Du Big Dry à l'Holocène en Afrique de l'Est et au-delà
From the Big Dry to the Holocene in Eastern Africa and beyond
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Challenges and Opportunities during the Last Glacial Maximum at the Forest Margins in Central Africa

Défis et opportunités aux abords de la forêt tropicale à la fin du Pléistocène en Afrique centrale

Els Cornelissen

Abstract: The environmental impact of The Big Dry (TBD) in Central Africa is mainly addressed with reference to the better documented dry phases of the Late Holocene. For its impact on the people, previous archaeological research shows the presence before, during and after TBD of two large technological traditions. The first bifacial tradition concerns the Lupemban and Tshitolian industries and the second that of microlithic industries on quartz. The characteristics of the latter correspond to the definition of miniaturization. This overview focuses on the Democratic Republic of Congo including the heartland of Lupemban and Tshitolian industries at the southwestern rim of the equatorial forest. However, at least for the Holocene, miniaturized industries in quartz are now documented here as well. They remain the only tradition found on dated Late Pleistocene and Holocene sites on the northwestern and northeastern edges of the forest.

Apart from the reassessment of lithic industries from older excavations, new perspectives on population history come from the reexamination of human remains of these excavations. Such a detailed analysis has shown that the Late Pleistocene hunter-gatherer-fishers from Ishango have more in common with their contemporaries in and outside of Africa than with people living in the area today. This agrees well with genetic evidence for increasing diversity in the Late Pleistocene *Homo sapiens* population in Africa. Ancient DNA from two Holocene burial phases in the rock shelter of Shum Laka (NW Cameroon) has revealed their deep shared past with Central African forest hunter-gatherers.

Keywords: Central Africa, equatorial forest, Lupemban, Tshitolian, microlithic and miniaturized quartz industries, Ishango, Shum Laka.

Résumé : L'impact environnemental du Big Dry en Afrique centrale est principalement abordé en référence aux phases sèches les mieux documentées de l'Holocène supérieur. Les recherches archéologiques antérieures montrent la présence avant, pendant et après cette grande sécheresse de deux grandes traditions technologiques. La première tradition dite bifaciale concerne les industries lupembiennes et tshitoliennes ; et la seconde, celle des industries microlithiques sur quartz. Les caractéristiques de ces dernières correspondent à la définition de la miniaturisation. Ce survol se centre sur la République démocratique du Congo, pays où se situe à la lisière sud-ouest de la forêt équatoriale la région de référence pour la séquence du Lupembien au Tshitolien. Les industries miniaturisées sur quartz y sont aussi documentées pour l'Holocène. Elles restent en revanche la seule tradition trouvée sur les sites datés du Pléistocène supérieur et de l'Holocène aux lisières nord-ouest et nord-est de la forêt.

Outre la réévaluation des industries lithiques issues de fouilles plus anciennes, de nouvelles perspectives sur l'histoire de la population proviennent du réexamen des restes humains de ces fouilles. Une analyse détaillée a montré que les chasseurs-cueilleurs-pêcheurs du Pléistocène tardif d'Ishango ont plus en commun avec d'autres populations contemporaines en Afrique et ailleurs qu'avec celles vivant dans la région aujourd'hui. Cela concorde avec les résultats génétiques d'une diversité au sein de la population d'*Homo sapiens* au Pléistocène tardif en Afrique. Les analyses ADN de deux phases d'inhumation holocènes dans l'abri sous roche de Shum Laka au Cameroun ont révélé leur longue interaction dans le passé avec les chasseurs-cueilleurs de la forêt d'Afrique centrale.

Mots-clés : Afrique centrale, forêt équatoriale, Lupembien, Tshitolien, industrie sur quartz, microlithique, miniaturisation, Ishango, Shum Laka.

INTRODUCTION

The Late Glacial Maximum (LGM) or The Big Dry (TBD) in Central Africa presents as anywhere else particular challenges for the environment and the populations. The dense rain forest is characteristic for the area today (fig. 1). Proxies for modelling the impact that the Late Pleistocene drought may have had on the rain forest, come from the better documented Late Holocene climatic arid phases between 4000 and 2000 cal. BP[1]. At present, the forest is home to hunter-gatherers (fig. 1) who are often considered to be the direct descendants from ancient Stone Age ancestors that would have been confined to forested environments. Comparative studies of their genetic profiles are a field exponentially growing and offer an alternative view into the past of an enormous region where palaeo-environmental records, archaeological sites both undated and radiometrically dated and human fossil remains are very thinly and unevenly spread. The western Atlantic rain forest is the best documented for the environment and genetic reconstructions. The least known part from all perspectives is the Inner Congo basin. A previous study (Cornelissen, 2002) looked specifically at the impact of TBD on distribution patterns of the available archaeological sites from Central Africa that were radiometrically dated between 40 and 12 ka BP (26 sites in Cornelissen, 2002, table 1). The key sites then are essentially those included in various later regional overviews (e.g. Mercader, 2002; Barham and Mitchell, 2008; Cornelissen, 2013 and 2016; Taylor, 2016).

In this chapter, a first topic to be discussed are the possible ways to envisage environmental reconstructions for the Central African rainforest in the Late Pleistocene. For the archaeological record focus will be on regions in the Democratic Republic of Congo (DRC). Political boundaries admittedly have little value for deep history, but the country today harbours the largest part of the African rain forest. Finally, ancient human DNA and human fossil remains that shed light on the population dynamics in the Later Pleistocene and Holocene in Central Africa will be shortly discussed.

1. EQUATORIAL FORESTS: A DYNAMIC ENVIRONMENTAL SETTING

Tropical rainforests are no longer considered as pristine environments and there is a growing body of evidence illustrating how the forest today is the result of human disturbances in historical times and of climate changes in the Late Holocene. At the end of the Pleistocene, TBD was a period of desertification, expansion of savannah and contraction of the rainforest into forest refugia. J. Maley (1996) is the key reference for forest refugia in Central Africa and recent updates are found in J. Maley et al. (2018). From the biodiversity standpoint, a refugium is identified in areas that today have high rates of endemic species, or for which evidence is found in palaeobotanical records. In terms of direct witnesses from the time of the TBD, palaeo-environmental records are very few. Only two sites (fig. 2) with paleo-environmental data cover TBD. They are the pollen record of the sediments of lake Barombi Mbo in SW Cameroon, first published in J. Maley and P. Brenac (1998), and fossil tree trunks in soil profiles at Osokari along a road cut from Walikale to Ubuntu in the eastern part of the DRC (Runge, 1997 and 2000; Runge et al., 2014). These are presented below followed by a concise survey of additional information from archaeological sites that were occupied at the time of TBD.

1.1 Direct record of palaeo-environment during TBD at lake Barombi Mbo (SW Cameroon) and Osokari (E DRC)

Since the original publication (Maley et Brenac, 1998) and twenty years later (Maley et al., 2018), the lower part of the pollen record of lake Barombi Mbo going back to 32 ka cal. BP remains the “only central equatorial site extending its record of past environmental change” to the TBD. The TBD is marked out by a sharp increase in Cyperaceae pollen of ± 35% between c. 24-18 ka cal. BP (Maley et al., 2018, fig. 10). These typical wetland herbs spread on the deltaic platform when the lake level decreased and can be used to reconstruct the lake level fluctuations (Maley et al., 2018, p. 12). The authors conclude from this that during the Pleistocene the lake level dropped to as much as 6 m and below the outlet. This significant decrease of the lake level points to more severe conditions at the end of the Pleistocene, compared to those of the Late Holocene climatic variations. Poaceae or grass pollen are markedly present before 11 ka cal. BP, attaining their highest peak between 18.7 and 16.2 ka cal. BP. They almost disappear between 11 and 4.1 ka cal. BP to the advantage of arboreal pollen. Poaceae peak again to 40% in the Late Holocene dry episodes situated between 4.1 and 1.7 ka cal. BP, yet grass pollen never dominated the tree pollen throughout the long sequence (Maley et al., 2018, fig. 10).

Osokari (Runge, 1997 et 2000; Runge et al., 2014) is situated in the eastern part of the equatorial forest in DRC. Largescale road construction groundworks over a distance of 600 km offered a unique view into the soils below today’s forest. Numerous fossil tree trunks were found at depths of 4.5 m to almost 8 m in the lower part of a profile along the road cut. Some trunks were found in direct contact with the top of the weathered basement or parent rock. Radiocarbon AMS on samples of more than 10 fossil trunks up to 1 m diameter at different locations of the road cut yielded dates ranging between 16.4-14.2 ka cal. BP (Hv-20288 in Runge, 1997, table 1) and 42.1-41 ka cal. BP (Beta-85901 in Runge, 1997, table 1). The state of conservation of the tree trunks was too degraded for identification of genus or species yet the $\delta^{13}C$ values lie between - 20 to - 26‰ and are in support of forest trees (Runge, 2000, p. 253). The colluvium and

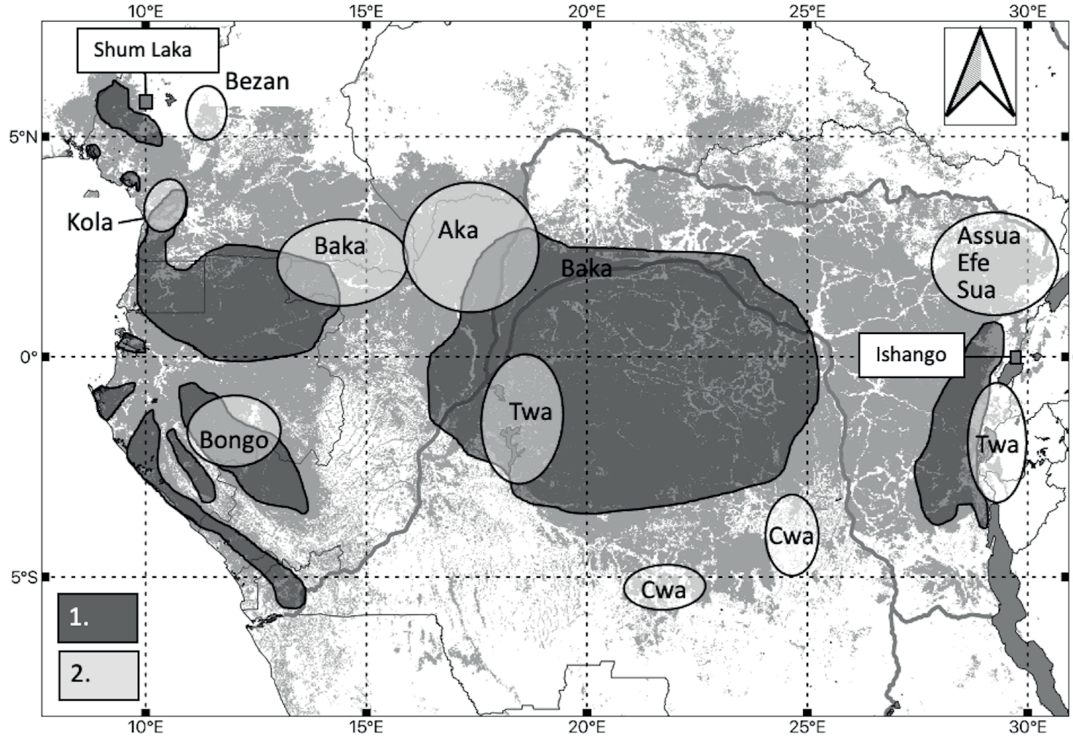

Fig. 1 – (1) Extent of reconstructed Late Holocene forest refuges (after Maley et al., 2018, fig. 1) projected on the extent of the Central African rain forest today; (2) Areas of present-day hunter-gatherer communities (after Bahuchet, 2014, fig. 1.1). Rain forest today based on categories 1-5 of P. Mayaux et al. (2003).

***Fig. 1** – (1) Étendue des blocs refuges forestiers reconstitués pour l'Holocène tardif et projetés sur l'étendue de la forêt aujourd'hui (d'après Maley* et al., *2018, fig. 1) ; (2) zones où se trouvent des chasseurs-cueilleurs aujourd'hui (d'après Bahuchet, 2014, fig. 1.1). Extension actuelle fondée sur P. Mayaux* et al. *(2003), catégories 1 à 5. Étendue de la forêt lors de l'Holocène tardif d'après J. Maley* et al. *(2018, fig. 1).*

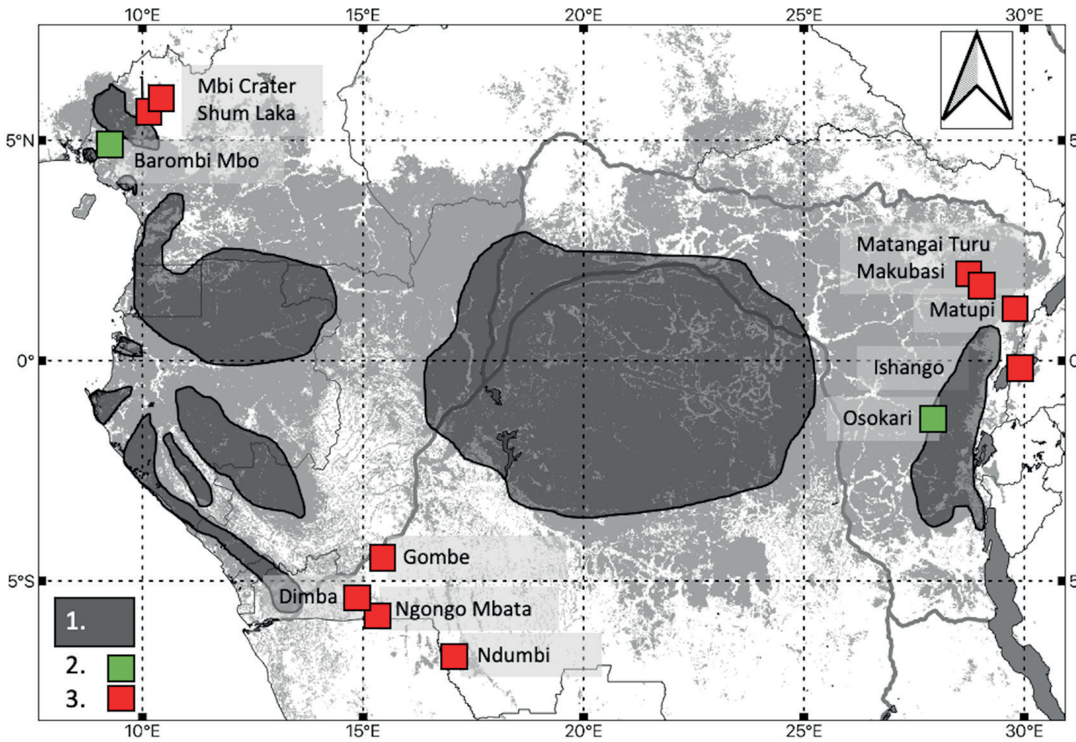

Fig. 2 – (1) Extent of reconstructed Late Holocene forest refuges (after Maley et al., 2018, fig. 1) projected on the extent of the Central African rain forest today (based on categories 1-5 of Mayaux et al., 2003) with locations of (2) palaeo-environmental and (3) archaeological sites mentioned in the text.

***Fig. 2** – Étendue des blocs refuges forestiers reconstitués pour l'Holocène tardif (1) et projetés sur l'étendue de la forêt aujourd'hui (Mayaux* et al., *2003) avec la localisation des sites (2) paléo-environnementaux et (3) archéologiques mentionnés dans le texte.*

the two stone-lines in the overlaying meters of sediment contain allochthonous elements. Heavy mineral analysis and geochemical composition reveal that the parent rock material is different from the soils below and above the stone-lines. Stone-line formation is related to erosion that can only take place in an open landscape with sparse vegetation, under increasing precipitation that would cause mass transport along the riverine network. The eroded materials are supposed to derive from the slopes of the higher mountains, the western ridge of the Albertine Rift Valley. The combination of increased precipitation on a thinly vegetated landscape triggering massive morphodynamic changes to the landscape is assumed to have taken place at the end of dry periods like TBD sometime around 14.5-13 ka cal. BP, when there is a strong increase in the Congo deep sea fan in sediment rate of detritic sediments (Maley et al., 2018). Charcoal contained in the upper stone line was dated to ca. 2.2 ka cal. BP and is synchronous with the Late Holocene perturbation as described from the western part of Central Africa (see below 1.3).

1.2 Environmental data from archaeological sites

Additional data for the impact of TBD on environment and human populations come from a few archaeological sites in Central Africa. Geographically, information is highly dispersed; in a straight line, the distance between the sites in NW Cameroon and those in NE DRC is c. 2,200 km (fig. 2). The sources in which human agency plays a role are diverse; charcoal might represent a selection from available firewood not too far from the site, phytoliths in caves are supposed to reflect the immediate surroundings of the caves brought in via human selection for food, thatching material, bedding, medicinal or ritual use, and as fire wood (Mercader et al., 2000, p. 106-107). Remains of hunted game may not represent the immediate surroundings of the site, but the environment at a larger distance that hunters habitually cover during their activities.

Two rock shelters at the north-western margin of the rain forest in NW Cameroon provide a partial environmental account. The first source is a sequence of charcoal samples at Shum Laka and the second source consists of a combination of pollen and fauna from Mbi Crater. At Shum Laka (Lavachery, 2001; Cornelissen, 2003), radiocarbon dating of charcoal fragments of *Protea madiensis* has yielded dates from bottom to top from 42-31 ka cal. BP, 39-34 ka cal. BP or prior to TBD, 25-24 ka cal. BP and 22-21.5 ka cal. BP during TBD as well as from the transition to the Holocene, 16-14.5 ka cal. BP and 12-11 ka cal. BP (calibrated cal. BP from Lavachery, 2001; Cornelissen, 2003). The savanna shrub was used as fire wood and thus most likely collected in the vicinity of the rock shelter. It is also found in upland grassland at elevations from 1,500-2,280 m which corresponds well with the altitude of the site. In the Pleistocene sediments, only four other plant species were identified which occurred just once in the charcoal samples. The one identifiable bone fragment found in the Pleistocene layers derives from a forest species *Hylochoerus meinertzhageni* (identification by Van Neer in Cornelissen, 2003). During the accumulation of the Pleistocene deposits, this suggests an open landscape with perhaps mountain/gallery forest near the site (Cornelissen, 2003, p. 8). *Protea madiensis* continues its presence throughout the Holocene deposits, yet species composition becomes increasingly more varied including forest trees and wooded savannah species (Lavachery, 2001, table IV). A similar pattern of increasing forest is evident in the species composition of fauna remains (Lavachery, 2001, table III); *Hylochoerus meinertzhageni* or the giant forest hog is present in all five Holocene, ash layers as well as *Syncerus caffer nanus* or forest buffalo in four of the ash layers. The Late Holocene climate perturbation (see below 1.3) apparently had no immediate effect on the environment around Shum Laka.

At Mbi Crater also in NW Cameroon and at a relatively high altitude of 2,000 m, palaeo-environmental data during the occupation of the site first come from the habitat of fauna (Hedges et al., 1987; Asombang, 1988, table 6.10; Cornelissen, 2002, p. 225 and fig. 7). The animals of which remains were brought into the cave in layer II dated to c. 24.3 ka-20.1 ka cal. BP, predominantly lived in open landscapes, although species from densely wooded and forested areas are represented in modest proportions. As from layer III dated to c. 10.5-9.9 ka cal. BP, the proportions change in favour of more and more species from forested and densely wooded environments. In the Mid Holocene layer IVA, dated to c. 5.1 and 4.3 ka cal. BP, more than half of the game comes from forested environments and this continues throughout the Late Holocene prior to the dry phase (layer VI dated to 3.2-2.7 ka cal. BP) as well as in the top layer. A preliminary assessment of pollen samples from the top 70 cm of sediment and at 170 cm from the surface yield the same taxa including Podocarpus. This is considered as an indication of a fairly stable environment with a relatively important forest component (Maley, pers. comm., 1986, in Asombang, 1988, p. 208).

On the opposite side of the rain forest in NE DRC, in the Ituri lowland rainforest, several caves were excavated and from three, phytoliths were identified (Mercader et al., 2000). In one of the caves, Matangai Turu NW, a date of 12.7 to 12.1 ka cal. BP was obtained from charcoal at 1.25 m below surface (UtC Nr 5075; Mercader et al., 2000, table 1 and fig. 2). The underlying 90 cm of sediments are thus considered of Late Pleistocene age. There is an abrupt change in tree-grass ratios between the sample dated to 12.7-12.1 ka cal. BP that has more arboreal and fewer grass phytoliths than samples lower in the column. In all, the results are taken as indication that the forests during TBD may have had a more open canopy than today and may have changed in plant species floral composition, but not to the extent that grassland would have replaced the tropical forest.

The long sequence of the Matupi cave on the eastern edge of the Central African rainforest presents a similar pattern as the sheltered sites from NW Cameroon. Today, the Mount Hoyo massif is covered in forest. The upper 10 cm have proportionally the highest representation of forest animals and postdate the most recent date of 680-554 cal. BP (Van Neer, 1989, p. 80-82). In the lower layers, animal bone is less well preserved, yet the identifiable species come from open environments. W. Van Neer concluded that a major environmental shift occurred sometime between 14.9-13.4 ka cal. BP and 3.6-2.4 ka cal. BP (recalibrated from Van Noten, 1977).

This shift is also observed in a study of speleothem pollen from caves near the archaeological excavations; a C4-dominated savannah grassland is present near the cave at ca. 14 ka cal. BP (Brook et al., 1990, 230Th/234U series). By 6 ka cal. BP, possibly much earlier, forest invaded the area.

Finally, a total of nine radiocarbon dates at Ishango (De Heinzelin, 1957; Brooks and Smith, 1987; Brooks and Robertshaw, 1990; Brooks et al., 1995; also in Crevecœur et al., 2016, p. 37-38) situate the Late Pleistocene occupation of the N.F.Pr. (Principal Fossiliferous Level), the main fossil bearing horizon, between 30 and 20 ka cal. BP. Ishango is situated at shore of lake Edward at the source of the Semliki river that flows today to the north into lake Albert, on the floor of the western branch of the East African Rift, the Albertine Rift. Five dates fall in the range between 26 and 23 ka cal. BP. The environmental associations of recovered mammals from the Late Pleistocene layers (Peeters, 1990) are lake margins, gallery forest and woodland between the open grasslands of the plateau and the valley. Riverine and lakeside exploitation are clearly visible in the abundant fish remains (see further 2.2).

The very faint picture emerging from the archaeological record is once again that of a dynamic environmental setting, showing comparatively less forested environments near the sites during the Late Pleistocene part than during the Holocene, but never to the extent that forest was entirely replaced by grasslands in the lowland and with continued gallery forests in the higher altitudes.

1.3 By proxy: genetic reconstructions from the Penultimate Glacial Maximum

For more remote periods including TBD, genetic studies of rainforest tree populations today may provide complementary information for reconstructing forest history over Pleistocene long timescales. Such is the study of R. Piñeiro et al. (2017), of two tropical trees characteristic of mature lowland rainforests, *Greenwayodendron suaveolens* subsp. *suaveolens* and *Scorodophloeus zenkeri*. The results support the fragmentation of the rainforest in western Atlantic Central Africa during glacial periods; fragmentation seems to have been stronger during the Penultimate Glacial Maxium at c. 130 ka than during TBD. Another interesting result is that trees do not all respond in the same way to climatic changes: their differential dispersal capacity may have impacted their response. A more efficient colonization would be through animal dispersion than in gravity dispersion leading to a broader colonization.

1.4 By proxy: The Late Holocene forest perturbations

For the 2500-2000 cal. BP reconstruction of forest refugia, data come from 19 studied palaeo-records. Of these 19 palaeoenvironmental sites 14 are located in the western half of Central Africa, only one in the Inner Congo Basin and four in the eastern part of the current forests (Maley et al., 2018, fig. 1).

Mapping (fig. 1) of the various so far located Late Holocene refugia across Central Africa reveals an extensive fluvial and lowland forest refuge west of Kisangani along the Congo river in the east, covering the Inner Congo basin down to the south of lake Mai Ndombe, and extending to the west to the interfluves of the lower Congo, Ubangi and Sangha rivers. A series of smaller fluvial refuges, persisting thanks to the high water tables, lie dotted along the Atlantic coast between 4°N and 1°S. Lowland to submontane forest refuges are reconstructed for south western Cameroon, a number of parallel refuges stretching over Equatorial Guinea in the west to the northwest of the Republic of Congo. Finally, a lowland to submontane forest refuge follows the western side of the Albertine Rift between the northern point of lake Tanganyika and the northern shore of lake Edward.

Outside the refuges (Maley et al., 2018, p. 51) and most likely presenting regional differences, forests were highly distributed, or were maintained as “micro-refuges” in favourable topographic positions, or disappeared and were replaced mainly by drier forest types, wooded savannahs and woodlands.

An earlier climatic crisis had set in at 4000 yrs cal. BP and had also affected the Central African rainforests but in a different manner (Maley et al., 2018); it favoured savannah expansion at the northern and southern margins of the rain forest, yet would have let the forest intact in its core area.

1.5 Forest contraction and forest fragmentation with floral diversity

The more open landscape during the TDB on archaeological sites at the north-eastern and north-western margin of the forest fits into the hypothesis formulated by J. Maley et al. (2018) that forest contraction was the TBD scenario rather than that of forest fragmentation as reconstructed for the Late Holocene forest perturbation. Yet the evidence inside the Ituri lowland would favour a forest fragmentation with change in floral composition.

The Mid to Late Holocene dry phases cannot be copied onto the period of TBD, yet they stand as a model or proxy for what the impact can be on the rainforests in less than 5000 years witnessing two climatic crises. J. Maley et al. (2018) see as major driver of these climatic crises “rapid sea-surface temperature variations in the equatorial eastern Atlantic, which modified the regional atmospheric circulation” and that “the change between ca. 2500 to 2000 cal. BP led to a large increase in thunderstorm activity, which explains the phase of forest fragmentation”.

Despite the fragmentary nature of the palaeo-environmental record for TBD in Central Africa, direct botanical evidence and that coming from archaeological sites, Late Holocene reconstructions and genetic data from tree species going back to the Penultimate Glacial Maximum, combine to support the hypothesis that the equatorial forest today is the outcome of a particularly dynamic history. This implies that humans in this region if and when present were able to exploit, live and survive in this continuously changing environment.

2. THE LATE PLEISTOCENE AND EARLY HOLOCENE ARCHAEOLOGICAL RECORD: SOUTH-WESTERN AND NORTH-EASTERN CENTRAL AFRICA

The poor state of the archaeological record in Central Africa is habitually explained in terms of research design and interest, difficult field access, low site visibility precisely in a densely forested environment, political instability and instable research facilities. The absence of datable volcanic layers and geological interest in general oriented on mining facilities and construction activities rather than on Pleistocene and Holocene landscape formation do not encourage locating archaeological sites with secure stratigraphy. The dearth of archaeological and behavioural data is most certainly not because Central Africa and its environments were inhospitable for human population. In fact, fragmentation and contraction of the forest and concomitant expansion of grassland may result potentially in relatively larger ecotone zones that provide the best of both worlds (Cornelissen, 2002). But when looking at the massive land movements documented at Osokari (Runge, 1997 and 2000; Runge et al., 2014), one may wonder whether the same hospitability would apply to such a dynamic landscape.

Archaeological sites radiometrically dated to the Late Pleistocene and Early Holocene remain in and at the fringes of the Central African rainforest, essentially those listed in E. Cornelissen (2002). Of some of these sites, more comprehensive studies were published in the meantime (Njuinye and Mosomu in Mercader and Martí, 2002; Shum Laka in Cornelissen, 2003). N. Taylor (2016) reassessed the finding circumstances of Lupemban sites in the broad region of Central Africa by applying various filters of site integrity. For DRC I took a broader look at surface finds in the north-eastern part of the Central African rainforest where the Ituri rock shelters, the cave of Matupi and the open-air sites of Ishango are located (Cornelissen, 2016), as well as at surface and open-air sites in Bas-Congo from the Early Holocene (Cornelissen, 2018) where reference sites Gombe (Cahen, 1976, 1978a and 1978b) and Dimba cave (Lavachery, 1990) lie. Two broad patterns are evident in the lithic component that to some extent is explained by the finding circumstances. In the sheltered situation of caves and rock shelters at the western and eastern margin of the rain forest as well as in the lowland Ituri forest, quartz was the preferred raw material for microlithic or miniaturized (see below 2.1) industries. The second technological pattern includes use of various rocks, which in the region on the south-western margin of the rain forest, are often silcretes, also known as *grès polymorphe*. Emphasis here is on bifacial shaping of tools such as the category of lanceolates, core-axes and elongated points, leaf-shaped and eventually transverse arrowheads and *petits tranchets*. Though Levallois and prepared cores for blade production are found on sites like Gombe (Cahen, 1976 and 1978a), they are not the essential part. The issue of what constitutes Lupemban, Tshitolian, microlithic or miniaturized quartz industries, or their age and label of Middle or Late Stone Age, is open for discussion due to the continuing lack of radiometrically dated sites in secure stratigraphic contexts. From that perspective and in many instances, typology remains often the only way to describe archaeological industries in the region.

With all these usual caveats in mind, an attempt is made below to present a regional assessment in the north-eastern quarter of the rain forest and in the main area of the Lupemban-Thsitolian sequence in Bas-Congo at the south western margin of the forest.

2.1 Pleistocene-Holocene bifacial technology and Holocene miniaturized quartz industries at the south western margin of the Central African rainforest

Compared to other regions in DRC, Bas-Congo is relatively well documented from the archaeological point of view since the early 20th century. Among these are the excavations of the 1920s on the open-air site at Gombe, Kinshasa, DRC, yielding a reference sequence of industries spanning the Early Stone Age through the Neolithic. Unfortunately, later excavations lead to a reassessment and identification of post-depositional processes that had blurred the previously separated archaeological horizons (Cahen, 1976, 1978a and 1978b). In their paper based on the Gombe site and the then available radiocarbon dates, D. Cahen et al. (1983) describe the disturbances as a regional feature for the entire southern part of the Congo basin. They also observed a large time gap at Gombe between the bottom of the sandy mantle and the top of the gravel floor. On a regional scale, the gap was consistent with no dates between 31.8-31.0 ka cal. BP for the lower limit and 19.4-17.1 ka cal. BP for the upper limit of the gap (calculated from Cahen et al., 1983, table 2, Lv-166 and Grn-7721). Though the authors do not explicitly refer to TBD, given the dating evidence, this climate crisis must have had an impact on the settlement in the area. Lithic industries with emphasis on bifacial technology are present before and after the gap in the region. The only date for such an industry in TBD comes from the Dibma cave which was not included in the regional overview. Most likely, this is explained by the inversion in the dating sequence at Dimba. The top layer was dated to ca. 2100-1800 cal. BP (de Maret, 1986) and yielded

Ngovo pottery and a few polished tools. Below, an accumulation of 3 m of red clays contained 3 archaeological horizons separated by archaeologically sterile layers (Lavachery, 1990). Bulk radiocarbon dating on charcoal from the middle horizon yielded a date of 23.4-20.3 ka cal. BP (Hv-6255), and another bulk date of 7.9-6.0 ka cal. BP (Hv-6256) comes from the underlying layer I, questioning the Late Pleistocene age of layer II (first published as b.c. dates in de Maret et al., 1977, without comments).

The main characteristic of the lithic assemblages found in three horizons in the red clays at Dimba cave is the presence of core-axes that are also found outside the cave on the surface (fig. 3).

Core-axes are "at the core" of the discussions on whether a lithic assemblage belongs to the Tshitolian and/or Lupemban technocomplex with a strong emphasis on "façonnage" or shaping instead of on prepared core technology resulting in blanks or flakes or blades of a predetermined shape in Middle Stone Age assemblages to be used as such, or to serve as blanks for microlithic inserts backed into standardized shapes and sizes. Core-axes described by J. D. Clark (1963), which D. Cahen (1978b) redefined as a "bifacial more or less parallel-sided tool on a large flake but most frequently on a chunk or cobble of relatively modest size", are extremely diversified as a typo-technological category. Both distal and proximal edge may be either pointed, chisel-shaped, oblique, straight or rounded. Their cross section may be triangular, plano-convex or lenticular. Though the definition includes bifacial shaping, in fact the shaping may be limited to a unifacial non-invasive modification of the edges. Other bifacially shaped tools are various points, lanceolates, arrowheads, leaf-shaped or tanged. Small transverse arrowheads and large tranchets are the two extremes of a whole range of tools with unmodified cutting edges and backed, blunted sides.

Another characteristic of the Dimba assemblages is the low portion of quartz among raw materials composed essentially of quartzitic and chalcedonic silcretes grading into chalcedony and cherts (Lavachery, 1990). Only c. 5% of the 190 artefacts from the upper layer III are made of quartz, including a tanged bifacially flaked arrowhead (fig. 4). The other 14 tools out of a total of 190 artefacts from level III are relatively small and do not exceed 6.3 cm in maximum size (fig. 4). Together with the three transverse arrowheads (one illustrated in fig. 4) all tool-types habitually associated with the Tshitolian are represented. In the lower levels, maximum size increases to 12 cm and more or less the same tool-types are present. Regardless of whether the Late Pleistocene date is correct or not, even if the Mid Holocene date would prevail, the Holocene presence of this essentially bifacial component in Bas-Congo seems established.

Quartz assemblages are infrequent in the archaeological record of southwestern Central Africa in the area of the key sites of Gombe and the Kinshasa plain. This might be explained by the abundant availability of silcretes of good flaking quality in the supposition that quartz would

Fig. 3 – Dimba, DRC. From top to bottom: dorsal, side and ventral view of one unifacial (left) and two bifacial core-axes found on the surface near the cave, 1973 (photo RMCA). All three in silcrete.

***Fig. 3** – Dimba, RDC. Du haut vers le bas : vues dorsale, latérale et ventrale d'un core-axe unifacial (à gauche) et de deux core-axes bifaciaux, tous en grès polymorphes et trouvés en surface près de la grotte de Dimba en 1973 (cliché RMCA).*

Fig. 4. Dimba, DRC: level III of Holocene age. From top to bottom: Core-axe and leaf-shaped arrowhead of the same maximum size of 6.3 cm, in silcrete (photo RMCA). Tanged arrowhead in quartz and transverse arrowhead in chert.
Fig. 4. Dimba, RDC : niveau III de l'Holocène. Du haut vers le bas : core-axe et pointe foliacée qui ont une même dimension maximale de 6,3 cm, en grès polymorphe, pointe de flèche pédonculée en quartz et pointe de flèche à tranchant transversal en chert (cliché MRAC).

be a second choice or back-up scenario in the absence of other rocks. Further to the south in the Kwango area, the undated site of Ndumbi (Planquaert, 1976) hinted that this might not be always the case. Larger implements in silcretes were found strewn on the surface of the slopes and include pics, bifaces, lanceolates and core-axes, whereas Levallois and blade cores are quasi absent like at Gombe. A controlled collection on the top of a small hill over 24 m² of 20 cm of sediment resting directly on the bedrock yielded essentially quartz artefacts, but also some in silcretes. Among the quartz tools are small leaf-shaped points as well as cores and a biface in quartzitic silcrete with polished working edge (Planquaert, 1976, p. 21). The author notes for Ndumbi (p. 26): "On the other hand, the almost exclusive choice of a raw material as ungrateful as quartz seems more surprising, especially in a region where polymorphic sandstones abound. This choice is certainly a deliberate one, for motives that are currently eluding us[(2)]."

The open-air site of Mbanza Ngungu provides another clear example of the deliberate choice for quartz in Bas-Congo (Cornelissen, 2018). Though Late Stone Age was not the focus of the KongoKing project (Clist et al., 2018), various researchers conducted surface surveys and excavations between 2012-2015 that resulted in Stone Age material from 31 surface and 10 excavated assemblages. Nine out of the 31 surface collections contained the same type of core-axe found outside the Dimba cave and in the red clays inside the cave. These core-axes are totally absent from the 10 sites where limited excavations took place, and are made almost exclusively on silcretes and quartzites. Geometric or backed implements of small size did not figure among surface collected material (Cornelissen, 2018).

At the open-air site of Ngongo Mbata, the quartz assemblage was dated to the Early Holocene (10.8-10.5 ka cal. BP, 9470 ± 50 BP Poz-60770 published as "en association avec du quartz microlithique d'origine Late Stone age" [Clist et al., 2015, p. 475] and 10.2-9.7 ka cal. BP, 8910 ± 50 BP Poz-80297 in E. Cornelissen [2018]). Characteristic for the assemblage of 785 artefacts is the high proportion of quartz (88.5%) and the diminutive nature. The largest quartz artefact does not exceed 8 cm. Of the remainder of 11.5% raw materials, half are on a grey banded chert. The presence of cortical quartz artefacts is quite striking; 75% have retained cortex. Like at Ndumbi, the exploitation of split quartz cobbles where the neocortex is used as the flaking platform is very recurrent at Ngongo Mbata, which as can be expected results in a tremendous amount of cortical flakes. Half of the 228 unmodified quartz flakes have a cortical proximal edge and a non-cortical dorsal face regardless of their size (Cornelissen, 2018, fig. 5.4). Modified pieces are few. These retouched pieces, scraper edges and notches do not exhibit much standardization. From Ishango (de Heinzelin, 1957 and 1962) we know that small quartz splinters have been set into bone handles without much modification in this particular case. A comparative study of the Ishango and the Ituri sites learns that small river cobbles of quartz were used for raw material (Mercader and Brooks, 2001), but not with the same observation on the intentional production of flakes with large cortical proximal edges. At Shum Laka (Cornelissen, 2003), vein quartz extracted from granite banks is exploited. Cortex on artefacts in general does not exceed 5% and there is no deliberate production of small cortical flakes. The quartz assemblages from the north-eastern, north-western, and south-western sites seem to be regional or local interpretations of a broad technological substratum.

The discussion on what is microlithic is far from settled like the discussion on Lupemban and Thsitolian. Size most certainly cannot be the sole parameter; small unmodified yet functional implements are part of stone equipment since a million of years (Kuhn and Elson, 2002; Pargeter, 2016, p. 233-234). The quartz assemblages from Bas-Congo only respond very partially to the four criteria that S. L. Kuhn and R. G. Elston (2002) propose for microlithic industries. They do not exhibit intentional production of blades of bladelets, backing for blunting edges is very rare, small tools of standard size and shape are absent as well as a macrolithic component. Essentially radial flaking of small split river cobbles results in a flake population of excessively many small flakes with a cortical proximal edge and no dorsal cortex. This proportion is so striking that there must be a true intention for their production. Also, if backing is intended to render one edge of the stone insert blunt in order to fit it into the handle, this may also be obtained by using the cortical part of these unmodified sharp quartz flakes. The characteristics for miniaturization listed by J. Pargeter (2016) for the Later Pleistocene site of Ntloana Tsoana in Lesotho apply much more to the Bas-Congo quartz assemblages. They are, sheer absence of formally retouched pieces, a systematic production of small flakes from small cores which is intentional and not imposed by the size or nature of available raw materials. At the site of Ntloana Tsoana, traces of utilisation were identified on the unmodified flakes, which has not been attempted for the Holocene quartz assemblages in Bas-Congo.

2.2 Pleistocene bifacial technology and Late Pleistocene-Holocene quartz technology at the north eastern margin of the Central African rainforest

The few excavated sites that are highly informative on environmental and behavioural patterns in the period under consideration are located in the north-eastern part of the Central African rain forest. The Ituri (Mercader and Brooks, 2001) and Matupi (Van Noten, 1977) rock shelters, and the Ishango open-air sites (De Heinzelin, 1957 and 1963; Brooks and Smith, 1987) cover a period from at least c. 40 ka cal. BP to the Late Holocene. The lithic assemblages have been described as microlithic, yet they would also fit into the description of a miniaturized technology (see 2.1; Pargeter, 2016); no centripetal debitage, primarily “simple” debitage and no bipolar percussion, small formal tools such as scrapers, very rare geometrics, points and perforators. On all these sites, the Pleistocene quartz industry continues in the Holocene layers to which gradually pottery is added. In a regional comparison (Mercader and Brooks, 2001), the similarities in stone equipment and technology between the sites situated in Pleistocene lowland forest and open landscapes lead to the conclusion that quartz technology is of practical use in any kind of environment and most certainly not an environmental indicator. All sites have in common that there is no trace of a prevalent bifacial large tool component; and on all sites, an intentional choice for quartz is evident.

Whereas on the sites in Bas-Congo the absence of preserved animal remains prevents any direct information on subsistence strategies, hunting in open environments and along gallery forests is obvious from the Pleistocene fauna remains of Matupi (Van Neer, 1989) and of Ishango (Peeters, 1990). At the Ituri sites, animal bone is not preserved in the layers dated between c. 3.1 ka cal. BP and c. 22.9-22.4 ka cal. BP (Mercader and Brooks, 2001, table 1 Beta 1270709 and Os-21250). At Ishango, intensive exploitation of aquatic resources is recorded, which is a subsistence strategy often underrepresented on archaeological sites. Detailed analysis of fish bones (Stewart, 1989) reveals fishing and fish consumption of small and very large fish. The very large fish were most probably harpooned and speared during spawning runs. Bone harpoons and barbed points are part of the standard equipment in the three Late Pleistocene layers at Ishango. The representation of the various fish skeletal parts indicates that processing, preparing and consuming all took place at the site. Closely in time, related repeated visits to the same locality might have been either part of logistic mobility by a task specific group, or of residential mobility implying that the environment offered a safe recurrent food source (see also Lane, 2014).

In the absence of a solid dated excavated Stone Age record, an assessment of how these excavated sites integrate in a broader regional frame was made through museum collections (Cornelissen, 2016). These are very partial and distorted through the selection of the easily recognizable, carefully made stone tools by collectors who were either untrained in archaeology or who proceeded according to now obsolete archaeological practice.

Lanceolates, core-axes and other bifacially trimmed artefacts in various volcanic and sedimentary rocks were collected from the surface or found in alluvial and colluvial deposits many meters below the surface during mining and construction works. They are totally absent from the few well dated Late Pleistocene sites such as Ishango, Matupi cave and the Ituri rock shelters. Their absence holds for the more ancient sites of Katanda as well (c. 80-70 ka; Feathers and Migliorini, 2001) that yielded finely finished bone tools, yet the stone tools on local quartz and quartzites are characterized by the absence of standardized tool categories (Yellen et al., 1995; Yellen 1996). Given the ancient dates outside of the north-eastern forest for the Lupemban at Twin Rivers (Barham and Smart, 1996; Barham, 2012), the finds might relate to an older technological tradition that at the end of the Pleistocene in the north-east part of the forest became replaced by the quartz technology. There are no Holocene sites belonging to bifacial technology in the north-east, except for the case of the Late Holocene sites on the lower Lomami river (Livingstone-Smith et al., 2017). The ad hoc bifacial flaking of small axes or adzes was found in association with pottery dated to c. 2000 cal. BP, and has no technological bearing at all with the Lupemban lanceolates and points.

The combined distribution pattern (Cornelissen, 2016) of microlithic and miniaturized industries on quartz with no bifacial component concentrates east of 28°E. The distribution of implements of Lupemban affinity and bifacially flaked artefacts goes further west to 26°E, yet they do not extend beyond. This artificial boundary coincides more or less with the valley of the north-flowing Lualaba river that becomes the Congo river flowing at Kisangani. Often Stone Age artefacts and particularly those of Lupemban affinity are associated or found within stone lines ("Stone line" accumulation filters 4 and 5 in Taylor, 2016). Interestingly, to the south, following the transect of road construction from Osokari to Kisangani to the west, the regional distribution of coarse stony horizons in soils decreases, whereas they increase in thickness in the opposite direction moving east to the Western Rift mountains (Runge, 2000, p. 252). The thinning out of the stone lines, be they of colluvial or alluvial nature, from east to west, may explain why the Lupemban artefacts also associated with stone lines do not cross the artificial boundary at 26°E. During the fieldwork along the road transect there were, however, no artefacts found in these stone-lines (Runge, 2000, p. 252; Runge et al., 2014, p. 76).

3. THE HUMAN RECORD IN CENTRAL AFRICA'S RAIN FORESTS

3.1 Hunter-gatherers today

Human remains dating to TBD are extremely few in Central Africa, nor are they numerous for the Holocene. Yet the hunter-gatherer groups that are living in the forest today (fig. 1) are often taken as the direct descendants of Pleistocene ancestors, for instance in genetic studies. The assumption to explain the genetic diversity between the hunter gatherer populations today in the east and those in the west (Verdu, 2014 based on Patin et al., 2009 and Batini et al., 2011) is that during TBD the forest would have contracted in these specific areas cutting of any contact and gene exchange for such a long period that this provoked the observed genetic distance. There are however many assumptions underlying this hypothesis (Verdu, 2014): present populations settle the same areas as their ancestors, these areas have always been forested, which is far from established (see previous discussion on palaeo-environment), and the populations themselves are and have always been confined to forest environments, which does not seem probable either.

As often, the label of hunter-gatherer today covers a diversity in subsistence mode, environment, cultural affiliation or stature of these populations (Bahuchet, 2014). When overlaying their current approximate distribution (Bahuchet, 2014, fig. 1.1) onto the forest today (fig. 1), most groups, but not all for instance in the eastern area, are situated within the rain forest. When their distribution was projected back into the past, and on the assumption that their area or pattern of mobility would not have changed (which given the time depth seems highly unlikely) not all of them would have been confined to the forested environments. For the area where Assua, Efe and Sua live today, at the north-eastern fringe, there is no refuge reconstructed, though archaeological phytoliths (Mercader et al., 2000) would indicate continued forest cover albeit different in floral composition and extent. The area of the Twa on either side of the Western Rift valley, and where the Cwa are at the southern fringe, all fall out of the reconstructed refuges. The area of the Twa in the Inner Congo basin may have been part of the fluvial refuge which is also true for part of the area where today the Aka live. The areas where Bezan, Kola, Baka and perhaps to a lesser extent also that of the Bongo may have seen a very dynamic environmental history. If there is a deep history for all these populations, and if the Holocene disturbances of the forest are taken as a proxy for possible scenarios, then their ancestors were equipped to respond to environmental changes caused by the TBD which does not necessarily imply to move and contract with the forest refuges.

3.2 Direct fossil human record: A Hunter-gather-fisher community during the TBD at Ishango

Ishango is the only site in the whole of Central Africa to have yielded fossil human evidence from TBD. The 138 humans remains from the main horizon N.F.Pr. (Principal Fossiliferous Level) have been described and reanalysed by I. Crevecœur and colleagues (2016). The minimum number is 12 individuals, five adults, one adolescent, four children and two perinatals. The bones are fragmentary and diverse, not found in anatomic connection, yet given the good preservation state of neo- and perinatal bones, one may assume that they were not washed onto the shore, but perhaps intentionally deposited on the lake shore where they decomposed and eventually became embedded in the sediments. The Ishango human bones have always been puzzling since their discovery in 1950 and their initial description for being robust in cranial and mandibular characteristics. They exhibit more similarities with Middle and early Late Pleistocene fossils worldwide than they do to recent, chronologically and geographically closer modern human populations. From this perspective, the Ishango population corroborates genetic theories on the complex history of isolation and diversification of Late Pleistocene African populations where archaic characteristics continued in specific areas (Crevecœur et al., 2016, p. 53).

An assessment of mobility habits consisted of comparing the relative tibial rigidity of one Ishango hunter-gatherer-fisher to that of modern runners and swimmers, LSA southern African terrestrial hunter-gatherers or foragers, and an Andaman fisher-forager population (Crevecœur et al., 2016, p. 51-53, fig. 18). The Ishango individual aligns well with the latter population, who have marine mobility including moving around in canoes for transportation and for fishing activities. The Ishango relative tibial rigidity is quite different from that of the Late Stone Age southern African terrestrial foragers. This would point to reduced mobility. Though the fragmentary state of preservation of the Ishango human bones does not permit to evaluate whether this was a general feature of the entire active population or was restricted to this single individual, the aquatic mobility corresponds with the conclusions on exploitation of aquatic resources in fish remains and the bone harpoons and barbed points assumed to have been used in spearing and procuring fish. A subsistence strategy relying on aquatic resources must surely have been an asset in a rainforest where waterways can function as routes of dispersion and mobility. The human bones represent all age profiles of a population, and may have been intentionally deposited on the beach. Taken together with the ensured seasonal access to fish, a protein-rich resource, this might be indicative of logistical mobility or seasonal residential mobility where the group remained at least part of the year at the outlet of the Semliki river. Careful deposition of the dead may be considered as part of a way to claim specific and recurrent resources.

3.3 Indirect aDNA analysis from Holocene hunter-gatherers at Shum Laka

Apart from using modern DNA to reconstruct patterning in deep history including the TBD, aDNA reconstructions are now available from four individuals out of the 18 that were buried in two phases during the Holocene in the rock shelter of Shum Laka (Ribot et al., 2001; Lipson et al., 2020). The two funeral phases are dated to c. 8 ka cal. BP and c. 3 ka cal. BP (Lipson et al., 2020, table 1 and supplementary table 2). The 18 individuals were deposited in various ways: during the earlier phase, one adult was laid down in a horizontal position, two youngsters in a primary double inhumation and the fourth burial consists of a bundle of long bones. Of the double inhumation, one boy died at the age of 4 ± 1 years and the other was an adolescent male who died at an age of 15 ± 3 years old. These two individuals were sampled and their preservation allowed aDNA profiling. Grave goods are rare, consisting of a round stone in association with the two adolescents and 8 bone tools found in the bundle. The Late Holocene funeral phase concerns 14 individuals; two adjacent primary single burials of a boy 8 ± 2 years old and a girl of 4 ± 1 years old also provided insight in ancient DNA.

In fact, the early burial phase dated to 8000 cal. BP was hypothesized to represent hunter-gatherers as the material culture associated with layers below and immediately above the structures did not represent any break with the preceding 20,000 years of miniaturized quartz industry. The recent funerary phase on the other hand, dated to 3000 cal. BP followed the introduction of new technologies (Lavachery, 2001) such as the use of basalt and tuffs for a macrolithic industry containing prepared cores resulting in triangular flakes and blade production reminiscent of Middle Stone Age technology, and bifacially flaked “waisted” axes with sometimes traces of polish. Pottery made its modest introduction with grooved, thick walled sherds. Because of these changes in technology, the assumption was that the second phase may represent newcomers in the area or contact; perhaps physical remains of the Bantu-speaking populations that migrated from the north-northwest to the south sometime in the Mid Holocene (for link between Shum Laka and migration of Bantu-speaking populations, see Grollemund et al., 2015). However, in the skeletal and anatomical characteristics of the populations from the two phases, there were no determinant features that may have allowed their identification as nomadic hunter-gatherers or as sedentary food-producers (Ribot et al., 2001). Also, the site itself, a rock shelter, might have been used as a stop during hunting parties or as a ritual place by either of those groups. In an alternative hypothesis, populations of both funerary phases may have been hunter-gatherers and the Late Holocene hunter-gatherers would have integrated new technology from migrating groups. This “contact” is however difficult to recognize in the archaeological record that is too coarse-grained for making the distinction between occupation on a seasonal, annual, or generational scale by various groups present in the region. In a rock shelter with limited sedimentation in the upper part mixed with ashes, this scale becomes completely blurred.

Ancient DNA of the four Shum Laka individuals showed strong similarities in genetic material between the two burial phases despite the c. 5,000 years that separate them (Lipson et al., 2020). Within each phase, the two persons had family ties; second degree such as uncle and cousin or half-siblings for the two Late Holocene children, and fourth degree or cousins for the Mid Holocene youngsters. When their DNA is compared to aDNA from elsewhere in Africa and with that of people today, the people of Shum Laka are not related to groups currently living in western Cameroon, nor to present-day Bantu-speakers. Their genome-wide ancestry profiles are strongly related to present-day hunter-gatherers of Central Africa. From this perspective, the pattern of a widely distributed and genetically related population in deep history correlates to the common background and evenly wide distribution of microlithic and miniaturized quartz industries. This would underscore the ability and flexibility of this population to deal with various climatic and concomitant environmental changes.

There are very few comparative sites to the ritual funeral use of Shum Laka. Much further to the east, the mortuary practices at Gogoshiis rock shelter in southern Somalia (Brandt, 1988) have been interpreted in terms of increased logistical mobility. The group of hunter-gatherers stays in one place and special task forces move and return which implies more sedentarism, defended habitats leading to formal disposal areas of the dead as claim and control of critical resources especially where there is an increase in population density and more tension over available resources.

4. DISCUSSION AND CONCLUSION: AN ARCHAEOLOGICAL RECORD IN THE MAKING

Reconstructions of Holocene climate fluctuations (Maley et al., 2018) show the nature of possible impact on the equatorial forest. These can be used as a proxy for the poorly directly documented effect of TBD in Central Africa. Assuming that the prolonged drought at the end of the Pleistocene would have similar consequences, a dynamic scenario seems plausible in which the Late Pleistocene forest fragmented or contracted into refugia, in some areas changed in species composition, was conserved on higher altitudes or along rivers, and in yet other places was replaced by open vegetation. Traces of game from gallery forest on archaeological sites may indicate that the river network in the Congo basin did not dry out. This implies that communication remained feasible between various regions. At times with torrential massive landslides as documented in the east (Runge et al., 2014), the Central African basin might have been less hospitable and indeed hunter-gatherer communities would get isolated. Once the riverine network and the vegetation were re-established, communication may have resumed which would explain the general shared substrate of the Holocene hunter-gatherers of Shum Laka with Central African hunter-gatherers in the rainforest (Lipson et al., 2020). Today, they are dispersed over a large geographic area covered in forest and restricted to certain areas, yet this spatial configuration is surely the outcome of a dynamic history of contact, isolation and reconnection. Many scenarios are feasible to cope with environmental changes: a change in mobility patterns, a conservative reaction implying moving with the preferred and exploited environments, and if that environment were to disappear completely, disappear as well, or a highly adaptive strategy allowing to settle various environments; or leaving the area and thus disappearing from the archaeological record. As argued elsewhere (Cornelissen, 2016), the river network ensures access to fresh water as well as to stable food sources like fish. Aquatic capturing techniques had firmly integrated Late Pleistocene subsistence strategies at the eastern edge of the rain forest in the Semliki valley by 20 ka cal. BP together with seasonal logistical mobility and incipient territorial claims.

In this highly dynamic environmental setting, two broad stone technologies were practiced.

In the north-eastern part of the equatorial forest, microlithic or miniaturized quartz industries are of Late Pleistocene and of Holocene age. If large lanceolates and bifacially trimmed artefacts are to represent the Lupemban, the bifacial technocomplex remains undated here, out of secure stratigraphic position and absent from dated Late Pleistocene and Holocene sites. Taking this absence of evidence as highly circumstantial evidence of absence, the bifacial technology may be a much older substrate that was supplanted by the wide spread of miniaturized technology on quartz. Whether this shift in technology and in choice of raw materials results from population migrations or from technological transfers cannot be evaluated on the basis of the available data.

A slightly different picture emerges from the Late Pleistocene and Early Holocene archaeological sites at the south-western fringe of the Equatorial. The site of Ngongo Mbata proves how brittle and fragile the archaeological record is in Central Africa. Before the dating evidence that sets miniaturized quartz technology in the Early Holocene at Ngongo Mbata, this technology was hardly visible in the south-western region. What exactly the advantage or use was for quartz inserts remains an open question. Site integrity including environmental setting and exploitation is poor for the bifacial technology. A single Holocene occurrence of miniaturized quartz technology does not exclude nor confirm the introduction of a "new" technology to the area. Hence looking for an explanation for the co-occurrence of two broad technocomplexes in the southwestern part is premature. A technology that allows for the exploitation of quartz is nevertheless an asset because the mineral is so ubiquitous. The systematic radial reduction of small river cobbles resulting in small flakes with a large cortical proximal edge may be an excellent alternative to the more elaborate sequence of blade- and bladelet production, backed or blunted into standardized geometric inserts in composite tools. Miniaturized quartz exploitation may be a valid technological alternative also in areas where various lithic raw materials are available.

The archaeological, palaeo-environmental and human fossil record spanning the Late Pleistocene and Holocene in and at the margins of the equatorial forest in Central Africa remains under construction. Despite the disparate nature of the evidence, a dynamic deep history transpires and refutes an immutable and static past for its people and environments.

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NOTES

(1) All previously published C14 dates were calibrated using Oxcal v.4.4.2 C. Bronk Ramsey (2009) r.5: Atmospheric data from A. G. Hogg et al. (2020) according to SHCal20 and expressed as ca. ka or yrs cal. BP for readability.

(2) Author's translation from M. Planquaert (1976, p. 26) : « En revanche, le choix presque exclusif d'une matière première aussi ingrate que le quartz paraît plus étonnant, surtout dans une région où les grès polymorphes abondent. Ce choix revêt certainement un caractère délibéré dont les motifs nous échappent actuellement. »

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