

## The Holocene History of the Southern Lake Chad Basin: Archaeological, Linguistic and Genetic Evidence

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**Abstract** Archaeological evidence indicates a complex history of settlement of the southern Lake Chad Basin from the mid-Holocene onward, in parallel with the gradual desiccation of the Sahara and reduction of lake and river systems in the region. These archaeological data can be compared with a growing body of data from historical linguistics and genetics, and the southern Lake Chad Basin is one of few areas in Africa where such comparisons can be undertaken. This paper will serve as a preliminary consideration of some of the issues generated by an initial comparison of archaeological, genetic and linguistic evidence for the peopling of the Lake Chad Basin. It focuses on the contexts of initial encounters between ancestral Nilo-Saharan and Chadic populations south of Lake Megachad and subsequent population expansions and diversifications around the Mandara Mountains.

**Résumé** Les données archéologiques indiquent une histoire complexe de la colonisation du bassin méridionale du lac Tchad à partir du milieu de l'Holocène, en parallèle avec le dessèchement progressif du Sahara et la réduction des réseaux hydrologiques dans la région. Ces données archéologiques peut être comparée à un ensemble croissant de données de la linguistique historique et la génétique, et le bassin méridionale du lac Tchad est l'un des rares zones en Afrique où de telles comparaisons peuvent être effectuées. Cet article servira comme un considération préliminaire de certains des questions générées par une comparaison des preuves archéologiques, génétiques et linguistiques pour le peuplement du bassin du lac Tchad. Il se concentre sur les rencontres initiales entre les populations ancestrales nilo-sahariennes et tchadiques au sud du lac Megachad, et sur les plus récentes expansions et diversifications des populations dans les alentours des Monts Mandara.

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## Introduction

At present, the southern Lake Chad Basin occupies a position of unusual potential for reconstructions of African culture history during the Holocene. The location and characteristics of this region have made it an area of significant ethnographic, archaeological and linguistic research during the last 60 years, whilst its cultural diversity—as well as the unfortunate mid-twentieth century identification of some of its inhabitants as *paléonigritiques*, members of an earlier stratum of human occupation on the continent—has meant that a significant amount of genetic research has taken place there as well. It is one of the few areas of sub-Saharan Africa where detailed comparisons between the results derived from research in these different disciplines may be feasible, and as such, could potentially play an important role in working out some of the methodological challenges involved in reconciling such different sources of data. It may be particularly useful to investigate fine-grained variation in these various forms of data, since genetic reconstructions, in particular, often are made at such general scales as to vitiate their utility for archaeologists.

This paper will thus serve as a preliminary consideration of some of the issues generated by comparison of archaeological, genetic and linguistic evidence for the peopling of the Lake Chad Basin. It focuses on a limited number of particularly salient issues whilst trying to provide an overview of the data available for the region as a whole. It will argue that one role for archaeological research in this region may involve constraining genetic and linguistic interpretations, both chronologically and in terms of palaeoenvironments and economic systems.

## Background: Environments and Initial Settlement

Geological and geomorphological data indicate that the southern Lake Chad Basin (Fig. 1) was probably unoccupied by humans during the terminal Pleistocene hyper-arid period, with the disappearance of Lake Chad and the spread of dune fields across the lakebed and south to the Mandara Mountains, whilst during the early Holocene, much of the area was under the waters of Lake Megachad (Servant & Servant-Vildary 1980; Talbot 1980: 42–45; Boutrais 1984: 51; Leblanc et al. 2006). In addition, to this point we have no significant archaeological evidence for occupation during the terminal Pleistocene, although taphonomic factors and issues of research emphasis probably play a role in our lack of knowledge for this period (MacEachern 2012b). This implies that human settlement took place through the movement of immigrants into an unoccupied region, probably in two separate phases. A Lake Chad Basin empty of human occupation during the terminal Pleistocene implies that genetic and linguistic reconstructions need not be complicated by the existence of humans in the region earlier in the Pleistocene: communities in the area today are descended from populations that immigrated at different times during approximately the last 12,000–10,000 years.



**Fig. 1** The southern Lake Chad Basin, with sites and regional research areas noted

As noted, human settlement of the southern Lake Chad Basin probably took place in two stages from the end of the Pleistocene onward: first, during the early Holocene climatic amelioration, and second, during the mid-Holocene regression of Megachad, which exposed wide expanses of sand and clay plains suitable for grazing and agriculture and seems to be associated with more intensive settlement. The first stage would have involved an initial colonisation of the region as the expanded terminal Pleistocene Sahara retreated northward, Megachad and its surrounding hydrological networks expanded, and Sudanian woodland environments began to dominate the region (Ballouche & Neumann 1996; Holmes et al. 1999; Wang et al. 2008). This phase would have extended from approximately 12,000 to 7,000 years ago and involved at least one cycle of decreasing and increasing aridity before the early Holocene lake highstand (Maley 1981; Ghienne et al. 2002). The early stage might have involved woodland-adapted LSA foraging communities moving in from the south (populations that presumably occupied grasslands and woodland environments south of about 10°N latitude but about whom almost nothing is known), or more arid-adapted groups from areas east and west of the Lake Chad Basin, similar to those designated ‘Epipalaeolithic’ (in the broadest sense) in Sahelian and Saharan West Africa (Clark 1976; Roset 1983; Vermet et al. 2007). Much of the region was submerged under Lake Megachad during the early Holocene, and the grasslands and river–lake networks of the modern southern Saharan and Sahelian zones would probably have been more attractive areas for settlement than the marshlands and woodlands south of Megachad at that time. Populations thus probably would not have been large, and indeed, we have almost no evidence of final Pleistocene/early

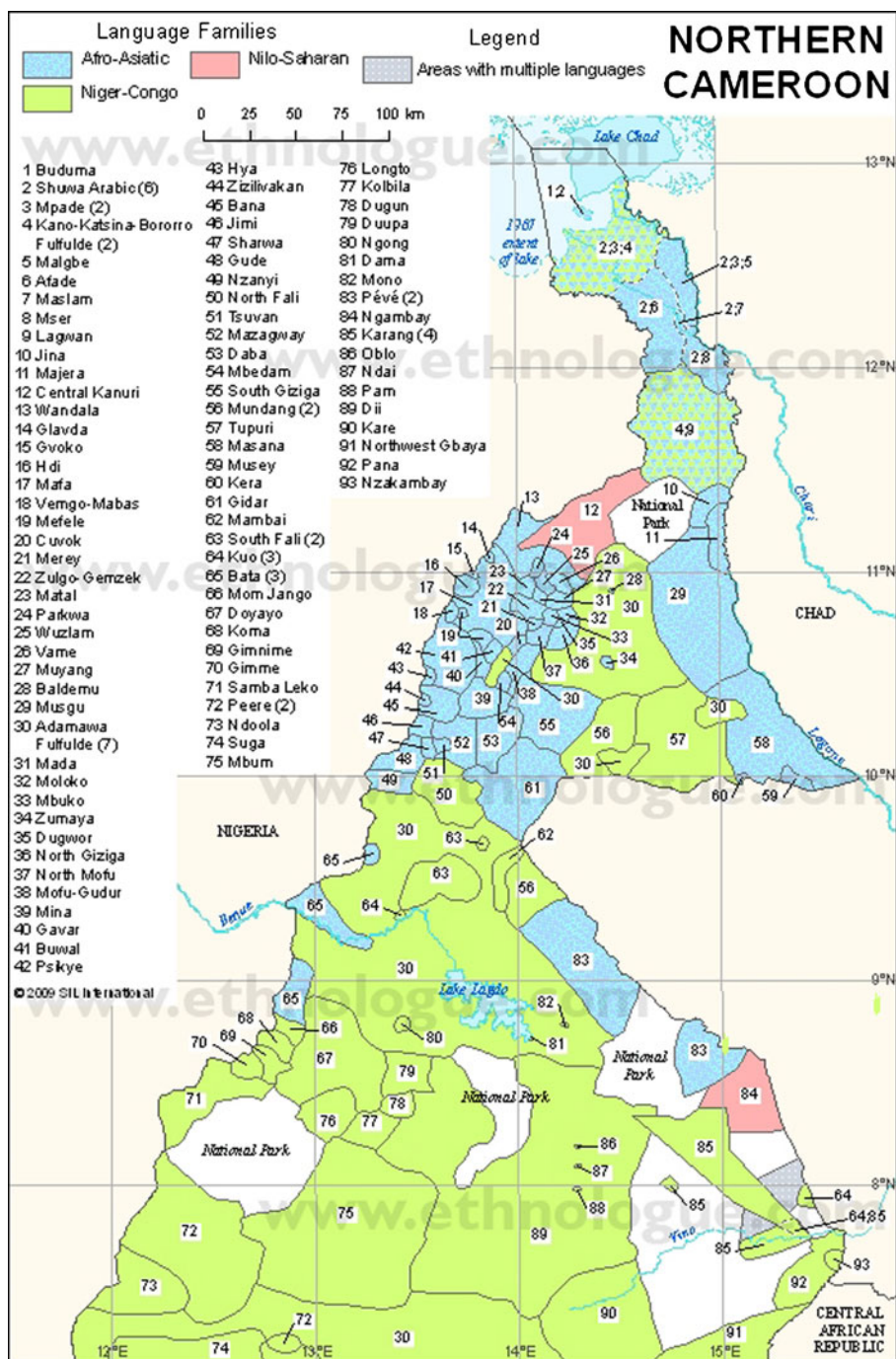
Holocene occupation from any part of the southern Lake Chad Basin (Marliac et al. 2000; MacEachern 2012b). This is also the case for the Middle Niger region to the west and the Wadi Howar to the east (McIntosh 1995: 373; Jesse & Keding 2007). It is possible that unsettled hydrological conditions deterred extensive settlement in all of these regions.

### **Background: Linguistics**

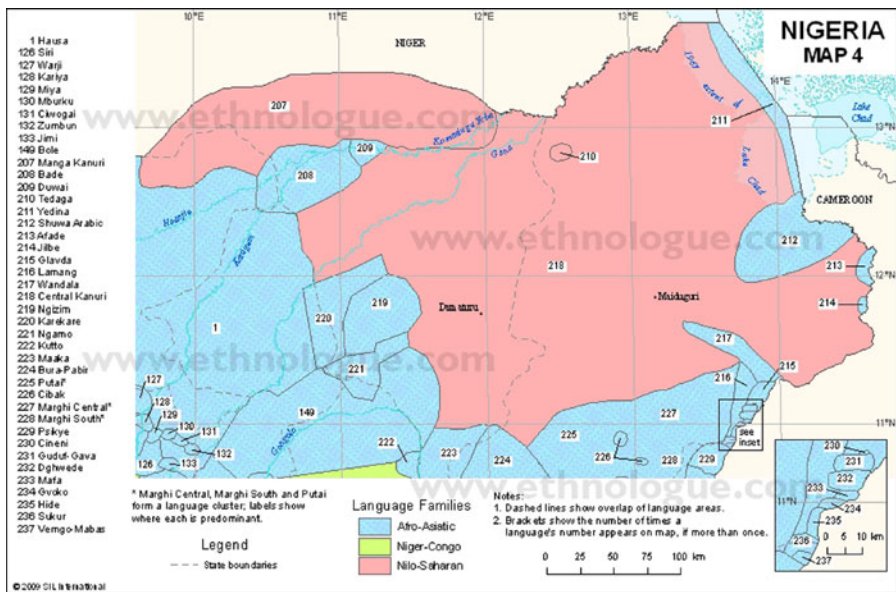
The southern Lake Chad Basin contains significant linguistic diversity today, with Nilo-Saharan (e.g., Saharan and Central Sudanic), Afroasiatic (Chadic, and latterly Shuwa Arabic), and Niger-Congo (Adamawa/Savanna, and latterly Fulfulde) found across the region, often in close proximity (Barreteau & Dieu 2000; Lewos 2009; Blench 2010). The existence of linguistic isolates like Laal and Jalaa in Chad and Nigeria, respectively (Blench 2010: 161–162); the uncertainty about the status of the Adamawa-Ubangian language family, especially the Ubangian languages (Dimmen-daal 2008); and the presence of Jarawan Bantoid languages in north-central Nigeria and Cameroon hint at the possibility of greater levels of linguistic diversity in the wider region in the Holocene, as well as the complexity of population movements in the region. The diversity and complex imbrication of languages from all of these different families in the southern Lake Chad Basin, perhaps not obvious in large-scale maps of African language families but very much evident on smaller scale linguistic maps of the region (Figs. 2, 3), testifies to complex processes of language contact and population movement that have been going on in this area for millennia (Barreteau & Dieu 2000; Lewos 2009).

There are few data available on the internal structure of the Adamawa language group, found to the south of the study area as well as along the Logone River, and still fewer on language contacts between Adamawan and either Nilo-Saharan or Chadic languages (Blench 2006). This dearth, combined with the paucity of archaeological data from the Benue Valley and Adamawa Plateau mean that even after 50 years of study, we can still say very little about prehistoric cultural relations between the Lake Chad Basin and regions immediately to the south. This is unfortunate, given the evidence for close relationships and even language shift between Adamawan- and Chadic-speaking populations in the region (see below), and the central role that this zone would have played in longer range contacts between the Lake Chad Basin and the forest and woodland zones of Central Africa.

Most of the groups living in and around the Mandara Mountains and on the plains between the mountains and Lake Chad speak Central Chadic languages today, with Kanuri and Fulfulde speakers occupying most areas where Chadic languages are not found (Barreteau & Dieu 2000). The latter language is a relatively recent addition to the area, associated with the spread of Fulani people over the last two centuries probably into areas previously occupied by Chadic speakers, but Kanuri has much deeper roots in the Lake Chad Basin. There is a good deal of disagreement about the position of Chadic within the broader Afroasiatic language family, with some researchers claiming that Chadic's closest linguistic relations are to the Berber languages of the Sahara (Ehret 2006a; Fleming 1983), whilst others claim a closer relationship with Cushitic languages in northeastern Africa (Blench 1999), a



**Fig. 2** Languages of northern Cameroon. Map is the property of SIL International and was accessed at [http://www.ethnologue.com/show\\_map.asp?name=CM&seq=30](http://www.ethnologue.com/show_map.asp?name=CM&seq=30). All rights reserved by SIL International



**Fig. 3** Languages of northeastern Nigeria. Map is the property of SIL International and was accessed at [http://www.ethnologue.com/show\\_map.asp?name=NG&seq=60](http://www.ethnologue.com/show_map.asp?name=NG&seq=60). All rights reserved by SIL International

distinction that has archaeological implications. The internal relations of the various Chadic language groups are reasonably well-accepted (Barreteau 1987; Newman 1977), with the status of the Masa language as a coordinate branch within Chadic the main point of contention. There seems to be a broad correlation between the linguistic affinities of the Chadic languages and their spatial patterning. Most Chadic languages are found in restricted territories and have relatively small numbers of speakers, with the expansion of Hausa through the last millennium as the most striking exception to this general pattern.

There is a remarkable diversity of Central Chadic languages spoken in the Mandara massif itself over very short distances, with extensive multilingualism facilitating interaction between different groups. This linguistic differentiation is central to the ethnic diversity of the area (MacEachern 2001b, 2002). These Chadic montagnard languages can be divided into a number of sub-groups (the Gbwata-Margyi, Wandala, Mafa, Mbuko-Pelasla, Daba and Kada groups especially), again with geographical positioning generally paralleling linguistic relationships. Chadic languages spoken in the northeastern and northwestern extremities of the Mandara Mountains are spoken in particularly small areas by particularly small numbers of people.

James Scott (2009: 7–8, 25) has written about the existence of ethnic “shatter zones” and areas of resistance and refuge on the peripheries of states in upland Southeast Asia characterised by extreme ethnic and linguistic diversity. In part, he bases this concept on African historical examples. Given the linguistic evidence and ethnohistorical data from the northern Mandara Mountains, it is hard to avoid the conclusion that this region is one such African “shatter zone.” The northeastern and northwestern extremities of the mountains were closest to the centres of local state

formation in the precolonial period (MacEachern *in press*) and thus most “shattered” in a linguistic sense. On the other hand, the fact that we find languages within these different Chadic montagnard groups noted above widely spoken on the plains around the Mandara Mountains well before the colonial period complicates this interpretation. Wandala became the language of an expansionist Islamic state after the eighteenth century. Before that, however, Wandala (including its Malgwa dialect) seems to have been spoken over fairly large areas on the plains north of the Mandara massif, as were the Margyi-Gbwata languages to the west in what is now Nigeria and Giziga-nord, Giziga-sud and Mbazla east of the mountains. The gradual and incomplete restriction of this group of languages to the Mandara Mountains over the last five centuries may then mark the gradual development of the Mandara “shatter zone” in relation to increasingly influential and predatory states in the area. The problem is, of course, that we cannot see what might have been earlier stages of that development in the relations amongst linguistic groups that may now have completely disappeared.

Given this linguistic diversity and the abundant ethnohistorical evidence for migrations in and around the Mandara Mountains, one goal in any comparison of archaeological, linguistic and genetic data for the region would involve increasing our understanding of how this complicated ethnolinguistic milieu developed. The degree of lexicostatistical resemblance between the different Chadic groups implies a significant time–depth for their differentiation (Barreteau & Dieu 2000; Tishkoff et al. 2009b: Supplementary Information). Given appropriate cautions about the inherent problems with using lexicostatistical data to estimate the timing of such linguistic processes, it still seems likely that the differentiation of these montagnard language groups was well underway by 2,000 years ago. As noted below, there continues to be significant disjuncture between linguistic and archaeological evidence for that peopling, even with recent archaeological evidence that people were beginning to occupy the Mandara massif at an earlier time than was previously thought (MacEachern 2012b; MacEachern et al. 2010). If people were beginning to move into the northern Mandara Mountains at the end of the first millennium BC, they left very little trace of their coming.

## Background: Genetics

The very high levels of ethnolinguistic diversity found in different parts of the southern Lake Chad Basin, greater than almost anywhere else in Africa, have made this region an attractive arena for genetic research on modern human populations.<sup>1</sup> This is particularly the case given that the region includes representation from three of the four African language phyla posited by Greenberg (1963). Unfortunately, some of this interest appears to be associated with the idea that Mandara montagnard populations are “paléonigritiques,” remnants of an earlier phase of human occupation of West Africa now surviving only in defensible (and primarily mountainous) refuge areas after being displaced by more advanced societies (Froelich 1964, 1968). This imprecise and impressionistic term was applied to diverse West and Central African

<sup>1</sup> To date, no work on ancient DNA has been undertaken in the Lake Chad Basin; research done in the Libyan Sahara failed to recover ancient DNA, probably due to environmental conditions (Ottoni 2009).

populations after World War II (Baumann & Westermann 1948), gathering small-scale societies that European outsiders saw as politically and culturally marginal into one ethnological designation. The *paléonigritique* concept was used by some geneticists working in the Mandara Mountains at the end of the twentieth century to describe montagnard populations (Spedini et al. 1999: 146).

We now have a significant number of studies on mtDNA, NRY and autosomal<sup>2</sup> genetic variation amongst a number of different southern Lake Chad Basin populations (Spedini & Destro-Bisol 1988; Rossi et al. 1991; Spedini et al. 1999; MacEachern 2001a; Spedini et al. 2001; Cruciani et al. 2002, 2010; Coia et al. 2005; Cerny et al. 2007, 2009; Tishkoff et al. 2009a; Cerezo et al. 2011). It is certainly the case that many regional populations have never been sampled at all, and in many instances, comparable data for these different genetic systems are not available for the same populations. One of the main challenges for a non-specialist in this field involves making sense of diverse results in circumstances where appraising the comparability of data sources requires technical knowledge. However, this work corresponds to a body of knowledge on genetic variability amongst diverse populations in a relatively small area that cannot be equaled in most parts of Africa. It has the potential to transform our understandings of human history in this area—especially when used in conjunction with data from archaeology and historical linguistics. The next section will provide some examples of such potential intersections of data.

## Intersections: Linguistics, Genetics and Archaeology

### Mid-Holocene Occupations

Ehret (2006b; see also Tishkoff et al. 2009b: 1041) posits on linguistic grounds that the present distribution of Chadic languages in the southern Lake Chad Basin may, in part, be the result of the widespread adoption by Nilo-Saharan speakers, previously occupying much of this area, of the languages of immigrant Chadic-speaking groups. Reconstructed elements of vocabulary suggest that both of these populations were herders and farmers, though possibly to differing degrees. Primarily on archaeological grounds, Ehret posits that these encounters would have taken place south of Lake Chad between approximately 6,000 BC and 5,000 BC. The Nilo-Saharan peoples were probably speakers of an ancestral Western Sahelian language most closely related to the modern Maban family, rather than a Saharan language such as Kanuri that is now important in the area. Such an adoption of Chadic languages by Nilo-

<sup>2</sup> *mtDNA* (or mitochondrial DNA) is DNA found in the mitochondria of humans and most other eukaryotic organisms. Since it is found outside the nucleus of cells, mtDNA is inherited only through one's mother, which allows the analysis of historical lineages of related mothers and daughters through time.

*NRY* is the Non-recombining Region of the Y chromosome. Most of the Y chromosome in human males cannot recombine with the X chromosome, and thus is passed inter-generationally only from father to son. It thus allows historical analysis of paternal lineages, analogous to the study of maternal lineages using mtDNA.

*Autosomal DNA* is any DNA which is not derived from sex chromosomes. Autosomal DNA is subject to recombination and so cannot be used for lineage-based genetic analyses like mitochondrial or NRY DNA. However, it can be used for biogeographic analyses of genetic relations between different human groups.



Saharan speakers would imply that cultural interactions between populations speaking these different languages were quite intense. These reconstructions parallel some recent genetic reconstructions in the region, which show genetic similarities between Chadic and Nilo-Saharan speakers (Tishkoff et al. 2009b), although those similarities are with Kanuri and Baghirmi populations, not still untested Maban ones. They are also not incompatible with other genetic reconstructions (Cerny et al. 2007; Cerny et al. 2009). Ehret's dating of these events is also generally consistent with genetic estimates for the time–depth of the L3f3 mitochondrial DNA lineage<sup>3</sup> associated with an initial demographic expansion of Chadic-speaking populations within the Lake Chad Basin (Cerny et al. 2009). At this point, a significant mass of genetic data points to a series of population movements and demographic expansions linking North Africa and sub-Saharan Africa in the early Holocene (e.g., Pereira et al. 2010), testifying to the opportunities afforded to human groups by the greening of the Sahara.

How does this accord with archaeology? First, it is important to note that there are actually disjunctures between the archaeological and linguistic data cited in this research. Thus, Ehret (2006b) notes lexical evidence for sorghum cultivation in proto-Chadic, presumably during the mid-Holocene, but no archaeological evidence exists for domesticated sorghum until thousands of years later. More importantly, reconstructions of linguistic affiliations for Chadic within Afroasiatic will also condition these reconstructions. If Chadic is most closely related to Berber, as Ehret (2006a) believes, then presumably we should be looking for the origins of Chadic languages to the north in the early/mid-Holocene 'Green Sahara,' perhaps amongst Capsian populations (Ehret 2006b). On the other hand, if Chadic is most close to Cushitic (Blench 1999), then the movement of ancestral Chadic speakers into the Lake Chad Basin might have come from the east, difficult to separate from other east–west population movements through the Sahelian zone notable in the genetic analyses (Cerny et al. 2007; Hassan et al. 2008; Tishkoff et al. 2009b). The latter finding of abundant evidence for east–west population movements south of the Sahara has very significant implications for archaeology, since the paucity of archaeological fieldwork between Lake Chad and the Nile (and indeed between Lake Chad and the Middle Niger) has conditioned researchers to emphasise the importance of north–south cultural connections and population flows in the prehistory of these parts of Africa.

We must also remember just how little archaeological evidence for human settlement there actually is in the southern Lake Chad Basin even as late as 6,000–5,000 BC, the period when intensive interactions between ancestral Chadic and Nilo-Saharan speakers were supposed to have taken place. Virtually the only known remains from this period are the Dufuna canoe and the lowest level of the Konduga site on the Bama Ridge, both in Nigeria. The affinities of the Konduga ceramics are certainly with contemporary Saharan pottery associated with herding communities, for example, from northwestern Sudan (Breunig et al. 1996). However, the marshlands and Sudanian woodland environments that would probably have covered the

<sup>3</sup> Mitochondrial (and other) DNA accumulates mutational changes at particular points along the DNA strands, which are then passed down through succeeding generations. These allow populations to be divided into different mtDNA lineages, which share a particular set of such mutational changes. The L3f3 lineage is found in different parts of the Lake Chad Basin. Lineages derived from the larger L3 group include virtually all non-African mtDNA types.

southern Lake Chad Basin at that time (Ballouche & Neumann 1996; Holmes et al. 1999; Wang et al. 2008) would not have been very suitable for herding, and in general, there was probably little scope for cultivation on the Bama Ridge or through most of the area southwest of Lake Chad in this period (Wendt 2007: 98). The Konduga site may have been the result of a fairly brief occupation by transient populations. It may, more generally, indicate one of two possibilities: (1) that the linguistic interactions between ancestral Chadic and Nilo-Saharan speakers took place at a later time (given uncertainties in dating estimates for both linguistics and genetics) in the southern Lake Chad Basin, when environments were drier, or (2) that such interactions took place in areas further to the north, or at any rate, away from Megachad (e.g., Dufuna), implying a much more complex and long-term process of movement of Chadic speakers into the southern Lake Chad Basin. This, at least, underlines the importance of palaeoenvironmental reconstructions in regions that have such complex environmental histories (Drake & Bristow 2006; Kropelin 2009).

Extensive archaeological evidence for human occupation and food production in the southern Lake Chad Basin dates only to some 4,000 years later, with the Gajiganna sites southwest of Lake Chad after about 1,800 BC (Breunig et al. 2001; Breunig & Neumann 2002; Wendt 2007). We would expect on linguistic grounds that by this time both Chadic and (Western Sahelian and Saharan) Nilo-Saharan languages would have been well established in the region, but in fact, this initial extensive occupation seems to be from people colonising the plains opened up by the shrinking Lake Megachad. The cultural affinities of Gajiganna ceramics are traceable over a wide area of the southern Sahara and neighbouring regions, with perhaps the most similarities to material from northwestern Niger and northwestern Sudan (Wendt 2007: 86–87). The complex patterns of ceramic similarity and difference over this large part of the continent in the mid-Holocene (cf. Livingstone Smith 2007) certainly imply significant long-distance contact, interchange and social manoeuvring, but make it difficult to identify this initial colonising population with any particular linguistic group. A number of sites located near the Mandara Mountains in Cameroon and Nigeria also date to the second millennium BC, and ceramics recovered from these sites are generally similar to Gajiganna pottery (MacEachern 2012b).

What of the economies of these groups moving into the southern Lake Chad Basin? The linguistic evidence would suggest that they were herders and cultivators (Ehret 2006b), but here we have a problem: the Gajiganna occupations have been intensively studied by archaeobotanists (more so than most archaeological traditions in West Africa), and there is no evidence of the use of domesticated cereals (*Pennisetum* millet) before about 1,200 BC (Klee et al. 2000; Neumann 2003; Klee et al. 2004). These data suggest that the communities initially pursued what, in more recent times, would be an unusual economy, combining herding with the gathering of the wild grasses that are extraordinarily abundant in the area. We should note the diversity of economies known from the region more recently, ranging from broad-spectrum foraging to specialised fishing/cattle pastoralism to intensive terrace agriculture (Seignobos & Iyebi-Mandjek 2000; Heiss and Dehnhard 2009; Nicolaisen 2010). It is not impossible that the Gajiganna economy represents a specialised version of an earlier, more generalised foraging/farming adaptation, the latter perhaps existing north of Lake Megachad in areas that have not been studied archaeologically. In that case, the absence of cereals might be associated with initial colonisation of still seasonally

inundated environments. However, at some point, Occam's Razor should be invoked: there does not appear to be a dramatic change in environment during the 600-year period between the initial appearance of the Gajiganna sites and the adoption of domesticated millet by Gajiganna people. It is hard to avoid the conclusion that archaeological and linguistic reconstructions for mid- and late-Holocene culture history in this area lead to very different results. If there were intense interactions between Chadic- and Nilo-Saharan-speaking communities in the Lake Chad Basin during the mid-Holocene, they might have taken place further to the north; colonisation of lands south of the lake probably involved other cultural trajectories.

### Late Holocene Intensification and Diversification

The picture after 1,000 BC south of Lake Chad looks rather different, as environments in the region trended toward modern (and more arid) conditions and with the progressive appearance of different food-producing traditions. These are: a continuation of the Gajiganna tradition (Magnavita et al. 2004), populations initially colonising the heavy *firki* clay plains south and southeast of the lake (Lebeuf 1969; Connah 1981; Groenenborn et al. 1996), the appearance of farming communities on the Diamaré plain east of the Mandara Mountains (Marliac et al. 2000), and expanded settlement around the Mandara Mountains themselves (MacEachern 2012b). This increase in the extent and intensity of human occupation probably involved communities speaking a variety of languages ancestral to the modern ones from the region and looks far more like the kind of cultural encounters indicated in the linguistic evidence accumulated by Ehret (2006b). The problem is, of course, that it occurs 4,000 years later than the estimates for the timing of those linguistic processes.

A number of important material changes are evident in the archaeological record of the southern Lake Chad Basin after 1,000 BC. Fibre-roulette decoration of various sorts becomes increasingly important on local ceramics through all of the sub-regions noted above. Africanist archaeologists have frequently tried to correlate roulette types with ethnolinguistic identities, but the patterns in the late Holocene spread of rouletting informatively analysed by Livingstone Smith (2007) show no evident relationship between material culture, genetics and large-scale language distributions: it appears that the origins of these decorations lie in the Tichitt-Méma-Niger Bend area and that they subsequently spread into the Lake Chad Basin from the west as part of a much larger process through which they would eventually be found (in many varieties) between the Atlantic and East Africa. The modern distribution of fibre-roulette sub-types in the area does not map onto major language families very well at all (Langlois 2005), and the prehistoric distribution is complex. The period after 1,000 BC was also one of increasing site size and intensity of occupation across the southern Lake Chad Basin (Lebeuf 1969; Marliac et al. 2000; Holl 2001; Magnavita et al. 2010; MacEachern 2012b), almost certainly associated with the development of more intensive agricultural systems, the spread of more productive crops like sorghum and increased levels of sedentism. From the archaeological evidence, it seems to be after about 500 BC that the region began to take on cultural characteristics that we would recognise there today.

How did the ancestors of modern populations participate in these processes? Genetically, the present northern Mandara montagnard and closely related Chadic-speaking

populations for which genetic data are available (Zulgo, Mada, Podokwo, Ouldémé and Mandara/Wandala) form a relatively tight genetic cluster (Tishkoff et al. 2009b), though with considerable variability in particular genetic systems (cf. Cerny et al. 2004; Wood et al. 2005a). Thus, the frequency of the very rare (in Africa) R-P25\* NRY sub-clade varies from about 61 % for Mandara/Wandala to 69 % for Ouldémé, who live 10 km south of the Wandala capital at Mora, and 95 % for Podokwo, who live about 7 km southwest of Mora (Wood et al. 2005b: Supplementary Information). It is also found in similar frequencies (67 %) amongst Tupuri populations. The utility of this marker in population studies has been questioned (Adams et al. 2006), but if taken as an accurate reflection of ancient population contacts, it would imply a significant male contribution to these populations ultimately from West Asia and the Nile Valley. Such biological relationships probably would have originated in the early Holocene when higher levels of rainfall would have ameliorated movements across the Sahara and along the Nile Valley. NRY data have not yet been collected for most Chadic populations, which may explain the disjuncture in distribution of R-P25\*. Given the abundant ethnohistorical evidence for a diversity of origins within even small Mandara montagnard populations, the processes of selection of individuals for genetic analysis is almost certainly going to introduce some degree of bias into the process of collecting genetic material for analysis. Thus, for example, the Ouldémé group, about 12,000 strong, includes communities claiming at least eight different points of origins in the Mandara Mountains and beyond over the last two to four centuries (MacEachern 2003 [1991]: 394).

The linguistic relationships between the Mandara montagnard Chadic languages indicate a period of initial differentiation by the end of the first millennium BC at least (Barreteau & Dieu 2000; Tishkoff et al. 2009b: Supplementary Information, Fig. 30j). This initial differentiation of ancestral Chadic montagnard languages might have been associated with the intensification of plains settlement around the Mandara Mountains by the ancestors of those montagnards or with the initial occupation of the mountains themselves, possibly associated with the retreat of Sudanian woodlands in the first millennium AD (MacEachern 2012a). Although earlier reconstructions saw the northern Mandara Mountains as substantially uninhabited until about 500 years ago, making reconciliation of archaeology and linguistics difficult, at least some portions of the massif were occupied not much after AD 1,000 (MacEachern 2012a), with the likelihood of earlier settlement. There are some similarities between linguistic and ceramic distributions in this area, although the level of dynamism in pottery production and distribution in recent periods makes such comparison difficult (MacEachern 2003 [1991]). To this point, there are too few genetic data to make any firm statements about genetic and ethnolinguistic relations in the Mandara Mountains themselves, although the available data certainly do not support claims by some geneticists that contiguous montagnard populations were largely isolated from one another (contra Spedini et al. 1999; cf. Coia et al. 2009). The Mandara/Wandala position as an outlier in the Mandara Mountain Chadic distributions (Tishkoff et al. 2009b) may be associated with higher levels of intermarriage with non-Chadic-speaking communities, given the development of a Mandara/Wandala state to the north of the Mandara Mountains after the sixteenth century AD.

If genetic and linguistic relations amongst Mandara montagnard communities seem at least somewhat straightforward, the same cannot be said for the plains to

the north and east of the Mandara massif. In that area, speakers of a number of Afroasiatic (both Chadic and Semitic [Baggara Arab]), Nilo-Saharan (Saharan [Kanuri/Kanembu] and Central Sudanic [Bulala]) and Niger-Congo (Adamawa) languages share a general genetic identity comparable to that of Mandara montagnard groups (Tishkoff et al. 2009b). There are some striking cases of genetic similarity associated with linguistic difference. Ethnolinguistic groups like the Tupuri, for example, seem to be essentially Chadic populations (with, as noted above, elevated percentages of the unusual R-P25\* motif shared with Mandara montagnards) that have adopted an Adamawa language, an observation in line with some linguistic data (Seignobos & Tourneux 2001). Such genetic similarities amongst very disparate language groups are quite striking. Indeed, there seem to be more such cases in the Lake Chad Basin than anywhere else in Africa according to the Tishkoff data, underlining the status of the region as a crossroads in this part of Central Africa. It would be extremely useful to have more genetic data on central Mandara montagnard populations like the Mofu, Mafa and Kapsiki who, on ethnohistorical terms, may have had more interaction with plains populations than those communities living in the northeastern Mandara Mountains. Recent mtDNA data for Mafa, Masa, Buduma, Hide and other populations (Cerezo et al. 2011) indicate a variety of external connections for these groups, including to North and East Africa, although at this point more detailed, local connections are difficult to detect.

## Chronologies

Researchers interested in multidisciplinary collaboration involving archaeology, linguistics and genetics need to pay much more attention to issues of chronology and comparability of chronological reconstructions. Archaeologists working in the Holocene have significantly more precise techniques for dating prehistoric occurrences and processes available to us, especially through radiocarbon dating, than do either linguists or geneticists working in the same period. This constrains our interpretations in valuable ways, making possible more sophisticated chronological models with finer time divisions, which is why both historical linguists and geneticists routinely make use of archaeological data in testing their reconstructions. Discussions of estimations of divergence times for linguistic communities (Renfrew et al. 2000; and see especially Ehret 2000) are probably much better known to archaeologists than are equivalent discussions on divergence times and mutation rate estimates in human genetics (see amongst many examples Arbogast et al. 2002; Henn et al. 2009), but the latter are extremely important and becoming more important through time. Estimates of the timing of genetic processes of population divergence or admixture appear to be critically subject to the specific characteristics of the genetic loci under study as well as the demographic history of the population(s) involved. Although in many cases, only median ages are widely reported or used in attempts to compare genetic with archaeological data, genetic studies usually come with very wide confidence intervals—in the case of a number of the papers cited in this article, for example, the 95 % confidence intervals (or equivalent) span all or most of the Holocene! This obviously makes these studies far less useful for multidisciplinary research.

Although recent research initiatives, many involving whole-genome scanning, are improving the precision of time estimates made in the course of genetic research (e.g., Price et al. 2009; Pugach et al. 2011), significant discrepancies between genetic and archaeological data still exist in many cases (e.g., Wollstein et al. 2010). Given that radiocarbon dating depends upon a fairly well-understood physical process, whilst both linguistic and genetic chronological reconstructions involve inferences about population histories and linguistic and biological processes that are not well-constrained physically, the greater precision of archaeological chronologies is likely to continue. Archaeologists need to make some effort to understand the limitations, assumptions and innovations in chronological reconstructions in these different fields, especially since our data are so often being used beyond archaeology.

## Conclusions

This concludes a limited and rather uneven examination of some of the intersections between archaeological, genetic and linguistic data on the Holocene occupation of the southern Lake Chad Basin. It is meant more as an initial consideration of some of the issues on the ground, and I hope as a spark for further research. Such a survey militates against firm and elaborate conclusions, but there are a number of observations stemming from this survey that may prove useful. The first is that linguistic and genetic reconstructions are potentially extraordinarily valuable to archaeologists working in this part of the continent, moving us away from the details of our particular sites and forcing us to think about broader regions and human interactions in ways that we sometimes forget to take into account. As I noted above, archaeological reconstructions of West and Central African culture history in the early/mid-Holocene emphasise north–south interactions between Saharan and sub-Saharan areas whilst more or less ignoring the importance of east–west interactions, especially east of Lake Chad—in part, because relatively few data exist in that region. Genetic and linguistic data offer a valuable corrective, demonstrating the importance of movements in just the areas where we might expect, through the east–west trending environmental bands between desert and forest. Different relationships between genetic and linguistic identities amongst montagnard and plains-dwelling populations may provide insights into processes of cultural interaction and acculturation in these areas in the past.

On the other hand, archaeology can serve to anchor linguistic and genetic reconstructions in local realities, in the details of chronologies, environments, occupations and materials. When identifying cultural processes in the southern Lake Chad Basin at a particular time, for example, we have to ask ourselves to what extent environments would have supported those processes in those times and places. It is unlikely that herders and farmers would have intensively occupied marshlands, absent significant external pressures. Similarly, an absence of archaeological evidence for a place and time when linguistics indicates intensive human occupation remains an anomaly to be investigated. In a different vein, most researchers would agree that ceramic variability across West Africa through the Holocene would not map on to linguistic/genetic identities in any simple way—but the complexity of that material variation underlies just how varied cultural interactions probably were during that period.

Researchers in all three disciplines need to pay much more attention to issues of chronology and to the comparison of chronological reconstructions across disciplinary boundaries. Careful comparison of archaeological, linguistic and genetic data for the Lake Chad Basin has the potential to provide us with a significantly enhanced understanding of the dynamics of human population history in the region. The emphasis in that last, hortatory sentence must be on the initial word, ‘careful,’ and researchers in all of these disciplines evidently have some work to do in teaching others the opportunities and limitations of their own research approaches.

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