

Abstract

Cattle (*Bos taurus*), domesticated from the extinct aurochs (*Bos primigenius*), has been an important animal to many human societies since the prehistoric times. Cattle provides not only meat for subsistence, but also hide, blood, dung, milk and traction that contribute to the organization of human beliefs, cultural attitudes and social complexity.

Cattle pastoralism originated in the Near East during the 11th and 10th millennia BP and spread southward and westward into neighboring regions. Zooarchaeological data also provide substantial information to an increasing economic importance of cattle for both meat and milk production in these regions.

As independent loci of origins of food domestications, the Yangzi and Yellow River Basins of China are thought to be the birth place of many important plant and animal domesticates, including rice, millet, pigs, and possibly dogs while domesticated wheat, barley, sheep, goats, and horses were introduced from other regions. Questions have been raised about the possibility of local domestication of cattle in the Yangzi and Yellow River Basins; unfortunately, with the absence of systematic biometric approaches, the precise circumstances of the earliest phases of cattle domestication remain unclear.

This study provides a comprehensive review of the available *Bos* sp. (including *Bos primigenius*, *Bos taurus* and *Bos gaurus*) materials excavated (from the Neolithic to Bronze Age) in China to date. I bring together biometrical information of *Bos* bones from Early Neolithic to Early Bronze Age (10,000 to 3,600 BP), in order to gain a better understanding of the morphological variation of this animal in a biological point of view - the main indicator for tracing domestication (both locally and imported from elsewhere).

The results of this work demonstrate that, during Early Neolithic, aurochs were widely hunted base on their relatively large body size compared to the standard animal and later samples. The general size diminution of *Bos* in the studied region makes its first appearance in middle Yellow River Valley no later than 4,300 BP. Small-sized domesticated cattle was soon intensively used in central China afterward. Domesticated cattle was introduced to China from Near East through Central Asia. The new custom of milk exploitation and the increase demand of sacrificial use may be the pull factors of the expansion and the incorporation of cattle husbandry.

Chapter 1

Introduction

The domestication of animals and plants, was considered as a key prerequisite for the later developments of the history of humankind (Diamond 2002), represents one of the most important achievements in human history during the process of Neolithization. The transition from hunting-gathering to agricultural societies did not only result in evolutionary changes of plants and animals, but it also brought about changes in human behavior, followed by the rapid spread of agriculture across the globe and human demographic expansions (Gignoux *et al.* 2011). Most importantly, the adoption of domestic plants and animals generated food surpluses, triggered an explosion of technology and the dispersal of languages, allow for the development of craft specializations, art, social hierarchies, and writing, and eventually gave rise to urbanization and the origin of the states (Diamond 2002, Diamond and Bellwood 2003).

Evidence suggests that several independent loci of food production emerged in the Old World during the Holocene, including the Fertile Crescent of Southwest Asia and the Yangzi and Yellow River Basins of China (Diamond 1997). The northern region of the Fertile Crescent has to date yielded the earliest record of stock keeping and plant cultivation dating back to mid 10th millennium BC, which includes the domestication of goat, sheep, pig, cattle, wheat, and barley (Peters *et al.* 2005; Helmer *et al.* 2005; Hongo *et al.* 2009; Peters *et al.* 1999; Zohary *et al.* 2012). This period coincides with the cultural period known as the Early Pre-Pottery Neolithic B (EPPNB). Shortly after, sheep and goat management spread quickly across the Near East, towards the south and the west into neighboring regions, even overseas to Cyprus. Cattle and pig husbandry moved considerably slower and in some regions as these taxa were less important to Neolithic agro-pastoral economies (Vigne 2011; Arbuckle 2013).

In China, evidence indicates that important crops and animals, such as rice (Zhao 2010 a), millet (Zhao 2004), soybean (Lee *et al.* 2011), pigs (Larson *et al.* 2010), and possibly dog (Larson *et al.* 2012), were domesticated from indigenous wild progenitors. Rice and millet cultivation had certainly begun by 8,000 BP in the Lower Yangzi River Valley and Northeast China, respectively, and domesticated pigs have been identified in the Lower Yangzi River Valley, which is based on the tooth shape analysis (Cucchi *et al.* 2012). These innovations then spread westward and eastward soon after 6,000 cal. BP (Qin 2012).

Domestic ungulates were initially exploited mainly for their meat. With an increase in the level of human control and technical innovations, secondary products such as milk and wool were also being exploited (Sherratt 1981).

It is argued that milk from sheep and goat was exploited since the beginning, if not earlier, of the middle PPNB in north Near East, while the use of fleece in this region began at around 7,000 cal. BC (Helmer *et al.* 2007).

Hide, blood, dung, milk, and traction, are important products and services provided by domestic ungulates (Helmer and Vigne 2007; Sherratt 1981). These resources are intimately linked to the shifting organisation of human beliefs, rapidly changing the cultural attitudes and social complexity that define the Early Bronze Age (Campbell *et al.* 2011). Multiple studies indicate that cattle pastoralism can be detected by overall individual cattle size diminution, increase in cattle bone frequencies within a faunal assemblage, shift to slaughtering younger individuals, shifts in carbon and nitrogen isotope ratios, and a reduction in sexual dimorphism. The presence of such patterns in zooarchaeological samples at sites such as Dja'de, Çayönü Tepesi, and Tell Halula, suggests that cattle pastoralism began in the Near East perhaps as early as the 11th and 10th millennia BP (Peters *et al.* 1999; Helmer *et al.* 2005; Hongo *et al.* 2009).

Unlike the work that has been done in the Near East, the exploration of the evidence for early domestication of cattle in China has been rather scarce. There is no doubt that cattle played a crucial role in the development of Chinese civilization since 4,000 BP, during which it became one of the most important animals for subsistence, bone tools and ornaments, and ritual purposes (Yuan and Flad 2005; Liang *et al.* 2012; Brunson *et al.* 2015). Cattle in China is generally believed to have been introduced from the Near East, together with wheat, barley, domestic sheep and goat (Zhao 2009; Yuan 2010). Unfortunately, there is currently no well-dated zooarchaeological evidence that corroborates this statement; the nature of cattle exploitation in early China, especially during the Neolithic, thus remains poorly understood. Recent debates on the wild or domestic status of the early cattle remains excavated in northeast China (10,660 BP) have introduced more complications into the debates around the indigenous or endogenous nature of domestic cattle in the Far East, and the possibility of the early domestication of cattle in China (Zhang *et al.* 2013; Lv *et al.* 2014).

Much of the previous research on Chinese cattle remains, especially from archaeological sites of earlier dates, were based on small zooarchaeological assemblages, and employed minimal or no standardization of measurements of bones or teeth. As a result, no systematic regional or temporal comparison of data has been undertaken to date, and few conclusions can be drawn from the existing evidence.

The Origin of Cattle in China from the Neolithic to the Early Bronze Age

In order to investigate the early development and exploitation of domestic cattle in China, I reexamine all available cattle bone assemblages excavated from China dating from the Early Neolithic to Early Bronze Age (*circa* 10,000 to 3,600 BP). The primary focus is to collect a standard biometrical dataset with which to test the various models for the origins and development of cattle exploitation in China.

The key aims of this study are therefore to:

- establish when and where the earliest cattle appeared;
- test the model for an early (autochthonous) origin for cattle domestication in China;
- test the model for a later (allochthonous) origin for domestic cattle in China;

If allochthonous,

- establish by what route(s) domestic cattle were introduced to China.

The objectives and methods of this study are:

- collect as much osteometric data of Chinese *Bos* as possible, from the literature and by revisiting bone assemblages that have previously been analyzed and results published;
- characterize the diversity and evolution of the isometric size estimated by the isometric size extracted from measurements of individual skeletal elements and log size index;
- identify independent domestication or import model based on the patterns of body size change.