quaternary Science Reviews*, vol. 2, pp/1392-1411.
- Bryant, RG, Bigg, GR, Mahowald, NM, Eckardt, FD and Ross, SG 2007. 'Dust Emission Response to Climate in Southern Africa', *Journal of Geophysical Research*, vol. 112, pp.1-17, doi:10.1029/2005JD007025, accessed 17 May 2020.
- Campbell, A 1998. 'The Present Status of Archaeology in Botswana', in Lane, P, Reid, A and Segobye, AK (eds.), *Ditswa Mmung: The Archaeology of Botswana*. Gaborone: Pula Press and the Botswana Society, pp.249-259.
- Campbell, AC and Graham, C 1971. 'The Impact of Man on the Environment of Botswana', *Botswana Notes and Records*, vol. 3, pp.91-110.
- Chapman, J (edited by Edward C Tabler) 1868 & 1971. *Travels in the Interior of South Africa 1849/1863: Hunting and Trading Journeys from Natal to Walvis Bay and Visits to Lake Ngami and Victoria Falls*. Two Volumes. Cape Town: A.A. Balkema.
- Chirenje, JM 1977. *Chief Khama and His Times, c.1835-1923: The Story of an African Ruler*. Plainsboro, New Jersey: Associated University Presses.
- Cooke, CK 1967. *A Preliminary Report on the Stone Age of the Nata River, Botswana*. *Arnoldia (Rhodesia)*, vol. 2, 40, pp.1-10.
- Cooke, CK 1979. *The Stone Age in Botswana: A Preliminary Survey*. *Arnoldia (Rhodesia)* vol. 8, 27, pp.1-32.
- Daggett, AM 2018. *Early Iron Age Social and Economic Organization in Sowa Pan, Botswana*. PhD thesis, Michigan State University.
- Davison, T 1983. *Wankie: The Story of a Great Game Reserve*. Third Edition. Bulawayo: Thorntree Press.
- Flint, RF and Bond, G 1968. 'Pleistocene Sand Ridges and Pans in Western Rhodesia', *Bulletin of the Geological Society of America*, vol. 79, pp.299-314.
- Gadibolae, MN 1985. 'Serfdom (Bolata) in the Nata River Area 1926/1960', *Botswana Notes and Records*, vol. 17, pp.2532.
- Haynes, G n.d. *Hwange National Park: The Forest with a Desert Heart*. Manuscript in author's possession, University of Nevada-Reno, Reno, Nevada, USA.
- Hitchcock, RK 1982a. *The Ethnoarchaeology of Sedentism: Mobility Strategies and Site Structure among Foraging and Food Producing Populations in the Eastern Kalahari Desert, Botswana*. PhD thesis, University of New Mexico.
- Hitchcock, RK 1982b. 'Prehistoric Hunter-Gatherer Adaptations', in Hitchcock, RK and Smith, MR (eds.), *Settlement in Botswana: The Historical Development of a Human Landscape*. Marshalltown: Heinemann Educational Books and Botswana Society, pp.47-65.
- Hitchcock, RK, Acheson-Brown, D, Self, E and Kelly, MC 2017. 'Disappearance and Displacement: The San, the Bamangwato, and the British in the Bechuanaland Protectorate, 1943-1945', *South African Historical Journal*, vol. 69, 4, pp.548-567.
- Hitchcock, RK and Nangati, FM 2000. 'People of the Two-Way River: Socioeconomic Change and Natural Resource Management in the Nata River Region of Southern Africa', *Botswana Notes and Records*, vol. 32, pp.1-21.
- Hodson, AW 1912. *Trekking the Great Thirst: Sport and Travel in the Kalahari Desert*. London: T Fisher Unwin.

- Holub, E 1881. *Seven Years in South Africa: Travels, Research and Adventures Between the Diamond Fields and the Zambezi, 1872-1879. Two Volumes.* London: Sampson Low, Marston, Searle and Rivington.
- Huffman, TN 2007. *Handbook to the Iron Age: The Archaeology of Pre-colonial Farming Societies in Southern Africa.* Scottsville: University of Kwa-Zulu Natal Press.
- Kopiński, D and Polus A 2011. 'Is Botswana Creating a New Gaza Strip? An Analysis of the "Fence Discourse"', in Rodrigues, CU and Tomàs, J (eds.), *Crossing African Borders: Migration and Mobility.* Madrid: Centro de Estudos Internacionais, pp.98-111.
- Laverick, J 2015. *The Kalahari Killings: The True Story of a Wartime Double Murder in Botswana, 1943.* The Mill, Brimscombe Port, Stroud, Gloucestershire, UK: The History Press.
- Livingstone, D 1857. *Missionary Travels and Researches in South Africa.* London: John Murray.
- Main, M 2008. 'Archaeological Sites Located in South Sowa Pan between 1993 and 1996: A Summary', *Botswana Notes and Records*, vol. 40, pp.46-55.
- Main, M and Huffman, T 2021. *Palaces of Stone: Uncovering Ancient Southern African Kingdoms.* Cape Town: Struik Travel and Heritage.
- Makgala, CJ and ML Fischer 2009. *The Impact of Zimbabwean Liberation Struggle on Botswana: The case of Lesoma Ambush, 1978.* New Contree, No. 57, pp.1-21.
- Matshetshe, K 2001. 'Salt Production and the Salt Trade in the Makgadikgadi Pans, Pula: Botswana Journal of African Studies', vol. 15, 1, pp.75-89.
- McGregor, J 2009. *Crossing the Zambezi: The Politics of Landscape on a Central African Frontier.* Suffolk and Harare: James Currey and Weaver Press.
- Miers, S and Crowder, M 1988. 'The Politics of Slavery in Bechuanaland: Power Struggles and the Plight of the Basarwa in the Bangwato Reserve, 1926-1940', in Miers, S and Roberts, R (eds.), *The End of Slavery in Africa.* Madison: University of Wisconsin Press, pp.177-200.
- Moffatt, R 1842. *Missionary Labours and Scenes from Southern Africa.* London: J Snow.
- Mohr, E 1876. *To the Victoria Falls of the Zambezi.* London: Sampson Low, Marston, Searle, and Rivington.
- Morton, F 2009. *When Rustling Became an Art: Pilane's Kgatla and the Transvaal Frontier, 1820-1902.* Claremont, South Africa: David Phillip Publishers.
- Morton, F 2018. 'Reconnecting Tswana Archaeological Sites with their Descendants: The Challenge of Developing Southern Africa's Cultural Heritage for Everyone', *Journal of African Diaspora Archaeology and Heritage*, vol. 7, 3, pp.226-242.
- Morton, F and Hitchcock, RK 2014. 'Tswana Hunting: Continuities and Changes in the Transvaal and Kalahari after 1600', *South African Historical Journal*, vol. 66, 3, pp.418-439.
- Morton, F, Ramsay, J and Mgadla, PT 2008. *Historical Dictionary of Botswana. Fourth Edition.* Lanham, Maryland: The Scarecrow Press.
- Parsons, QN 1973. *Khama III, the Bangwato, and the British with Special Reference to 1895-1923.* PhD thesis, University of Edinburgh).
- Parsons, QN 1977. 'The Economic History of Khama's Country in Botswana, 1844-1930', in Palmer, R and Parsons, N (eds.), *The Roots of Rural Poverty in Central and Southern Africa*, pp.113-143. London: Heinemann.
- Parsons, QN 1982. 'Settlement in East Central Botswana, circa 1800-1920', Hitchcock, RK and Smith, MR (eds.), *Settlement in Botswana: The Historical Development of a Human Landscape.* Marshalltown: Heinemann Educational Books and Botswana Society, pp.115-128.
- Sebolai, MK 1978. 'A History of Socio-Political Changes in the Condition of the Masarwa (Bushmen) in the Bangwato Reserve, ca. 1700-1940. BA essay, University of Botswana.
- Smithers, RHN 1971. *The Mammals of Botswana.* Salisbury: Marsdon Printers.

- Tlou, T and Campbell, A 1997. History of Botswana. Second Edition. Gaborone: Macmillan.*
- Vanderpost, C and Hancock, P 2018. Makgadikgadi: Botswana's Dusty Wetlands. Totnes, Devon: Sandor Books Ltd.*
- Walker, N 1991. Game Traps: 'Their Importance in Southern Africa', Botswana Notes and Records, vol. 21, pp.235-242.*
- Walker, N 1998. 'The Late Stone Age', in Lane, P, Reid, R and Segobye, A (eds.), Ditswa Mmung: The Archaeology of Botswana. Gaborone, Botswana: Pula Press and the Botswana Society, pp.65-80.*
- Wilkins, J 2021. 'Homo Sapiens Origins and Evolution in the Kalahari Basin, Southern Africa', Evolutionary Anthropology, pp.2021, pp.1-18, <https://doi.org/10.1002/evan.21914>. accessed 10 September 2021.*