Zooarchaeological Data Tell Stories of the Kuahuqiao People

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Abstract

This paper analyzes zooarchaeological data obtained from the Kuahuqiao site in Python computing environment. The statistical results show that (1) the faunal assemblage in the region varied in three chronological periods, with turtles, deer, pigs, cattle (buffaloes), dogs and ducks being the most populous species (2) the diversity of animals identified is consistent with wetland environments in the middle and lower reaches of the Yangtze River (3) technical progress might have occurred in period 3 as evidenced by the saw marks and perforations observed on the bones during the period.

1. Introduction

Flourishing in the Ningbo-Shaoxing Plain, the Kuahuqiao Culture (8200-7000BP) stands as one of the most important archaeological cultures in eastern China during the Neolithic period. It is named after Kuahuqiao site, a neolithic settlement situated in the present-day Xiaoshan district of Hangzhou city in Zhejiang Province. Bounded in the north by the Qiantang River, in the south by Kuaiji Mountain and in the east by the Hangzhou Bay (Fig 1), Kuahuqiao area has a subtropical monsoon climate and a wide range of habitats (Pan et al. 2017).

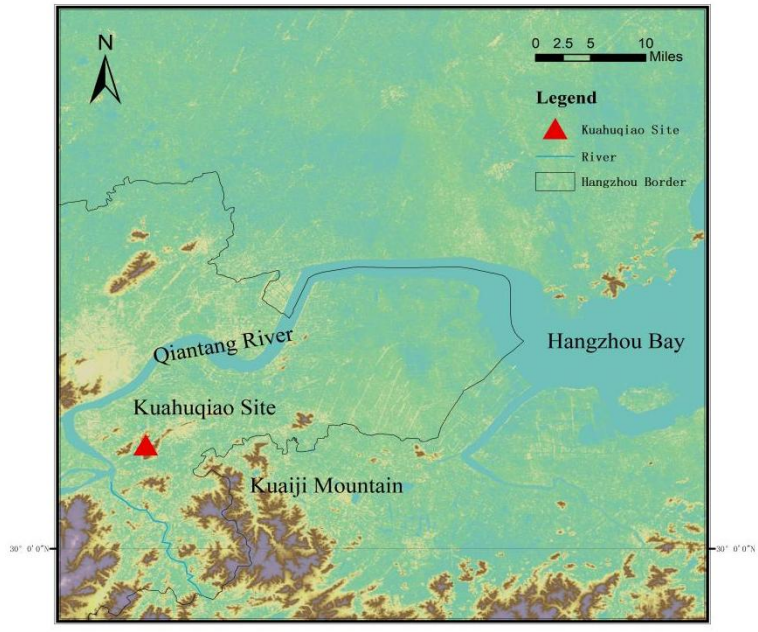

Fig 1. Map indicating the location of Kuahuqiao site (made by ArcGIS 10.2)

Archaeological excavations were conducted in 1990, 2001 and 2002 after the discovery of Kuahuqiao site in 1990. The preservation of wood, animal and plant remains makes the study of lifeways of the Kuahuqiao people possible. Evidence shows that Kuahuqiao people developed various economic strategies ranging from

collecting and hunting, rice cultivation to fishing during their occupation. With refined ceramic vessels, domesticated rice, the earliest domesticated pig in southern China (Jiang 2013), the earliest known dugout canoe, and the repair technique using natural lacquer as an adhesive (Wu et al. 2018), Kuahuqiao site has provided significant insights into the lifestyle, technology, and social organization of the people who once inhabited the region.

2. Materials and methods

Zooarchaeology contributes to the understanding of human prehistory and the relationship between humans, animals, and the environment (Steele 2015). To better understand the lifeways and living environment of Kuahuqiao people, data analyses were conducted in python according to standard zooarchaeological practices. The data used in this study is the zooarchaeological dataset published by the Chinese Archaeology website (http://kaogu.cssn.cn/ywb/database/).

3. Result

3.1 Taxa Analysis

(1) Taxa composition in the region

38 taxonomic groups of animals are identified, at different taxonomic levels. Some are identified at a less specific level, such as “Mammal” and “Bird” (class), while others are identified at the genus/species level, like “*Cervus nippon*”. For this study, bones identified at all taxonomic levels are included in the calculation of NISP (Number of Identified Specimens) and MNI (Minimum Number of Individuals) to avoid the absence of important animal taxa.

NISP data suggest that turtles, deer, cattle (buffaloes) and pigs comprise the majority of the animal taxa in the region (Table 1 and Fig 2). Undifferentiated mammals (1098/22.6%) account for over one-fifth of faunal assemblage, together with other important taxa like *Emydidae/Trionychidae* (890/18.3%), undifferentiated cervid (803/16.5%), *Bos* sp./*Bubalus* sp. (781/16.1%) and *Cervus nippon* (337/6.9%). For taxa identified at the genus/species level, *Cervus nippon* ranks the first in terms of quantity while *Sus scrofa* (245/5.0%) and *Canis familiaris* (162/3.3%) ranks the second and the third respectively.

Table 1. Top 10 taxa by NISP and MNI

Top 10 taxa by NISP			**Top 10 taxa by MNI**		
Taxa	**NISP**	**%**	**Taxa**	**MNI**	**%**
Mammal	1098	22.6%	Cervid	35	13.8%
Emydidae/Trionychidae	890	18.3%	*Bos* sp./*Bubalus* sp.	34	13.4%

Cervid	803	16.5%	*Canis familiaris*	30	11.8%
Bos sp./*Bubalus* sp.	781	16.1%	*Cervus nippon*	26	10.2%
Cervus nippon	337	6.9%	Bird	23	9.1%
Bird	297	6.1%	*Sus scrofa*	20	7.9%
Sus scrofa	245	5.0%	*Anas* sp.	15	5.9%
Canis familiaris	162	3.3%	Mammal	14	5.5%
Fish	53	1.1%	*Grus japonensis*	7	2.8%
Callinectes sp.	32	0.7%	*Anser cygnoides*	7	2.8%

The high frequency of mammals in this area is not surprising, given that mammals are a broad taxonomic group encompassing a wide range of animals. However, the abundance of deer is notable. Their combined total (NISP=1140) would exceed that of mammals, if undifferentiated cervid and *Cervus nippon* are grouped together.

In terms of MNI, deer are also significantly represented, accounting for 13.8% of the total assemblage, followed by *Bos* sp./*Bubalus* sp. (34/13.4%), *Canis familiaris* (30/11.8%), *Cervus nippon* (26/10.2%) and undifferentiated bird (23/9.1%) (Table 1 and Fig 2). At the genus/species level, the top four taxa are *Canis familiaris* (30/11.8%), *Cervus nippon* (26/10.2%), *Sus scrofa* (20/7.9%) and *Grus japonensis* (7/2.8%). (The turtles are excluded from MNI calculation due to the limited and vague archaeological records regarding the preservation status of the shells recovered.)

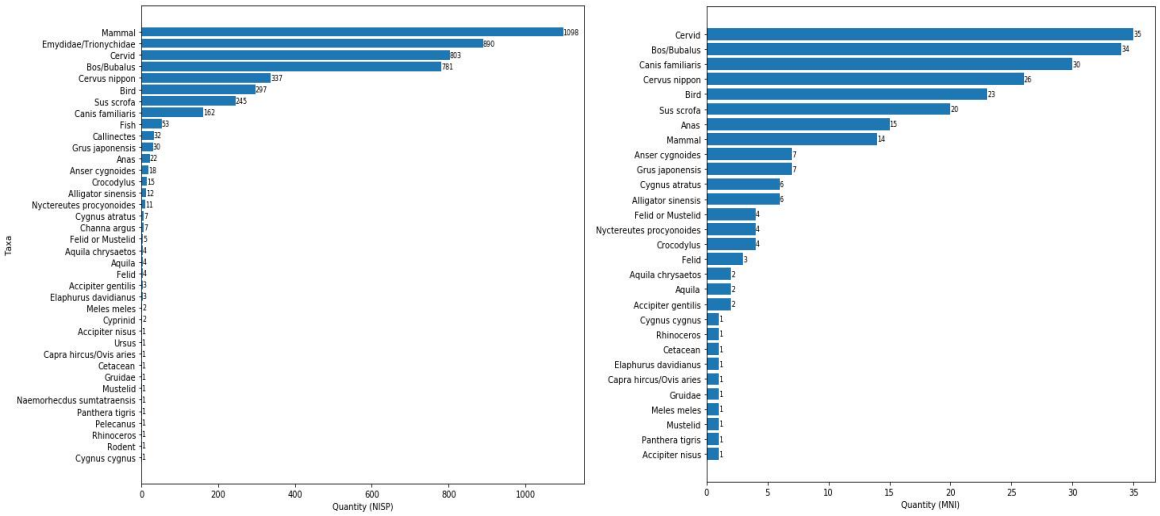

Fig 2. Left. Taxa by NISP ; Right. Taxa by MNI

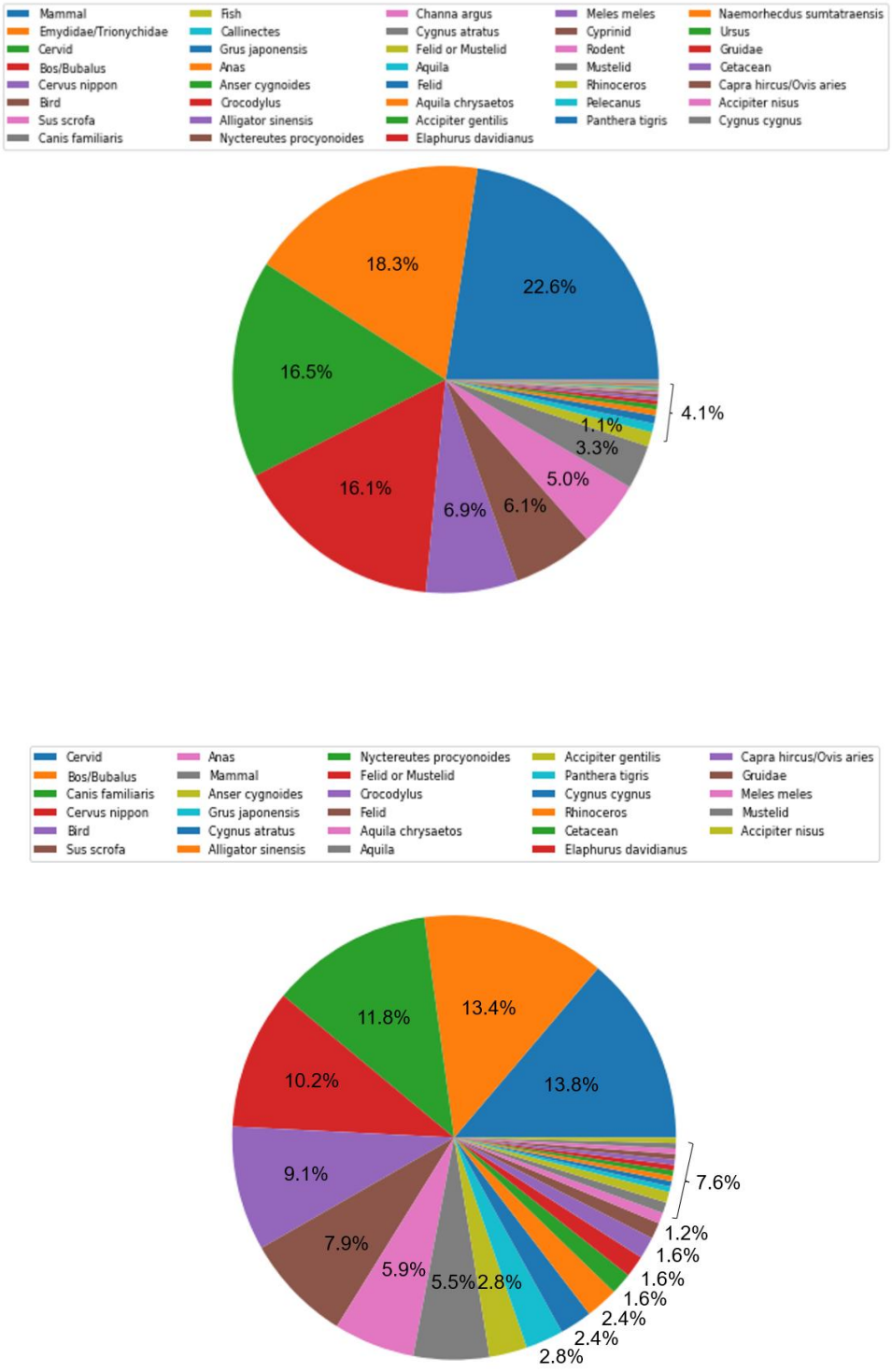

Fig 3. Upper. Taxa by NISP (%) ; Lower. Taxa by MNI (%)

To improve the comparability of the data, specimens are reclassified to five categories. For instance, 'Cervid', '*Bos* sp./*Bubalus* sp.', '*Cervus nippon*', '*Sus scrofa*', '*Canis familiaris*', '*Nyctereutes procyonoides*', 'Felid', 'Mustelid', '*Elaphurus davidianus*', '*Meles meles*', 'Rodent', '*Panthera tigris*', '*Naemorhecdus sumtatraensis*', '*Rhinoceros*

sp.', '*Capra hircus/Ovis aries*', '*Ursus* sp.' and 'Cetacean' are reclassified as "Mammal".

Taxa	NISP	%
Mammal	3459	71.2%
Reptile	917	18.9%
Bird	396	8.1%
Fish	55	1.1%
Crustacean	32	0.7%
Total	**4859**	**100%**

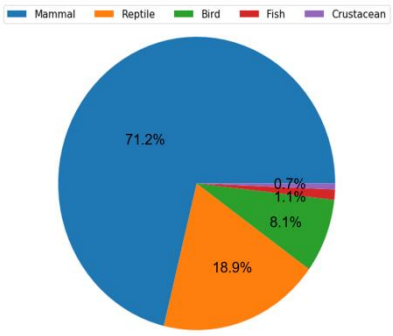

Fig 4. Table and pie chart of reclassified taxa (by NISP)

Zooarchaeological data are consistent with wetland environments in the middle and lower reaches of the Yangtze River where Kuahuqiao people once lived. The region had extensive wetlands, marshes and estuaries, which were likely inhabited by various forms of wildlife and aquatic animals such as mammals (71%), reptiles (19%), birds (8%) and fish (1%) (Fig 4).

(2) Taxa change during periods

The period between 8200 and 7000 BP is further divided into early phase (8200-7800BP), middle phase (7700-7300BP) and late phase (7200-7000BP) (Pan et al. 2017). In this paper, period 1, 2 and 3 are used to indicate each phase.

The composition of fauna kept changing throughout three periods with the majority of bone deposits being recovered from period 3 contexts (Table 2 and Fig 7&8). While this may reflect actual taxa shifts, it could also be attributed to sampling bias.

Table 2. Number of taxa identified in different periods

Period	Number of Taxa Identified
1	24
2	23
3	30

'Cervid', '*Bos* sp./*Bubalus* sp.', '*Cervus nippon*', '*Sus scrofa*', '*Canis familiaris*', '*Grus japonensis*', '*Alligator sinensis*' and '*Anas* sp.' appeared in all periods. '*Channa argus*', '*Accipiter nisus*' and 'Rodent' only appeared in period 1. 'Cyprinid', '*Nyctereutes procyonoides*', '*Naemorhecdus sumtatraensis*', '*Rhinoceros* sp.' appeared in period 2 but later disappeared in period 3. '*Aquila chrysaetos*', '*Elaphurus davidianus*', '*Meles meles*', '*Ursus* sp.', '*Capra hircus/Ovis aries*', 'Pelecanus', '*Panthera tigris*', 'Cetacean',

'*Cygnus cygnus*' and 'Gruidae' were taxa that newly appeared in period 3.

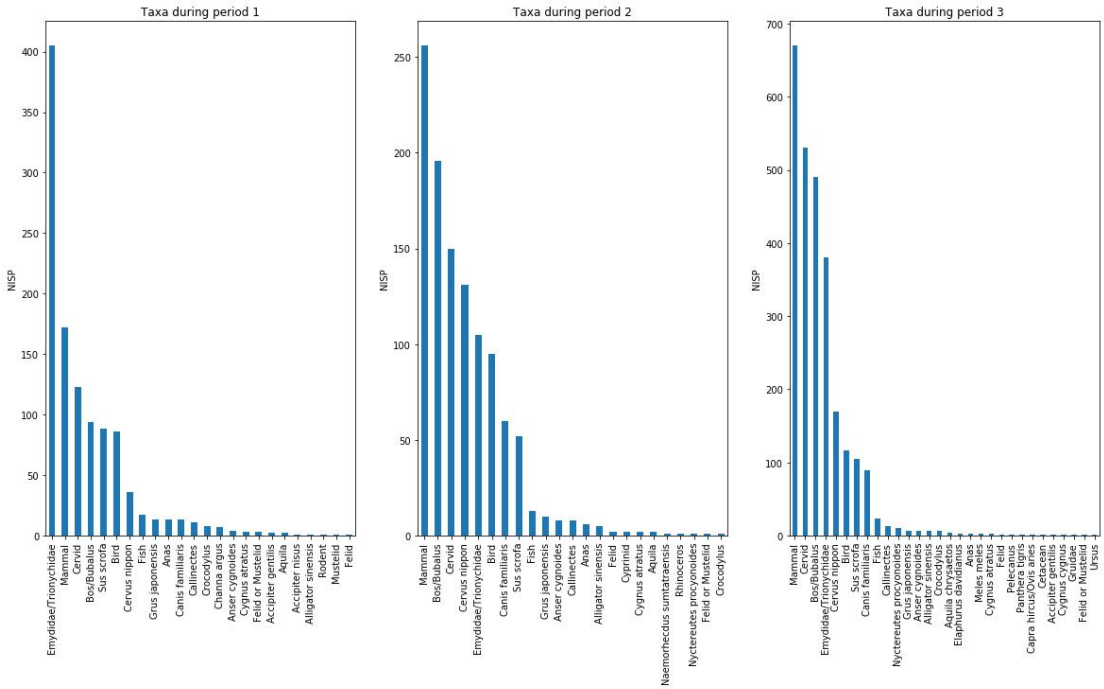

Fig 5. NISP of different taxa during period 1,2 and 3

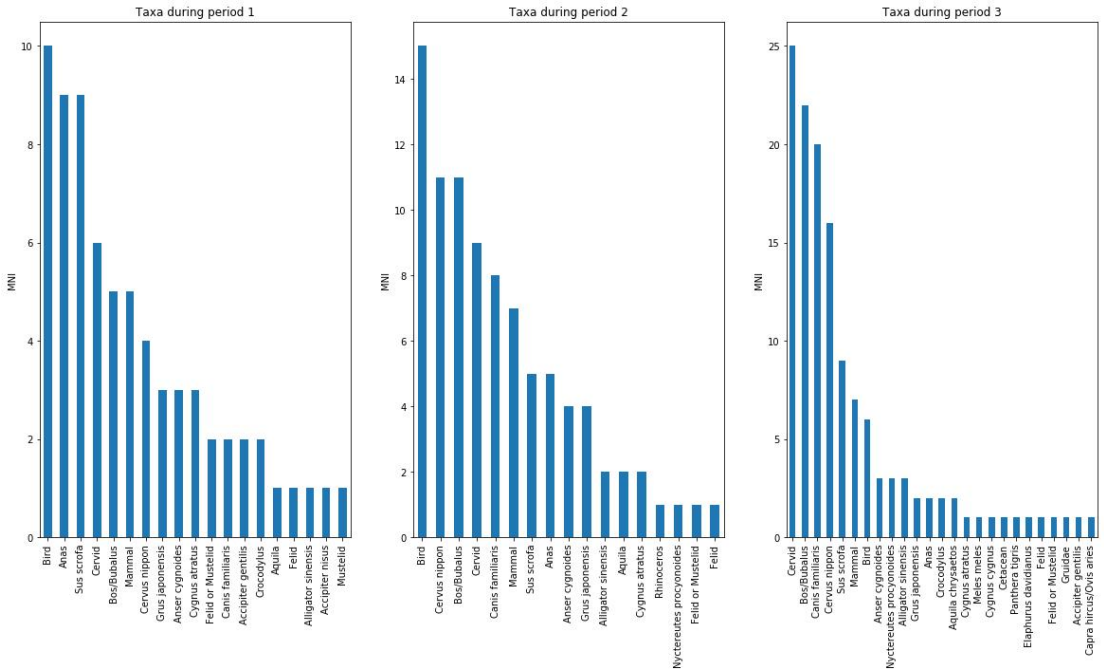

Fig 6. MNI of different taxa during period 1,2 and 3

We also investigate the quantity of major fauna in the region in different periods. Cattle (buffaloes), deer, pig, dog, duck, turtle and crane remains are taken for further quantification.

The results reveal that Kuahuqiao region witnessed an increasing number of cattle (*Bos* sp./*Bubalus* sp.), deer (*Cervus nippon*), and dogs (*Canis familiaris*) and a decreasing number of ducks (*Anas* sp.). The quantity of pigs (*Sus scrofa*) fluctuated, with the population in period 2 being the lowest. For cranes (*Grus japonensis*), although MNI data varies from that of NISP in period 2, its quantity showed a downward trend overall from period 1 to period 3.

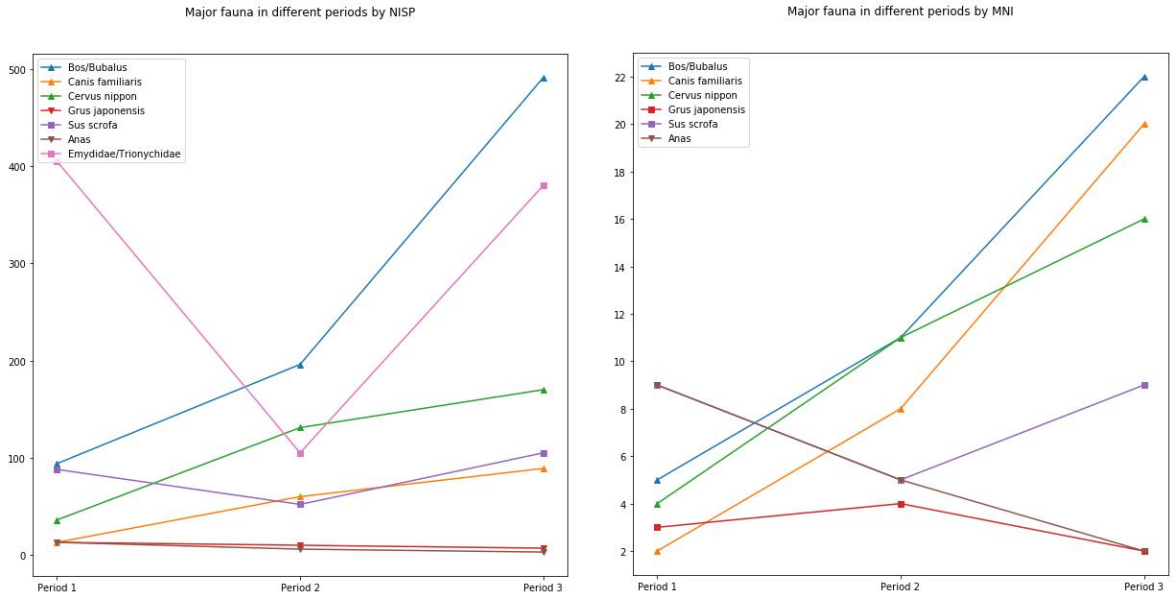

Fig 7. Major fauna in the region in different periods by NISP and MNI

The decline of ducks and cranes and the increase in terrestrial animals may correspond to coastal environmental transitions (Liu et al. 2020). Nevertheless, the available information is insufficient to allow any firm conclusions.

3.2 Mark Analysis

Of 4936 fragments analyzed, approximately 2.4% exhibit a total of 15 types of anthropogenic marks. These marks are primarily processing marks (N = 34), cut marks (N=32), slash marks (N=26) and burn marks (N=6) .

Deer dominates the animal taxa in terms of the number of marked bones and the types of marks. 71% of marked bones come from *Cervus nippon* and cervid species. For the 34 processed bones, 24 of them are antlers or ulnae of *Cervus nippon* (N = 17) or cervid (N = 7). Deer bones were also cut, slashed, burnt, polished, bit, scraped, sawed and perforated. In addition, malformation and lesions were observed on some

specimens (Table 3). The prevalence of deer bones with marks can be explained by the abundance of deer species in the surrounding area as discussed in the previous section and the fact that deer antlers and ulna are much easier to be processed. Deer was an important meat resource during neolithic time in the lower Yangtze River region and might be hunted in a sustainable manner (Zhang et al. 2022). Another possible explanation is that deer bones were favoured by Kuahuqiao people for ideological purpose. Other archaeological findings suggest the existence of art and religion in the region and some incised designs on antlers are interpreted as realistic representations and abstract designs by scholars (Jiang 2013).

The cattle (buffaloes) remains saw the widest variety of elements with marks. Marks were found on a total of 11 different types of cattle (buffaloes) bone elements, ranging from mandibles to tibiae. Previous studies have shown that water buffalo (*Bubalus mephistopheles*) played a significant role in the Kuahuqiao culture. Buffaloes were not only used as vital animal power for rice cultivation but also provided a secondary source of sustenance. Patterns of butchering and cooking were identified from water buffalo bones (Jiang 2013), indicating that buffalo meat might have been consumed by the Kuahuqiao people for additional sources of protein and nutrition.

Table 3. Summary table for marks on the bone

No.	Mark	Total	Taxa	Sub total	Element	Quantity
1	Processed	34	*Cervus nippon*	17	Antler	13
					Ulna	4
			Mammal	8	Rib	8
			Cervid	7	Antler	6
					Ulna	1
			Bird	2	Limb	2
2	Cut	32	Cervid	21	Antler	21
			Cervus nippon	4	Antler	4
			Mammal	4	Rib	2
					Vertebrae	2
			Bos sp./ *Bubalus* sp.	2	Mandible	1
					Rib	1
			Cervid	1	Pelvis	1
3	Slashed	26	*Cervus nippon*	12	Antler	12
			Cervid	10	Antler	8
					Cannon bone	1
					Skull	1
			Bos sp./ *Bubalus* sp.	4	Calcaneus	1
					Sacrum	1
					Tibia	1
					Ulna	1

4	Fire	6	*Bos* sp./ *Bubalus* sp.	3	Metacarpal	1
					Pelvis	1
					Radius	1
			Cervus nippon	2	Femur	1
					Mandible	1
			Cervid	1	Mandible	1
5	Polished	5	Cervid	2	Antler	2
			Bos sp./ *Bubalus* sp.	2	Scapula	2
			Mammal	1	Rib	1
6	Lesion	4	Cervid	2	Humerus	1
					Mandible	1
			Bos sp./ *Bubalus* sp.	2	2nd Phalange	1
					Mandible	1
7	Bite	3	*Sus scrofa*	2	Pelvis	1
					Scapula	1
			Cervid	1	Antler	1
8	Perforation	2	*Emydidae/ Trionychidae*	2	Shell	2
9	Lesion?	2	*Sus scrofa*	1	Pelvis	1
			Mammal	1	Femur	1
10	Scraped	1	Cervid	1	Antler	1
11	Sawed	1	*Cervus nippon*	1	Skull	1
12	Perforation?	1	*Cervus nippon*	1	1st Phalange	1
13	Malformation	1	*Cervus nippon*	1	Antler	1
14	Lesion/Burn	1	*Bos* sp./ *Bubalus* sp.	1	Mandible	1
15	Carved and Perforation	1	Cervid	1	Antler	1
Sum		**120**		**120**		**120**

These marked bones are further staged and analyzed. Table 4 shows that the majority of the artificial traces were formed in the period 3, especially in the case of "processed" bones (Fig 8). Only 16 fragments demonstrated evidence of artificial marks during period 1, and this number had grown almost fivefold to 84 in period 3.

Table 4. Bones with anthropogenic marks by period

Period	**Sub total**	**Period**	**Sub total**
Period 1	**16**	**Period 3**	**84**
Cut	7	Processed	27
Processed	3	Slashed	21
Carved and Perforation	1	Cut	18

Fire	1	Polished	3
Lesion	1	Fire	3
Lesion?	1	Bite	3
Polished	1	Lesion	2
Slashed	1	Perforation	2
Period 2	**20**	Perforation?	1
Cut	7	Lesion?	1
Processed	4	Malformation	1
Slashed	4	Sawed	1
Fire	2	Scraped	1
Lesion	1		
Lesion/Fire	1		
Polished	1		
Total :120			

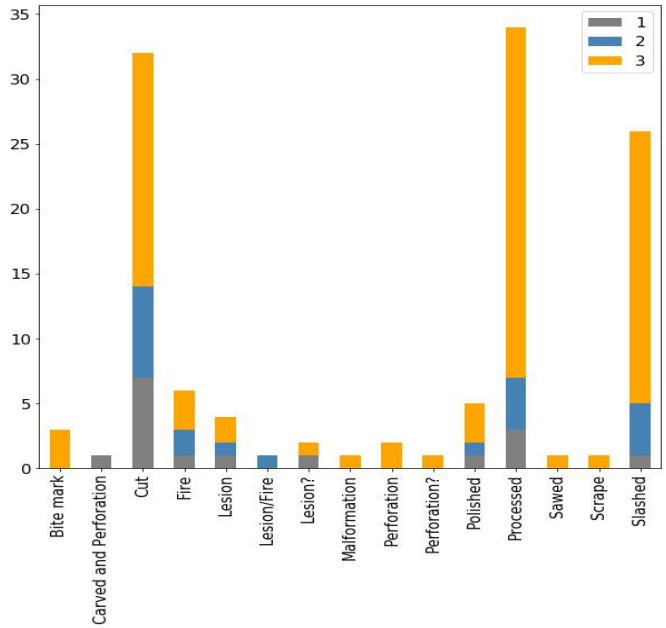

Fig 8. Mark types by period

It is interesting to note that "Scraped", "Malformation" and "Sawed" marks only appeared in period 3. Meanwhile, more perforation marks were observed in period 3. If not a sampling bias, this phenomenon could be related to potential technological advancements in the late period, when saws and other tools were made and used in daily activities.

4. Conclusion

Zooarchaeological data show that the faunal assemblage at the Kuahuqiao site varied from early phase to late phase. Wild terrestrial and aquatic animals are common in the living area of Kuahuqiao people, which are consistent with wetland environments in

the middle and lower reaches of the Yangtze River. And it is worthwhile to notice the prevalence of deer (*Cervus nippon*) in the region.

The majority of animal remains and bones with evidence of anthropogenic activity were recovered from the layers of period 3 (7200-7000BP), suggesting that the Kuahuqiao culture was well developed over this period of time. A variety of artificial marks were identified on deer antlers and ulnae as well as on the bone elements of cattle (buffaloes). “Sawed” marks were among several other marks that newly appeared in period 3, indicating potential technical progress in the late phase of Kuahuqiao culture.

References

Jiang, L. (2013). The Kuahuqiao Site and Culture. In A Companion to Chinese Archaeology, A.P. Underhill (Ed.). https://doi.org/10.1002/9781118325698.ch26

Liu, Y., Deng, L., He, J., Jiang, R., Fan, D., Jiang, X., Jiang, F., Li, M., Chen, J., Chen, Z. & Sun, Q. (2020). Early to middle Holocene rice cultivation in response to coastal environmental transitions along the South Hangzhou Bay of eastern China. Palaeogeography, Palaeoclimatology, Palaeoecology, Volume 555, 2020, 109872, ISSN 0031-0182. https://doi.org/10.1016/j.palaeo.2020.109872.

Pan, Y., Zheng,Y. & Chen, C. (2017). Human Ecology of the Early Neolithic Kuahuqiao Culture in East Asia. Handbook of East and Southeast Asian Archaeology.

Steele, Teresa E. (2015). The contributions of animal bones from archaeological sites: the past and future of zooarchaeology. Journal of Archaeological Science, Volume 56, pp.168-176, ISSN 0305-4403. https://doi.org/10.1016/j.jas.2015.02.036.

Wu, M., Zhang, B., Jiang, L., Wu, J. & Sun, G. (2018). Natural lacquer was used as a coating and an adhesive 8000 years ago, by early humans at Kuahuqiao, determined by ELISA. Journal of Archaeological Science, Volume 100, pp.80-87, ISSN 0305-4403. https://doi.org/10.1016/j.jas.2018.10.004.

Zhang, Y., Sun, G., Wang, Y., Huang, Y., Kikuchi, H., &Yang, X. (2022). Sustainable Hunting Strategy of Sika Deer (Cervus nippon) in the Neolithic Lower Yangtze River Region, China. Frontiers in Earth Science, Volume 9.