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Chèvres de bât nord-américaines, *Capra hircus* Linnaeus, 1758. Photo David Suisse / *North American pack goats, Capra hircus Linnaeus, 1758 (photo courtesy of David Suisse)*.

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Pack goats in the Neolithic Middle East

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ABSTRACT

This article advances the hypotheses that sheep (*Ovis aries* Linnaeus, 1758) and goats (*Capra hircus* Linnaeus, 1758) in the Neolithic Middle East were employed regularly as pack animals and were domesticated to serve as pack animals. The employment of pack ovicaprines, especially pack goats, can explain how obsidian and other goods that circulated in exchange networks were transported across long distances and mountainous terrain. A pack goat can carry 30% of its weight over 24 km of mountainous terrain daily. A lactating dam can provide milk for human consumption on the trail. Compared to pack sheep and pack cattle, pack goats are more agile and adaptable to a greater variety of environments. Training a goat to pack is not difficult, and research on caprines' social preferences suggests that the wild sheep (*Ovis orientalis* Gmelin, 1774) and wild goat (*Capra aegagrus* Erxleben, 1777), if born in human captivity, could be trained to pack. Findings support the hypothesis that dairying originated from the training and use of pack goats in the Neolithic. Goats usually don't sustain bone pathology from bearing pack loads, and bone pathology and increased bone robustness from pack-bearing, especially of goats, may be impossible to discern from the faunal record. Neolithic figurative evidence of pack ovicaprines is highlighted.

KEY WORDS

Domestication,
milking,
ovicaprines,
goats,
Neolithic,
Middle East,
pack animals,
exchange networks.

RÉSUMÉ

Des chèvres de bât au Moyen-Orient néolithique.

Cet article avance les hypothèses que les moutons (*Ovis aries* Linnaeus, 1758) et les chèvres (*Capra hircus* Linnaeus, 1758), dans le Moyen-Orient néolithique, étaient régulièrement utilisés comme bêtes de somme et étaient domestiqués dans ce but. L'utilisation des caprinés de bât et plus particulièrement des chèvres de bât, peut expliquer comment l'obsidienne et d'autres produits circulant dans les réseaux d'échange ont été transportés sur de longues distances et en terrain difficile et montagneux. Une chèvre de bât peut transporter 30 % de son poids sur 24 km de terrain montagneux par jour. Les femelles en lactation peuvent fournir du lait pour la consommation humaine sur le chemin. Comparativement aux moutons et bovins de bât, les chèvres de bât sont plus agiles et adaptables à une plus grande variété d'environnements. La formation d'une chèvre au portage n'est pas difficile et la recherche sur les préférences sociales des caprinés suggère que les moutons sauvages (*Ovis orientalis* Gmelin, 1774) et les chèvres sauvages (*Capra aegagrus* Erxleben, 1777) nés en captivité pourraient être entraînés à porter des charges. Les résultats soutiennent l'hypothèse que l'exploitation laitière a débuté avec la formation et l'utilisation de chèvres de bât dans le Néolithique. Les chèvres de bât portant des charges raisonnables ne développent généralement pas de pathologies osseuses; les pathologies et la robustesse osseuses résultant de la charge mécanique, surtout chez les chèvres, peuvent être impossibles à discerner dans les ressources fauniques. Les preuves figuratives néolithiques des caprinés de bât sont mises en valeur.

MOTS CLÉS

Domestication,
laiterie,
caprinés,
chèvres,
Néolithique,
Moyen-Orient,
bêtes de somme,
réseaux d'échange.

INTRODUCTION

The hypothesis that ovicaprine – sheep (*Ovis orientalis* Gmelin, 1774) and goat (*Capra hircus* Linnaeus, 1758) – regularly served as pack animals in Antiquity has received scant favor. Some zooarchaeologists dismissed it (e.g. Russel 2012: 229; Uerpmann & Uerpmann 2012: 80); others (e.g. Halstead & Isaakidou 2011; Zeder 2012; Greenfield & Arnold 2015) did not consider this possibility in their theorizing of how the earliest domesticated ovicaprine were exploited. Nevertheless, for Asia's poorest of the poor, goats have a multifunctional relevance that includes vital transport and traction service (Devendra 2012). For the Phala, nomadic pastoralists of Tibet's Chang Tang plateau, where agriculture is impossible, pack sheep and pack goats were crucial for survival. Every spring, hundreds of sheep and goats would transport salt harvested from a remote salt pan for later trade for necessary grain, bearing the salt-loads round-the-clock on a month-long, 225 km journey home (Goldstein & Beall 1990).

Hiking with pack goats (Fig. 1) is also a popular American past-time. It originated with John Mionczynski during his field research on the Rocky Mountain bighorn sheep (*Ovis canadensis* Shaw, 1804) for the U.S. Forest Service and Wyoming Fish and Game Department. At first thinking it was a foolish idea that a goat could pack, out of desperation for a pack animal that could negotiate the Rocky Mountains' difficult terrain, he discovered that his 11-year-old Toggenburg, Wethervane, could do the job. His book, *The Pack Goat* (Mionczynski 1992), summarizes his pack goat wisdom gained from Wethervane and from many other pack goats after that.

The goat's uncanny abilities to serve as hiking guide and transporter of fragile cargo are exceptional. Mionczynski (2017) related how, on a hiking expedition to Upper Fremont Glacier for the U.S. Geological Survey, his American Alpine

goat, Alpie, alerted the hiking party to an impending boulder slide, saving the party from certain death, and that his Toggenburg, Brownie, easily transported 41 kg of expensive scientific equipment. Upper Fremont Glacier, a remote corner of Jackson Peak, Wyoming, is 4100 m above sea level, "exposed, windy, subject to daily lightning attacks, virtually devoid of vegetation of any kind and three days from the trailhead" (Mionczynski 2017: 19).

Evidence suggests that training the oriental mouflon (*Ovis orientalis* Gmelin, 1774), ancestor of the domestic sheep (Demirci *et al.* 2013), and bezoar goat (*Capra aegagrus* Erxleben, 1777), ancestor of the domestic goat (Daly *et al.* 2018), to carry human-imposed loads would have been easy. If an ovicaprine is separated from its mother, its social preference is for its foster mother's species (Kendrick *et al.* 1998). This effect is not related to domestication (Schaller 1977: 280; Kendrick *et al.* 2001) and is greater for males (Kendrick *et al.* 2001).

For Mionczynski (1992), goats that are removed from the dam at birth and bottle-fed will follow the owner around constantly. At age six months, pack goats in-training can participate in a pack-goat string. With positive reinforcement they can be trained to come when their name is called, to follow other simple verbal or hand commands, and to cross streams by walking on logs or by swimming. A pack goat in good condition can carry on average about 30% of its weight on a 24 km day's trip over mountainous terrain, work for three to four days in desert conditions without water, and traverse rough and rocky terrain better than a llama. Any breed of goat can be trained to pack, and the Toggenburg, the breed closest to its bezoar ancestor, makes a model pack goat.

Ovicaprine are able to detect a moving person at 1.5 km (Schaller 1977: 187). Mionczynski (1992: 130) wrote of the goat that "walking with one is like wearing a pair of binoculars". Aristotle, c. 384-322 BCE, similarly reported that



FIG. 1. — North American pack goats, *Capra hircus* Linnaeus, 1758 (photo courtesy of David Suisse).

the goat's eye "is most to be prized for acuteness of vision" (Aristotle, *HA* 13). Compared to pack sheep, pack goats require less water and can better negotiate terrain that is steep or stony, lead a pack train, and signal by bleating when danger is present (Phillips 2001: 21). Of all domesticated animals, goats use poor-quality, low-protein roughages most efficiently (Konuma *et al.* 2012) and so are the best transport animals for uncertain environments.

A NEED FOR PACK ANIMALS IN THE NEOLITHIC MIDDLE EAST

The earliest evidence for domesticated cattle, sheep, and goats – the term *domesticated* meaning herein bred and raised in human captivity – comes from the upper Euphrates-Tigris basin (northern Syria and southeast Anatolia) *c.* 8700 BCE (Helmer *et al.* 2005; Peters *et al.* 2005). The onset of ruminant domestication coincides with the beginning of the Middle East's pre-pottery Neolithic B (PPNB), a cultural phase that ended *c.* 7000 BCE with pottery's invention (Helmer *et al.* 2007: 44). By 7500 BCE ovicaprine domestication was present throughout southwest Asia (Peters *et al.* 2005; Conolly

et al. 2011). Domesticated cattle were imported to the eastern Fertile Crescent (northern Iraq and western Iran), where wild cattle (*Bos primigenius* Bojanus, 1827) were not prolific due to the dry climate and mountainous terrain, sometime between 6000–5500 BCE (Arbuckle *et al.* 2016).

Prior to ruminant domestication, in the Upper Paleolithic through the pre-pottery Neolithic A (PPNA), the procurement of Anatolian obsidian, prized for its sharp cutting edge and beauty, entailed overland transport through the Taurus Mountains to points South, sometimes covering distances of over 700 km (Carter *et al.* 2013; Frahm & Hauck 2017: fig. 1; Barge *et al.* 2018: fig. 3). During this time obsidian-procurement depended on trade networks (Watkins 2008; Ibáñez *et al.* 2015; Frahm & Hauck 2017) and usually entailed the most direct path to the closest obsidian source (Carter *et al.* 2013; Ibáñez *et al.* 2015; Frahm & Hauck 2017: fig. 1).

Trade networks in the PPNB increased in complexity. Now the procurement of Anatolian obsidian sometimes entailed travel from more distant obsidian sources; sometimes circumvented settlements lying on direct paths to and from targeted obsidian sources (Carter *et al.* 2013; Ibáñez *et al.* 2015) or entailed travel in the central Zagros mountains

(Barge *et al.* 2018: figs. 4, 5). This suggests that compared to previous times, trade networking in the PPNB period entailed more arduous travel. Other commodities that were subject to stepped-up, non-local importation in the PPNB period included practical goods, such as basalt (Watkins 2008:156), fine flint, and quite likely, bitumen (i.e., mastic) (Hole 2003), and luxury decorative goods, such as marine shell (Hole *et al.* 1969: 243-245; Smith 1974; Bar-Yosef Mayer 2017; Alarashi *et al.* 2018), native copper, turquoise (Hole *et al.* 1969: 246), and other exotic stone (Barge *et al.* 2018).

MALE VS FEMALE PACK GOATS

Skeletally-mature male goats are on average larger than skeletally-mature female goats, and for this reason it might be assumed that in antiquity, skeletally-male goats would have been preferable to female goats as pack animals. However, finding little evidence of Neolithic domesticated, skeletally-mature, male goats does not undermine the hypothesis of Neolithic pack goats. Female pack goats have the advantage of providing milk on the trail (Mionczynski 1992). Wild female ovicaprids are less aggressive and more vigilant than males and are herd leaders (Schaller 1977), so it is not surprising that female pack goats make better leaders of pack-goat strings (Mionczynski 1992: 67). On the other hand, Mionczynski (1992:118) reported that keeping wethers (castrated male goats) is much easier than keeping does.

Despite evidence that herders engaged in the practice of castrating working cattle for greater docility as early as the PPNB (Helmer *et al.* 2018), retaining wethers until they were significantly larger than the does might have been cost-ineffective at some Neolithic Middle East sites. For example, it was common practice at late pre-pottery Neolithic Middle East sites to slaughter male goats that were young, currently interpreted as younger than age two years (Arbuckle & Atici 2013). This harvesting strategy complies with “herding for tender meat at the maximum weight” (Helmer *et al.* 2007: table 1).

On the basis of 36 modern, Zagros-area, museum-housed bezoar skeletons, Zeder (2001) concluded that by age one year, modern wild male bezoars, and by extrapolation Neolithic Middle East domesticated male goats, were significantly larger than their female counterparts, yet this conclusion may be erroneous. The wildlife biologist George B. Schaller reported on the basis of his thousands of field observations of living bezoars (Schaller 1977: 101-105, tables 1, 8, 9, 13), that at age one year bezoar males are smaller than bezoar females; at age three and a half years they are as large as the females; at age four and a half years they are larger than females; and at age five and a half years they are almost twice the size of the females. Because a wild goat's age can be determined by counting growth rings on the horns, such field assessments are possible. Discussion of why such a significant disagreement exists between these two zoologists is outside this paper's scope. It suffices to say that in the Neolithic Middle East, female pack goats may have been employed significantly more often than male pack goats also because of their greater average size. Interpreting harvest profiles may be subject to this consideration.

LABOR REDUCTION: THE PROMPT FOR OVICAPRINE DOMESTICATION?

Vigne & Helmer (2007: fig. 13) pointed to the fact that when ruminant domestication first took place, hunting contributed to 80% of the meat consumed at sites and remained the dominant meat-procurement strategy for 1000 years subsequent to ruminant domestication. In addition, findings suggest that at Halan Çemi Tepesi, a rare Epipaleolithic-to-PPNA transition site in southeast Anatolia, when ovicaprids were hunted but not yet domesticated, the wild ovicaprid population was flourishing (Starkovich & Stiner 2009). These findings support the Vigne & Helmer (2007) and Helmer *et al.* (2007) hypothesis that ruminants were not initially domesticated merely to ensure a stable meat supply.

Vigne & Helmer (2007) and Helmer *et al.* (2007) suggested that the desire for milk may have been one reason for ruminant domestication, yet at the first ruminant-herding sites, where dairying was unknown, how would the people have known that ruminant milk would be good human food? In adults the absence of lactase-persistence (LP)-associated allele(s) usually causes lactose-intolerance, the inability to digest fresh milk (Itan *et al.* 2010). Lactose-intolerance has been a deterrent to milk consumption in east Asia (Dong 2006), where high levels of lactase deficiency prevail (Itan *et al.* 2010) and where ovicaprid domestication may not have taken place until 4500 BP (reviewed in Vigne 2015: 128). On the other hand, not only ruminant domestication, but also sophisticated dairying practices, evidenced by clay pottery fat residues of fermented dairy products, such as yogurt or cheese from presumably ruminants (reviewed in Leonardi *et al.* 2012; Vigne 2015:142), though the species have been undetermined by these methods (Greenfield & Arnold 2015), was adopted in the Neolithic Middle East when LP frequency is presumed to have been at or near zero (Leonardi *et al.* 2012; Mathieson *et al.* 2015; Broushaki *et al.* 2016; Gallego-Llorente *et al.* 2016). These findings strongly suggest that the motivation to harvest milk for human consumption occurred subsequent to ruminant domestication.

Labor reduction is a more fundamental human motivation. In light of evidence for PPNB transport-cattle, Vigne (2015:142) expanded the ruminant-domestication-for-milk hypothesis to include ruminant-domestication for transport, traction, and fiber. In this connection, Zeder's (2012: 245, 246) contention that animal domestication for work depended upon prior knowledge of animal domestication for food is contradicted: in the northern latitudes, labor reduction by use of sledge-animals was hunter-gatherers' motivation for holding captive wild reindeer (Mirov 1945; Storli 1996) and possibly also for domesticating the wolf (Germonpré *et al.* 2012). Like reindeer, wild ovicaprids will approach humans out of curiosity (Mionczynski 1992: 132) and are easily bonded to humans (Schaller 1977: 280). When ovicaprids were only wild, ovicaprid hunters, like reindeer hunters, may have realized at some watershed moment that their quarry could be trained to work. At Halan Çemi Tepesi obsidian was transported over 100 km to the site, and the faunal findings indicate that quarry-transport costs were deliberately minimized (Starkovich & Stiner 2009).

The hypothesis that Neolithic herders nursed their domesticates for easier taming is not new and has evidentiary support from indigenous peoples of southeast Asia and elsewhere (Milliet 2007: 890, 891). A Neolithic nursing bottle may have consisted of a pliable leather pouch with an end serving as a nipple (though leather artifacts are usually perishable and so inferred from the archaeological record). Certainly, if the earliest herders bottle-fed their ovicaprine for easier trainability to pack, these herders would have tried ovicaprine milk as human food. If at first they were discouraged by adverse gastrointestinal effects, the convenience of having a walking beverage with them on the trail might have been incentive enough to continue drinking their pack goats' milk. Assuming lactase-deficient PPNB-time people were like lactase-deficient people of today, most could have tolerated some lactose and have progressively increased their lactose tolerance. Their lactose-intolerance could have been further reduced by fermenting the milk (Leonardi *et al.* 2012; Weaver *et al.* 2013).

Lipid studies so far have been limited to clay pottery residues, so one way to rule in the hypothesis that ruminant milk was exploited in the pre-pottery Neolithic Middle East is to show that domesticated adult ruminants (presumably females that were milked) were present in zooarchaeological assemblages (Helmer *et al.* 2007: table 1; Greenfield & Arnold 2015). Yet the domestication-for-packing hypothesis predicts this also, because the more skeletally-mature the animal, the heavier pack-load it can carry. The finding that adult domestic ruminants of a particular species were more frequent than younger domestic ruminants of that same species has been interpreted as demonstrating a focus on herding that species for milk (Greenfield & Arnold 2015). In Neolithic south-eastern Europe harvest profiles show evidence of a milk-herding focus only for goats, which southeastern Europe received from the Middle East (Greenfield & Arnold 2015). Neolithic Middle East harvest profiles suggest goats were the earliest and predominant species to be milked (Vigne & Helmer 2007; Helmer *et al.* 2007), and show some but lesser evidence for milking sheep and cattle (Vigne & Helmer 2007).

Domesticated adult goats outnumbered domesticated adult sheep at many PPNB-time Middle East sites (Helmer 2008; Helmer & Gourichon 2008; Peters *et al.* 2015: 16, 17), even at sites where sheep, but not goats, were indigenous (e.g. Ali Kosh, Deh Luran Plain, Iran: Hole *et al.* 1969; Chogha Bonut, Susiana Plain, Iran: Redding 2003). Though a goat-milk preference can be accounted for by the facts that goat milk is more digestible than cow milk (Park 2010) and sheep milk (Peters *et al.* 2015: 17); that goats are easier to milk than sheep (Peters *et al.* 2015: 17) and were so than Neolithic cattle, which required their calves to be present to release milk (discussed in Vigne & Helmer 2007); and that compared to sheep, goats produce twice the amount of milk and for longer periods of time (Phillips 2001: 21), the hypothesis that adult goats were preferred to adult sheep only because of milk is not parsimonious, because given that the need for transport animals prompted ovicaprine domestication, the goat's superior packing ability should enter into the argument.

Certainly the need for transport would not have been limited to hunting and between-settlement exchange, but must have comprised routine domestic activities as well. Regarding this point, evidence suggests that at the earliest levels of Chogha Bonut and Ali Kosh the entire communities migrated seasonally between the Zagros lowlands and Zagros highlands (Hole *et al.* 1969: 342-345; Redding 2003), a lifestyle that continued on the Susiana Plain into the pottery Neolithic at Tepe Tula'I (Sutliff 2015), where the only domesticated livestock were goats (Hole 1974). Pack goats would have been the best transporters for these communities' seasonal migrations.

It should not be doubted that some Neolithic Zagros-area communities were seasonally mobile (i.e., nomadic transhumant), contrary to the opinion of Arbuckle & Hammer (2018). Ganj Dareh, level E (c. 7900 BCE) was an early Neolithic, Zagros-area, goat-herding community for which faunal remains provide incontrovertible proof that the community occupied the site only during the warmer months (Hesse 1979). In addition, the Arbuckle & Hammer (2018) arguments against nomadic transhumance at Ali Kosh (Bus Mordeh) c. 7500 BCE, are flawed. They argued that no summer upland camps that could have been associated with lowland Ali Kosh have been discovered; however, if domiciles were only semi-permanent or ephemeral, then their archaeological discovery would depend solely on chance. These authors further argued that juvenile goats were culled on site during the spring and summer, i.e., during the time a seasonally transhumant community would be in the uplands. However, it cannot be known when juveniles were culled on site. Juveniles could have been culled on site in the early spring, before migration to the uplands, or even during the winter. Moreover, no plant evidence exists suggesting that Ali Kosh (Bus Mordeh) was occupied during the summer (Hole *et al.* 1969: 345), despite the fact that the Bus Mordeh phase produced a prodigious amount of wild and cultivated plant remains, much more so than any other ensuing phase (Helbaek 1969). Thus, the Arbuckle & Hammer (2018) contention that the Ali Kosh (Bus Mordeh) people fed their goats year-round with cultivated plants has no empirical support. Arbuckle & Hammer (2018) also failed to consider the Sutliff (2015) re-analysis of the Tepe Tula'I findings, which support the thesis of nomadic transhumance.

OSTEO-PATHOLOGY AND BONE ROBUSTNESS AS EVIDENCE FOR NEOLITHIC PACK GOATS

Zooarchaeology has looked primarily for pathology in the faunal assemblage to conclude an animal was used for transport or traction (Russel 2012: 228). Yet pathologies associated with pack bearing may not occur if overloads are below a certain strain threshold (Robling *et al.* 2014:198, 199). According to Mionczynski (1992), pack goats are generally much more robust than stall-confined goats. The only pathology associated with pack bearing that he reported was fallen back-feet pasterns, which sometimes occur in pack goats that have not received prerequisite

exercise. Furthermore, it cannot be assumed that domesticated non-pack ovicaprids and pack ovicaprids would be distinguishable in an osteological assemblage by the presence of pathology or by their limb bones' robustness. Compared to pack ovicaprids, non-pack ovicaprids that were pastured might have had a greater opportunity to run, jump, and climb, sustaining equal, better, or worse osteological effects. This point is especially pertinent to goats, which engage in high-impact jumping (Moreno *et al.* 2008), tree- and ledge-climbing (Schaller 1977), and other high-risk behaviors driven by curiosity (Smith & Sherman 2009: 149). Thus, even if some Neolithic ovicaprids were used for pack transport and others not, an *a posteriori* mustering of evidence from osteological assemblages for these two groups might be impossible.

Helmer (2008) and Helmer *et al.* (2018) argued that the deformation of the first and second phalanges in various Neolithic European and Middle East sites' cattle is evidence of mechanical load-bearing. This pathology seen among cattle bones at PPNB Cafer Höyük (southeast Anatolia) caused these authors to hypothesize that cattle transported obsidian to PPNB Cafer Höyük, but this would have required 200 km of travel over mountainous terrain. Most cattle avoid steep mountain slopes even to obtain salt, a strong positive behavioral reinforcer (Cook 1966). Goats' sure-footedness is one reason why Mionczynski (1992) abandoned using his pack horse for pack goats on his Rocky Mountain expeditions. Regarding long overland journeys, points to consider are that cattle cannot easily go more than 24 hours in hot weather without water (D. W. Bailey pers. com. July 9, 2018), are more difficult to nourish with wild vegetation than goats are (Mionczynski 1992: 25; Konuma *et al.* 2012), and require half of their 24-hour day recumbent; ovicaprids require less than a third (Houpt 2011).

Evidence suggests that at Cafer Höyük goats were domesticated in the early PPNB (Helmer 2008; Peters *et al.* 2015:16). In the first phases of the PPNB occupation (8700–8200 BCE), of the total faunal assemblage (N = 978) goats were only slightly more frequent than sheep, comprising 28% vs 26% respectively, but in the final phase (8200–7500 BCE), of the total faunal assemblage (N = 3,297) goats comprised 38%, and sheep only 15% (Helmer 2008: table 1). The increased percentage of goats cannot be attributed to the final phase as having a drier climate, which goats can tolerate better than sheep, because the percentage of cattle increased slightly as well, going from about 9% to about 12%.

At Cafer Höyük, a primary supplier of obsidian for the trade network (Cauvin 2002: 22), a correlative pattern of obsidian usage was found. For the first PPNB phases the percentage of the total lithic assemblage comprising obsidian was about 50% and in the final phase it had increased to 90% (Cauvin 2002: 21). Noting that obsidian harvesting could take place only during the spring and summer because of the high altitude at which Bingöl, Cafer Höyük's only obsidian source, was located, and assuming that the Cafer Höyük herders were seasonally, vertically transhumant, Cauvin (2002) theorized

that herders lived with their herds at Bingöl during the spring and summer and harvested obsidian.

In the mountainous regions of southern Europe, the tradition of long-distance vertical transhumance over hundreds of kilometers applied primarily to goats and sheep but rarely to cattle, which generally didn't migrate more than 5 km (Stagno 2018). An abrasion analysis and isotope study of ruminant tooth enamels (discussed in Peters *et al.* 2015: 27, 28) as regards Cafer Höyük may find support for the hypothesis that pack ovicaprids aided obsidian procurement, that pack goats' role in this endeavor increased disproportionately relative to that of pack sheep, and that cattle were employed for other heavy-transport jobs.

FIGURATIVE EVIDENCE OF PACK OVICAPRIDES

It cannot be assumed on the basis of little figurative evidence that animals did not work regularly in the Neolithic Middle East. From the Neolithic through the fourth millennium, a plethora of figurative findings exists of animals and of humans, but few exist of working animals and of working humans.

Ovadia (1992) reported two figurines, both dating to the early fourth millennium, of pack ovicaprids—one of a ram and one of a ram or a goat—but only one of a pack bovine, which also dated to this time period. Morales (1990: 60) reported from Cayönü (southeastern Anatolia) dating to the PPNB or PPNC (Erim-Özdoğan 2011), two clay figurines of unidentified quadrupeds that “seem to have carried a burden (or a rider?) as there are lumps of clay or depressions for appliqué on top of the back”.

Evidence suggests that at Cayönü in the early- to middle-PPNB domesticated ovicaprids played a role in the site's economy (Peters *et al.* 2015: 6). Towards the end of the PPNB there was a precipitous increase in domesticated ovicaprids (Hongo *et al.* 2009: 66) and a precipitous increase in ovicaprine figurines and counting-tokens, which Erim-Özdoğan (2011: 211) attributed to “organized or reciprocal accounting trade over long distances”. Because most identified quadruped figurines at Cayönü were of ovicaprids (Morales 1990; Erim-Özdoğan 2011), which during the PPNB through the early-pottery Neolithic far outnumbered cattle in the osteological record (Hongo *et al.* 2009: table 1), these figurines may be of pack ovicaprids employed in the trade networks.

CONCLUSION

Using ovicaprids to transport goods requires no sophisticated training or technology. Compared to cattle and sheep, the goat is best for transporting goods in difficult, mountainous terrain and across long, arid distances. Finding no evidence of pathology or no biomechanical markers of packing from a site's goat bone assemblage should not be taken as evidence that pack goats were not regularly employed. In light of the facts discussed here, it is a compelling conclusion that the first domesticated goats were pack goats.

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