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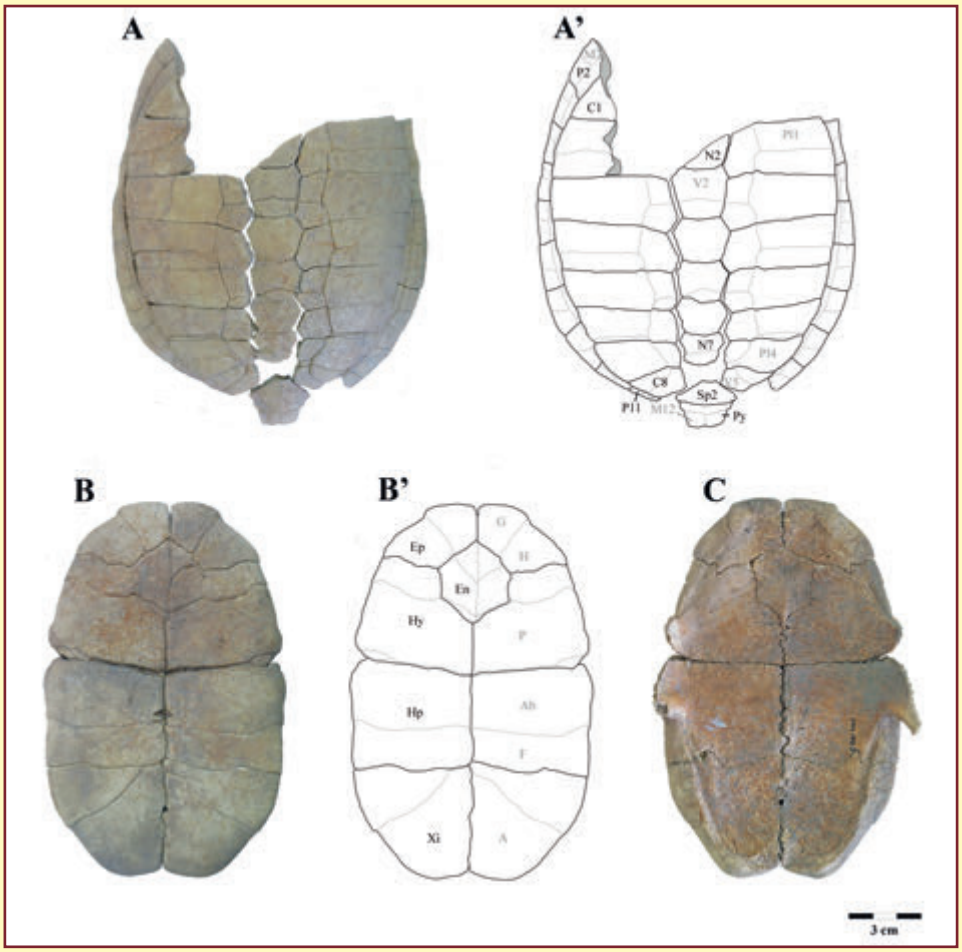

VOLUME 31 https://doi.org/10.15366/archaeofauna2021.31 October 2022

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Revista incluida en las bases de datos ICYT (CINDOC), Catálogo Latindex, Zoological Record, The Arts & Humanities Citation Index y Current Contents / Arts & Humanities (JCR)

ARCHAEOFAUNA
Laboratorio de Arqueozoología. Depto. Biología.
Universidad Autónoma de Madrid
Cantoblanco 28049. Madrid. España

Editor: Eufrasia Roselló Izquierdo
Editor Adjunto / Assitant Editor: Laura Llorente Rodríguez
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ISSN - 1132-6891

ARCHAEOFAUNA

INTERNATIONAL JOURNAL OF ARCHAEOZOOLOGY

Volume 31 https://doi.org/10.15366/archaeofauna2021.31 Octubre 2022

Depósito Legal: M. 30872-1992

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Imprime:
ImpresiónA2

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Archaeofauna 31 (2022): 57-75

Subsistence strategies in the Inner Congo Basin since the 14th century AD: the faunal remains from Nkile and Bolondo (DR Congo)

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(Received *28 April 2021*; Revised *30 June 2021*; Accepted *22 December 2021*)

ABSTRACT: The faunal remains are described from Nkile and Bolondo, two archaeological sites in the equatorial rainforest of the Democratic Republic of Congo. Both river-side settlements, located in the Ruki-Tshuapa basin and dating to between the 14th century to the second half of the 20th century, show a heavy reliance on aquatic food resources. The animal remains show that fishing was a major subsistence activity, whereas hunting, slaughtering of domestic stock and harvesting of molluscs were less frequent activities. The contribution to the diet of the different animal taxa suggested by the zooarchaeological data is in line with recently published stable isotope results obtained on humans and animals from Bolondo. The type of fish, and in particular their reconstructed sizes, show that the major exploited fishing grounds were shallow waters that became accessible during the low water seasons (nowadays July-August and a minor season in March at both sites). The proportions of the exploited fish taxa are comparable to those marketed nowadays in larger urban centres. Juvenile fish, and to some extent, small crocodiles, were heavily exploited but it is argued that at the time this was still a sustainable activity that did not deplete the fauna as much as today since human populations were smaller and the fishing gear less effective.

KEYWORDS: RAINFOREST, SUBSISTENCE, FISHING, AFRICA, ZOOARCHAEOLOGY

RESUMEN: Se describen aquí los restos de fauna de Nkile y Bolondo, dos yacimientos arqueológicos en la selva tropical de la República Democrática del Congo. Asentamientos fluviales en la cuenca del Ruki-Tshuapa que datan entre el siglo XIV hasta la segunda mitad del siglo XX, evidencian una dependencia intensa sobre los recursos acuáticos. Los restos demuestran que la pesca fue una actividad de subsistencia preferente mientras que tanto la caza como el sacrificio de animales domésticos y la recolección de moluscos eran actividades menos frecuentes. La contribución a la dieta de los distintos taxones animales que la evidencia zooarqueológica pone de relieve, concuerda con los resultados de isótopos estables recientemente publicados sobre los restos humanos y de fauna de Bolondo. Los tipos de peces, y particularmente las tallas que inferimos de los mismos, demuestran que las zonas principales de pesca fueron siempre aguas someras que serían accesibles durante la estación seca (actualmente entre julio y agosto con un

https://doi.org/ 10.15366/archaeofauna2021.31.002

pico secundario en el mes de marzo en ambos sitios). Las proporciones de los taxones ictiológicos explotados resultan comparables con las actualmente comercializadas en los grandes centros urbanos. Los peces juveniles, así como los pequeños cocodrilos, eran explotados de modo sistemático si bien concluimos que en aquellos momentos ello constituía una actividad sostenible que no mermaba la fauna como hoy lo hace al ser las poblaciones humanas mucho más restringidas que las actuales y los aparejos de pesca menos efectivos.

PALABRAS CLAVE: SELVA TROPICAL, SUBSISTENCIA, PESCA, AFRICA, ZOOARQUEOLOGÍA

INTRODUCTION

The Congo Basin, in particular its central part, is one of the least known regions in Africa from an archaeological and bioarchaeological point of view. This is partly due to the environmental characteristics of the region, i.e. a dense tropical rainforest with large floodplains where archaeological prospection is hampered by the lack of ground visibility. Moreover, for practical reasons, archaeological surveys have this far been carried out along rivers leaving the archaeological map blank of interfluvial sites (Eggert, 2014; Cornelissen, 2015). Most of the field work has been done by two teams in this region that was mainly archaeological *terra incognita* before the second half of the 1970s (Smith *et al*., 2017: 1). Within the framework of the *River Reconnaissance Project* directed by Manfred Eggert (then University of Hamburg), excavations took place in the western and central part of the Congo Basin where both Nkile and Bolondo – the sites dealt with in this paper – are located (Eggert, 1983; Wotzka, 1995). The eastern part of the Congo Basin has been surveyed between 2010 and 2013 by the missions of the Royal Museum of Central Africa, Tervuren (Smith *et al*., 2017). These efforts led to the establishment of a relative chronology for the last two and a half thousand years based on ceramic styles combined with radiocarbon dates anchoring it in time (Wotzka, 2006; Eggert, 2014; Smith *et al*., 2017). Fauna is poorly or not preserved at all on the sites in the study region (Van Neer, 1990), making the assemblages from Bolondo and Nkile quite unique (Figure 1). After a taphonomical evaluation, the faunal remains described below are interpreted from a palaeo-economical point of view with a particular emphasis on the fishing practices.

MATERIAL

The first excavations at Bolondo took place in 1983 during the *River Reconnaissance Project* while the most recent fieldwork, led by Hans-Peter Wotzka, was conducted in 2016 (Bleasdale *et al*., 2020). Bolondo is a fishing camp, a so-called *longanda* (plur. *nganda*), located on the right bank of the Tshuapa River, that is inhabited up to the present day. The occupation of *nganda* is typically seasonal, but nowadays Bolondo has sufficiently risen above the river to be out of reach of the water permitting the place to be occupied all year round. This location of the site in the floodplain, directly adjacent to the riverbank, combined with the house construction techniques – light structures on artificial mounds – has led to a waterlogging phenomenon. Layers of white river clay, used as flooring, alternate with layers of archaeological material allowing the organic material, both faunal and botanical, to be much better preserved than on higher ground sites (Bleasdale *et al*., 2020).

The faunal remains from Bolondo are from two human graves and from several trenches corresponding to settlement contexts. About two thirds of the hand-collected bones (around 200 remains) are from the 1983 excavation campaign during which also several human burials were uncovered (Wotzka, 1995). Five individuals from these graves were radiocarbon dated, placing the burial period between the 15th and 20th centuries AD (Bleasdale *et al*., 2020). Thanks to fine sieving during the 2016 campaign, numerous faunal remains were retrieved from the residues that served initially for archaeobotanical analysis. Samples were taken from each archaeological layer in two pre-excavated 1x1m trenches (Trench 1 and Trench 5), each of which was extended by 0.25 m^2 for this purpose. Wherever possible 10 litres of sediment were taken (2 l for the thinnest layers) for a total of 160 litres that

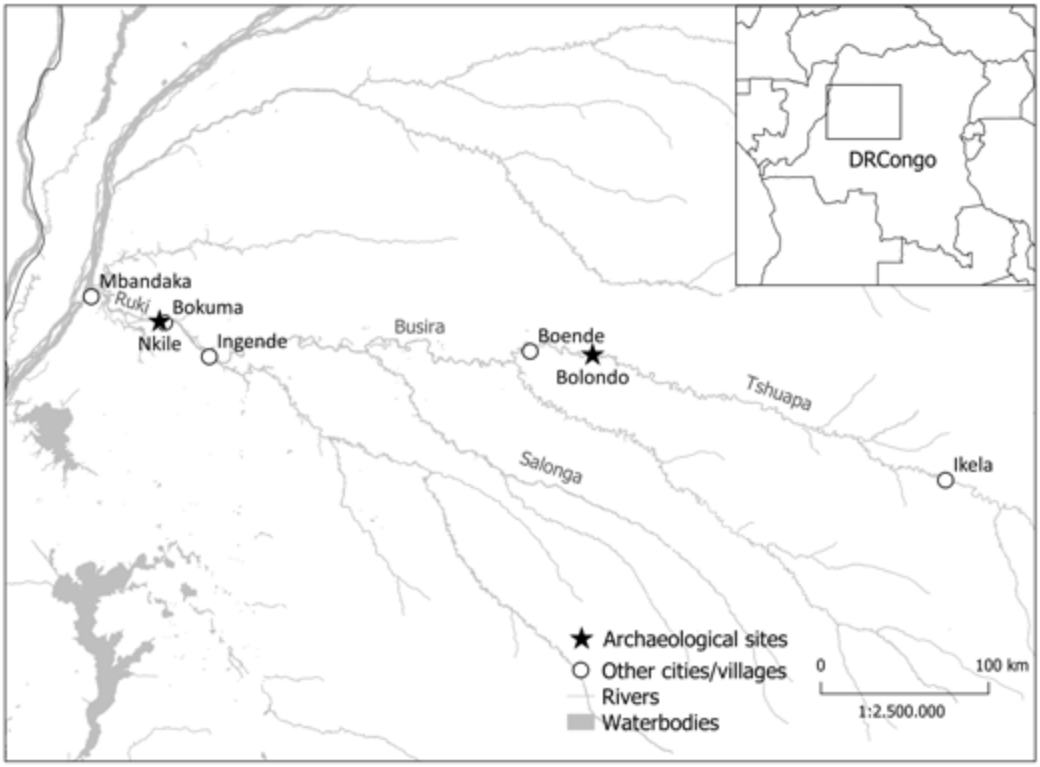

FIGURE 1

Map of Central Africa indicating the major watercourses and the localities mentioned in the text.

were first flotated and then tower sieved through 2.5 mm and 1 mm meshes (Bleasdale *et al*., 2020). Through this process, more than 7000 faunal remains (mainly fish) were retrieved. For the purpose of this paper, the material coming from the 2016 campaign has been grouped into phases based on the ceramic finds. Trench 1, that yielded only a small part of the entire faunal assemblage, was divided into three phases, all of them associated with the so-called Bolondo Group. The first phase, comprising the upper layer, was associated with both the Bolondo Group and the Ilemba-Bokonda Group, the latter being chronologically situated in the 20th century. The second phase was mainly associated with the Bolondo Group, radiocarbon dated to around AD 1400-1600. The third and oldest phase was associated with the Bolondo Group and the Bosanga Group, dated between the 14th and 15th centuries AD. Most of the faunal material comes from Trench 5 that has a longer stratigraphy and that yielded a more varied set of ceramic groups. The first and most recent phase of Trench 5 is associated with Ilemba-Bokonda ceramics. The most recent finds of these upper layers date to the second half of the 20th century. The second phase that is associated mainly to the Bokone Group, also yielded a few Bolondo and Wema sherds, dating this phase approximately to the 19th century and somewhat before. The third phase is associated mainly with the Bolondo Group with a few sherds of the Bosanga, Wema and Inkaka Groups. In addition to the relative chronology, a few radiocarbon dates are available that place this occupation in the 16th century AD. The fourth phase, finally, is associated to ceramics of the Wema Group and has been radiocarbon dated to the 14th and 15th centuries AD (Wotzka, 1995; Neumann *et al*., 2022).

An assemblage of around 200 hand-collected remains is available from Nkile, a site along the Ruki river that was excavated during the 1977-78 field season (Eggert, 1983; Wotzka, 1995). This village, located about 3 km downstream of Bokuma, was abandoned around AD 1915. Immediately adjacent to the river shore, three trenches were excavated with the following dimensions: NKI 2: 150 x 350 cm; NKI 3: 100 x 200 cm and NKI 6: 150

x ca. 250 cm. Another trench, NKI 4, excavated about 30 m farther inland and measuring 100 x 100 cm, yielded only one animal bone. The excavations were carried out in artificial spits but for the present faunal analyses, all the animal remains have been lumped as the archaeological material was strikingly homogenous throughout the different levels. The ceramics found in the Trenches 2, 3 and 6 overwhelmingly belong to the Botendo Group. The start of this ceramic group is unclear, but the material no doubt comprises the entire 19th century. The deposits of which the fauna are studied correspond to the youngest occupation phase of the village, until it was given up at the beginning of the 20th century. The sole animal bone from NKI 4, which yielded a more mixed assemblage in its lower layers, possibly belongs to an older phase than the material from the other trenches.

METHODS

The faunal remains were identified with the aid of the comparative collections housed at the Royal Belgian Institute of Natural Sciences. For each taxon the skeletal elements were noted and in the case of fish a size reconstruction was carried out on the basis of sufficiently well preserved bones. Each bone was directly compared to modern specimens of known length and the size estimations were expressed in centimeters standard length (SL), i.e. the length of the fish from the tip of the snout to the base of the tail. For the quantification, number of identified specimens (NISP) were noted and the minimum number of individuals (MNI) was established. It should be underlined that the modern fish skeletons available for comparison are mainly from specimens acquired from the Egyptian and Sudanese Nile, the Niger and the Senegal rivers and with only few fish from more southerly basins. The present-day ichthyofauna of the study region, although still poorly known (Monsembula Iyaba & Stiassny, 2013; Sonet *et al*., 2019), comprises numerous taxa that are not available in our reference collection. An impression of the wealth of species present in the Ruki basin is given in the checklist of FishBase (https://www.fishbase.de/trophiceco/FishEcoList.php?ve_code=815, accessed 16th April 2021). Information on the occurrence of species and their ecology mentioned in the descriptions below was taken from FishBase, unless stated otherwise. Because of the species richness of the ichthyofauna, identifications of the archaeological material often did not go beyond family level. In a few instances measurements could be taken of the mammal remains and this was done according to the guidelines of Driesch (1976).

THE FAUNAL REMAINS

Bolondo

Besides the abundant faunal remains found in the settlement (Table 1), Bolondo also yielded a smaller amount of hand-collected finds associated to two human burials. The sole faunal element found in the grave of Individual 2, was a maxillary tooth of a small antelope. This tooth was probably not intentionally placed in the burial and may be considered as background fauna that was already present in the sediment when the grave was dug. In the burial of Individual 1, a small crocodile humerus occurs which can probably also be considered as an intrusive element. However, the 27 teeth, mainly canines with their roots artificially pierced, are clearly grave goods and presumably were part of a necklace. Sixteen of these teeth are from a canid, most probably dog since there are no wild canids living in forested areas. Ten other specimens resemble felids, the size of a domesticated cat, but a precise identification is difficult. One other tooth may be an incisor of a monkey (Cercopithecidae).

The hand-collected faunal remains from the settlement contexts of Bolondo consist of only 76 fragments whereas the total NISP from the sieved fractions is almost 2600. Of the 75 mollusc remains found in the settlement only two were sufficiently preserved to permit an identification as *Limicolaria*. One specimen allowed measuring its height (34 mm) and the other one still had its colours preserved, suggesting that it is a rather recent shell. Among the unidentifiable molluscs are both gastropods and bivalves.

The fauna from Bolondo, like that of Nkile, is dominated by fish remains. The identification was not only hampered by the limited reference material, but also by the small average size of the fish recovered from the sieved samples which made manipulation of the remains and observation of their morphological characteristics difficult. In the case of the vertebrae, identification appeared in addition extremely difficult as we were often dealing with

young individuals in which diagnostic characters were not always clearly developed. This explains why the majority of the unidentified fish in Table 1 are vertebrae. Of the 15 fish taxa that are found in the sieved samples there are only seven occurring in the hand-collected material. It is clear that the most abundant fish taxa in the hand-collected fauna are the same as those that are frequent in the

	Total HC	**Trench 1**			**Trench 5**				**Total sieved**
		Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3	Phase 4	
Limicolaria sp. (garden snail)	**2/2**	-	-	-	-	-	-	-	**-**
Protopterus cf. *dolloi* (lungfish)	**7/4**	-	-	-	1/1	-	4/3	-	**5/4**
Polypterus sp. (bichir)	**2/2**	-	19/3	3/1	320/2	160/3	497/10	66/3	**1065/22**
Heterotis niloticus (African bonytongue)	**-**	-	-	-	3/1	-	-	-	**3/1**
Mormyridae (elephantfish)	**-**	-	1/1	1/1	13/2	3/2	9/4	17/2	**44/12**
Cyprinidae (minnows)	**-**	-	-	-	1/1	-	4/2	7/1	**12/4**
Distichodus sp. (distichodus)	**-**	-	-	-	1/1	-	-	1/1	**2/2**
Distichodus sp./*Citharinus* sp. (distichodus/moon fish)	**-**	-	-	-	4/1	4/1	1/1	-	**9/3**
Hydrocynus sp. (tiger fish)	**-**	-	-	-	-	1/1	-	-	**1/1**
Alestidae (African tetras)	**-**	-	-	-	23/2	1/1	3/3	2/2	**29/8**
Chrysichthys sp. (claroteid catfish)	**-**	-	-	-	-	2/2	-	-	**2/2**
Clariidae (clariid catfishes)	**10/9**	-	4/4	10/4	67/22	10/7	66/34	50/25	**207/96**
Synodontis sp. (squeaker catfish)	**4/3**	-	1/1	-	15/2	5/1	41/16	44/13	**106/33**
Schilbeidae (schilbeid catfishes)	**-**	-	-	-	3/1	-	-	-	**3/1**
Siluriformes (catfish)	**7/4**	4/1	50/15	35/8	185/14	106/11	279/30	221/30	**880/109**
Cichlidae (cichlids)	**6/2**	-	4/4	1/1	38/8	20/5	52/16	29/7	**144/41**
Lates sp. (lates perches)	**1/1**	-	-	-	1/1	-	-	-	**1/1**
Parachanna sp. (snakehead)	**9/5**	-	-	-	12/3	1/1	-	7/5	**20/9**
Serpentes (snakes)	**-**	-	-	-	18/1	4/1	7/1	6/1	**35/4**
Crocodylidae (crocodile)	**8/4**	-	-	-	-	2/2	7/1	-	**9/3**
Testudines (turtle)	**1/1**	-	-	-	-	-	-	-	**-**
Rodentia (rodent)	**-**	-	2/1	3/1	-	-	3/1	2/1	**10/4**
Cercopithecidae (monkey)	**1/1**	-	-	-	-	-	-	-	**-**
Canis lupus f. familiaris (dog)	**1/1**	-	-	-	-	-	-	-	**-**
Carnivore, fox size	**2/2**	-	-	-	-	-	-	-	**-**
Carnivore, dog size	**1/1**	-	-	-	-	-	-	-	**-**
Suid	**1/1**	-	-	-	-	-	-	-	**-**
Suid?	**1/-**	-	-	-	-	-	-	-	**-**
Cephalophus nigrifrons (black-fronted duiker)	**1/1**	-	-	-	-	-	-	-	**-**
small antelope	**3/3**	-	-	-	-	-	-	-	**-**
Tragelaphus spekii (sitatunga)	**1/1**	-	-	-	-	-	-	-	**-**
medium-sized antelope	**1/1**	-	-	-	-	-	-	-	**-**
Capra aegagrus f. hircus (goat)	**2/2**	-	-	-	-	-	-	-	**-**
small bovid	**3/-**	-	-	-	-	-	-	-	**-**
large bovid	**1/1**	-	-	-	-	-	-	-	**-**
total identified	**76/52**	4/1	81/29	53/16	705/63	319/38	973/122	452/91	**2587/360**
unidentified molluscs	**10**	2	2	9	56	9	-	-	**78**
unidentified fish	**62**	1	15	9	206	122	291	138	**782**
unidentified mammal	**35**	-	1	-	6	1	2	2	**12**
unidentifiable (mainly fish)	**15**	27	299	95	536	543	1800	657	**3957**
total unidentified	**122**	30	317	113	804	675	2093	797	**4829**

TABLE 1

Species list of the settlement contexts from Bolondo, indicating the Number of Identified Specimens (NISP) and the Minimum Number of Individuals (MNI) in the hand-collected (HC) and sieved material. The figures in the columns are NISP/MNI. For Trenches 1 and 5, the sieved finds are shown by phase.

sieved material, namely catfish (with Clariidae and *Synodontis*), *Parachanna* and Cichlidae. Remains of lungfish (*Protopterus*) are relatively frequent compared to their numbers in the sieved material and are from somewhat larger specimens.

The skeletal elements by which the lungfish are represented in both the hand-collected and sieved material are the typical upper and lower jaws with their heavy toothed surface. In addition, a ceratohyal and two parasphenoids were found. Few elements allowed a size reconstruction, but it appears that very small to medium-sized individuals were present. The following estimated lengths were obtained: two fish of 5 to 10 cm SL, two individuals of 15 to 20 cm SL, and one fish of each of the length classes 30-50 cm SL, 40-50 cm SL and 50-60 cm SL. In the Ruki river basin only *Polypterus dolloi* occurs. Lungfish can use atmospheric oxygen and therefore easily survive in shallow, oxygen-poor environments. They have the ability to dig into the mud to survive the dry season in a cocoon, but this is not seen in the study region as the floodplains never dry out completely.

In terms of number of remains, *Polypterus* is the most abundant fish taxon in the sieved samples, but this is a result of the numerous scales (Figure 2) that represent 95% of the skeletal elements of these fish. The rhomboid scales are well ossified and typically covered with ganoine that gives them a shiny external aspect. Many scales show traces of burning. In some of the smaller samples of which the ratio of burned scales was quantified it appears that up to one third of the specimens had been exposed to fire. Other skeletal elements of bichir that were easily recognisable are the vertebrae (29 specimens), the bifurcated dorsal spines (8 specimens), skull roof and other cranial fragments characterised by a fine granular surface (9 specimens). The reconstructed sizes that could be obtained on nine of these remains vary between 15 to 30 cm SL. For the estimation of the body size we also used the scales, which showed that there was a wider range in lengths among the bichirs. In Figure 3 the variation of the scale width is shown in a sieved, random sample. Using measurements taken on three modern specimens of 13.5, 17 and 29 cm SL the reconstructed sizes in the archaeological sample appear to vary between about 8 and 48 cm SL, with the majority of the obtained estimations between 15 and about 25 cm SL. In

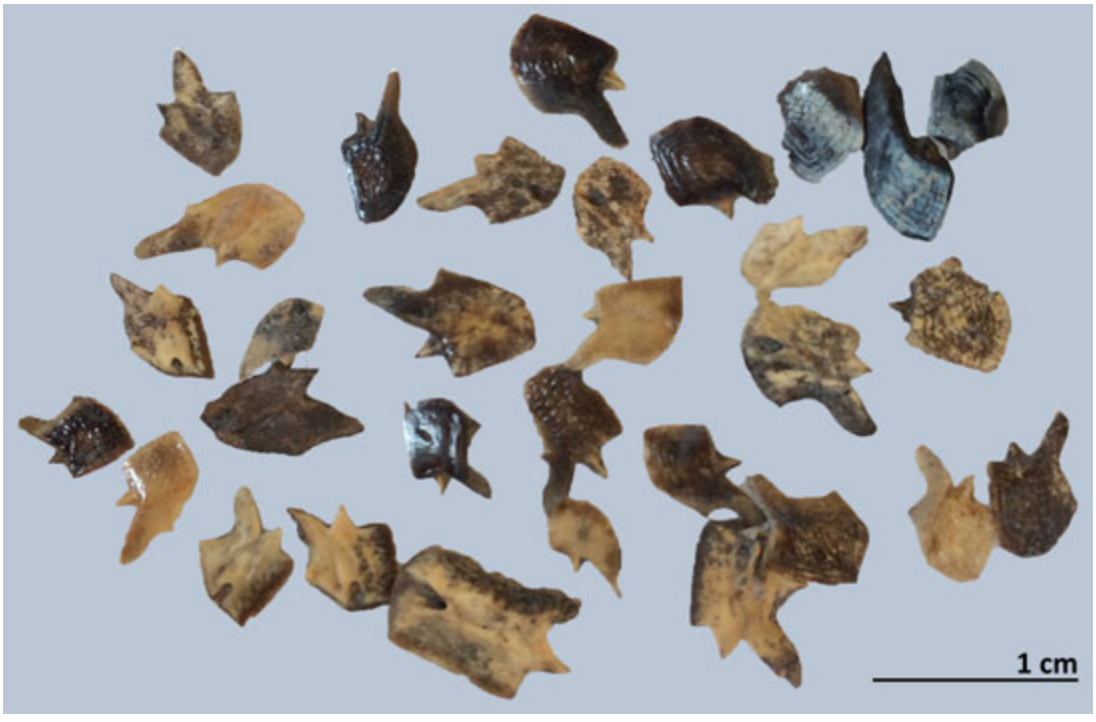

FIGURE 2

Polypterus scales showing the effect of various degrees of exposure to fire.

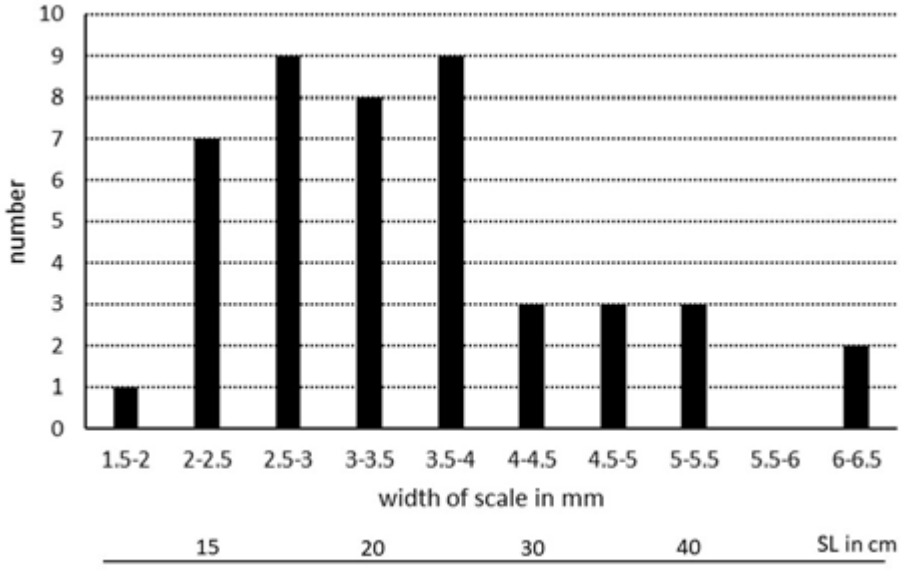

FIGURE 3

Greatest width of *Polypterus* scales in a random sample of 45 specimens. The approximate corresponding standard lengths (SL) are indicated at the bottom of the graph.

the other material, a comparable size range and the same abundance of small scales are seen with only occasional larger outliers of up to 65-70 cm SL. Six bichir species have been reported for the Ruki basin and they are all typical of swamps and shallow parts of the river.

At Bolondo a few remains of African bonytongue (*Heterotis niloticus*) were found, a species that is lacking at Nkile. In the surface layer of Trench 5, three fragments occur of the typical scales of this species, that cannot be mistaken for those of any other African taxon. Cockerell (1910) describes them as 'large oval scales with the exposed portion thick and corrugated, with a more or less vermiform sculpture'. The presence of this species at Bolondo is somewhat surprising as it is not listed among the native taxa of the Ruki basin. It has been introduced in the Ubangi River in 1960 and was already common in the area of Mbandaka in the 1980s (Vanden Bossche & Bernacsek, 1990). The presence of this fish is attested in Trench 5 in the uppermost level which is in line with the very recent date of these layers. Young *Heterotis* live in shallow waters with abundant aquatic vegetation and the adults are reputed for their floating nests, made of plant matter, in which they deposit their eggs.

The presence of Mormyridae was attested in almost every layer by vertebral centra that have a very typical, reticulated lateral side. Twenty-eight species belonging to 11 genera of this family have been reported from the Salonga region (Monsembula Iyaba & Stiassny, 2013) and for the entire Ruki basin no less than 44 species in 12 genera are listed in FishBase (https://www.fishbase.de/trophiceco/FishEcoList.php?ve_code=815, accessed 16th April 2021).

Six vertebral centra that were measurable have been compared to modern specimens and it appears that the mormyrids from Bolondo were between 5 and 10 cm SL (3 specimens) and 10-15 cm (3 specimens). Also the Cyprinidae remains, precaudal vertebrae and a single dentary, are from small fish that could not be identified beyond family level. The closely related genera *Distichodus* and *Citharinus*, belonging to the suborder of the Citharinoidei, share many osteological characteristics hampering a precise identification of isolated bones. Two skeletal elements, a quadrate and an opercular, were identifiable as *Distichodus*, but the nine vertebrae had to be classified as representing the *Distichodus/Citharinus* group. The reconstructed sizes of these fish range between less than 5 and 7 cm SL. Thirty remains of Alestidae have been identified of which one opercular could be attributed to a tiger fish (*Hydrocynus* sp.) of about 5 cm SL. The identification of four other cranial

bones and 25 vertebrae had to remain at family level.

Catfishes are the most common fish found at Bolondo, both in terms of NISPs and of MNIs. Of the 1200 siluriform remains almost 75% could not be identified any further. These unidentified catfish bones are mainly fragments of the skull roof, the pectoral girdle, and pectoral and dorsal spines of which the articular facets were lacking. Among the identified taxa, the Clariidae family is the most abundant. The articular facet of 78 of the pectoral spines match very well with *Clarias*, and four dentaries could be attributed to *Channallabes*. No evidence for *Heterobranchus* was found, whereas the possible presence of *Clariallabes* could not be verified due to the lack of comparative specimens. The reconstructed sizes show that the clariids were relatively small with most fish measuring between less than 10 cm and 30 cm SL (Figure 4). Some specimens in the smallest length class (<10 cm SL) appear to be even below 5 cm SL, but an accurate estimation was not possible due to lack of very small comparative specimens. Clariidae are typical floodplain dwellers that can survive extreme conditions thanks to their accessory breathing organs allowing the uptake of oxygen from the air.

The numerically second most important catfish taxon is *Synodontis,* a genus that could easily be identified on the basis of its pectoral and dorsal spines, its cleithrum and, when sufficiently preserved, its skull roof. The size reconstructions show a heavy preponderance of small fish: more than 70% of the individuals are less than 10 cm SL and even one third are smaller than 5 cm SL (Figure 4).

The presence of *Chrysichthys* is attested by two cleithra belonging to fish measuring 8-9 cm SL and 15-18 cm SL and also for the schilbeid catfish the osteological evidence is scant. Three vertebrae of this catfish family belonging to two small individuals were found.

Among the percomorph fish, Cichlidae are the most frequent taxon at Bolondo. Identified skeletal elements include various cranial and pectoral girdle elements, dorsal and anal spines and pterygophores as well as a few vertebrae. The average small size of the cichlids is clear from the length reconstructions, showing that about half of the fish were smaller than 10 cm SL (Figure 4).

The presence of *Lates* is indicated in the hand-collected material by a second precaudal vertebra of a fish measuring 30-40 cm SL and in the sieved samples by a cleithrum of an individual of the same size. The genus was not noticed during a survey in the Salonga National Park (Monsembula Iyaba & Stiassny, 2013) and it is not mentioned either in the checklist of FishBase for the Ruki river; (https://www.fishbase.de/trophiceco/FishEcoList.php?ve_code=815, accessed 16th April 2021). However, the rare occurrence of *Lates niloticus* is mentioned for the region of Ikela on the Tshuapa river (Matthes, 1964), one of the Ruki headwaters.

Parachanna finally is represented at Bolondo by remains of dentary, maxilla, premaxilla and opercular that correspond mainly to individuals of 20-25 cm SL (MNI=6) and somewhat larger fish (MNI=4). One individual is less than 20 cm SL. Two species (*P. obscura* and *P. insignis*) have been reported from the region. Snakeheads typically inhabit floodplains with abundant aquatic vegetation.

Three reptile taxa were found but their identification was not very precise, due to the lack of adequate reference material (in the case of the snakes) or the absence of diagnostic characters in the case of the turtle and the crocodile remains. The presence of snakes is attested by vertebrae and ribs which, judging from their sizes and the occurrence of traces of burning, may represent human food waste. The unidentified turtle bone was a plastron fragment, whereas the crocodile remains consist of two ribs, a vertebra, a lower jaw fragment, a tibia, a femur and 11 dermal scutes. In our study region three species occur, i.e. African slender-snouted crocodile (*Crocodylus cataphractus*), Nile crocodile (*Crocodylus niloticus*) and dwarf crocodile (*Osteolaemus osborni*). Given the environment of the site, it is likely that the remains are from dwarf crocodile that typically occupy dense swamps and flooded forests (Eaton, 2010). It is also the species that is nowadays most frequently marketed at Mbandaka (Figure 5). The two long bones were compared to a modern specimen of *Osteolaemus* with a total length of about one meter. It appears that the femur is of a similar sized specimen and that the tibia belonged to an individual that was about one third larger. In the sieved samples only small scutes were found that belonged to young crocodiles but of which the exact length could not be established.

Remains of mammals, both wild and domesticated are rare at Bolondo. In the sieved material only remains of isolated molars and incisors of small rodents were found, animals that lack in

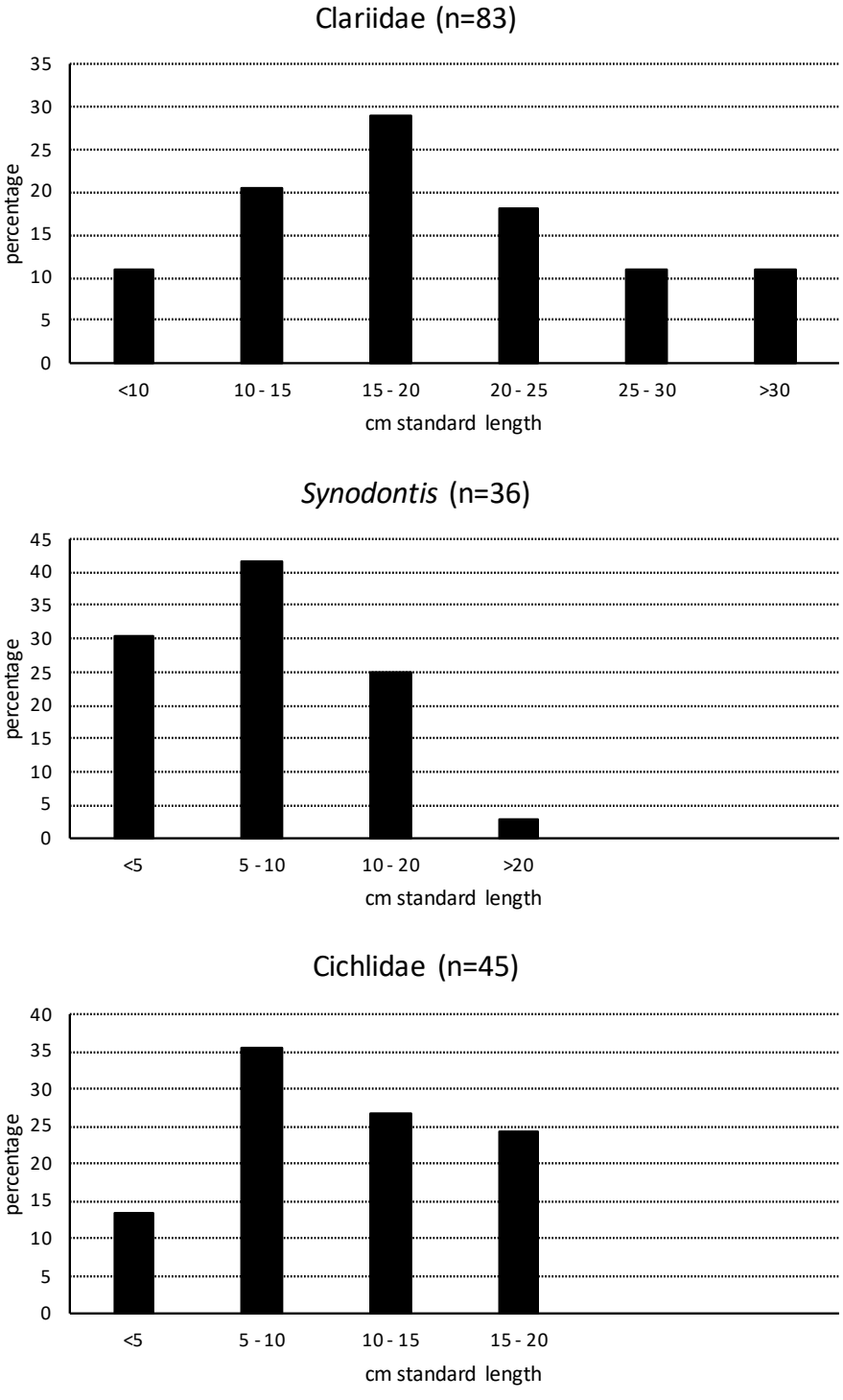

FIGURE 4

Proportions of the various length classes in the clariid catfish, the *Synodontis* and the Cichlidae of the sieved samples from Bolondo. The MNI on which the estimations were carried out are indicated (n).

FIGURE 5
Dwarf crocodiles for sale at a market in Mbandaka in December 2016 [© Théodore Trefon (2017)].

the hand-collected fraction. The sole evidence for a cercopithecid monkey at Bolondo is a jaw fragment. Six antelope remains were found of which two could be identified to species. The presence of sitatunga (*Tragelaphus spekii*) is indicated by a third phalanx (DLS: 55; Ld: 50) with its characteristic elongated shape, an adaptation to life on muddy substrate. A complete metacarpal (GL: 113; Bp: 16.3; SD: 10.7; Bd: 16.9) fits perfectly with black-fronted duiker (*Cephalophus nigrifrons*). The presence of domestic goat is indicated by a scapula (SLC: 17.7; GLP: 29.2; LG: 24.5; BG: 19.9) and a mandible with the third and fourth premolars and the first and second molars still in place. The scapula was identified on the basis of the criteria mentioned in Boessneck *et al*. (1964) and the mandible corresponded to goat judging from the morphology of the premolars (cf. Zeder & Pilaar, 2010). These goat remains have been radiocarbon dated to 450 ± 30 BP (Poz-98263) for the mandible and 460 ± 30 BP (Poz-98264) for the scapula. The corresponding calibrated calendar dates (95% probability) are AD 1413-1480 and AD 1412-1471 respectively. This firmly places the goat bones in the 15th century AD which is, to our knowledge, the earliest presently known evidence for domestic livestock in the Congo Basin. In addition to the antelope and goat remains mentioned above there are still three other bovid bones that could not be identified any further. Other poorly identified remains from the hand-collected assemblage of the settlement are two suid fragments that could either be a wild species or domestic pig. The presence of domestic dog is attested by a mandible (alv. L. M1: 17.6 mm) with cut marks on the ventral side near the angular process and on the buccal side, below the second molar. Two of the three other, unidentified, carnivore remains are in the size range of domestic dog and the third bone is from a somewhat smaller, presumably wild carnivore.

Nkile

The faunal assemblage from Nkile, like that of Bolondo, consists mainly of fish remains (Table 2). All three snail genera, *Homorus*, *Limicolaria* and *Subulina*, belong to the Achatinidae, a family

	NKI 2	NKI 3	NKI 6	Total
Homorus sp.	1/1	-	1/1	2/2
Limicolaria sp. (garden snail)	-	-	1/1	1/1
Subulina cf. *avakubiensis* (awlsnail)	-	-	1/1	1/1
Protopterus sp. (lungfish)	-	-	1/1	1/1
Protopterus cf. *dolloi* (lungfish)	-	-	8/2	8/2
Mormyrops sp. (elephantfish)	-	1/1	4/3	5/4
Cyprinidae (minnows)	-	-	1/1	1/1
Bagridae (bagrid catfishes)	2/1	1/1	2/1	5/3
Clariidae (clariid catfishes)	8/2	1/1	11/8	20/11
Synodontis sp. (squeaker catfish)	1/1	-	2/2	3/3
Cichlidae (cichlids)	6/3	-	1/1	7/4
Ctenopoma sp. (climbing perch)	1/1	-	-	1/1
Parachanna sp. (snakehead)	11/3	3/2	35/6	49/11
Crocodylidae (crocodile)	-	-	2/1	2/1
Cercopithecidae (monkey)	-	-	1/1	1/1
Genetta sp. (genet)	-	1/1	-	1/1
Philantomba monticola (blue duiker)	-	1/1	1/1	2/2
Canis lupus f. familiaris (dog)	-	-	1/1	1/1
Ovis ammon f. aries / *Capra aegagrus* f. hircus (sheep/goat)	-	-	2/1	2/1
small bovid (sheep/goat size)	3/1	1/1	1/1	5/3
total identified	33/13	9/8	76/34	118/55
unidentified gastropods	1	-	1	2
unidentified fish	20	-	60	80
unidentified mammals	9	1	12	22
total unidentified	30	1	73	104

TABLE 2

Species list of Nkile, indicating the Number of Identified Specimens (NISP) and the Minimum Number of Individuals (MNI) in the three trenches adjacent to the river Ruki.

of terrestrial pulmonate gastropods. They are typical of well vegetated environments, and because of their small size it is unlikely that they represent human food waste. Among the 97 fish remains, 10 different taxa were identified. In four cases, identifications had to remain on family level for the reasons mentioned above. Half of the identified fish remains (NISPs) belong to *Parachanna*. The majority of the snakeheads from Nkile are in the size class 30-40 cm SL (MNI=5), but there are also smaller specimens of 20-30 cm SL (MNI=2) and larger ones of 40-50 cm SL (MNI=2) and even 50-60 cm SL (MNI=2). The clariid catfish are the second most important taxon in terms of NISPs. Two pectoral spines match well with *Clarias*, whereas the sole dentary found differs from both *Clarias* and *Heterobranchus*. Clariids smaller than 20 cm SL are lacking at Nkile, possibly due to the lack of sieving during the excavations, but apart from that there is a lot of variation in size. The majority of the fish are medium-sized, measuring 20-30 cm SL (MNI=3), 30-40 cm SL (MNI=3) and 40-50 cm SL (MNI=2). In addition there are larger animals of 50-60 cm SL, 60-70 cm SL and 80-90 cm SL (one individual of each). The *Polypterus* finds consist of one typical ganoid scale, an opercular, a posttemporal and five skull roof fragments with the fine granular typical of this genus. The opercular and the posttemporal belong to an individual of 40-50 cm SL. All the other fish taxa are represented by few remains. The sole *Protopterus* bone is a lower jaw of an animal of around 60 cm SL. The finds of *Mormyrops* consist of a basioccipital, a quadrate and an articular, and two precaudal vertebrae. The material represents at least four individuals measuring 50-60 cm SL (2 individuals) and 70-80 cm SL (2 individuals). The sole cyprinid bone is a mesethmoid of a large fish, measuring between 70 and 80 cm SL, that could not be identified beyond family level due to the lack of adequate comparative material. Five remains could be attributed to the bagrid catfish family, i.e. two hyoid fragments, a cleithrum, a precaudal vertebra and a piece of the Weberian apparatus. The reconstructed sizes

of these bagrids are 40-45 cm SL, ca. 60 cm SL (MNI=2) and 80-90 cm SL. Another catfish, besides the already mentioned clariids, is *Synodontis*. The three bones, each corresponding to a different individual, are a humeral process (10-15 cm SL), a frontal bone (10-15 cm SL) and an unidentifiable skull roof fragment of a somewhat larger individual (ca. 20 cm SL). Seven bones belong to the Cichlidae, a family that counts numerous species in Central Africa. The identified material consists only of cranial remains, i.e. three operculars, two interoperculars, one lacrimal and one premaxilla. The reconstructed sizes are 15-20 cm SL, 20-25 cm SL (2 individuals) and 25-30 cm SL. *Ctenopoma* finally, is represented by an opercular of a fish measuring 10-15 cm SL.

Two dermal scutes indicate the presence of crocodile, and in one case a cutmark is visible on the external surface. Compared to the fish, mammal remains are also rare, both the identified and unidentifiable fragments. The sole primate bone is a proximal fragment of a second phalanx from a cercopithecid that could not be identified more precisely. The fronto-parietal part of a skull demonstrates the presence of genet and two antelope remains could also be identified. These specimens, a jugal fragment and a caudal vertebra, could easily be assigned to blue duiker (*Philantomba monticola*), which is the smallest species living in the region. An upper molar and a first phalanx compare morphologically to sheep and goat. In addition, there are five remains that can be either ovicaprid or an antelope of similar size, and that are listed as small bovids. Finally, there is an ulna fragment of dog of which the olecranon is missing as a result of carnivore gnawing. This piece also shows traces of human working: at the medial side several parallel cut marks are visible below the proximal articular surface.

Besides the aforementioned remains that were found in Trenches NKI 2, NKI 3 and NKI 6, there is still a single find from NKI 4. That trench is located more inland and yielded the lower jaw of a suid with the first molar fully developed and functional, and with the third and fourth permanent premolars piercing. On the basis of size and the enamel pattern of the teeth, an identification as warthog (*Phacochoerus*) or giant forest hog (*Hylochoerus meinertzhageni*) can be excluded. The gross morphology of the molar compares to that of both the bush pig (*Potamochoerus porcus*) and the domestic pig (*Sus scrofa* f. *domestica*), but using the diagnostic criteria described by Cooke & Wilkinson (1978: 439-440) the jaw can be attributed to domestic pig.

TAPHONOMY

Apart from the animal remains associated with the human skeletons at Bolondo, that are mainly funerary gifts, the majority of the faunal remains found at Nkile and Bolondo can be considered food remains. Exceptions are the small snails, i.e. *Homorus* sp. and *Subulina* sp. found at Nkile, that can be considered penecontemporaneous intrusives (*sensu* Gautier, 1987). Possibly the *Limicolaria* sp. found at both sites also fall in this category although these achatinids are edible and often exploited as food (Felagha *et al*., 2020). The two specimens from the hand-collected sample of Bolondo are large and may represent snails that were harvested for food. Among the unidentified molluscs from Bolondo shell fragments of both gastropods and bivalves were found few of which seem to be of large individuals that could represent food waste. They probably are from individuals that died naturally on the spot or from molluscs that were eaten by some of the fish species, in which case they would be stomach content. Molluscs are part of the diet of several catfish taxa (Clariidae, Bagridae, *Synodonti*s etc.) and large cyprinids (Sandon & Tayib, 1953). Other animals that possibly were not consumed by humans are the small rodents found in the sieved material from Bolondo that may be from intrusive animals that had died naturally. All the other vertebrate remains, including those of dog, are considered human food waste. As mentioned above, the dog ulna found at Nkile and the mandible from Bolondo showed cut marks.

The large amount of small-sized fish seen at Bolondo are believed to represent food waste as well. Theoretically, some of the smaller fish could be stomach content of the few large piscivorous fish encountered at the site, i.e. *Lates* or *Hydrocynus,* however no evidence of etching due to digestion was found. Accumulations of large numbers of small fish have been reported from a modern rivershore locality in Senegal, representing fish disposed off by fishermen while cleaning their nets (Van Neer & Morales-Muñiz, 1992), but the assemblage from Bolondo is clearly different. The association with archaeological and archaeobotanical remains makes this alternative explanation

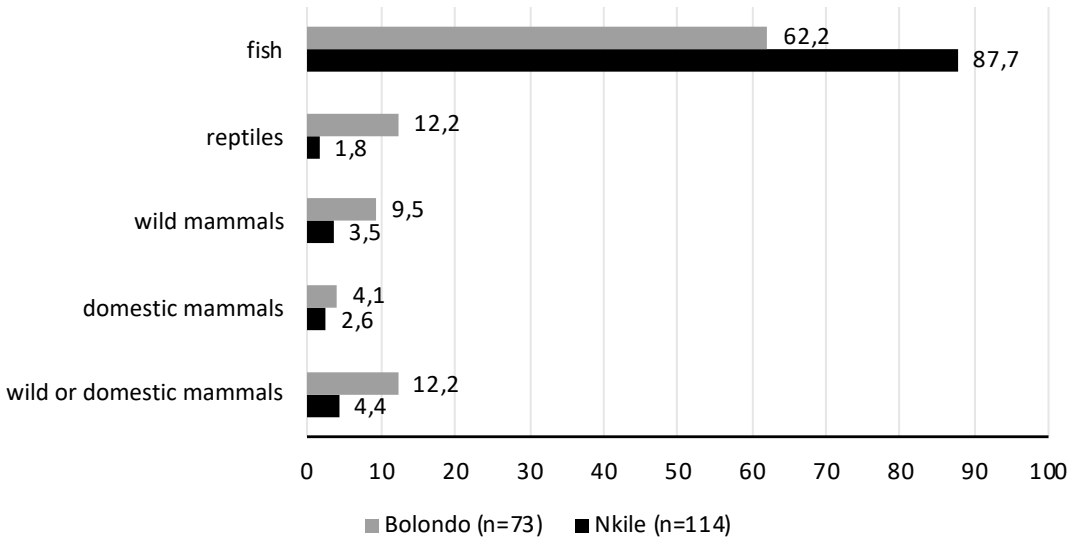

FIGURE 6

Proportion of the fish, reptiles, wild and domestic mammals in the hand-collected samples from at Nkile and Bolondo. The percentages are based on the NISPs.

highly unlikely and, in addition, there are numerous fish bones with burning marks. These were observed not only on the *Polypterus* scales mentioned above but also on many catfish and cichlid bones. The observed colours vary from black to grey-white showing that sometimes the fish were exposed to high temperatures. It is likely that the traces of burning are partly accidental, due to the fact that food remains ended up in hearths. Nevertheless, some of them can be considered as a result of intentional exposure to fire. A traditional way of preparing bichirs is to throw the fish into the fire and to peel off the hard scales once the fish are cooked (WVN, personal observation, Uganda, Lake Albert, December 1989).

SUBSISTENCE

No matter whether the NISPs or the MNIs are considered, it is clear that the most commonly practised subsistence activity was fishing. The evidence for possible harvesting of molluscs is meagre, but it cannot be excluded that some large achitinids or even freshwater bivalves were used for human consumption. Hunting is indicated by the presence of cercopithecid monkeys at both Nkile and Bolondo, and there are antelopes at both settlements as well. These include typical forest species, i.e. blue and black-fronted duiker and in addition there is the sitatunga, a larger antelope that typically occurs in marshy, forested areas. Carnivores were also occasionally hunted, as shown by the bone of a genet and a few remains of unidentifiable similar-sized carnivores. Evidence for the keeping of domestic animals is present but it appears that these species were not often used as food. As the presence of tsétsé flies hampers cattle raising in the equatorial forest, livestock production in this region nowadays focuses on small ruminants, poultry and pigs. In the villages, chicken and goats, sometimes sheep or some pigs are kept in small numbers, mainly for own use (Tollens, 2010). Both at Nkile and Bolondo a few ovicaprid remains occur among which only goat could be positively identified at Bolondo. The bones were not suitable for an evaluation of the stature or the type of breed they may have belonged to, but given the type of environment the site is located in, it is likely a dwarf goat typical of the region (Weaver, 2020). The suid remains found at Bolondo, do not permit a distinction between the domestic form and the wild species occurring in the region, i.e. giant forest hog and bush pig. However, the first molar found at Nkile is from domestic pig which is the sole evidence for this animal thus far in Central Africa (Van Neer, 2000). As no bird remains were found at all, it could not be verified if poultry was kept. Cut marks show that dog

was consumed at both sites, a practice that is well documented for West Africa and the Congo Basin (Frank, 1965).

The importance of fishing is clearly shown when comparing the amount of fish bones to that of reptiles, wild mammals and domestic mammals. In Figure 6 the relative importance is indicated of the various animal groups for the hand-collected assemblages of Nkile and Bolondo. A category of wild/domestic mammals was also retained to include the bones on which the distinction could not be made. In the sieved material from Bolondo, 97% of the remains are from fish, the other bones are from crocodile and snakes. Small crocodiles and water cobra (*Boulengerina annulata*) are nowadays regular bycatches during fishing (Pagezy, 1992; Dounias, 2011). The poor contribution of non-fish is obvious and the same pattern is seen when the unidentified fish are compared to the other unidentified vertebrates (Table 1).

Thanks to a recent stable isotope study carried out on the humans and fauna from Bolondo (Bleasdale *et al*., 2020) dietary information obtained from zooarchaeological and isotopic analyses can be confronted. Usable carbon and nitrogen stable isotopic data were obtained from the bone collagen of 11 humans and a series of animal bones, including two goats, a duiker (re-identified in our present faunal report as *Cephalophus nigrifrons*), an unidentified antelope, a dog, an unidentified fox-sized carnivore, two crocodiles, a clariid catfish and a bichir. Oxygen and carbon isotopes from tooth enamel from humans and a smaller faunal sample were also investigated. The isotopic data show that people relied not only on terrestrial, domestic fauna but also on aquatic resources although the latter signal is not always clear. Fish may have contributed less to the overall diet than mammals because of their relatively low meat weight and since fishing was a seasonal activity. Also interesting about the isotopic results is that the dog has carbon and nitrogen ratios comparable to those of the humans, indicating that it fed on the leftovers of human meals. The fact that the unidentified fox-sized carnivore has similar isotopic values suggests that this bone was also from a dog that was somewhat smaller than the specimen positively identified as dog. The two goats are clearly separated isotopically from the antelopes: they have a higher $\delta^{15}N$ ratio and their $\delta^{13}C$ is less depleted. This indicates that these animals were kept and fed in a more open environment.

FISH EXPLOITATION

A comparison of the fish faunas exploited at both sites is hampered by the fact that only for Bolondo sieved samples are available. When considering the hand-collected fish bones (Table 3), it appears that the spectrum at both sites is largely comparable with *Parachanna* and catfish, in particular Clariidae, as major taxa. Other shallow water fish such as lungfish and bichir are also well represented and Cichlidae occur in fair amounts.

	Nkile (n=98)	Bolondo (n=46)
Parachanna sp. (snakehead)	50	20
Clariidae (clariid catfishes)	21	22
Synodontis sp. (squeaker catfish)	1	9
Bagridae (bagrid catfishes)	5	-
Siluriformes (catfish)	-	15
Protopterus sp. (lungfish)	1	15
Polypterus sp. (bichir)	8	4
Cichlidae (cichlids)	7	13
Lates sp. (lates perches)	-	2
Ctenopoma sp. (climbing perch)	1	-
Mormyrops sp.	5	-
Cyprinidae (minnows)	1	-

TABLE 3

Proportions of the various fish taxa in the hand-collected samples from Nkile and Bolondo. Percentages are calculated on the basis of the number of identified specimens (n).

The sieved samples from Trench 1 and Trench 5 of Bolondo consist of 111 and 1403 fish bones respectively. The material from Trench 1 is dominated by siluriforms that make up 94% of the identified remains. Mormyrids and cichlids are represented by a few bones only, and among the catfish all but one of the identified remains are from clariids. In addition to these four taxa also the presence of *Polypterus* should be mentioned which is only attested by scales.

The much larger sample from Trench 5 yielded 14 fish taxa, but the most abundant fish are also here the catfishes. They represent 78% of the NISP and among the bones identified to family, it appears there are about twice as many Clariidae as *Synodontis*. Cichlidae account for about 10% of the number of identified bones. The sample sizes in the different phases of Trench 5 are large enough to permit a diachronic comparison of the fish taxa (Table 4).

The figures in Table 4 suggest an increase through time in the amount of exploited catfish and

a possible decrease in the cichlids. When only the proportions of Clariidae, *Synodontis* and Cichlidae are considered, the number of observations in Phase 2 are rather limited and chance fluctuations may have affected the proportions. Nevertheless, it seems that, in general, the amount of clariids decreases through time and that of *Synodontis* increases (Figure 7). It is unclear if this shift is due to a change in the abundance of the fish through time or if it is related to the employed fishing gear. The number of observations on the fish lengths per phase is too small to verify if a decrease in size and thus possible overfishing may have been involved.

	Phase 1 (n=384)	Phase 2 (n=162)	Phase 3 (n=477)	Phase 4 (n=380)	Total sieved (n=1403)
all Siluriformes	70,3	75,9	80,9	82,9	78
Cichlidae	9,9	12,3	10,9	7,6	9,9
Polypterus	4,4	5,6	3,8	0,5	3,3
Mormyridae	3,4	1,9	1,9	4,5	3
Alestidae	6	1,2	0,6	0,5	2,1
Parachanna	3,1	0,6	-	1,8	1,4
others	2,9	2,5	1,9	2,1	2,3

TABLE 4

Proportions through time of the major fish taxa in the sieved samples from Trench 5 at Bolondo. Percentages are calculated on the basis of the number of identified specimens (n).

Even if the sites are located in the equatorial African rainforest, there is seasonal variation in the waterlevels that has an influence on the accessibility of the fish populations. The lowest water levels in the Ruki are in July and August (Devroey, 1957: 283), based on observations over about two decades (1933-1955) at Ingende, which is near Nkile. Also in the month of March there is a drop in the water levels at that locality. At Boende, on the Tshuapa river, closer to Bolondo, a similar pattern was observed between 1916 and 1955 (Devroey, 1957: 289). These dry seasons are ideal for fishing as the lowering of the waters results in the formation of ponds and small lakes, both of natural and anthropic origin (Inogwabini, 2005; Comptour *et al*., 2016). It is obvious from the species composition and the preponderance of shallow water fish taxa at Bolondo and Nkile that these are the aquatic environments that were preferably exploited for the fish they contained. During the season that the waters lowered and became wadable, it must have been possible to capture fish with a variety of methods adapted to shallow environments. The fishing gear used in such waters of the Congo Basin, although not preserved as archaeological artefacts, is known both by museum collections, and by a set of photographs and written documents present in archives since the end of the 19th century, notably at the RMCA (Royal Museum for Central Africa, Tervuren, Belgium). Some of the fishing devices are still in use today (Bahuchet & Rameau, 2016) and include, amongst others, fish weirs, finely woven baskets as well as nets used to scoop water (and fish) out of the ponds (Dounias, 2011). Very often the

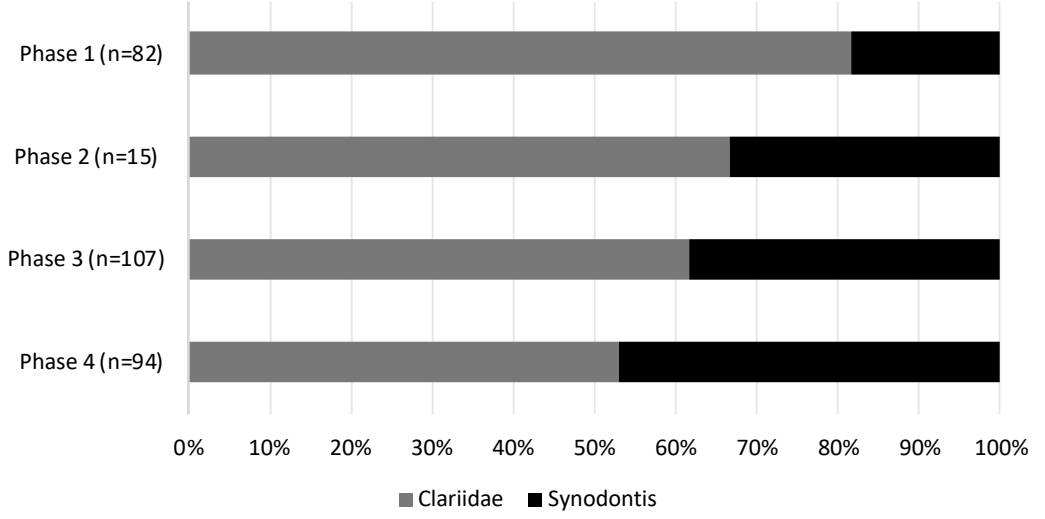

FIGURE 7

Proportions through time of the Clariidae and *Synodontis* in the sieved samples from Trench 5 at Bolondo. n = the number of specimens on which percentages are calculated.

latter type of fishing was practised as a communal activity that took place during the low water season and that aimed at catching a great number of fish of all sizes in a single event (Figure 8). These practices often involved a large number of participants and are known to have been widespread in the past (Van Leynseele, 1979; Comptour *et al*., 2016). Another category of fishing gear frequently used in the shallow water environments of the region are stationary traps that exist in many forms and sizes adapted to the type of fish and water level. The average small size of the fish captured at Bolondo and Nkile suggest that the fishing gear used at these sites must have been finely meshed and these may have been baskets and traps of the kind mentioned above. Whether ichthyotoxic plants were used by fisherfolk in the past is hard to prove and the sole zooarchaeological evidence for such a practice is known from a coastal site in Ecuador (Béarez, 1998). With the possible exception of the small size of the fish, we have no indications for fish poisoning at the studied sites, but the practice is mentioned in the literature for pre-colonial and colonial times (Boulenger, 1901; Malaisse, 1968; Eggert, 1987) and attested by both documents and photographs in the aforementioned archives of the colonial period. For the sake of completeness, it should be mentioned that at Bolondo a pierced cylindrical ceramic artefact, reminiscent of present-day net weights used on the Congo river, was found although contemporary weights observed at Bolondo are made of laterite.

The species spectrum and the relative importance of the various fish taxa seen at both sites compare rather well to those seen in present markets of urban centres such as Mbandaka to which fisherfolk bring their catch for sale (Vanden Bossche & Bernacsek, 1990: table 11). The species list in the latter FAO-report also mentions that fingerlings account for about 4% of the fish offered for sale. Nowadays, there are concerns about the over-exploitation of fish populations due to the use of modern fine-meshed nets (1-2 cm) and chemical poisoning of ponds during the low water season

FIGURE 8

Women scooping water out of a pond closed by an artificial dam; region of Lake Mai-Ndombe. AP.0.0.9449, © RMCA Tervuren; photo L. Van den Broeck, 1899-1914.

(Inogwabini, 2005). However, when traditional techniques are applied in traditional ways, the quantities of fish extracted do not compare to those obtained by modern gear (Inogwabini, 2014). Still today floodplain fisheries can be very productive without signs of biological overfishing, although more quantitative information about small-scale fisheries is needed to evaluate the selectivity of the fishing gears and their impact on the ecosystem (Misund *et al*., 1999). As mentioned above, it is unclear if ichthyotoxic plants were used at Bolondo or Nkile, but it is obvious that the fisherfolk were capable of capturing numerous small-sized fish. Our zooarchaeological data show that this practice seems to have been ongoing already for centuries, apparently without having a negative effect on the fish populations. Possibly the removal of small fish had no adverse effect on the ichthyofauna as the human populations were smaller in the past and fishing pressure was therefore still sustainable.

It has been argued that heavy exploitation of fish populations can still be sustainable when it is not carried out all year long, nor everywhere, as observed at least among the Libinza of the Ngiri river not far from our research zone (Van Leynseele, 1981). The ponds and fishing grounds in that region have owners that still practise a certain degree of control when the stocks seem to decline.

A few documents from the *Fonds Affaires Indigènes et Mains-d'oeuvre*, available for consultation in the RMCA archives, are part of a survey carried out at the end of the 1940s on the initiative of the Belgian colonial administration about fishing practices and customary law. It appears that this type of customary or ownership control was widespread in the past but that it was discouraged by the colonial authorities in order to assert their ownership of the land. Among those forms of fish population control carried out by the fisherfolk, temporary fishing bans could be imposed to allow fish stocks to recover (De Noyette, 1948).

During the large part of the high water season, the sites are surrounded by water and this period is unfavourable for fishing as fish are very dispersed and access to the waters is difficult. This period of the year is typically devoted to hunting, in particular of duiker (Pagezy, 1986), a species also present in the faunal assemblages. It should be underlined, however, that based on historical documents and ethnographic data available for the region, it appears that sites like Bolondo and Nkile are traditionally not occupied by the entirety of its population throughout the year but are instead part of a larger web of semi-permanent functional encampments linked to an inland village (Eggert, 1987; Dounias & Bahuchet, 2000).

CONCLUSIONS

The faunal remains from Bolondo and Nkile, two riverside settlements located along the Ruki-Tshuapa basin, described in the present paper are the sole assemblages known thus far for the Inner Congo basin. The excellent preservation of the bones is due to the exceptional waterlogged conditions and probably also to the rather recent nature of the deposits that correspond to human occupation spanning the 14th to 20th centuries AD. At both sites, subsistence has predominantly been based on the exploitation of the aquatic environment, i.e. fishing and the capture of reptiles (crocodiles and possibly water cobra). These activities mainly took place during the low water season when pools and small ponds that formed in the floodplain became wadable and therefore could easily be exploited with the aid of fine-meshed fishing gear such as scoop baskets and nets. Also stationary traps and ichthyotoxic plants may have been used, as was done until very recent times. Throughout a sequence of about 600 years at Bolondo no shift is seen in the species spectrum or in the sizes of the fish that would be indicative of over-exploitation. It appears that the fish were exploited over the centuries in a sustainable way, probably because fishing was only practised seasonally and rather locally. Among the rare terrestrial resources used at both sites are some wild animals, i.e. cercopithecids, some carnivores and antelopes, mainly duikers. Domestic animals are also rare and include goat, pig and dog that all served as food.

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