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From snout to tail

Exploring the Greek sacrificial animal from the literary, epigraphical, iconographical, archaeological, and zooarchaeological evidence

Edited by Jan-Mathieu Carbon & Gunnel Ekroth

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ABSTRACT

Animal sacrifice fundamentally informed how the ancient Greeks defined themselves, their relation to the divine, and the structure of their society. Adopting an explicitly cross-disciplinary perspective, the present volume explores the practical execution and complex meaning of animal sacrifice within ancient Greek religion (*c.* 1000 BC–AD 200).

The objective is twofold. First, to clarify in detail the use and meaning of body parts of the animal within sacrificial ritual. This involves a comprehensive study of ancient Greek terminology in texts and inscriptions, representations on pottery and reliefs, and animal bones found in sanctuaries. Second, to encourage the use and integration of the full spectrum of ancient evidence in the exploration of Greek sacrificial rituals, which is a prerequisite for understanding the complex use and meaning of Greek animal sacrifice.

Twelve contributions by experts on the literary, epigraphical, iconographical, archaeological and zooarchaeological evidence for Greek animal sacrifice explore the treatment of legs, including feet and hoofs, tails, horns; heads, including tongues, brains, ears and snouts; internal organs; blood; as well as the handling of the entire body by burning it whole. Three further contributions address Hittite, Israelite and Etruscan animal sacrifice respectively, providing important contextualization for Greek ritual practices.

Keywords: Greek animal sacrifice, anatomy, division, butchery, body part, multi-disciplinary approaches, zooarchaeology, iconography, epigraphy, texts, cross-cultural comparisons

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MICHAEL MACKINNON

5. Animal heads and feet in ancient Greek ritual contexts

Their relationship between sacred and profane

Abstract

Although traditional demarcations for sacrificial faunal remains among ancient Greek sites—(i) altar offerings; (ii) consumption debris; (iii) butchery refuse—provide a basis for study, the reality is not always so simple. This chapter re-examines the representation of heads and feet within zooarchaeological data for Greek ritual sites in light of the cultural and natural biases that can affect these samples. Attention here focuses upon aspects including (1) taphonomic factors shaping assemblage formation; (2) the association of heads and feet with an animal's hide, and, in turn, the role of the hide in ritual operations; (3) the relationship between holocaust sacrifice and expected representation of heads and feet; (4) consumption of heads and feet in feasting; (5) symbolism (whether expressed or not) surrounding the use, display or role of animal heads and feet in antiquity. Where possible, comparisons are made with the evidence for heads and feet among non-ritual zooarchaeological assemblages in Greek antiquity to provide a wider context for their distribution among ritual sites and to explore further the relationship between sacred and profane in this respect.*

Keywords: Greek animal sacrifice, zooarchaeology, taphonomy, cattle, sheep/goat, pig, head, feet, hide, bone assemblage, altar, consumption, feasting, butchery refuse/debris

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Introduction

Traditional divisions ascribe zooarchaeological remains recovered from ancient Greek ritual contexts into categories linked with (i) altar offerings (i.e., often the materials burnt for the gods or heroes venerated); (ii) consumption debris (i.e., materials correlated with ritual dining and feasting at such events), and (iii) butchery refuse (i.e., materials associated with the initial preparation of the animal carcasses for offering and consumption). These components help provide a broad basis for understanding the wider processes and operational sequences of animal sacrifice. Nevertheless, as Gunnel Ekroth notes,[1] the reality within such sacrifices does not always fit neatly into generalized patterns which might be anticipated or expected, and caution is thus warranted. As in greater archaeological practice, sometimes it is tempting, or convenient, to ascribe cultural characteristics to an assemblage of materials on the basis of where it was recovered. Thus, materials found in a domestic context are surmised to relate to domestic activities; materials recovered from a cemetery are linked with funerary activities; materials associated with a sanctuary correlate to ritual events or contexts. Aspects of interest can be further developed by drawing upon social parameters and concepts within reconstructions: e.g., materials from a "high status" site are tied to high status activities; those from "lower status" sites become exemplary of a lower level of social distinction. Although it can certainly be the case that recovered archaeological artifacts link fairly directly to assumed activities and social categories as understood through spatial and contextual assignment of such materials, this is not a given. Repeated episodes of non-critical assessment and relatively basic or simplistic extrapolation between where materials are recovered and their assumed role can run the risk of creating long-standing platforms of problematic tautologies.

The purpose of the current chapter is to re-examine some of these purported connections by exploring patterns in zooarchaeological materials from sites of Greek antiquity. The available database of such faunal remains, as collected from

* Special thanks are extended to Gunnel Ekroth and Jan-Matthieu Carbon, not only for their roles in organizing the conference *From snout to tail* in Uppsala, December 2016, but for the broad insights and spirited scholarship they bring to the interdisciplinary exploration of the issue of animal sacrifice in Greek antiquity overall.

[1] Ekroth 2009, 35.

both ritual (i.e. temple, sanctuary, and altar contexts) and non-ritual (i.e. **not** temple, sanctuary, and altar contexts) sites, forms the basis of investigation. Note, however, that the terms "ritual" and "non-ritual" are themselves constructs scholars have placed upon sites, which through such labelling may *a priori* lure us to label materials recovered from these places under the same heading provided for the site or its context.[2] The intention in this chapter is to demonstrate that such a path of investigation and reconstruction is difficult to traverse. The ritual/non-ritual continuum is malleable, unfixed, and ambiguous. Such a statement may not seem revolutionary, and has been asserted already,[3] but it is important to stress it, and to illustrate its merits, in an environment where the enticement to ascribe something in more concrete, fixed, and unambiguous terms may be favoured or prioritized. Accordingly, shades of grey in an argument (in other words, the murky "middle ground") may prove far more helpful as a measure of human behaviour and practice than might a fixation on the extremes of black and white (that is, the more concrete endpoints), even if, by comparison, this "grey-zone" itself may run the risk of being indecisive, dull, and mundane.

The study of heads and feet among ancient Greek faunal assemblages

Evidence for sacrifice of animal parts, such as the thigh and tail, registers fairly distinctly among several ancient Greek ritual sites.[4] Correlations these parts share with recovered zooarchaeological remains such as the femur, pelvis, sacrum, and caudal vertebrae have similarly been explored,[5] as has the relationship between left and right sides in the choice of such elements.[6] The situation with faunal remains associated with the head and feet of sacrificed animals, however, remains less securely investigated, given that these components may, depending upon the circumstances, cut across the various categories outlined above: altar offerings, consumption debris, butchery refuse.[7] For instance, one might expect these elements (at least the heads) to be charred on the altar in the case of a holocaust sacrifice,[8] but is such an assumption always justified? Similarly, when might butchery and/or consumption debris incorporate elements from heads and feet, and when might this not be the case? Re-examining the representation of heads and feet among zooarchaeological data for Greek ritual sites, in light of the cultural and natural biases that can affect these assemblages and their subsequent interpretation, is necessary, and will help shape some of the arguments presented here. Attention within the current study focuses upon (1) taphonomic factors shaping assemblage formation; (2) the association of heads and feet with an animal's hide, and, in turn, the role of the hide in ritual operations; (3) the relationship between holocaust sacrifice and the expected representation of heads and feet in faunal assemblages; (4) consumption of materials associated with head and feet in ritual feasting; (5) symbolism (whether expressed or not) that might surround the use, display or role of animal heads and feet in antiquity. Where possible, comparisons will be made with the evidence for heads and feet among non-ritual zooarchaeological assemblages in Greek antiquity to provide a wider context for the distribution of these skeletal elements among ritual sites and to explore further the relationship between sacred and profane aspects in this respect. Nonetheless, given the concerns addressed above, caution is warranted in *a priori* ascribing a fixed division between ritual and non-ritual components, at least as regards our investigations of recovered archaeological materials from ancient sites.

In exploring such aspects, this study will draw upon data for skeletal parts among zooarchaeological assemblages—that is, percentages of heads, teeth, limbs, ribs, vertebrae, feet, etc., tabulated for the various taxa. This information will be pre-

[2] Given this concern, the use of the terms "ritual" and "non-ritual" within this chapter should be offset with quotation marks, to contextualize their non-fixed nature. To avoid repetitive use of such quotations within the body of the text for this chapter, however, I shall avoid this configuration, and leave the assumption that such is the case.

[3] For a general introduction to these complexities, as they relate to Greek antiquity more particularly, see Eidinow & Kindt 2015, notably the chapters under 'Part I: What is ancient Greek religion'. For wider discussions of the multiple theoretical stances developed and explored in the assessment of ancient Greek rituals and animal sacrifice, see e.g. Detienne & Vernant 1989; Graf 2012; Naiden 2013.

[4] For general syntheses of these aspects and examples from various sites (alongside further references) see Ekroth 2008a; 2008b; 2009; 2011; 2013a; 2013b; 2014; 2016; 2017a; 2017b.

[5] Cf. e.g. publications by Ekroth listed in the previous footnote; Hägg 1998; Hitch 2015; Scullion 2013; Trantalidou 2013.

[6] MacKinnon 2010; 2013, with an example of this from the site of Nemea.

[7] Ekroth 2007, 266–268; 2009, 134–142, detail the components of interest among altar deposits, consumption debris, and butchery refuse, more clearly with regard to Greek sacrificial assemblages. Essentially, the central criteria to consult include the types of bones, the degree of fragmentation, the presence and location of cut and chop marks, and whether the bones are burnt or not. Nevertheless, divisions are not always clear among assemblages, in turn necessitating more detailed, individual studies of various faunal deposits, as well as more cross-site comparisons (as this chapter attempts). Moreover, as faunal remains are subject to a range of taphonomic factors, which in turn can shape the assemblages retrieved (and the ultimate patterns drawn), these biases must also be considered.

[8] Even if a holocaust sacrifice involved some measure of chopping up the animal and removing its hide, as Scullion 2009 argues, at least the heads should register within this scenario; the feet are more likely to have been removed with the hide in this case. For the practical execution of holocausts, see also the contribution by Ekroth in this volume, *Chapter 12*.

sented in the form of various graphs that display these variables for the three principal domesticate taxa found at ancient Greek sites—cattle, sheep/goat, and pig.[9] Immediately, it is important to signal potential biases. First, most zooarchaeological reports publish statistics for the frequency of these three animal taxa among sites, but not all provide a breakdown by skeletal part. Thus, the overall frequency (typically by NISP %)[10] of cattle, sheep/goat, pig, etc., is available, but not proportions by skeletal element within each taxon. The latter statistics are truly instrumental when parts of an animal carcass (and its skeleton) can undergo different selective choices (e.g. "I'd like the prime rib and not the ham hock"), or can be subject to different input and output steps along a production/consumption continuum (e.g. "chop the heads off first, and put them here; then remove the feet and send them there; then disarticulate the joints, then fillet the meat, etc."). Increasingly, it is these nuanced aspects of the skeletal parts that are critical to report, perhaps even more so, one might argue, than overall frequencies of animal taxa. Nevertheless, in this current overview, only those sites or cases where clear data about all skeletal elements of interest were provided can be used—thus, at this stage, some key sites, such as Delos, as well as some selected deposits among other sites, such as Isthmia and Ephesos (notably the Artemision assemblages among the latter site), have to be excluded from aspects of the current study.[11]

A second concern centers upon representational variance among elements. Put simply, some elements, such as teeth and limb bones can more easily be identified as belonging to cattle, sheep/goat or pig, while other elements, such as ribs and vertebrae are not always readily distinguished, and may not be reported by particular animal (or at all in NISP counts).[12] This disproportionate treatment for skeletal elements creates problems should one desire a more balanced zooarchaeological assessment of the role of all parts of an animal's body. In large measure, under-reporting of ribs and vertebrae among faunal assemblages can often lead to the neglect of these skeletal elements within larger arguments and reconstructions of activities and procedures for a site. Some zooarchaeological reports tally rib and vertebrae counts under larger groupings on the basis of an animal's size (e.g. "large-mammal ribs", "medium-mammal vertebrae"), but correlating these more general classes and their statistics to specific ones reported through NISP counts by any individual or "non-aggregate" category, or by designation of animal or skeletal element, is problematic. Consequently, drafting firm conclusions about relative frequencies of ribs and vertebrae across faunal assemblages, on the basis of the limited data available for those components, is currently a challenging venture.

A final worry among reports of skeletal element data involves taphonomic, survival, and recovery biases for faunal assemblages. Among the various parts of an animal's skeleton, teeth are durable and survive well archaeologically. Similarly, denser bones and bone sections, such as phalanges, metapodials, distal ends of tibiae, etc., often have higher probabilities of survival.[13] Moreover, larger, conspicuous pieces and elements register a greater likelihood of retrieval than smaller bits. This discrepancy is minimized when employing screens or other enhanced recovery methods. Zooarchaeologists are well aware of these biases and of the degree of variation within them that can exist across sites.[14] Consequently, in exploring trends within the datasets used in this current chapter, various attempts to standardize or correct some of these taphonomic and recovery biases may be initiated, in a quest to estimate what might be more absolute figures or frequencies for the various skeletal parts being considered. Nonetheless, even if such biases are not completely addressed or standardized, the fact that most of these concerns may, to some degree, conceivably be levied across all sites sets up a precedent whereby sites can be compared on a relative scale, even if their absolute figures may be more a factor of taphonomic, recovery, and retrieval biases than representative of cultural behaviours. In other words, there is less of an interest in this current investigation in the absolute numbers (i.e. 20%, 30%, 40% etc.) for whichever particular category is being considered, so much as a greater emphasis upon more general comparisons among sites (e.g. "this site registers more of this element than that site") and on the reasons why any patterns observed might exist.

[9] These taxa generally account for more than 90% of the faunal remains recovered from Greek ritual sites. They similarly dominate at non-ritual sites. For the investigation of osteological evidence for the role and use of other taxa (including wild fauna, dogs, equids, exotics, reptiles, amphibians, and fish) among Greek sacrificial sites, see Ekroth 2007, 256–260; 2014, 339–342; Mylona 2008; 2013; Theodoropoulou 2013. Additionally, note that the term "sheep/goat" is commonly employed in the zooarchaeological literature, and will be used throughout this chapter to denote the collective grouping of this taxon.

[10] NISP = Number of Identified Specimens; or more generally a count of the number of faunal elements that can be ascribed to a particular animal or taxonomic group. NISP is a common quantification measure used in zooarchaeological practice; refer to Reitz & Wing 2008 for further discussion of the concept.

[11] For reports about these sites, see the following: Delos: Prost 1997; Brun & Leguilloux 2013. Isthmia: Gebhard & Dickie 1999; Gebhard & Reese 2005. Ephesos: Bammer *et al.* 1978; Forstenpointner 2001; 2003; Forstenpointner *et al.* 1999; 2005; 2008.

[12] These concerns are detailed, more completely, in Driver 1991; 2011.

[13] Bone density is also linked with factors such as an animal's age, and stage of tissue development. Younger, immature bone tends not to survive as well as older, mature bone. This presents a further level of bias to consider when reviewing overall patterns for skeletal parts.

[14] Lyman 1994 remains a seminal publication about taphonomy and its effects within zooarchaeological studies.

Table 1. Sites, dates/period and references for zooarchaeological samples considered (or otherwise noted) in this chapter (arranged alphabetically by site).

Site	Dates/Period	Reference
Amathous	Archaic (7th–6th centuries BC)	Columeau 1996; Gardeisen 2006
Asine	Helladic to Geometric	Moberg 1992; Moberg Nilsson 1996
Delos	2nd century BC	Prost 1997
Didyma	Roman (2nd century AD)	Boessneck & von den Driesch 1983; Boessneck & Schäffer 1986; Klapper 1994
Eleutherna	Hellenistic (3rd–1st centuries BC)	Vila 1994
Ephesos	Archaic to Hellenistic/Roman	Bammer 1998; Bammer *et al*. 1978; Forstenpointner 2001; 2003; Forstenpointner *et al*. 1999; 2005; 2008
Eretria	Geometric	Chenal-Velarde 2001; Chenal-Velarde & Studer 2003; Huber & Méniel 2013; Studer & Chenal-Velarde 2003
Heraklea	Archaic/Hellenistic	Forstenpointner *et al.* 2010
Isthmia	Iron Age to Archaic	Gebhard & Dickie 1999; Gebhard & Reese 2005
Kalapodi	Archaic to Late Classical (6th–3rd centuries BC)	Stanzel 1991
Kourion	8th–6th centuries BC	Davis 1996
Lerna	Helladic (largely)	Gejvall 1969
Miletos	Archaic (7th–5th centuries BC)	Peters 1993; Peters & von den Driesch 1992
Mytilene	Archaic to Hellenistic	Ruscillo 1993; 1997; 2013
Nemea	Archaic	MacKinnon 2013; 2018
New Halos	Hellenistic	Prummel 2003
Nichoria	Middle Helladic to Iron Age	Sloan & Duncan 1978
Olympia	Late Archaic	Benecke 2006
Oropos	Iron Age (8th–6th centuries BC)	Trantalidou 2007
Plakari-Karystos	Geometric to Archaic (10th–6th centuries BC)	Groot 2014
Tegea	Geometric	Vila 2000; 2014
Tenos	3rd–2nd centuries BC	Leguilloux 1999
Thasos	6th–4th centuries BC	Bergquist 1998; des Courtilis *et al*. 1996
Thebes	Classical to Roman	Boessneck 1973
Thera	Hellenistic to Roman	Becker 1997
Tiryns	Helladic to Mycenaean	von den Driesch & Boessneck 1990
Troy	Bronze Age to Roman	Fabiš 1996; 1999; 2002

Patterns within the data

The locations of the sites comprising the database of investigation for this assessment are shown in *Fig. 1*; associated date ranges/periods for the faunal assemblages consulted, as well as the references for each assemblage, are listed in *Table 1*. Note that since this current study focuses upon variation among parts of the skeleton between ritual and non-ritual sites of Greek antiquity, the list of sites is restricted to those that report such zooarchaeological data in a clear and relatively standardized fashion. Among the zooarchaeological literature for various sites, other cases exist where mention of a preponderance of some skeletal part is made, but without this aspect enumerated in NISP counts (and thus quantified in more direct counts, as opposed to more generic terms such as "much", "a majority", etc.), such examples must be omitted from the current synthesis. Sites are pooled across a wide timeframe, with representatives from Bronze Age/Helladic contexts through to early Roman times. The bulk of the sites, however, date to somewhere in the 1st millennium BC, roughly Archaic, Classical and Hellenistic times.[15] Although this timeframe of 1,000 years, more or less, is relatively broad and includes various cultural phases, my intention in this current investigation is not to dissect strictly any temporal variation through the different periods/phases considered here, but rather to seek a general overview of sacrificial practice within the wider temporal scope indicated. Moreover, I am fully aware that different gods and heroes may have been venerated at different sites, and that the sacrificial assemblages, as regards species and parts selected at each, may vary.[16] Never-

[15] In narrowing the timeframe for this current study, Bronze Age sites were generally excluded. Halstead & Isaakidou 2017 provide a comprehensive list of Neolithic and Bronze Age faunal samples from Greece, with further discussion of the information these assemblages can provide (including ritual aspects), alongside further references.

[16] Kadletz 1976 collects and tabulates the ancient references connected with sacrifice to various deities in Greek and Roman religion, summariz-

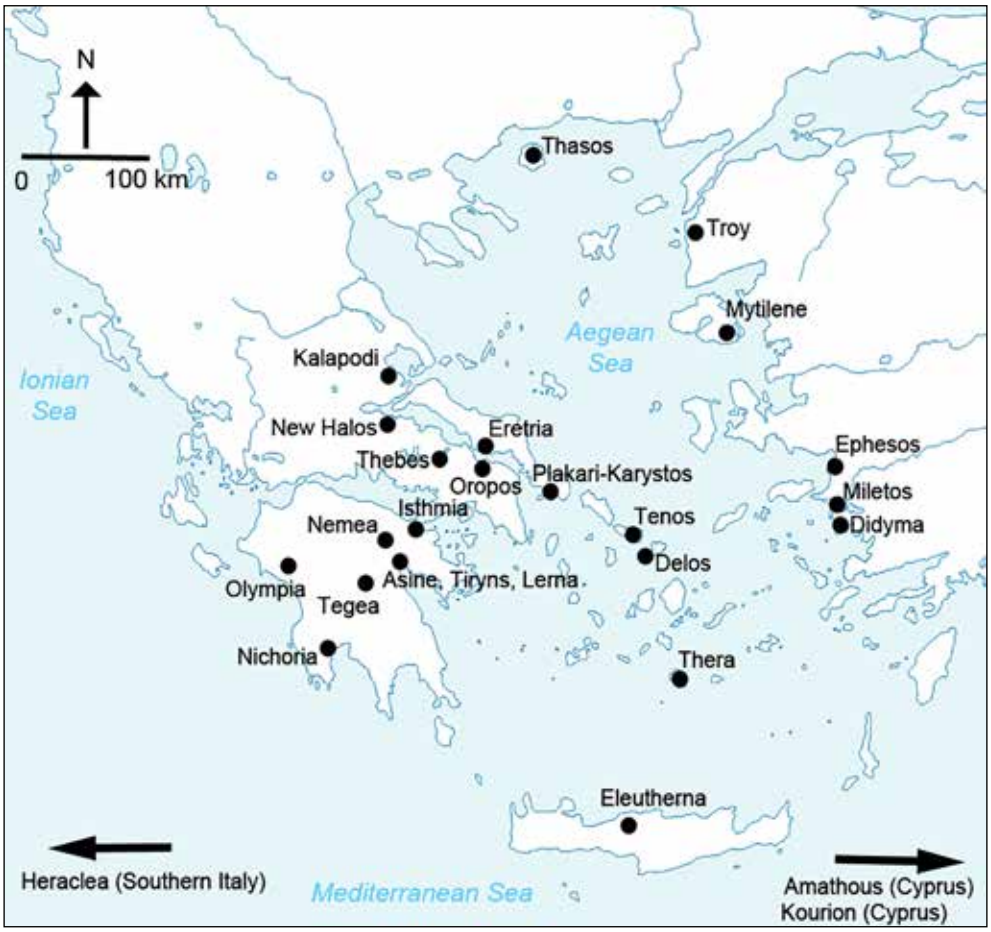

Fig. 1. Location of sites providing zooarchaeological samples, which are considered in this chapter. Map: Michael MacKinnon.

theless, at this initial exploratory stage of investigation, my overall goal is to pool sites into larger collective groups to determine broad patterns, notably as regards the range and frequency of skeletal parts. Thus, we may ask: do ritual and non-ritual sites really differ in what skeletal elements they register? Do they differ especially with regard to the representation of heads and feet? Three general categories of material are employed for this investigation, deriving from two types of sites: (1) burnt materials from ritual sites; (2) unburnt materials from ritual sites, and (3) unburnt materials from non-ritual sites.[17] Ritual sites include temples, sanctuaries, altars, and the like; non-ritual chiefly encompasses domestic contexts. As noted already, dichotomous ritual and non-ritual labeling is problematic, but at this stage, such designations at least set a basis for preliminary, general comparisons. Geographically, most of the sites examined are located in central and southern Greece, but a few are provided from areas in the Aegean, Turkey, and southern Italy in order to augment samples.

ing much of these within lists and tables that specify the types of animals accepted for each god. Ekroth 2002 supplies a comprehensive assessment of hero-cults in Greek antiquity, from the vantage of both literary and archaeological evidence. In addition to the individual site reports, the connection of god, hero, skeletal part, etc., as regards sacrifice in Greek antiquity is variously outlined in Ekroth 2007; 2008a; 2008b; 2009; 2011; 2013a; 2013b; 2014; 2016; 2017a; 2017b. A table summarizing many of these aspects is provided in MacKinnon 2018.

[17] Burnt materials from ritual sites, in such cases, relate predominantly to carbonized and calcined bones that are presumably associated with sacrificial/temple/altar offerings. Burnt remains are occasionally noted from non-ritual sites, but the degree of burning for these is neither of the intensity nor quantity exhibited for burnt (altar/sacrificial) materials from ritual sites. More specifically, among these non-ritual contexts: (i) calcination is rarely, if ever, noted; (ii) carbonization, when expressed, is typically linked with charring of the ends of bones, a pattern often linked to the exposure of these parts to an open flame during cooking. Thus, while some burnt bones (probably burnt through cooking operations) register at non-ritual sites, their frequency, expression, and placement upon individual elements, and nature of burning overall cannot be compared reliably against burnt sacrificial faunal samples from ritual sites.

Cattle

Fig. 2 displays the relative NISP frequencies for a range of skeletal-part categories (including ribs and vertebrae) for cattle, across the various sites under consideration. Non-ritual sites are listed at the bottom of the graph; ritual ones are at the top. Among ritual sites, "RU" records unburnt, and "RB" stands for burnt assemblages. The sites are arranged (moving from top to bottom within each group noted above) in terms of descending frequency of the "head + teeth" category. A general assessment of the graph shows no particular trend between ritual and non-ritual categories overall; nor is there any marked separation between burnt and unburnt examples among the ritual category itself. Ritual sites at Amathous and Tegea, for example, display patterns almost identical to non-ritual contexts indicated for Eleutherna and Oropos—all with a marked predominance of "head + teeth" remains, and very few ribs or vertebrae noted. The traditional explanation for this discovery invokes arguments for specialized deposits of the head as a waste component, or as a first product removed in carcass processing, with the "meatier" ribs and vertebrae dined upon elsewhere.[18] That argument seems sensible, but such an activity here cuts across both ritual and non-ritual contexts. This, in turn, questions the value of demarcating Tegea and Amathous as ritual contexts with regard to patterns within the cattle faunal remains recovered, except for the connection with a sanctuary (i.e. the context of their recovery) which leads to the assumption that these materials constituted waste from some type of "ritual meal". Although all animals eaten within sanctuaries need not necessarily be sacrificial victims, the case above outlines some of the complexities in trying to dissect distinct ritual/non-ritual dichotomies in the representation of faunal patterns. Similarly, non-ritual New Halos exhibits a comparable trend to ritual Heraklea, among other sites: both display a predominance of fore- and hind-limb cattle elements. Certainly, in the case of burnt materials from ritual sites, a firmer argument of an association with ritual events might be forwarded—as these contexts might incorporate aspects such as *thysia* and holocaust sacrifice, procedures where burning is typically necessary in the ritual event.[19] However, unburnt ritual assemblages, often assessed as processing or dining debris from ritual events, can be no different in their skeletal-part distributions than non-ritual assemblages. This then invokes two questions: (1) should these assemblages be ritualized simply because of their context (which itself may not be outlined clearly in any site report beyond the mention of "fill/material" from a ritual site);[20] (2) should non-ritual sites be assessed differently?

Notwithstanding these issues, mean values for the ritual and non-ritual components of cattle, as a whole, are displayed in the central portion of *Fig. 2*. Admittedly, one should be cautious here, since the calculation of statistical means by nature homogenizes variability among assemblages. Despite these concerns, however, as a general guide, the trends displayed by the mean values for the various skeletal-part categories for cattle between ritual and non-ritual sites are very close, thus accentuating some of the intrinsic problems in crafting ritual/non-ritual dichotomies. Overall, cattle heads and feet register with slightly greater frequency among non-ritual sites than among ritual ones. This suggests that ritual contexts may have exported more cattle heads and feet (or at least the associated bones within these regions), on a relative scale. Given that these skeletal parts are often byproducts of the initial division of the animal, when it was skinned and prior to the extraction of parts later designated as altar debris or sacrificial cooking debris from the ritual event, it seems natural that these heads and feet, as butchering debris, might be treated separately and eventually removed from the area, perhaps even to non-ritual contexts.[21] When removing the hide of an animal, one generally either initially or ultimately cuts at the lower ends of the limbs, often in the region of the metapodials and phalanges. From this juncture, one can peel back the hide, cutting and lifting the layer between the underlying muscles and fat as one progresses over the entire skeleton. As it is difficult to fidget with separating the hide in the area around the metapodials and phalanges, workers are known to initially retain these bones within the hide, leaving the tanners and hide processors to extract them later. In fact, leatherworkers might have kept these bones within the hide until the later stages of tanning, since the weight of the bone can help stretch and stabilize the hide. Little meat surrounds the metapodials and phalanges, so

[18] Ekroth 2016, 37–38.

[19] In many cases remains of burnt sacrifices are recovered within fills, dumps, or deposits at a sanctuary or near an altar, often in fairly homogeneous states, that is, with the entire collection of bones displaying signs of burning, and often with materials calcined and as a result fragmented into small, brittle pieces. Nonetheless, this need not be uniform; cases exist where remains of burnt sacrifices are found mixed with unburnt bones as well. See Ekroth 2009 and MacKinnon 2013; 2018, among others, for further discussion.

[20] This point about the nature of the deposit is critical and presupposes an integrated investigation and correlation of the character/nature/taphonomic history of all finds within a deposit, not to mention a thorough understanding of the geological, cultural, and natural circumstances that affected the creation and subsequent taphonomic history of that deposit. In many cases, this level of detail is not assessed or reported.

[21] It is worth mentioning here that bones from cattle feet and lower legs were extremely under-represented among faunal materials collected at the 4th-century BC Altar of Zeus/Jovis at Poseidonia, Italy, where they accounted for less than one percent of bones retrieved. The impression here is that these materials were removed from this "ritual" region and presumably deposited outside the area. See Leguilloux 2000 for further details. Unfortunately, full NISP statistics for all categories of skeletal parts from this site were unavailable in order to include it in this current study.

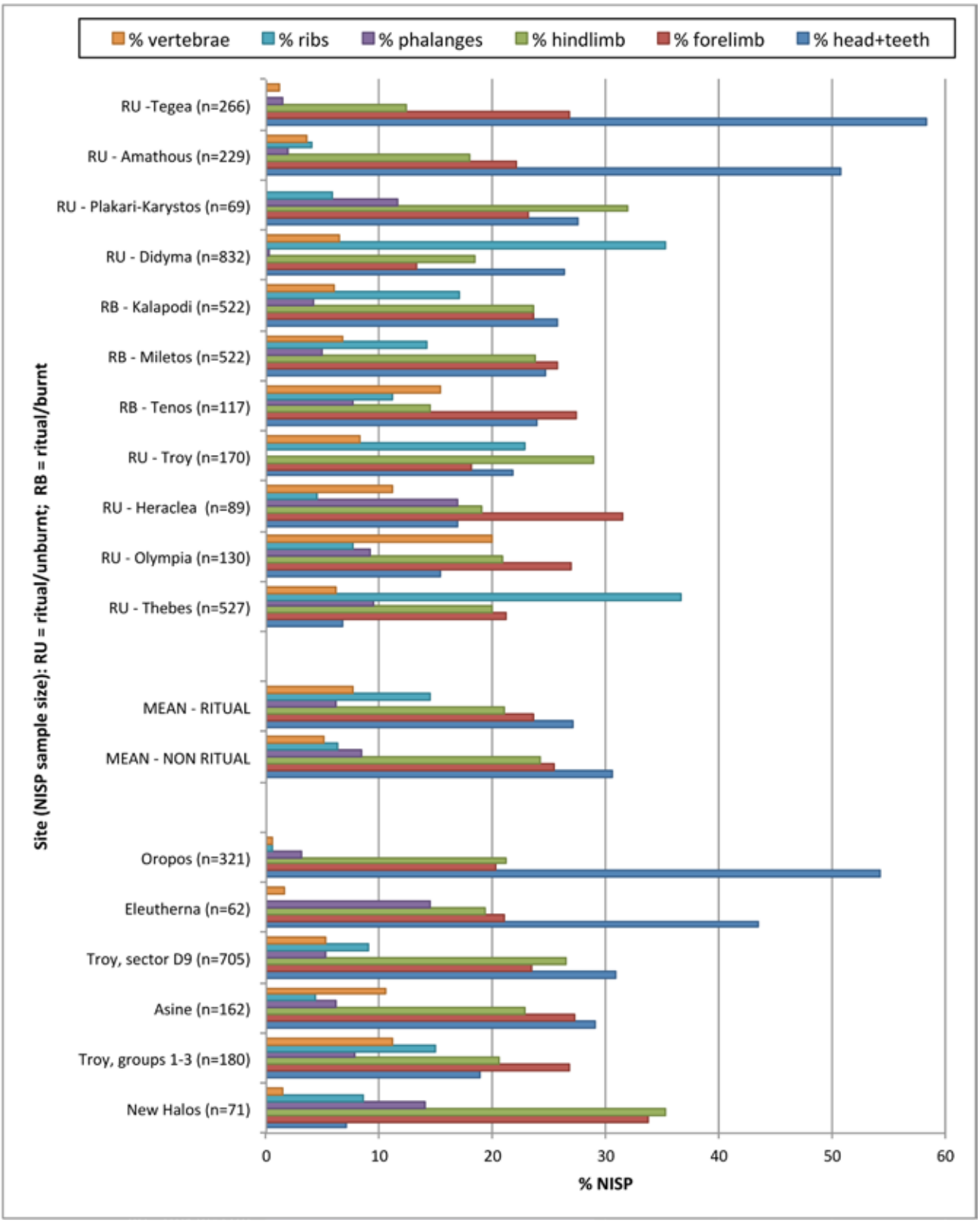

Fig. 2. Cattle: NISP frequencies for six skeletal-part categories (vertebrae, ribs, phalanges, hindlimb, forelimb, head + teeth) among ritual and non-ritual sites for Greek antiquity. Chart: Michael MacKinnon.

there is typically no great demand for reserving these bones for the butcher.[22] The head may also be retained in the hide, which could help explain why cranial fragments (and especially teeth, the most durable of all skeletal elements, and frequently the most numerous component in the "head + teeth" category outlined here) are not as prevalent among ritual sites in Greek antiquity as compared to non-ritual sites. Along with the metapodials and phalanges, the heads may have been removed from ritual areas and delivered subsequently to tanners and hide processors while these elements still remained with the hide.

Conversely, to achieve this same pattern of cattle heads and feet registering with greater frequency within non-ritual as opposed to ritual contexts for ancient Greek sites, one might also argue the possibility that non-ritual sites exported select non-head and foot parts (i.e. limbs and torsos), to send to ritual sites, but this scenario seems unlikely given that values for forelimbs and hindlimbs within *Fig. 2* are fairly equivalent between site types, thus implying no marked movement of these parts between ritual and non-ritual contexts.[23] Generally, the impression is that the heads and feet of the animals in question were retained within the hides, or otherwise represent the unimportant butchery refuse left over in the quest to extract the select parts either to burn on the altar or to consume as part of the ritual feast.[24] Fairly abundant and rather widespread evidence exists among ritual contexts for officiating priests claiming animal hides as perquisites.[25] Moreover, there are references to the sale of hides from sacrificial victims,[26] and thus, the potential for these parts to move between ritual and non-ritual settings.

Although zooarchaeological evidence tends to support some measure of exporting hides (with head and feet attached) from Greek ritual sites to other contexts, hides/skins (with parts of the head and feet) can also sometimes be brought into sanctuaries, although arguably it seems the latter possibility was less prominent. Generally, these materials fall within a larger category of individual gifts to the gods, as votive offerings. The skeletal elements in association might be specifically selected, such as in the case of gifts of antlers, horns, heads, claws or teeth. Alternatively, the head and foot bones of interest here might be attached (either deliberately or inadvertently) to the gifts of skins or hides. In this case, any head or foot bones contained may have been removed from their accompanying hides/skins while being processed within the sanctuary, and eventually, perhaps deposited along with other faunal materials collected or produced within that setting.[27]

The relationship between hide processing (incorporating activities such as tanning, leather working, etc.) and ritual/non-ritual spaces in Greek antiquity remains underexplored. Few definitive examples of tannery complexes are noted for Greek antiquity, at least when compared to those for Roman contexts, where far more evidence, from textual, archaeological and zooarchaeological sources, is noted.[28] It is unlikely that any type of hide, even a single small piece, was fully worked and processed within sanctuary settings in Greek antiquity; almost certainly such activities were conducted outside these areas. Practical issues associated with limited space, foul smells, and access to adequate water and other materials necessary for tanning no doubt inhibited such operations within a sanctuary, and may even have curtailed their operation in the vicinity of such ritual spaces. Indeed, legislation prohibited the tanning of hides above the sanctuary of Herakles on the Ilissos in Athens, likely a measure to restrict any dirty water and chemicals that might be associated with those activities from polluting the sanctuary.[29]

Exploring more of *Fig. 2*, it can be noted that ritual sites, on average, yield slightly higher frequency values for cattle ribs

[22] MacKinnon 2004, 177–184.

[23] Given the ceremonial aspects (which involved components such as anointing the animal victim, slitting its throat, collecting blood, etc.) the assumption has typically been that live animals were brought to the altar to be sacrificed in Greek antiquity. This would result in processing of an entire animal, with all its component skeletal parts (and selection of these as altar waste, dining waste, and butchery waste) within that setting. Nevertheless, however remote it might seem, the possibility exists that some animal parts correlating with *thysia* sacrifice may have been processed outside ritual sites and subsequently imported to them. The assumption is that this was taboo (as assurance of proper sacrificial status and procedure might be placed in question); but the issue warrants greater scrutiny, overall. Larson 2017 cautions against drawing such a fixed dichotomy in exploring the issue of deer sacrifice in Greek antiquity. While there is far less evidence for the sacrifice of deer during this period, as opposed to the sacrifice of domestic livestock such as cattle, sheep, goats and pigs, the question of where these deer were killed—be this at the sanctuary or outside it, i.e. in the wild, or at a special game park—requires more investigation. If some of these wild animals were indeed killed outside the sanctuary, and subsequently brought to the sanctuary to serve as burnt offerings to the gods, then frameworks stressing such an action as forbidden may need revising.

[24] Ekroth 2009; 2016; 2017a proposes this same point.

[25] Cf. e.g. *LSAM* 37, lines 6–15; *LSCG* 28, lines 5–9; see also Naiden 2013, 202; Scullion 2009, 154–156; Carbon 2017.

[26] See, for example, *IG* II² 1496.

[27] See Ekroth 2016, 39 and Larson 2017, 49 for further details of hides/skins as votive offerings in Greek sanctuaries. Among the pieces identified as such are deer and wild boar, but also a variety from exotic beasts, including lions, camels, and gazelles.

[28] For an overview of some of these data, alongside measures for recognizing tanning and tanneries in the archaeological record, see the collection of papers in Audoin-Rouzeau & Beyries 2002 and Thomson & Mould 2011. Leguilloux 2004 assesses the evidence, including zooarchaeological remains, for the leather and hide industries in Roman antiquity.

[29] *LSS* 4; Dillon 1997, 126 suggests a connection between these hides and the animals sacrificed in the sanctuary.

and vertebrae than do non-ritual sites. Does this imply these elements factored more in ritual dining of beef than among non-ritual contexts? Such a hypothesis is possible, but one should also be wary that research biases may have forced individuals to seek out and identify these elements more astutely at ritual sites—notably in efforts to investigate the role of caudal vertebrae in sacrifice overall.[30] Thus, it may be that a desire to prioritize some sacred meaning for an assemblage, as "ritual dining waste", has elevated the importance of finding, describing, and discussing ribs and vertebrae in such contexts. Preservation and identification biases can further amplify the frequency of cattle phalanges in faunal assemblages, which may account for foot bones of cattle registering overall at nearly double the rate of such elements for sheep/goat (see *Fig. 3* for sheep/goat).[31] It is unlikely that such a pattern implies that relatively more cattle (as opposed to sheep/goat) hides, with feet attached and later removed while processing the hides, were retained within Greek ritual sites, although this scenario remains a possibility. Nevertheless, nothing firmly registers in the data to denote marked variation between burnt and unburnt ritual deposits in this respect. If cattle hides were typically stripped from sacrificial carcasses (even for holocaust examples) and provided to priests or other agents (and presumably removed from the area for processing elsewhere), one might expect near zero representation of foot elements in ritual settings, and notably in ritually burnt assemblages. This does not always seem to be the case. Indeed, the high frequency of foot elements from cattle that are recovered within Greek ritual sites suggests that hide removal may not have been consistently performed among such contexts.

Sheep and goats

Although cattle factored in certain rituals in Greek antiquity, sacrifice of sheep and goats was more plentiful. Additionally, samples of sheep/goat bones tend to be more abundant among sites, which may assist in drawing upon larger, more statistically-reliable sample sizes for investigation. *Fig. 3* presents the results for skeletal-part assessments for sheep/goat among ritual and non-ritual contexts. As with *Fig. 2*, non-ritual sites are listed in the bottom portion of the graph, and ritual sites are displayed in the top part, with sites arranged by decreasing percentage of "head + teeth" figures. Among the sheep/goat data presented, there is a greater tendency for forelimb and/or hindlimb elements to dominate some ritual assemblages, notably shown among burnt examples at the sites of Plakari and Eretria. Here, there is firm evidence for deliberate selection of thighbones (femur) for *thysia* sacrifice. Nevertheless, a number of sites in the middle territory of the ritual section displayed in *Fig. 3* yield rather mixed results, with varying proportions of skeletal parts, but often dominated by limb elements. Some of these examples are burnt; some are not, underlying in turn the variability within the use and distribution of sheep/goat elements in ritual settings. Put simply, patterns for altar-, consumption-, and butchery-refuse are not particularly clear-cut among these cases in the middle section of the ritual portion of the graph in *Fig. 3*. Notwithstanding the concerns centering around the varying degrees to which faunal and archaeological reports provide the requisite details and data investigators may desire,[32] the

[30] By way of comparison, it is important to indicate here that overall frequency values for the "rib" and "vertebrae" categories are highest for cattle (*Fig. 2*), as compared to sheep/goat (*Fig. 3*) and pig (*Fig. 4*). Given their greater size, and the lack of remains from any similarly sized taxa, investigators may have been more inclined to identify any "larger" vertebrae or ribs recovered as belonging to cattle, in this case, while perhaps remaining more cautious in assigning any smaller-sized (and noticeably non-cattle) vertebrae and ribs as either sheep, goat or pig (given the potential overlap in size and features for ribs and vertebrae among these three taxa). Essentially, therefore, this discrepancy may be linked with problems of identification by association, as outlined above, and expressed in Driver 1991; 2011.

[31] This phenomenon occurs among a number of sites, regardless of timeframe or context. For example, cattle extremity bones (that is, those connected with the lower leg and foot) account for, on average, 30% of NISP totals among Roman sites in Italy (MacKinnon 2004, 196–200), while associated values for sheep/goat and pigs tally 22% and 15%, respectively. While a host of taphonomic, recovery and preservation issues can influence this bias, one possibility, as outlined by Groot 2014, 42, is that enhanced fragmentation of large cattle elements (such as the long bones, perhaps within measures to butcher these into smaller cuts), inadvertently augmented the chances of identifying smaller elements, such as phalanges, for this taxon. The same degree of fragmentation for limb bones may not have been practiced in the case of smaller taxa, such as sheep, goats and pigs, in turn leading to relatively more of their long-bones being identified. Given the complicated (and not always predictable) nature of bone taphonomy, and the range of cultural and natural possibilities and permutations that can affect the composition of a faunal assemblage, this reinforces the need for more nuanced assessments of the formation processes that underline all zooarchaeological samples.

[32] Part of this confusion may link to a lack of detail in distinguishing specific contexts or sub-levels of deposits within a site, as can result when faunal remains are pooled from a wider zone at a site and reported as a general unit (e.g. Kalapodi, Miletos). Additional concerns may register if the nature and degree of burning among materials is not detailed sufficiently within reports. For example, ascribing descriptors such as "mostly burnt", "often burnt", etc., without specifics as to what elements are affected and to what intensities, add levels of uncertainty. The degree of burning often acts as a hallmark for the activity. Dinner debris is normally never burnt to the degree of altar debris. Generally in burning "rubbish", such as food waste, fires are not stoked to reach the intensity or duration to calcine bone materials. Nonetheless, the possibility exists that one could, technically, burn dinner debris to such as state (i.e. calcine it) and that it could thus mimic sacrificial debris (be this *thysia* or holocaust, depending on the materials from the dinner debris that were burnt). This issue requires further investigation, even if assumed to be a remote or unexpected possibility, as it could explain some of the variability exhibited in the "middle section" of *Fig. 3*.

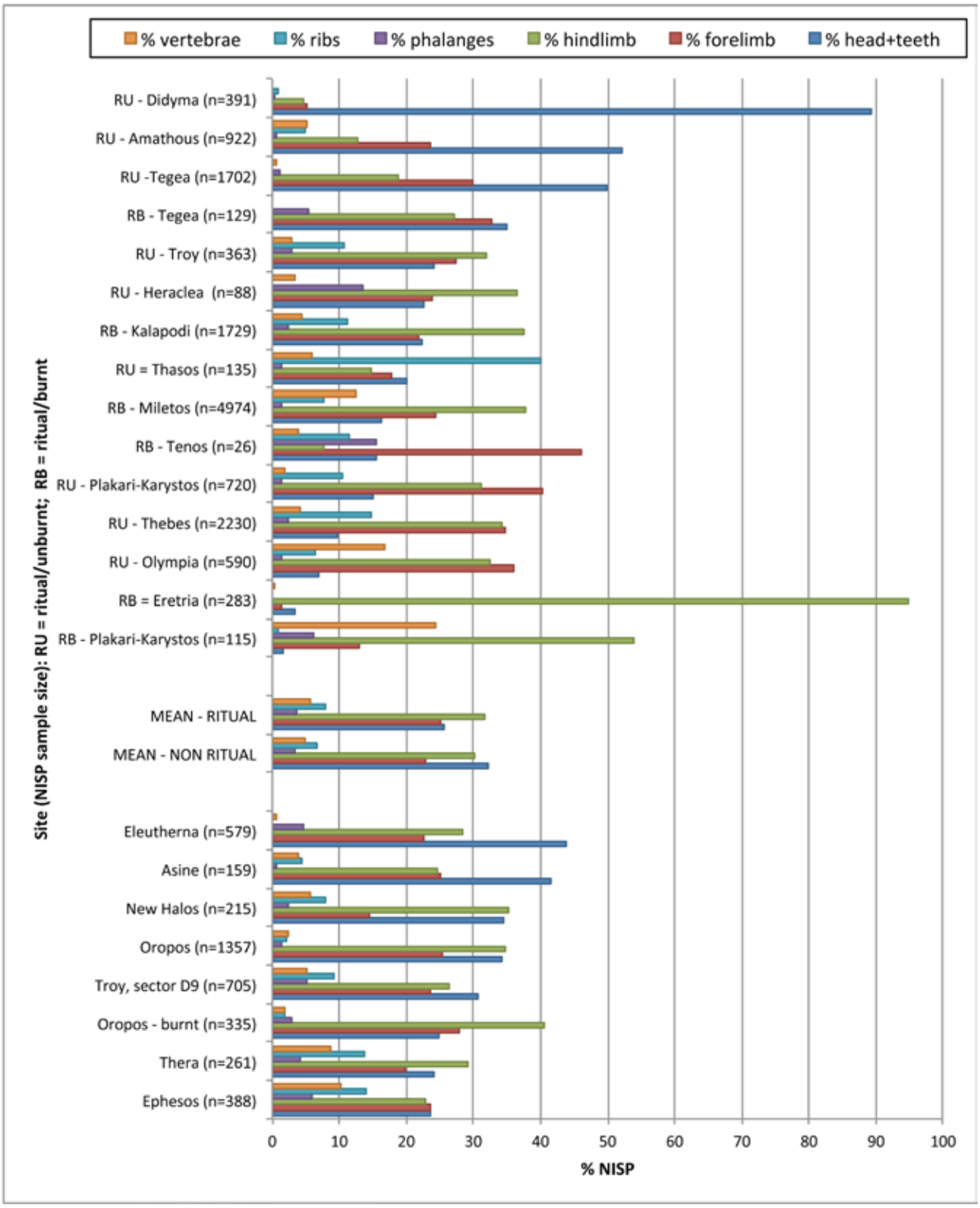

Fig. 3. Sheep/goat: NISP frequencies for six skeletal-part categories (vertebrae, ribs, phalanges, hindlimb, forelimb, head + teeth) among ritual and non-ritual sites for Greek antiquity. Chart: Michael MacKinnon.

wider hypothesis that faunal materials from all three activities, even if separated in practice, eventually were disposed of in the same deposit, should be entertained.[33] If so, then hopes of dissecting components become rather difficult, which in turn forces us to re-evaluate some notions of ritual practices (and some of the stages therein) as being both distinct and spatially separate in terms of the types of faunal remains generated. At the top end of the ritual portion of the graph in *Fig. 3* sit contexts heavily dominated by cranial elements, notably the sites of Didyma, Amathous, and Tegea. Caution is required in ascribing too much significance here. Recall that these sites also recorded similar patterns for cattle parts (*Fig. 2*), specifically a greater frequency of elements deriving from heads and teeth. While it is possible that this cranial dominance reflects similar processing for cattle and sheep/goat, with retention of heads as butchery waste and removal of the remaining parts of the skeleton for other purposes (ritual burning, consumption, sale or otherwise), the correlation of this trend across multiple animal taxa at these sites prompts the hypothesis that the patterns observed may reflect artificial/post depositional factors (i.e. they are due, at least in some measure, to taphonomic, preservation, recovery and identification biases, etc.) as opposed to being solely cultural in their formation. In the case of Didyma specifically, a fragmentary inscription attests to the sale of sacrificial meat and parts of animals, including heads and extremities.[34] Although the inscription is not specific as to which type of animal is concerned, perhaps referencing any four-footed herd animal, it is tempting to attribute the associated faunal evidence as part of a scenario of a specific stockpiling of heads at Didyma, albeit both cattle and sheep/goat heads (below, it will be further revealed that the same pattern arises for pigs, *Fig. 4*; thus, heads dominate among assemblage counts for all three taxa).

In some cases, Didyma being one, but also at Thebes and Kalapodi, the "head + teeth" category is disproportionately affected by relatively high counts for horn cores, often those of goats over sheep.[35] Both cultural and taphonomic factors may help understand aspects of this phenomenon. Goat horn cores tend to survive better than those of sheep, so preservation and recovery factors probably play a role in this specific bias of goat over sheep, although when numbers are overwhelmingly either sheep or goat, as regards the recovered horn cores, then a much stronger argument for species-specific cultural selection of one taxon might apply.[36] The latter aspect subsequently begs the question: why retain horn cores within ritual settings in the first place? Some of this might not be deliberate or obvious. The inscription from Didyma mentions cutting the horns prior to the sale of the heads, a process that might in turn leave the horns as "leftovers" and in need of some form of disposal at the sanctuary.[37] Alternatively, more deliberate actions might underscore the patterns observed. As noted by Gerhard Forstenpointner, for example, horns may have been specifically curated within sanctuary sites to construct altars, as in the case of the Keraton (i.e. "bone/horn altar") at Delos (although here, cattle horns were selected).[38] Regardless of taxon, however—cattle, sheep or goat—horns are often imbued with symbolic meaning, as signs of strength, supremacy, power, and procreative vigour, among other aspects.[39] One can then correlate the horn's ties in ritual: its portrayal, alongside the *bucranium*, is common in ancient iconography, a point which will be developed later in this chapter in a wider commentary on the symbolic significance of animal heads in ancient ritual.

As with the case for cattle (*Fig. 2*), the sheep/goat non-ritual and ritual patterns (*Fig. 3*) draw parallels, notably when outliers at the extreme ends of each graph are removed. When mean values are compared, as shown in the center of the graphs in *Figs. 2* and *3*, similar conclusions between taxa can again be made. Heads register with slightly more frequency among non-ritual sites for both cattle and sheep/goat. Forelimbs, hindlimbs, ribs and vertebrae are marginally better represented at ritual sites, but not significantly. If sheep/goat butchery refuse, which we might expect to include the head and feet, is often missing from sanctuary contexts, at least in

[33] This possibility is noted by Groot 2014, 42, as well, specifically in the case of some materials from the site of Plakari-Karystos. This might also explain the somewhat "mixed" assemblage (i.e. containing burnt and unburnt remains from an array of species and skeletal parts) retrieved from the *bothros* that was excavated within the *temenos* at the site of Miletos.

[34] *LSAM* 54, but to be consulted as *I.Didyma* 482. For further information about the sale of sacrificial meat in Greek antiquity, with particular reference to Athens, see Rosivach 1994. Parker 2010 examines the issue of the sale and consumption of "un-sacrificial" meat.

[35] A preference for goat over sheep, in some cases, such as the site of Ephesos, may relate to veneration of Artemis, for whom goats were especially selected. Nonetheless, this explanation is not universal for all cases noted.

[36] A further reason why goat horns seem preferred among ancient Greek ritual assemblages may be a function of their shape—being long and pointed, as opposed to curved, in the case of sheep. This may have made them more practical and stable for purposes of construction, such as the formation of horn altars.

[37] I am grateful to Jan-Matheiu Carbon for assistance with the Didyma inscription.

[38] See Forstenpointner *et al.* 2013 for further details about, and references to, the Delian "horn altar".

[39] Forstenpointner *et al.* 2013, 238–240. See Forstenpointner 2000, 51–65, for discussion of the symbolic importance of the 2,118 caprine horn cores recovered from Geometric and Corinthian layers of the Artemision site at Ephesos. Further examples of horn cores in association with ancient Greek ritual contexts are outlined in Jameson 1988, 92–93. Ekroth 2014, 327, notes that head of cattle, sheep, and even deer adorned ancient religious altars and architecture, and are often depicted in sacrificial scenes on Attic vases. The symbolic nature of the horn is perhaps best encapsulated in the form of the "cornucopia" or "horn of plenty" as portrayed in ancient Greek and Roman myth and culture (De Girolami Cheney 1998, 19). See also Zachari in this volume, *Chapter 7*.

relation to altar- and feasting-debris, then no substantial proof exists, on average across all sites, that this material was initially retained at, or subsequently exported back to, non-ritual sites. Again, it is important to stress that this is a comparison across all sites, recognizing that some ritual sites, like Tegea, Amathous, and Didyma, do register deposits with substantially high frequencies of head elements. Nonetheless, it should be noted that these sites simultaneously record a lack of feet elements, so each case might not qualify neatly as expected butchery refuse in this respect (i.e. only half of what we might expect is there).[40]

Sheep/goat phalanges (i.e. their feet) seem under-represented among most sites (*Fig. 3*), ritual and non-ritual, barely registering averages of 3–4%, values far less than what one might anticipate given the durability of these elements within archaeological assemblages, and the ease with which they might be identified. As a comparison, note that corresponding values for cattle phalanges (*Fig. 2*) average about double this rate. What should be concluded from this pattern? Are sheep/goat hides, with feet attached, generally removed from both ritual and non-ritual settings, and deposited at some outside/off-site processing and tanning locations? While it is possible phalanges of sheep/goat are being exported in their constituent hides and consequently under-represented among both ritual and non-ritual sites in Greek antiquity, the fact that pig phalanges are also under-represented casts doubt on this deficiency being truly a cultural phenomenon related solely to the treatment of skins or hides. The expectation is that pig skins would not be stripped from the carcass as might sheep/goat hides (i.e. pig skins tend to be left attached), so no imbalance in pig phalanges should result. Moreover, pigs have twice the number of phalanges than sheep/goat, so, if anything, their values should be far more inflated. This is not the case (see *Fig. 4*).

Admittedly, what is desired for a deeper exploration of these issues are large samples from various contexts (ritual and otherwise) from the same site with which to test these import/export hypotheses. The site of Troy, for example, provides some comparisons to this effect, but its patterns are not significantly skewed to support any marked import/export of skeletal parts between ritual and non-ritual spots.[41] Comparisons at Nemea indicated some zooarchaeological connections between ritual and non-ritual assemblages, but samples were too small for several of the contexts considered to yield strong statistical results.[42] Consequently, putting aside the case of burnt *thysia* sacrifice among Greek ritual sites, and the unique skeletal part patterning (and charred/calcined nature) these samples exemplify (i.e. in this sense, the burning of thighbones and sacrum/tail elements predominantly), zooarchaeological materials associated with consumption debris and butchery debris, be this ritual or not, register little marked variation among Greek sites overall.

Pigs

As already anticipated, an examination of the patterns displayed for pigs among Greek ritual and non-ritual sites might help qualify some of the trends noted for cattle and sheep/goat. Generally, in relation to cattle or sheep/goat, pigs are more infrequently found in sacrificial deposits from Greek antiquity; thus, their sample sizes are typically smaller across ritual sites overall. Mytilene and Ephesos, however, stand as notable exceptions to this pattern, since the particular sites at these locations have connections to Demeter, for whom pigs were especially sacrificed.[43] Nevertheless, what arises from an inspection of both the ritual and non-ritual sections of the graph for pigs (*Fig. 4*) is a general predominance of cranial elements. This phenomenon is fairly standard across many sites where pigs register, regardless of timeframe or location;[44] thus, the concept is more likely a taphonomic, recovery, and identification aspect than definitive proof that pig heads were imported or exported among sites with the result of skewing the frequency of skeletal proportions.[45] Nevertheless, even with these concerns, a marked predominance of pig heads, beyond the 50% threshold, might indicate some import/export/retention dynamics concerning this element. Rather conspicuously among the ritual sites, Tegea and Didyma register high frequency counts in the "head + teeth" category for pigs, just as they did for cattle and sheep/goat. Does this mean that all three taxa were processed similarly? Perhaps, but this is probably influenced, at least in part, by taphonomic patterns, more than being solely a cultural construct: overall, larger and bet-

[40] The situation is not always clear-cut, however, as horn cores may dominate counts among the "head + teeth" category. Thus, at Didyma, where a "horn core bias" registers in the faunal assemblage, the remaining portions of the cranium, as well as the feet, could have been sold or taken away with the hide.

[41] See Fabiš 1996; 1999; 2002, for zooarchaeological reports for Troy.

[42] MacKinnon 2013 provides results for Nemea.

[43] Clinton 2005 provides a thorough account of the use of pigs in Greek rituals.

[44] This trend occurs, for example, across many Roman sites I have investigated. See MacKinnon 2004 for patterns relating to Roman Italy.

[45] The age of the animal may also factor in this pattern. Overall, pigs tend to be killed at younger ages among Greek sites (sacrificial or otherwise) than is the case for other livestock taxa, such as cattle or sheep/goat. The younger age for pigs, thus, can introduce a bias towards teeth (which preserve well, even if deciduous) rather than long-bones (which register a greater propensity to degrade taphonomically, especially if from immature individuals); this bias would bolster counts for the "head + teeth" category.

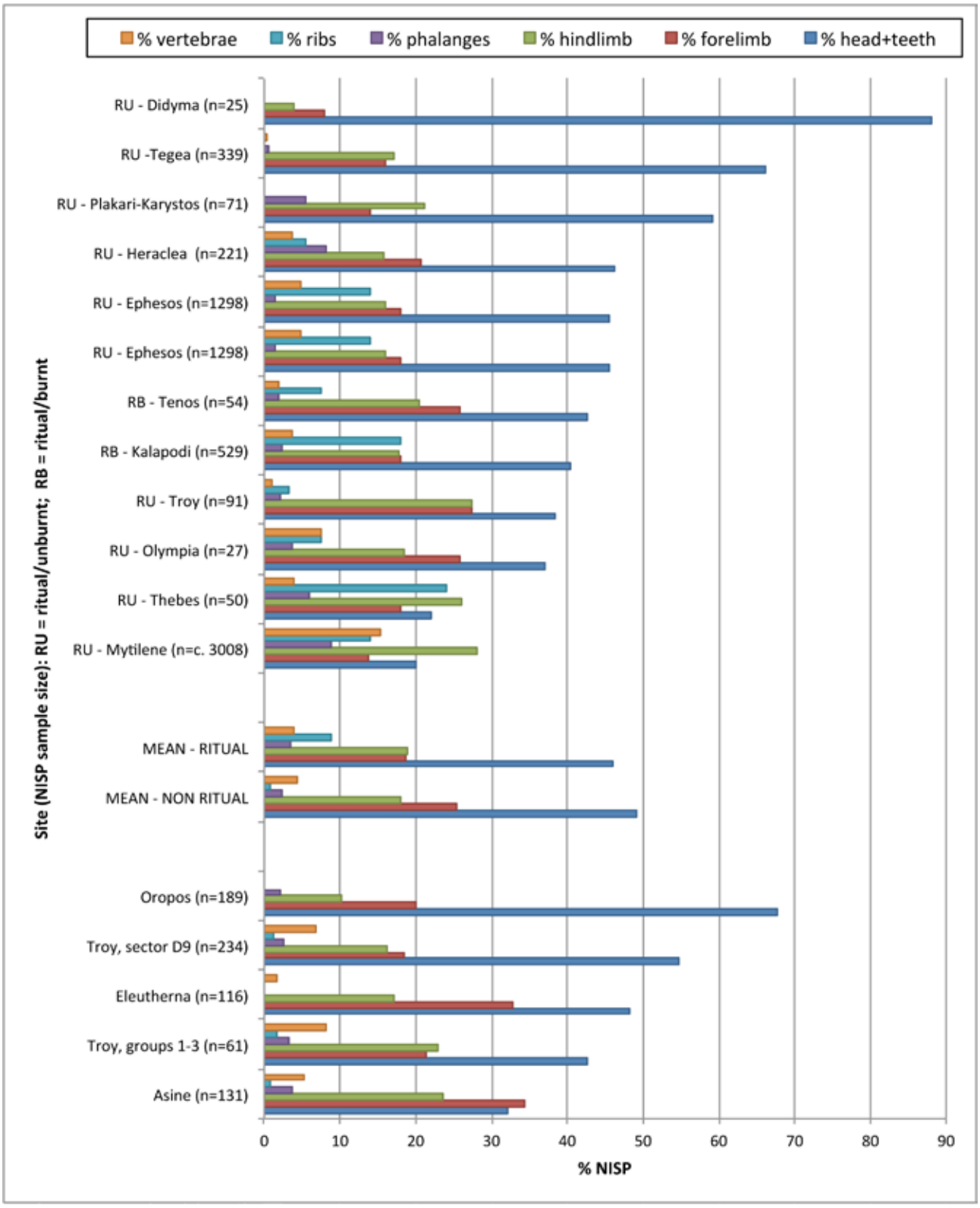

Fig. 4. Pig: NISP frequencies for six skeletal-part categories (vertebrae, ribs, phalanges, hindlimb, forelimb, head + teeth) among ritual and non-ritual sites for Greek antiquity. Chart: Michael MacKinnon.

ter-preserved faunal elements dominate NISP counts among those two assemblages.[46] Ribs and vertebrae of pigs register infrequently among most non-ritual sites, but comprise sizeable proportions of counts at places such as Mytilene, Thebes, and Ephesos, among ritual sites. Again, caution is warranted; this may be an artificial construct, if ribs and vertebrae in these cases have been identified as pig largely via association biases. Thus, if a deposit is noted as "all pig", then investigators might be inclined to identify ribs and vertebrae as pig, even if such precision would not normally be administered in deposits of mixed taxa (i.e. ones containing a mixture of remains from "medium-sized" animals including dog, pig, sheep, goat, etc.—species whose ribs often look similar). Moreover, as noted earlier, researchers may be more prone to include counts of ribs and vertebrae among ritual assemblages than might be the case in reporting for non-ritual contexts. Consequently, counts for the category of "consumption debris" from ritual feasts may be more apt to register these elements than might figures for non-ritual sites—which ultimately places a bias upon patterns drawn from the data.

Even with some of these concerns, mean values for pigs among ritual and non-ritual sites (*Fig. 4*) display strikingly similar trends, just as they did in the cases for cattle (*Fig. 2*) and sheep/goat (*Fig. 3*) respectively. Direct zooarchaeological cases for *thysia* sacrifice (be this thighbones or sacrum/tail bones) involving pigs are not known from the available faunal literature for Greek ritual. Generally, in most cases, and as exemplified at Mytilene, whole pigs were sacrificed.[47] Questions then surface as to whether the burnt pig remains from Kalapodi and Tenos represent pure altar debris (and any type of *thysia* sacrifice contained therein) or are mixtures from cooking and feasting debris.[48] Overall, however, assessment of the data for pigs prompts similar concerns as broached earlier in the discussion of trends for cattle and sheep/goat, specifically of a greater need to scrutinize the effects of taphonomy, preservation and recovery biases in faunal samples from ancient Greek contexts, and to do so with an eye towards the influence of these factors across the entire array of taxa recovered from these sites as a whole. In the present study, comparison of the three principal taxa—cattle, sheep/goat, pig—reveals some similar patterns, not simply between any individual taxon (e.g. cattle vs pig; sheep/goat vs pig; cattle vs sheep/goat), but also between ritual and non-ritual settings. Such findings might not surface had attention focused on any single taxon, type of site, or select body part (be this altar offerings, consumption debris or butchery debris).

Summary and conclusions

To summarize, a few key points can be proposed. First, what surfaces most distinctly from the graphs presented above for cattle, sheep/goat, and pigs is that comparisons of mean values for the various skeletal-part categories between ritual and non-ritual sites, on average, are markedly similar in each case. Certainly, this does not negate the fact that some ritual patterns are unique, as regards selection of different elements to burn on the altar, but any sort of uniqueness one might wish to attribute to butchery or consumption debris within a ritual context is rather mundane, I would argue, when set against this pattern among non-ritual sites. This is not to say the events themselves are similar, but rather that from a zooarchaeological perspective the materials that result are not particularly distinctive. The resemblance might be further enhanced in that general patterns pertaining to the ages of the animals involved, the types and locations of butchery marks evident, and the overall health of the animals also display little variation between ritual and non-ritual sites, with regard to these butchery and consumption debris categories. To express these aspects more bluntly: same stuff, different spots. Butch-

[46] There is also the bias that augmented identification of cranial elements (especially maxillae, mandibles, and their associated teeth) bolstered NISP figures for these pieces in relation to other skeletal parts at these sites. In the case of Tegea, specifically, teeth account for more than 50% of the pig assemblage, but figures are also quite high when sheep/goat and cattle components are assessed. Enhanced post-depositional modification of a sample can also create a scenario where teeth become isolated from their respective mandible/maxilla, which can artificially elevate counts if each individual tooth is subsequently counted and recorded. This situation can be further aggravated if a tooth becomes fragmented which might lead to it potentially being counted more than once.

[47] Given the detail in which it is reported, the Mytilene material provides an ideal osteological study of holocaust sacrificial ritual. Nevertheless, although all parts of the pig skeleton are present within this assemblage, a testament to some measure of holocaust activity, proportions among the various elements are not as perfectly aligned as might be expected. For example, left side elements occur more frequently (by 12%), while forelimb bones are 40% more plentiful than hind-limb bones. Ruscillo 2013, 189, suggests that the latter discrepancy may be a factor of taphonomic biases, given that the west side of the pit containing these materials was destroyed, but further acknowledges the possibility of cultural causes, such as the splitting of the offerings into two parts, variation among portions shared with event participants (with front- and hind-limbs used differently), or even the removal of sections (namely hind-limbs) from the area. Should cultural factors underlie this differential treatment of skeletal parts for the Mytilene faunal material, then it brings into question the nature of holocaust sacrifice as representing the strict burning of an entire animal, with subsequent deposition of all of its skeletal elements. See further below and Ekroth in this volume, *Chapter 12*.

[48] Ekroth 2014, 343–344 notes that thighbones, sacra and caudal vertebrae from pigs hardly register among burnt assemblages from Greek sacrificial altars. She suggests that, in general, pigs may have instead been sacrificed in rituals in a manner that highlighted the meatier aspects of these animals. Pork was a popular meat for consumption, and does register among dining debris both within and outside ritual settings in Greek antiquity.

ery and consumption debris, thus, at least from a general osteological point of view, do not seem to be markedly different depending on their location or context among ancient Greek sites, whether these be ritual sites or not. Nevertheless, as noted above and as needs to be re-iterated, this does not imply equality among these activities, for cultural variables and conditions are certainly distinct between such contexts. Going forward, then, it is important now to "fine-tune" our patterns for each site and build a fuller, more nuanced, picture of each. Thus, while general patterns might seem similar among ritual and non-ritual sites across aspects such as skeletal elements, ages, and other components, enhancing our investigations by cross-cutting these categories at more refined levels may show critical variation (e.g. are the lower right legs of all young, female sheep of the same breed, which were destined for consumption, butchered in the same fashion between ritual and non-ritual settings?—and similar questions that engage various aspects in an interrelated fashion). Such an examination requires a greater eye to scrutiny and precision in the initial observation of zooarchaeological remains, with the simultaneous obligation to record these details and make them available subsequently. This can be challenging in an environment where space for publication or dissemination is limited.

A second point to stress is that no marked patterns arise in the ritual assemblages to denote any special curation of foot elements particularly: heads perhaps, but not feet. Whether or not any preference for heads reflects (1) deliberate retention of horns among ritual sites; or (2) relates to some type of symbolic role of heads as visual markers of sacrifice, or (3) denotes removal of other elements with heads left behind as waste,[49] or (4) is simply a factor of taphonomic, recovery, and identification biases among taxa, is a matter of debate, and troublesome to pinpoint neatly, when it may well be the case that each variable may apply in unique combination across any given site. The notion of an animal's head as a recognizable, visual marker is not as marked within Greek sacrificial iconography in the same measure as the case where tails and chunks of meat are typically displayed being roasted on fires,[50] but *bucrania* are ubiquitous in Greco-Roman iconography.[51] Moreover, animal heads often assume significance in many cultural practices. Roman funerary contexts, for example, register a greater incidence of heads of animals, such as pigs and equids. Arguments centering upon symbolism—such as the head as a marker of a grave, or indicator/advertiser of proper veneration or sacrifice—tend to be applied in a number of Iron Age and Roman cases,[52] and similar notions may be worthwhile to explore more deeply for Greek antiquity. An animal's head is its biggest, socially recognizable asset, even if it might be less valuable in terms of any meat or physical product it might supply.[53]

As for the feet, phalanges for sheep/goat and pig are rather poorly represented among both ritual and non-ritual sites for Greek antiquity, but curiously more numerous when cattle are assessed. This is probably a taphonomy, recovery, and identification problem, and not a reflection that hides or leg bones with feet, or any other permutation that includes foot bones, were valued more in the case of cattle than they were for sheep/goat (or pigs for that matter) in Greek ritual contexts. This has relevance especially when one tries to reconcile textual or iconographic evidence that suggests specific prerogatives, such as the hide, or leg of meat (with foot attached) were awarded to the priest or other ritual official.[54] Overall, most of the deposits ascribed as butchery and dining debris from ritual contexts contain no more exceptional patterns, in terms of skeletal-part frequencies, than do their correlates outside of ritual spots, be this in Greek antiquity and beyond. In fact, one could insert hundreds of Roman non-ritual sites into these same graphs presented above for the ritual sites in Greek

[49] Whether or not these heads were subsequently butchered to remove elements such as the tongue, cheek muscles, brain, and other edible components, for ritual dining, requires more research. Given that these parts tend not to be associated with the "best-quality" meat from an animal's carcass, however, suggests that deliberate, specific and prioritized procurement of "head elements" for ritual dining was probably unlikely, at least in relation to "better-quality" cuts of meat that could be obtained (such as materials associated with the torso and upper legs of an animal). Nonetheless, as outlined by Ekroth 2007, 260–268, there is evidence that a host of animal taxa, including game, dogs, equids, fish, birds, etc. could supplement consumption debris within ritual settings. In this context, therefore, heads of cattle, sheep/goat and pig might easily have been incorporated into large stewpots when fashioning ritual meals.

[50] For the iconographical evidence, see, especially, van Straten 1995, but also Ekroth 2009, 132–134; 2013a, 19–25.

[51] Tyler Jo Smith in this volume, *Chapter 6*, examines the portrayal of animal heads in scenes of sacrifice in Greek vases most astutely. See also the contribution by Zachari, *Chapter 7*.

[52] Groot 2008, 183.

[53] By their nature, *bucrania* are most meaningful when displayed as complete pieces. In that form one could more readily distinguish the type of animal chosen (see also Zachari in this volume, *Chapter 7*). Hypothetically, as a fairly fragile element, itself comprised of a variety of individual bones, a *bucranium* was likely more susceptible to breakage than other elements of the skeleton. Thus, by way of speculation, if burnt or charred (tactics that would enhance breakage, in an already fragile skeletal element), crania might lose their recognizable nature, a situation that might render the head less common in depictions from charred sacrificial contexts overall for Greek antiquity. As noted, the issue requires greater investigation overall, particularly through experimental archaeology (especially tests that explore burning rates and fragmentation patterns for different skeletal elements across various animal taxa).

[54] For further discussion of various animal products (including joints of meat) received by the priest within ancient Greek ritual settings, see Meuli 1946, 220–221; Gill 1974, 127–133; Le Guen-Pollet 1991, 13–23; Ekroth 2009, 145; 2011, 36–40; 2013b, 115–129.

antiquity and nothing might seem out of place in terms of the overall trends displayed for proportions of skeletal parts.[55]

To conclude, the graphs presented thus far in this chapter outline skeletal-part frequency values that separated limbs by front and back leg and also included counts for ribs and vertebrae. Within these calculations, phalanges (the feet) were given their own category, so as to highlight their representation specifically. Suffice it to say that "there are many ways to skin a cat" here. In preparing statistics for this chapter, graphs were also constructed that excluded the categories for ribs and vertebrae and assessed the remaining skeletal-part groups by one of four classes: (1) head + teeth; (2) primary cuts (that is, scapula, humerus, pelvis, and femur); (3) secondary cuts (i.e. radius, ulna, tibia, and fibula); and (4) limb extremities (i.e. metapodials, carpals, tarsals, phalanges). As noted previously, among the faunal reports consulted, ribs and vertebrae were not always expressly identified to an individual taxon, such as cattle, sheep/goat, or pig. Thus, in an effort to avoid some of the biases that can result from this omission, and in turn potentially include sites not originally recorded in *Figs. 2–4*, figures were re-calculated on the basis of the revised four-category system outlined above. These new graphs are presented as *Fig. 5* (cattle), *Fig. 6* (sheep/goat) and *Fig. 7* (pigs). Obviously, these revised figures cannot afford a comprehensive picture of patterns of use for skeletal parts for an entire animal, given that ribs and vertebrae are excluded. Nonetheless, depending upon how animal hides are apportioned, the section of the leg from the metapodial downwards to the foot is occasionally considered "waste" or at least less important from the point of view of meat acquisition.[56] Consequently, this can affect results, notably in investigations concerning import/export of hides/skins, an angle of interest in the current assessment of the representation of animal parts among ritual and non-ritual sites in Greek antiquity. Additionally, sub-dividing an animal carcass into "primary" and "secondary" cuts affords an opportunity with which to compare the quality of meat in association. Primary cuts of meat tend to be meatier, fattier, and of higher quality than secondary cuts. Typically, these pieces are sought after or prized, and often indicative of higher status, although tastes and value as regards meat choices are certainly culturally circumscribed, and by no means universal among groups. Nonetheless, at least in the world of Greco-Roman antiquity, primary cuts of meat likely enjoyed more dietary and social prestige than did those associated with secondary cuts.[57] Affixing value to cuts of meat, thus, might affect which parts register among dining and butchery assemblages from Greek sites, especially when considered within a framework of attributing a hierarchy in apportioning various meat cuts among the officials and celebrants involved in the ritual.[58]

Space does not permit a detailed exploration of the data shown in *Figs. 5–7*, but generally the patterns noted mimic their respective counterparts in *Figs. 2–4*. Elements from the "head + teeth" category tend to dominate many examples, especially in the case for pigs. Taphonomic biases play a role here. Teeth survive well in the archaeological record and can inflate statistics for some zooarchaeological counts, again especially as regards values for pigs. In fact, among the taxa represented, pigs register very little variation in the patterns noted (excepting the case of Didyma), be this among individual representatives listed for either the ritual or non-ritual categories of site presented, or between these two general groups as a whole. This finding perhaps establishes a commonality that might emerge in our assessment of the representation of skeletal parts for pigs among a host of sites for Greek antiquity. In other words, one might expect whole pigs to be butchered and consumed (be this within a sacrificial setting or not) with little (or at least, less marked, in relation to other taxa) import/export or movement of parts beyond those contexts. The same, however, cannot be said for cattle and sheep/goat, where patterns displayed in *Figs. 5* and *6* show greater variations among assemblages. Given that vertebrae are excluded from *Figs. 5* and *6*, the case for *osphys* sacrifice is not observable, but elevated frequencies for "primary" cuts for cattle and/or sheep/goat at sites such as Isthmia and Eretria clearly suggest *thysia* sacrifice, predominantly the femur bone in these cases.[59] Nonetheless, caution should be exercised in uncritically attributing too much cultural importance to certain patterns displayed among sheep/goat and cattle figures. For example, enhanced identification of the readily-recogniz-

[55] MacKinnon 2004 provides comparative data for frequencies of skeletal parts for cattle, sheep/goat and pig for various sites in Roman Italy, for example.

[56] MacKinnon 2004, 177–184.

[57] MacKinnon 2017.

[58] To illustrate this hierarchy in portioning, Carbon 2017 provides an excellent synthesis of the priestly perquisites in the post-sacrificial division of meat and animal parts in Greek sacrifice.

[59] It should be mentioned here that further contexts at Isthmia, specifically burnt cattle bones from Pits A, B, and C at the Palaimonion, were argued by Gebhard & Reese 2005, 137–139 to represent remains from holocaust sacrifices to the hero Melikertes-Palaimon. However, the breakdown by skeletal element as reported for these findings could not be neatly translated into the categories used among the graphs in this investigation. Nevertheless, these "holocaust" assemblages were overwhelmingly dominated by "head" and "thorax" (i.e. rib and body vertebrae) elements (*c.* 37% head and *c.* 57% thorax), with far fewer bones from the tail and limbs represented. While a holocaust ritual may apply, the imbalance in parts calls into question the treatment of the tail and limb elements within this scenario. Were these removed before or after burning (presumably before)? And, more importantly, must a holocaust sacrifice contain all skeletal parts, collectively, and in more equal frequencies, to be deemed as such (see also Ekroth in this volume, *Chapter 12*). If the presence of burned elements from an animal's head is used as principal argument to suggest a holocaust sacrifice, is this justified? Might it be the case that a head, alone, was burnt, in a special form of ritual?

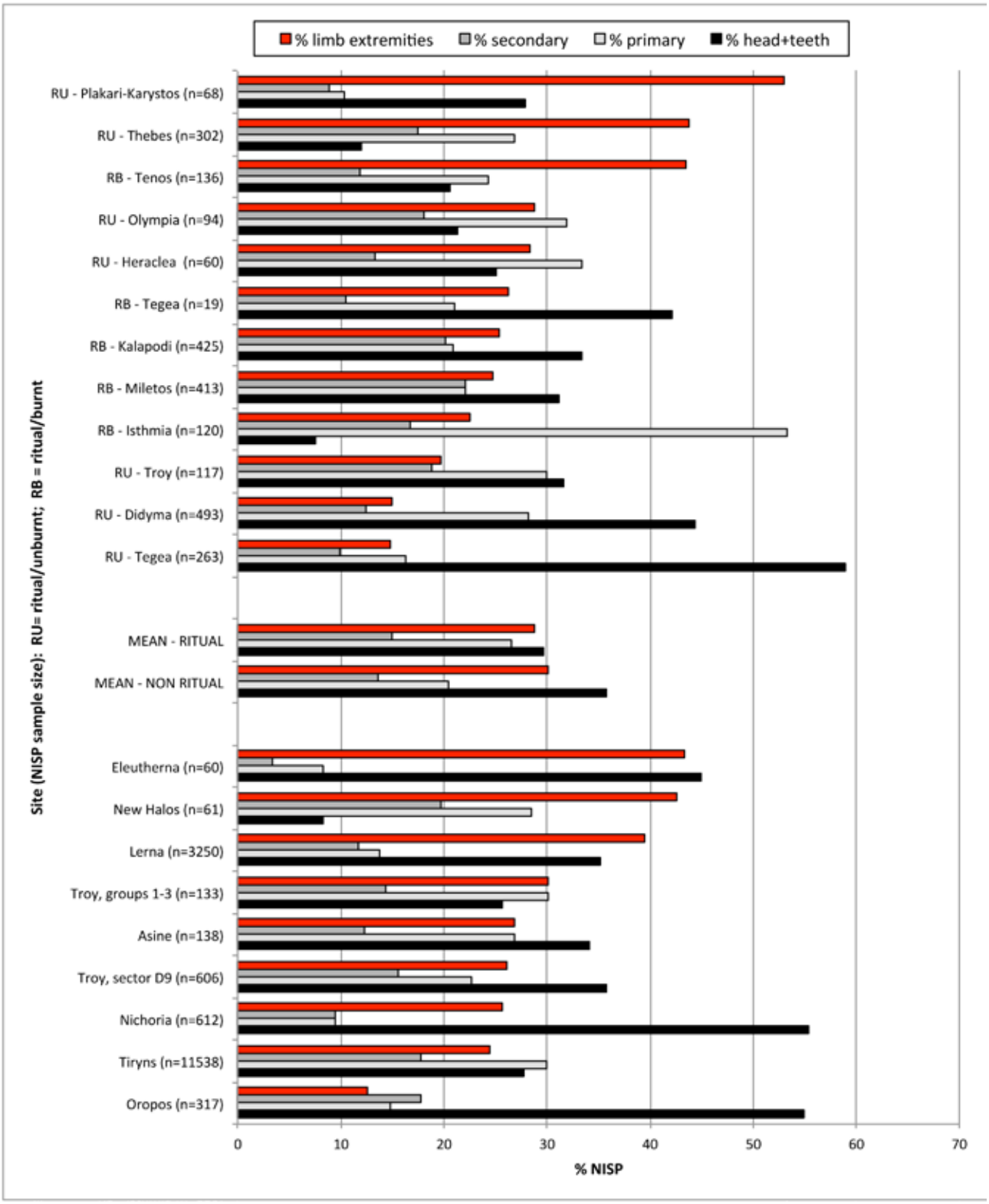

Fig. 5. Cattle: NISP frequencies for four skeletal-part categories (limb extremities, secondary cuts, primary cuts, head + teeth) among ritual and non-ritual sites for Greek antiquity. Chart: Michael MacKinnon.

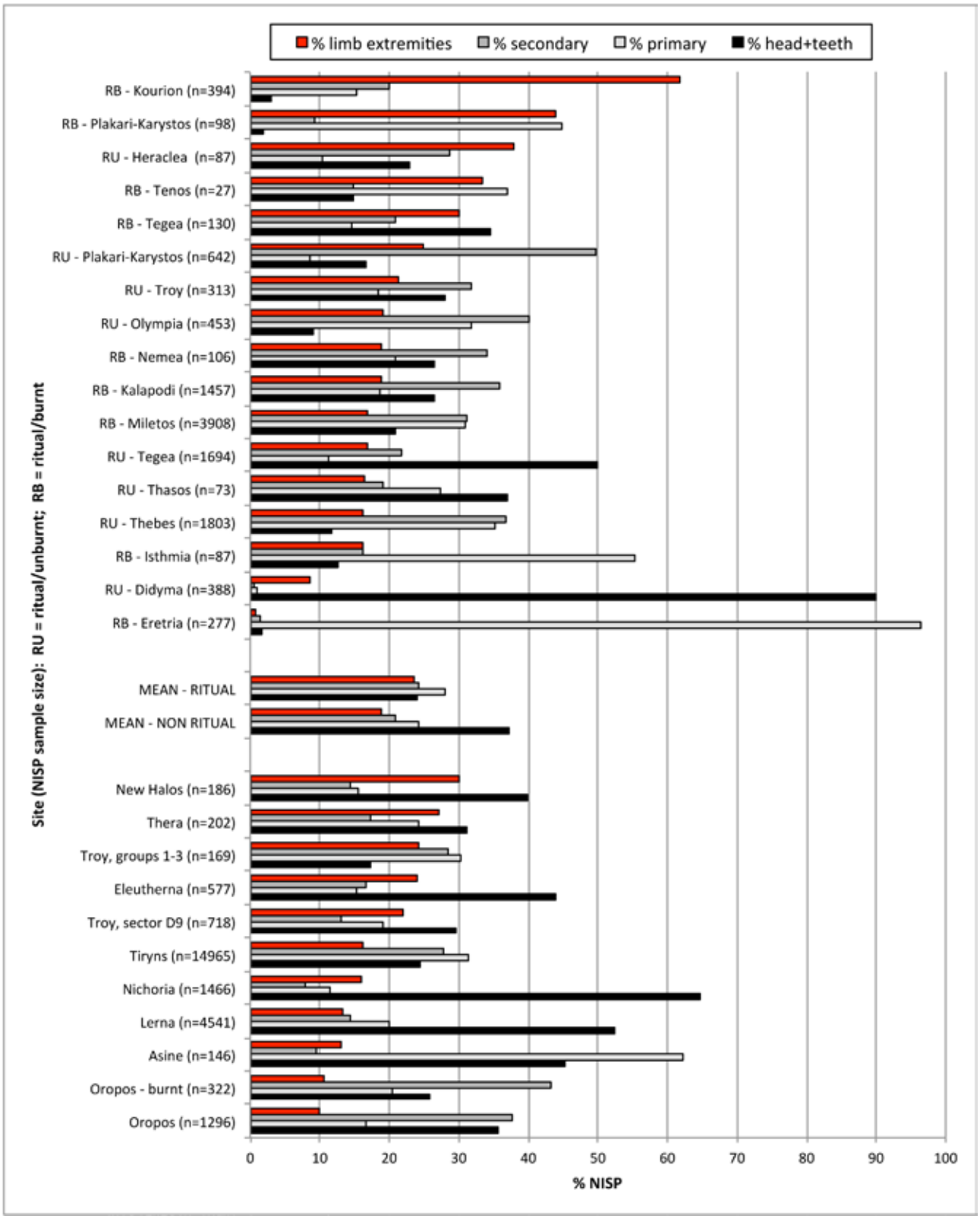

Fig. 6. Sheep/goat: NISP frequencies for four skeletal-part categories (limb extremities, secondary cuts, primary cuts, head + teeth) among ritual and non-ritual sites for Greek antiquity. Chart: Michael MacKinnon.

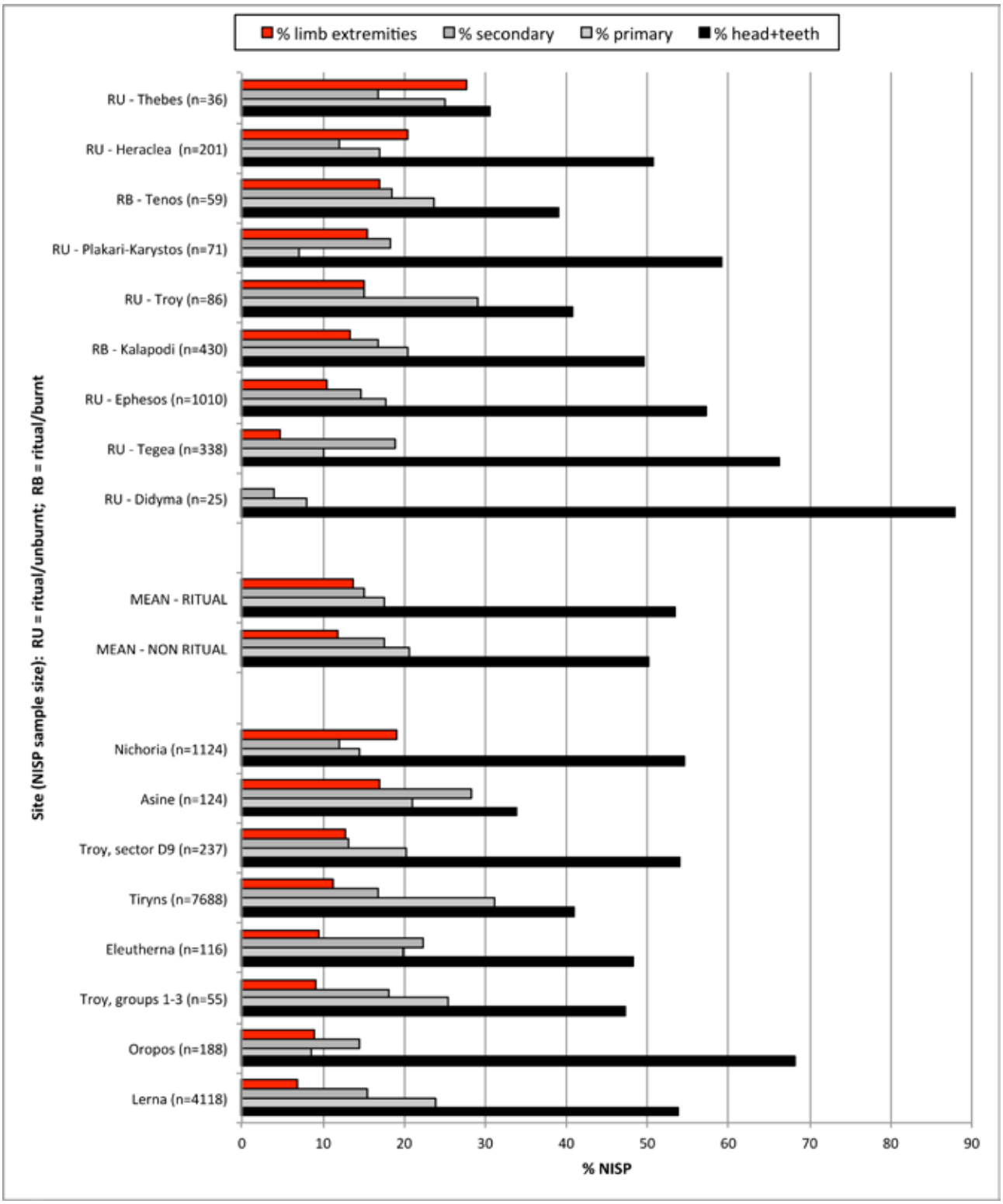

Fig. 7. Pig: NISP frequencies for four skeletal-part categories (limb extremities, secondary cuts, primary cuts, head + teeth) among ritual and non-ritual sites for Greek antiquity. Chart: Michael MacKinnon.

able astragalus bone within sheep/goat and cattle assemblages can elevate the frequency of both the "hindlimb" and "limb extremities" categories. Add to this a bias that might favour both the preservation and identification of cattle phalanges and the result registers as a far larger incidence of "limb extremities" for this taxon (*c.* 30%), compared to either sheep/goat (*c.* 20%) or pig (*c.* 12%).

Regardless of these particular issues and concerns, perhaps the most critical observation to note overall when examining respective trends for *Figs. 2–4* and *Figs. 5–7* is that average patterns for ritual and non-ritual deposits for each animal taxon remain nearly identical. This reinforces the notion of a greater need to scrutinize the representation and distribution of skeletal parts more assiduously in our investigation of Greek faunal samples across all types of sites. The same conclusion emerged in the analysis of *Figs. 2–4* as well. Moreover, it is important in those investigations to compare trends across all three taxa (in this case, cattle, sheep/goat, and pig) simultaneously, in order to gauge the degree to which a particular pattern that surfaces among one taxon is noted within another. This should not imply that different taxa were not treated differently within ancient ritual settings, but if all three register a certain bias in the representation of skeletal parts, then a focused argument for a unique treatment of any single taxon—without taking into consideration the pattern for the other taxa—becomes less convincing overall.

Looking to the future, a case can be put forward that a deeper, critical assessment of faunal assemblages from Greek antiquity, with a lens towards depositional context, taphonomy, cultural practice, import/export of parts, and inter-, let alone intra-, site variability, inevitably helps create a more nuanced, albeit probably greyer, picture of antiquity. Although the resulting picture might be less concrete in yielding definitive conclusions—that is, black and white statements—, its goal, as noted within the introduction to this chapter, is to be comprehensive and encompassing. Nevertheless, as we progress, more attention should be placed on refining our understanding of skeletal parts among the different sites. Certainly, acknowledging the investigatory biases and concerns outlined in this chapter is a key step, but a movement towards reporting both NISP and MNI (= Minimum Number of Individuals) counts for elements and skeletal-part categories can assist. MNI values help correct biases linked with aspects such as differential fragmentation and the like, and thus move us closer to comparisons along more "absolute" lines, as opposed to the wider, "relative" scope NISP counts afford.[60] Comparisons by skeletal weight for various element categories also provides an avenue of investigation that can help offset concerns with using NISP and MNI counts. Investigations of the categories of ribs and vertebrae, moreover, need more attention, even if these must be lumped into more general pools that record them by general size categories. Furthermore, experimental archaeological ventures, such as the work of Gunnel Ekroth, Gerhard Forstenpointner, and Jake Morton,[61] are key to refining our ideas, but more importantly are venues (such as this volume) that provide an interdisciplinary forum of investigation, uniting multiple lines of evidence in search of collective answers … even if our answers still keep us within that grey zone. After all, "grey is good".

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Bibliography

Audoin-Rouzeau, F. & S. Beyries, eds. 2002. *Le travail du cuir de la préhistoire à nos jours : XXIIe Rencontres internationales d'archéologie et d'histoire d'Antibes*, Antibes.

Bammer, A. 1998. 'Sanctuaries in the Artemision of Ephesus', in *Ancient Greek cult practice from the archaeological evidence. Proceedings of the Fourth International Seminar on Ancient Greek Cult, organized by the Swedish Institute at Athens, 22–24 October 1993* (ActaAth-8°, 15), ed. R. Hägg, Stockholm, 27–47.

Bammer, A., F. Brein & P. Wolff 1978. 'Das Tieropfer am Artemisaltar von Ephesos', in *Studien zur Religion und Kultur Kleinasiens. Festschrift für Freidrich Karl Dörner*, vol. 1 (EPRO, 66), eds. S. Sahin, E. Schwerthein & J. Wagner, Leiden, 107–157. https://doi.org/10.1163/9789004295377_005

Becker, C. 1997. 'Tierknochenfunde aus der Höhle Pilarou—Reste von Tieropfern oder profane Schlacht—und Speisebfäle', in *Das Dorische Thera* vol. 5. *Stadtgeschichte und Kultstätten am nördlichen Stadtrand*, ed. W. Hoepfner, Berlin, 151–183.

Benecke, N. 2006. 'Animals sacrifice at the Late Archaic Artemision of Olympia: The archaeozoological evidence', in *Archaeozoological studies in honour of Alfredo Riedel*, eds. U. Tecchiati & B. Sala, Bolzano, 153–160.

[60] Reitz & Wing 2008, 205–210 provide a general overview the concept of MNI, and the variety of techniques employed in its calculation.

[61] Ekroth 2009 and her contribution to this volume, *Chapter 12*; Forstenpointner 2003; Forstenpointner *et al.* 2013; Morton 2015 and his contribution to this volume, *Chapter 2*.

Bergquist, B. 1998. 'Feasting of worshippers or temple and sacrifice? The case of Herakleion on Thasos', in *Ancient Greek cult practice from the archaeological evidence. Proceedings of the Fourth International Seminar on Ancient Greek Cult, organized by the Swedish Institute at Athens, 22–24 October 1993* (ActaAth-8°, 15), ed. R. Hägg, Stockholm, 57–72.

Boessneck, J. 1973. *Die Tierknochenfunde aus dem Kabirenheiligtum bei Theben (Böotien)*, Munich.

Boessneck, J. & A. von den Driesch 1983. 'Tierknochen aus Didyma', *AA* 1983, 611–651.

Boessneck, J. & J. Schäffer 1986. 'Tierknochenfunde aus Didyma II', *AA* 1986, 285–294.

Brun, H. & M. Leguilloux 2013. 'Rituels sacrificiels et offrandes animales dans le Sarapieion C de Délos', in *Bones, behaviour and belief. The zooarchaeological evidence as a source for ritual practice in ancient Greece and beyond* (ActaAth-4°, 55), eds. G. Ekroth & J. Wallensten, Stockholm, 167–179. https://doi.org/10.30549/actaath-4-55-13

Carbon, J.-M. 2017. 'Meaty perks: Epichoric and topological trends', in *Animal sacrifice in the ancient Greek world*, eds. S. Hitch & I. Rutherford, Cambridge, 151–178. https://doi.org/10.1017/9781139017886.007

Chenal-Velarde, I. 2001. 'Des festins à l'entrée du temple ? Sacrifices et consommation des animaux à l'époque géométrique dans le sanctuaire d'Apollon à Erétrie, Grèce', *Archaeofauna* 10, 25–35.

Chenal-Velarde, I. & J. Studer 2003. 'Archaeozoology in a ritual context: The case of a sacrificial altar in Geometric Eretria', in *Zooarchaeology in Greece. Recent advances* (British School at Athens Studies, 9), eds. E. Kotjabopoulou, Y. Hamilakis, P. Halstead, C. Gamble & P. Elefanti, London, 215–220.

Clinton, K. 2005. 'Pigs in Greek rituals', in *Greek sacrificial ritual, Olympian and chthonian. Proceedings of the Sixth International Seminar on Ancient Greek Cult, organized by the Department of Classical Archaeology and Ancient History, Göteborg University, 25–27 April 1997* (ActaAth-8°, 18), eds. R. Hägg & B. Alroth, Stockholm, 167–179.

Columeau, P. 1996. 'Les restes de faune du sanctuaire d'Aphrodite à Amathonte', *BCH* 120:2, 779–797. https://doi.org/10.3406/bch.1996.4627

Davis, S.J.M. 1996. 'Animal sacrifices', in *The sanctuary of Apollo Hylates at Kourion: Excavations in the Archaic precinct* (SIMA, 109), ed. D. Buitron-Oliver, Jonsered, 181–182.

De Girolami Cheney, L. 1998. 'Abundance', in *Encyclopedia of comparative iconography: Themes depicted in works of art*, ed. H.E. Roberts, London, 19–22. https://doi.org/10.4324/9780203825587

des Courtils, J., A. Gardeisen & A. Pariente 1996. 'Sacrifices d'animaux à l'Hérakleion de Thasos', *BCH* 120:2, 799–820. https://doi.org/10.3406/bch.1996.4628

Detienne, M. & J.P. Vernant eds. 1989. *The cuisine of sacrifice among the Greeks*, Chicago & London.

Dillon, M.P.J. 1997. 'The ecology of the Greek sanctuary', *ZPE* 118, 113–127.

Driver, J.C. 1991. 'Identification, classification and zooarchaeology', *Circaea* 9:1, 35–47.

Driver, J.C. 2011. 'Identification, classification and zooarchaeology', *Ethnobiology letters* 2, 19–39 (revised reprint). https://doi.org/10.14237/ebl.2.2011.32

Eidinow, E. & J. Kindt, eds. 2015. *The Oxford handbook of ancient Greek religion*, Oxford. https://doi.org/10.1093/oxfordhb/9780199642038.001.0001

Ekroth, G. 2002. *The sacrificial rituals of Greek hero-Cults in the Archaic to the early Hellenistic periods* (Kernos supplément, 12), Liège. https://doi.org/10.4000/books.pulg.490

Ekroth, G. 2007. 'Meat in ancient Greece: Sacrificial or secular?', *Food & History* 5:1, 249–272. https://doi.org/10.1484/j.food.1.100193

Ekroth, G. 2008a. 'Meat, man and god. On the division of the animal victim at Greek sacrifices', in *Μικρός Ιερομνήμων. Μελέτες εις μνήμην Michael H. Jameson*, eds. A.P. Matthaiou & I. Polinskaya, Athens, 259–290.

Ekroth, G. 2008b. 'Burnt, cooked or raw? Divine and human culinary desires at Greek animal sacrifice', in *Transformations in sacrificial practices. From antiquity to modern times*, eds. E. Staviranopoulou, A. Michaels & C. Ambos, Berlin, 87–111.

Ekroth, G. 2009. 'Thighs or tails? The osteological evidence as a source for Greek ritual norms', in *La norme en matière religieuse en Grèce ancienne* (Kernos supplément, 21), ed. P. Brulé, Liège, 125–151. https://doi.org/10.4000/books.pulg.562

Ekroth, G. 2011. 'Meat for the gods', in *Nourrir les dieux ? Sacrifice et representation du divin* (Kernos supplément, 26), eds. V. Pirenne-Delforge & F. Prescendi, Liège, 15–41. https://doi.org/10.4000/books.pulg.1677

Ekroth, G. 2013a. 'What we would like the bones to tell us: A sacrificial wish list', in *Bones, behaviour and belief. The zooarchaeological evidence as a source for ritual practice in ancient Greece and beyond* (ActaAth-4°, 55), eds. G. Ekroth & J. Wallensten, Stockholm, 15–30. https://doi.org/10.30549/actaath-4-55-04

Ekroth, G. 2013b. 'Forelegs in Greek cult', in *Perspectives on ancient Greece. Papers in celebration of the 60th anniversary of the Swedish Institute at Athens* (ActaAth-8°, 22), ed. A.-L. Schallin, Stockholm, 113–134.

Ekroth, G. 2014. 'Animal sacrifice in antiquity', in *The Oxford handbook of animals in Classical thought and life*, ed. G.L. Campbell, Oxford, 324–354. https://doi.org/10.1093/oxfordhb/9780199589425.013.020

Ekroth, G. 2016. 'A view from the Greek side: Interpretations of animal bones as evidence for sacrifice and ritual consumption', *Journal of ancient Judaism* 7:1, 35–50. https://doi.org/10.30965/21967954-00701004

Ekroth, G. 2017a. 'Bare bones: Zooarchaeology and Greek sacrifice', in *Animal sacrifice in the ancient Greek world*, eds. S. Hitch & I. Rutherford, Cambridge, 15–47. https://doi.org/10.1017/9781139017886.002

Ekroth, G. 2017b. '"Don't throw any bones in the sanctuary!" On the handling of sacred waste at ancient Greek cult places', in *Ritual matters: Material remains and ancient religion* (MAAR Supplementary Volumes, 13), eds. C. Moser & J. Knust, Philadelphia, 33–55.

Fabiš, M. 1996. 'Archaeofaunal remains from the Lower Sanctuary. A preliminary report on the 1994 excavations', *Studia Troica* 6, 217–236.

Fabiš, M. 1999. 'Studies in Hellenistic Ilion: The archaeofaunal remains of C29, w28, and y28/29, Lower City', *Studia Troica* 9, 237–252.

Fabiš, M. 2002. 'Ilion before Alexander: The archaeofaunal remains from D9', *Studia Troica* 12, 245–274.

Forstenpointner, G. 2000. 'Stierspiel oder Bocksgesang? Archäozoologische Aspekte zur Interpretation des Hornviehs als Opfertier in der Ägäis', in *Österreichische Forschungen zur Ägäischen Bronzezeit* (Wiener Forschungen zur Archäologie, 3), ed. F. Blakolmer, Vienna, 51–65.

Forstenpointner, G. 2001. 'Demeter im Artemision?—Archäologische Überlegungen zu den Schweineknochenfunden aus dem Artemision', in *Der Kosmos der Artemis von Ephesos* (Österreichisches Archäologisches Institut. Sonderschriften, 37), ed. U. Muss, Vienna, 49–71.

Forstenpointner, G. 2003. 'Promethean legacy: Investigations into the ritual procedure of 'Olympian' sacrifice', in *Zooarchaeology in Greece. Recent advances* (British School at Athens Studies, 9), eds. E. Kotjabopoulou, Y. Hamiliakis, P. Halstead, C. Gamble & P. Elefanti, London, 203–213.

Forstenpointner, G., R. Krachler & B. Schildorfer 1999. 'Archäologische Untersuchungen zu den Formen des Tieropfers im Artemision von Ephesos', in *100 Jahre Österreichische Forschungen in Ephesos. Akten des Symposions Wien 1995* (Archäologische Forschungen, 1), eds. H. Friesinger & F. Kinzinger, Vienna, 225–232.

Forstenpointner, G., G.E. Weissengruber & A. Galik 2005. 'Tierreste aus früheisenzeitlichen Schichten des Artemisions von Ephesos', in *Synergia. Festschrift für Friedrich Krizinger*, vol. 1, eds. B. Brandt, V. Gassner & S. Ladstätter, Vienna, 85–92.

Forstenpointner, G., A. Galik & G.E. Weissengruber 2008. 'Archäozoologie', in *Das Vediusgymnasium in Ephesos: Archäologie und Baubefund* (Forschungen in Ephesos, 14), ed. M. Steskal, Vienna, 211–234. https://doi.org/10.1553/0x001a81a1

Forstenpointner, G., A. Galik & G.E. Weissengruber 2010. 'Tierreste aud dem Demeterheiligtum von Policoro/Herakleia (Basilicata, Italien)', in *Standortbestimmung. Akten des 12. Österreichischen Archäologentages vom 28. 2. bis 1.3. 2008 in Wien* (Wiener Forschungen zur Archäologie, 13), eds. M. Meyer & V. Gassner, Vienna, 135–146.

Forstenpointner, G., A. Galik & G.E. Weissengruber 2013. 'The zooarchaeology of cult. Perspectives and pitfalls of an experimental approach', in *Bones, behaviour and belief. The zooarchaeological evidence as a source for ritual practice in ancient Greece and beyond* (ActaAth-4°, 55), eds. G. Ekroth & J. Wallensten, Stockholm, 233–242. https://doi.org/10.30549/actaath-4-55-17

Gardeisen, A. 2006. 'Le dépôt archaïque du rampart Nord d'Amathonte, IV. L'assemblage archéozoologique', *BCH* 130:1, 7–35. https://doi.org/10.3406/bch.2006.7405

Gebhard, E.R. & M.W. Dickie 1999. 'Melikertes-Palaimon, hero of the Isthmian Games', in *Ancient Greek hero cult. Proceedings of the Fifth International Seminar on Ancient Greek Cult, organized by the Department of Classical Archaeology and Ancient History, Göteborg University, 21–23 April 1995* (ActaAth-8°, 16), ed. R. Hägg, Stockholm, 159–165.

Gebhard, E.R. & D.S. Reese 2005. 'Sacrifices for Poseidon and Melikertes-Palaimon at Isthmia', in *Greek sacrificial ritual, Olympian and chthonian. Proceedings of the Sixth International Seminar on Ancient Greek Cult, organized by the Department of Classical Archaeology and Ancient History, Göteborg University, 25–27 April 1997* (ActaAth-8°, 18), eds. R. Hägg & B. Alroth, Stockholm, 125–154.

Gejvall, N.G. 1969. *Lerna: A preclassical site in the Argolid* vol. 1. *The fauna*, Princeton.

Gill, D. 1974. 'Trapezomata: A neglected aspects of Greek sacrifice', *HThR* 67:2, 117–137. https://doi.org/10.1017/s0017816000003217

Graf, F. 2012. 'One generation after Burkert and Girard. Where are the great theories?', in *Greek and Roman animal sacrifice. Ancient victims, modern observers*, eds. C.A. Faraone & F.S. Naiden, Cambridge, 32–54. https://doi.org/10.1017/cbo9780511894602.005

Groot, M. 2008. *Animals in ritual and economy in a Roman frontier community: Excavations in Tiel-Passewaaij* (Amesterdam Archaeological Studies, 12), Amsterdam. https://doi.org/10.5117/9789089640222

Groot, M. 2014. 'Burned offerings and sacrificial meals in Geometric and Archaic Karystos: Faunal remains from Plakari (2011–2012)', *Pharos* 20:2, 25–52.

Hägg, R. 1998. 'Osteology and Greek sacrificial practice', in *Ancient Greek cult practice from the archaeological evidence. Proceedings of the Fourth International Seminar on Ancient Greek Cult, organized by the Swedish Institute at Athens, 22–24 October 1993* (ActaAth-8°, 15), ed. R. Hägg, Stockholm, 49–56.

Halstead, P. & V. Isaakidou 2017. 'Sheep, sacrifices, and symbols: Animals in later Bronze Age Greece', in *The Oxford handbook of zooarchaeology*, eds. U. Albarella, M. Rizzetto, H. Russ, K. Vickers & S. Viner-Daniels, Oxford, 113–126. https://doi.org/10.1093/oxfordhb/9780199686476.013.8

Hitch, S. 2015. 'Sacrifice', in *A companion to food in the ancient world*, eds. J. Wilkins & R. Nadeau, London, 337–347. https://doi.org/10.1002/9781118878255.ch32

Huber, S. & P. Méniel 2013. 'Annexe 1 : analyses archéozoologique. La faune terrestre du sanctuaire d'Apollon', in *Eretria* XXII. *Le sanctuaire d'Apollon Daphnéphoros à l'époque géométrique*, ed. S. Verdan, Gollion, 243–254.

I.Didyma = T. Wiegand & A. Rehm 1958. *Didyma* II. *Die Inschriften*, Berlin.

Jameson, M.H. 1988. 'Sacrifice and animal husbandry in Classical Greece', in *Pastoral economies in Classical Antiquity* (PCPS Supplement, 14), ed. C.R. Whittaker, Cambridge, 87–119. https://doi.org/10.2307/j.ctv27h1pxv.7

Kadletz, E. 1976. *Animal sacrifice in Greek and Roman religion*, Dissertation, University of Washington.

Klapper, C. 1994. *Die Tierknochenfunde aus dem Apollon-Heiligtum in Didyma/Westtürkei—8. Jh. V. Chr.–7. Jh. N. Chr.*, Dissertation, University of Munich.

Larson, J. 2017. 'Venison for Artemis? The problem of deer sacrifice', in *Animal sacrifice in the ancient Greek world*, eds. S. Hitch & I. Rutherford, Cambridge, 48–62. https://doi.org/10.1017/9781139017886.003

Le Guen-Pollet, B. 1991. 'Espace sacrificiel et corps des bête immolées. Remarques sur le vocabulaire désignant la part du prêtre dans la Grèce antique, de l'époque classique à l'époque impériale', in *L'espace sacrificiel dans la civilisations méditerranéennes de l'antiquité. Actes du colloque tenu à la Maison de l'Orient, Lyon, 4–7 juin 1988* (Publications de la bibliothèque Salomon-Reinach, 5), eds. R. Étienne & M.-T. Le Dinahet, Paris, 13–23.

Leguilloux, M. 1999. 'Sacrifices et repas publics dans le sanctuaire de Poséidon à Ténos : les analyses archéozoologiques', *BCH* 123:2, 423–456. https://doi.org/10.3406/bch.1999.7235

Leguilloux, M. 2000. 'L'hécatombe de l'ekklesiasterion de Poseidonia/Paestum. Le témoignage de la faune', in *Rites et espaces en pays celtes et méditerranéen. Étude comparée à partir du sanctuaire d'Acy-Romance (Ardenne, France)* (Collection de l'École française de Rome, 276), ed. S. Verger, Rome, 341–351.

Leguilloux, M. 2004. *La cuir et la pelleterie à l'époque romaine*, Paris.

LSAM = F. Sokolowski, *Lois sacrées de l'Asie Mineure* (École française d'Athènes. Travaux et mémoires, 9), Paris 1955.

LSCG = F. Sokolowski, *Lois sacrées des cités grecques* (École française d'Athènes. Travaux et mémoires, 18), Paris 1969.

LSS = F. Sokolowski, *Lois sacrées des cités grecques. Supplément* (École française d'Athènes. Travaux et memoires, 11), Paris 1962.

Lyman, R.L. 1994. *Vertebrate taphonomy*, Cambridge. https://doi.org/10.1017/cbo9781139878302

MacKinnon, M. 2004. *Production and consumption of animals in Roman Italy: Integrating the zooarcheaological and ancient textual evidence* (JRA supplement, 54), Portsmouth.

MacKinnon, M. 2010. "'Left' is 'right': The symbolism behind side choice among ancient animal sacrifices', in *Anthropological approaches to zooarchaeology: Complexity, colonialism and animal transformations*, eds. D. Campana, P.J. Crabtree, S.D. deFrance, J. Lev-Tov & A.M. Choyke, Oxford, 250–258.

MacKinnon, M. 2013. '"Side" matters: Animal offerings at ancient Nemea', in *Bones, behaviour and belief. The zooarchaeological evidence as a source for ritual practice in ancient Greece and beyond* (ActaAth-4°, 55), eds. G. Ekroth & J. Wallensten, Stockholm, 129–147. https://doi.org/10.30549/actaath-4-55-11

MacKinnon, M. 2017. 'Tastes of meat in antiquity: Integrating the textual and zooarchaeological evidence', in *Taste and the ancient senses*, ed. K.C. Rudolph, New York, 161–177. https://doi.org/10.4324/9781315719245-10

MacKinnon, M. 2018. 'The faunal remains from the Hero Shrine', in *Excavations at Nemea* IV. *The Shrine of Opheltes*, ed. J. Bravo, Berkeley, 79–100. https://doi.org/10.1525/9780520967878-009

Meuli, K. 1946. 'Griechische Opferbräuche', in *Phyllobolia. Festschrift für Peter von der Mühll zum 60. Geburtstag am 1. August 1945*, ed. O. Gigon, Basel, 185–288.

Moberg, K. 1992. 'The animal bones', in R. Hägg & G.C. Nordquist, 'Excavations in the Levandis Sector at Asine, 1989', *OpAth* 19, 66–68.

Moberg Nilsson, K. 1996. 'Animal bones from Terrace II in the lower town of Asine', in *Asine* III. *Supplementary studies on the Swedish excavations 1922–1930* vol. 1, (ActaAth-4°, 45:1), eds. R. Hägg, G.C. Nordquist & B. Wells, Stockholm, 111–115.

Morton, J. 2015. 'The experience of Greek sacrifice: Investigating fat-wrapped thighbones', in *Autopsy in Athens. Recent archaeological research in Athens and Attica*, ed. M.M. Miles, Oxford, 66–75.

Mylona, D. 2008. *Fish-eating in Greece from the fifth century B.C. to the seventh century A.D. A story of impoverished fishermen or luxurious fish banquets?* (BAR-IS, 1754), Oxford. https://doi.org/10.30861/9781407301938

Mylona, D. 2013. 'Dealing with the unexpected. Unusual animals in an Early Roman cistern fill in the Sanctuary of Poseidon at Kalaureia, Poros', in *Bones, behaviour and belief. The zooarchaeological evidence as a source for ritual practice in ancient Greece and beyond* (ActaAth-4°, 55), eds. G. Ekroth & J. Wallensten, Stockholm, 149–166. https://doi.org/10.30549/actaath-4-55-12

Naiden, F.S. 2013. *Smoke signals for the gods. Ancient Greek sacrifice from the Archaic through Roman periods*, Oxford. https://doi.org/10.1093/acprof:oso/9780199916405.001.0001

Parker, R.C.T. 2010. 'Eating unsacrificed meat', in *Paysage et religion en Grèce antique. Mélanges offerts à Madeleine Jost* (Travaux de la Maison René-Ginouvès, 10), eds. P. Carlier & C. Lerouge-Cohen, Paris, 137–145.

Peters, J. 1993. 'Archaic Milet. Daily life and religious customs from an archaeological perspective', in *Archaeozoology of the Near East. Proceedings of the First International Symposium on the Archaeozoology of Southwestern Asia and Adjacent Areas*, eds. H. Buitenhuis & A.T. Clason, Leiden, 88–91.

Peters, J. & A. von den Driesch 1992. 'Siedlungsabfall versus Opferreste: Essgewohnheiten im archaischen Milet', *IstMitt* 42, 117–125.

Prost, F. 1997. *Le sanctuaire d'Anios à Délos. Contribution à l'histoire politique et religieuse des Cyclades*, Dissertation, Université Paris-Sorbonne, Paris IV.

Prummel, W. 2003. 'Animal husbandry and mollusk gathering in Hellenistic New Halos (Thessaly)', in *Housing in New Halos, a Hellenistic town in Thessaly, Greece*, eds. H.R. Reinders & W. Prummel, Lisse, 175–223.

Reitz, E.J. & E.S. Wing 2008. *Zooarchaeology*, Cambridge. https://doi.org/10.1017/cbo9780511841354

Rosivach, V.J. 1994. *The system of public sacrifice in fourth-century Athens* (American Classical Studies, 34), Atlanta.

Ruscillo, D. 1993. 'Faunal remains from the Acropolis site, Mytilene', *EchCl* 37, 201–210.

Ruscillo, D. 1997. 'The secret rites of Lesbos: A faunal reconstruction (abstract)', *AJA* 101:2, 362. https://doi.org/10.2307/506513

Ruscillo, D. 2013. '*Thesmophoriazousai*. Mytilenean women and their secret rites', in *Bones, behaviour and belief. The zooarchaeological evidence as a source for ritual practice in ancient Greece and beyond* (ActaAth-4°, 55), eds. G. Ekroth & J. Wallensten, Stockholm, 181–196. https://doi.org/10.30549/actaath-4-55-14

Scullion, S. 2009. 'Sacrificial norms, Greek and Semitic: Holocausts and hides in a sacred law of Aixone', in *La norme en matière religeuse en Grèce ancienne* (Kernos supplément, 21), ed. P. Brulé, Liège, 153–169. https://doi.org/10.4000/books.pulg.563

Scullion, S. 2013. 'Bones in Greek sanctuaries: Answers and questions', in *Bones, behaviour and belief. The zooarchaeological evidence as a source for ritual practice in ancient Greece and beyond* (ActaAth-4°, 55), eds. G. Ekroth & J. Wallensten, Stockholm, 243–255. https://doi.org/10.30549/actaath-4-55-18

Sloan, R.E. & M.A. Duncan 1978. 'Zooarchaeology of Nichoria', in *Excavations at Nichoria in Southwest Greece*, vol. 1. *Site, environs, and techniques*, eds. G. Rapp & S.E. Aschenbrenner, Minneapolis, 60–77.

Stanzel, M. 1991. *Die Tierreste aus dem Artemis/Apollon Heiligtum bei Kalapodi in Boötien/Griechenland*, Dissertation, University of Munich.

Studer, J. & I. Chenal-Velarde 2003. 'La part des dieux et celle des hommes : offrandes d'animaux et restes culinaires dans l'aire sacrificelle nord', in *Eretria* XIV. *L'Aire sacrificielle au nord du Sanctuaire d'Apollon Daphnéphoros*, ed. S. Huber, Gollion, 175–185.

Theodoropoulou, T. 2013. 'The sea in the temple? Shells, fish and corals from the sanctuary of the ancient town of Kythnos and other marine stories of cult', in *Bones, behaviour and belief. The zooarchaeological evidence as a source for ritual practice in ancient Greece and beyond* (ActaAth-4°, 55), eds. G. Ekroth & J. Wallensten, Stockholm, 197–222. https://doi.org/10.30549/actaath-4-55-15

Thomson, R. & Q. Mould, eds. 2011. *Leather tanneries. The archaeological evidence*, London.

Trantalidou, K. 2007. 'The contribution of the study of animal bones in the social understanding of early Iron Age Oropos', in *Oropos and Euboea in the early Iron Age. Acts of an international round table, University of Thessaly, June 18–20, 2004*, ed. A. Mazarakis Ainian, Volos, 379–425.

Trantalidou, K. 2013. 'Dans l'ombre du rite : vestiges d'animaux et pratiques sacrificielles en Grèce antique', in *Bones, behaviour and belief. The zooarchaeological evidence as a source for ritual practice in ancient Greece and beyond* (ActaAth-4°, 55), eds. G. Ekroth & J. Wallensten, Stockholm, 61–86. https://doi.org/10.30549/actaath-4-55-07

van Straten, F.T. 1995. *Hierà kalá. Images of animal sacrifice in Archaic and Classical Greece* (Religions in the Graeco-Roman World, 127), Leiden.

Vila, E. 1994. 'Les vestiges osseux animaux de l'habitat hellénistique d'Eleutherna', in *Ελεύθερνα* vol. 2:2: *Ενα ελληνιστικό σπίτι, "Σπίτι Α", στη θέση Νησί*, eds. T. Kalpaksis, A. Furtwängler & A. Schnapp, Rethymno, 193–201.

Vila, E. 2000. 'Bone remains from sacrificial places: The Temples of Athena Alea at Tegea and of Asea on Agios Elias (the Peleponnese, Greece)', in *Archaeozoology of the Near East IV-B, Proceedings of the 4th International Symposium on the Archaeozoology of Southwestern Asia and adjacent areas*, eds. M. Mashkour, A.M. Choyke, H. Buitenhuis & F. Poplin, Groningen, 197–203.

Vila, E. 2014. 'Étude archéozoologique des vestiges osseux de la fouille dans le temple', in *Tegea* I. *Investigations in the Temple of Athena Alea 1991–94* (Papers and monographs from the Norwegian Institute at Athens, 3), eds. G.C. Nordquist, M.E. Voyatzis & E. Østby, Athens, 545–562.

von den Driesch, A. & J. Boessneck 1990. 'Die Tierreste von der mykenischen Burg Tiryns bei Nafplion/Peloponnes', in *Tiryns. Forschungen und Berichte* XI, eds. H.-J. Weisshaar, I. Weber-Hiden, A. von den Driesche, J. Boessneck, A. Rieger & W. Böser, Mainz, 87–164.