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To cite this version:

Angelos Gkotsinas. An investigation of Iron Age to Classical Animal Bone Deposits in Northern Greece (Macedonia) : Argilos, Karabournaki and Kastri Thassos. Archaeology and Prehistory. Université Paul Valéry - Montpellier III; Université de Montréal (1978-..), 2021. English. NNT : 2021MON30072 . tel-04558504

HAL Id: tel-04558504
https://theses.hal.science/tel-04558504

Submitted on 25 Apr 2024

THÈSE
Pour obtenir le grade de
Docteur

Délivré par **Université Paul-Valéry Montpellier 3**

Préparée au sein de l'école doctorale 60 : Territoires, Temps, Sociétés et Développement

Et de l'unité de recherche UMR5140 : Archéologie des Sociétés Méditerranéennes

Spécialité : **Préhistoire, Protohistoire, Paléoenvironnements méditerranéens et africains**

Présentée par **Angelos Gkotsinas**

An Investigation of Iron Age to Classical Animal Bone Deposits in Northern Greece (Macedonia): Argilos, Karabournaki and Kastri Thassos

Soutenue le 13 décembre 2021 devant le jury composé de

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Thèse de doctorat effectuée en cotutelle

au

Université Paul-Valéry Montpellier 3

École doctorale 60 : Territoires, Temps, Sociétés et Développement

UMR5140 : Archéologie des Sociétés Méditerranéennes

et

Université de Montréal

Département d'Histoire, Faculté des Arts et des Sciences

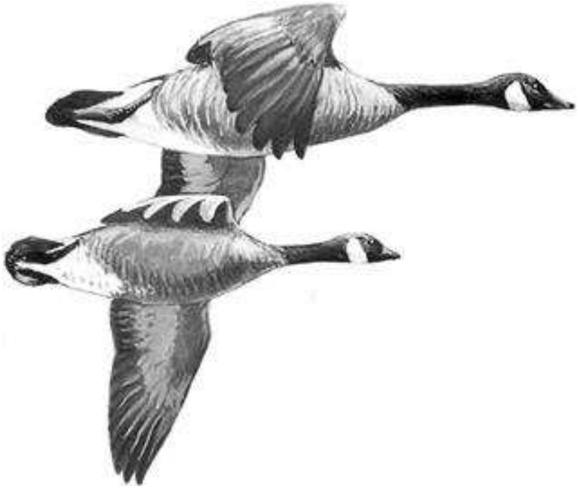
Thèse présentée
à l'Université Paul-Valéry Montpellier 3 en vue de l'obtention du grade de Philosophiæ Doctor (Ph.D.) en Archéologie
Spécialité : Préhistoire, Protohistoire, Paléoenvironnements méditerranéens et africains

et à

la Faculté des études supérieures de l'Université de Montréal en vue de l'obtention du grade de Philosophiæ Doctor (Ph.D.) en Histoire

Décembre 2021

... to Huntingville, Quebec



Résumé

Au cours des dernières décennies, la recherche zooarchéologique en Macédoine, dans le nord de la Grèce, s’est principalement concentrée sur des matériaux provenant de sites du Néolithique et de l’Âge du Bronze. Ainsi, les données disponibles rendent notre compréhension de l’élevage au premier âge du Fer et aux périodes archaïque et classique dans cette région assez fragmentaire. Cette recherche doctorale vise à combler ces lacunes, en étudiant — pour la première fois dans son ensemble — la question de l’élevage, un domaine crucial de l’économie primaire, en Macédoine du premier âge du Fer à l’époque classique.

L’étude est basée sur des ensembles de données primaires de restes d’ossements animaux récupérés dans trois établissements bien fouillés, deux sur le continent (Argilos, Karabournaki) et un sur l’île de Thassos (Kastri). Les données analysées permettent d’explorer l’exploitation animale dans ces trois établissements, en étudiant la gestion des animaux, les techniques de cuisson de la viande et les stratégies de consommation et de rejet, après avoir reconstitué tous les modes de dépôt potentiels ayant abouti à la formation des assemblages. De plus, les données sont comparées aux données publiées pour la Grèce du Nord afin d’éclairer les particularités de chaque assemblage par rapport à la gestion de la faune domestique et sauvage. Les résultats permettent d'alimenter les discussions animées qu'ont déclenché de récentes analyses paléoenvironnementales et isotopiques sur la question de savoir dans quelle mesure l’environnement a affecté les stratégies d’élevage et d’alimentation des animaux dans cette région.

Les stratégies de gestion des principaux animaux domestiques en Macédoine mises en évidence par ce travail suggèrent un profil plutôt hétérogène entre les établissements, très probablement en raison des différentes priorités économiques, conditions environnementales régionales et contraintes géomorphologiques. Il s'avère cependant que les besoins nutritionnels et en matières premières ont été complétés partout par l’exploitation de la faune sauvage, comprenant une variété d’espèces terrestres et marines. Des pratiques similaires d’élimination des carcasses et des déchets sont également attestées dans tous les sites, révélant des aspects de l’organisation intracommunautaire. De plus, durant l’ère archaïque et classique, les pratiques d’enterrement des animaux suggèrent l’existence de conceptions communes parmi les sociétés locales, sauf en matière de sacrifice rituelles, où il semble y avoir une différenciation marquée entre les divers groupes de population.

Pour terminer, les résultats obtenus pour la Macédoine au cours des sept premiers siècles du premier millénaire avant J.-C. sont discutés dans le cadre plus vaste du bassin égéen. Ils contribuent ainsi à la discussion des problématiques actuelles, soit générales comme l'exploitation des ressources naturelles, la gestion des animaux, la mobilité de l'élevage, le degré d'intégration entre élevage et agriculture, soit spécifiques, comme la question du sacrifice olympique.

Mots-clés : zooarchéologie, élevage, économie pastorale, gestion des animaux, isotopes, transhumance, Argilos, Karabournaki, Kastri Thassos, Macédoine

Abstract

Over the past decades, the zooarchaeological research in the Macedonian region of Northern Greece, has mostly focused on materials from Neolithic and Bronze Age sites. Thus, the available data render our understanding of animal husbandry in the Early Iron Age, Archaic and Classical periods in this area rather fragmentary. This doctoral research aims to address these gaps, investigating – for the first time as a whole – the issue of animal husbandry, a crucial domain of the primary economy, in the region of Macedonia from the Early Iron Age to the Classical era. The study is based on primary datasets of animal bones remains recovered from three well-excavated settlements, two in the mainland (Argilos, Karabournaki) and one in the island of Thassos (Kastri). The analysed data provide an opportunity to explore the animal exploitation in these three settlements, investigating animal management; cooking techniques; consumption and discard strategies, having first disentangled all potential depositional pathways to the formation of the sample assemblage. Additionally, the data are compared to the available published data from the Macedonian region in order to enlighten the peculiarities of each assemblage in relation to the management of domestic and wild fauna. Moreover, relevant paleoenvironmental and isotopic analyses have triggered a vivid discussion regarding the extent to which the environment affected the animal herding and feeding strategies in this area.

The management strategies of the main domestics in the area under study, suggest a rather heterogenous profile between the settlements, most probably due to the economic priorities, the regional environmental conditions, and the geomorphological restrictions. The nutritional and the raw material needs were complemented by the exploitation of the wild fauna, including a variety of both terrestrial and marine species. Similar carcass and discarding practices were observed within all settlements, revealing aspects of intra-communal organization. Moreover, during the Archaic and Classical era, common practices in animal burials suggest the existence of somehow common perceptions among the local societies, however, in terms of ritual sacrifices, seemed to be a distinct differentiation between the population groups.

The results are discussed in the frame of the Aegean basin, contributing to the ongoing discussion regarding animal management, the mobility of livestock husbandry, the degree of integration between herding and arable farming, the Olympic sacrifice, and the exploitation of natural resources during the first seven centuries of the first millennium BC.

Keywords: zooarchaeology, animal husbandry, pastoral economy, animal management, isotopes, transhumance, Argilos, Karabournaki, Kastri Thassos, Macedonia

Résumé français détaillé

Une étude des dépôts d'ossements animaux de l'âge du Fer à l'époque classique en Grèce du Nord (Macédoine) : Argilos, Karabournaki et Kastri Thassos

La présente étude est issue d'un programme de recherche de l'Archéologie des Milieux et des Ressources du Laboratoire Archéologie des Sociétés Méditerranéennes - UMR5140. Il s'est déroulé en Grèce, en France et au Canada, respectivment dans les musées archéologiques d'Amphipolis et de Thassos, à l'Université Paul-Valéry Montpellier 3 et à l'Université de Montréal.

Introduction

La côte nord de la mer Égée et la région historique de l'ancienne Macédoine, dans le nord de la Grèce, ont toujours été des zones à grand potentiel. Géographiquement, cette région est située dans la partie méridionale de la péninsule des Balkans, formant un passage terrestre et maritime, reliant l'Anatolie et le Proche-Orient aux Balkans et à l'Europe centrale. Elle a été au carrefour de la diffusion des cultures depuis la préhistoire. Au cours de l'histoire, elle est devenue une « pomme de discorde » d'une part entre les tribus autochtones, d'autre part entre les locaux et les étrangers, en raison de ses terres fertiles et de ses abondantes ressources naturelles.

Du premier âge du Fer à l'ère classique (1100/1050-323 av. J.-C.), la région géographique de la Macédoine actuelle, dans le nord de la Grèce, a connu des changements et des développements importants dans ses structures sociales, économiques et politiques. La région a été habitée par diverses populations au cours de l'histoire. Les sources antiques définissent certains d'entre elles comme des Thraces et d'autres comme des Paeoniens, tandis que les Macédoniens étaient également présents, de même que les Grecs venus de plus loin au sud. Certains de ces groupes, comme les Visaltes et les Edoniens, étaient parfois organisés en tribus et en royaumes dont la répartition géographique était mouvante. Certains des groupes susmentionnés s'étaient installés en Macédoine depuis la préhistoire tandis que d'autres sont arrivés plus tard, à la suite de déplacements et de mouvements de population plus importants qui ont eu lieu dans la région au cours du 1er millénaire avant notre ère. L'un des événements les plus importants qui ont déterminé ces mouvements a été la deuxième colonisation grecque (8e-5e siècle av. J.-C.) dans le cadre de laquelle des colonies ont été fondées sur les îles (par exemple Thassos) et le long des côtes de Macédoine et de Thrace (par exemple à Argilos). L'influence des métropoles de la Grèce du Sud sur les colonies a contribué à la formation d'entités tribales, de chefferies et de royaumes dans la région.

Le commerce s'est également développé, comme l'indiquent les nombreuses importations de céramique en provenance de toute la région égéenne et de la Méditerranée orientale. L'organisation intra- et intercommunale des sites a également changé. Les espaces publics ont été intégrés dans le tissu urbain, bien que les espaces de nature publique ou industrielle aient été clairement séparés des autres. Au niveau intercommunal, des groupes des groupes de sites se sont formés, partageant des identités communes et un même concept « d'appartenance ». Cette situation a commencé à évoluer au 6e siècle avant J.-C., lorsque de nouvelles données politiques, économiques, sociales et culturelles ont conduit à l'incorporation de toute la région étudiée au royaume de Macédoine. Tous les changements susmentionnés ont eu lieu dans une zone géographique où le paysage naturel était également en constante évolution, comme le montrent les données paléo-environnementales disponibles. Les changements climatiques qui se sont produits à la fin de l'âge du Bronze et au début de l'âge du Fer, ainsi que l'activité humaine à travers la culture, l'élevage et l'exploitation forestière, ont modifié le paysage, principalement à basse et moyenne altitude, où se trouvaient les établissements humains, affectant la végétation et les écosystèmes de la faune sauvage.

L'examen des changements cruciaux qui se sont produits au cours du premier millénaire av. J.-C. a fait appel à de nombreuses méthodes et approches différentes, dont la zooarchéologie. À ce jour, la recherche zooarchéologique en Macédoine s'est principalement concentrée sur les matériaux provenant de sites du Néolithique et de l'âge du Bronze. Par conséquent, la compréhension du premier âge du Fer et des périodes archaïque et classique en Macédoine reste plutôt fragmentaire. La publication de Kastanas et l'étude préliminaire d'Assiros sont les seules sources d'information disponibles pour les sites d'habitat, se concentrant sur un cadre géographique spécifique.

Cependant, des publications et des rapports zooarchéologiques concernant le premier âge du Fer et les périodes archaïque et classique sont disponibles pour les cimetières et les sanctuaires de toute la Macédoine, notamment ceux d'Akanthos, de la zone industrielle de Drama, d'Ivani Prionia, de Kentria Thassos, de Larnaki Thassos, de Mikro Livadi Mavropigi, de Nea Irakleitsa, d'Oisyme et de Tsiganadika Thassos. Le fait que la collecte d'ossements soit souvent limitée ou insuffisante lors des fouilles de sites d'habitat est l'une des principales raisons de l'absence de rapports zooarchéologiques pour le premier millénaire avant J.-C., à cause du manque d'intérêt, jusqu'à récemment, des fouilleurs et des spécialistes pour cet aspect des données archéologiques.

Cette recherche doctorale vise à étudier — pour la première fois dans son ensemble — la question de l'élevage et la relation entre les hommes et les animaux à travers l'exploitation et la consommation de ces derniers en Macédoine, du premier âge du Fer à l'époque classique. De plus, l'étude tente d'explorer certaines questions fondamentales entourant le rôle du bétail au sein des établissements fondés par les Grecs du Sud, appelés *poleis*, et ceux fondés par les populations locales, afin d'identifier la structure de leurs économies politiques et de détecter d'éventuelles différences. Pour ce faire, les dépôts d'os d'animaux de trois colonies de la région de Macédoine, Argilos, Karabournaki et Kastri Thassos (ci-après « Kastri ») sont étudiés. Le premier est une *polis* grecque située sur le continent, et les deux autres sont des établissements locaux situés respectivement sur le continent et sur l'île de Thassos. Leur étude explore les aspects de l'économie liés à la gestion des animaux domestiques et ses effets sur l'organisation sociopolitique de ces établissements. C'est ainsi que sont explorés les choix alimentaires à travers le temps, les techniques de cuisson, les pratiques de consommation et les stratégies de rejet, les pratiques agricoles, l'exploitation des ressources fauniques naturelles, la mobilité de l'élevage et le degré d'intégration entre l'élevage et l'agriculture. Les modes d'élevage seront également étudiés en relation avec les unités domestiques, les marchés et les sanctuaires. Finalement, les données de ces trois sites sont combinées avec celles d'études déjà publiées de contextes domestiques, de cimetières et de sanctuaires afin de développer une synthèse de l'exploitation des animaux en Macédoine, du premier âge du Fer à l'ère classique, qui pourra servir de base à de futures recherches dans la région.

Les sites

Argilos

La ville antique d'Argilos est l'une des quatre colonies fondées par des immigrants de l'île d'Andros au milieu du 7e siècle av. J.-C. Elle était construite sur le littoral nord du golfe Strymon, à l'ouest du fleuve Strymon. Les fouilles systématiques ont commencé en 1992, organisées par le Service archéologique grec et l'Institut archéologique canadien, d'abords par l'Université de Concordia puis par l'Université de Montréal, respectivement sous la direction du Dr Z. Bonias et du Prof. J. Perreault, et elles sont toujours en cours. À ce jour, les fouilles ont révélé des vestiges architecturaux et du matériel s'étendant du 7e à la fin du 3e siècle av. J.-C. L'histoire de la ville, d'après les vestiges archéologiques et les données historiques, peut être divisée en cinq grandes phases d'occupation. La première phase couvre la période allant de la fondation de la ville, au milieu du 7e siècle av. J.-C., jusqu'au milieu du 6e siècle av. J.-C. La deuxième phase s'étend du milieu du 6e siècle avant. J.-C. au premier quart du 5e siècle av. J.-C., la troisième du premier au quatrième quart du 5e siècle av. J.-C. et la quatrième du quatrième quart du 5e siècle av. J.-C. au milieu du 4e siècle av. J.-C. Enfin, la cinquième et dernière phase couvre la période allant du milieu du 4e siècle av. J.-C. jusqu'à la fin du 3e siècle av. J.-C., période à laquelle la ville est totalement abandonnée.

La ville antique occupait deux collines côtières, sur un site connu aujourd'hui sous le nom de « Palaikastro ». Les parties fouillées ont concerné quatre secteurs. Le secteur de l'Acropole occupe le sommet de la colline, le secteur sud-est se trouve sur le versant sud/sud-est, le secteur de Koutloudis un peu plus au sud et enfin le secteur de la route nationale entre l'ancienne route nationale et la côte. La ville devait être fortifiée et les bâtiments publics et privés se trouvaient *intra muros* et occupaient apparemment les pentes des deux collines, du sommet jusqu'à la côte. Sur l'Acropole, les fouilles ont révélé de nombreuses traces architecturales de phases et d'usages différents. Les structures les plus anciennes datent du milieu du 6e siècle avant J.-C. et les plus récentes de la fin du 3e siècle av. J.-C. Parmi les différents bâtiments découverts, le bâtiment A est le plus grand, situé au centre du secteur. Il s'agissait d'un espace de travail artisanal entièrement équipé qui produisait de l'huile d'olive, daté de la cinquième et dernière phase de la ville. Dans le secteur sud-est, sept bâtiments résidentiels ont été révélés, développés de part et d'autre d'une grande route pavée (Route 1). Dans le secteur de Koutloudis, quatre bâtiments ont été découverts jusqu’à présent, à savoir les bâtiments H, L, Q et P, délimités par un système orthoganal de routes qui semblent suivre la grille hippodamienne, formant des parcelles rectangulaires. Enfin, dans le secteur de la route nationale, une partie de la muraille de la ville, une décharge et les vestiges de deux routes parallèles menant du port à la ville ont été mis au jour, ainsi que des éléments de structures d’usage inconnu. Ils ont été utilisés du 6e au milieu du 4e siècle avant J.-C., tandis que des strates plus anciennes ont livré de la poterie domestique locale ainsi que des objets importés de la mer Égée orientale et des Cyclades datant de la seconde moitié du 7e siècle avant J.-C., ce qui en fait les plus anciennes découvertes datables de la ville.

Karabournaki

Le village antique de Karabournaki est situé sur le promontoire du même nom (Mikro Karabournou), sur le golfe thermaïque. De nombreux chercheurs identifient le site avec l’ancienne Therme, qui a donné son nom au golfe, comme le rapportent plusieurs auteurs antiques. Les fouilles systématiques ont commencé en 1994 par la 16^{e} Éphorie des Antiquités préhistoriques et classiques en collaboration avec l’Université Aristote de Thessalonique, sous la direction des Professeurs M. Tiverios et E. Manakidou et du Dr D. Tsiafaki. L’Éphorie a effectué des fouilles jusqu’en 1996 sur la zone plate (trapèze) au nord de la colline (*toumba*) et dans le cimetière trouvé à l’est, près de la *toumba*, tandis que l’Université Aristote a commencé au sommet de la *toumba* des fouilles qui sont toujours en cours.

L’établissement n’était pas fortifié, et seule une partie de celui-ci a été révélée au sommet de la *toumba*. Les constructions les plus anciennes sont des « *argelae* » semi-souterraines, en forme de ruche, datées de la fin du 8e et du début du 7e siècle avant J.-C. Leurs parties souterraines étaient creusées dans le sol naturel et les parties hautes étaient construites en brique crue. Leur utilisation initiale n’a pas encore été définie avec certitude mais elle pourrait avoir été liée à des activités artisanales. Plus tard, elles ont été utilisées comme des dépotoirs pour des objets hors d'usage (par exemple, poterie et poids de métier à tisser) et des restes organiques (par exemple os et coquilles).

Dans la zone résidentielle du site sont conservées des parties de maisons qui, pour le moment, peuvent être regroupées en deux phases, la première datant du milieu du 6e siècle av. J.-C. Des foyers en argile ont été découverts à l’intérieur de certaines d’entre elles, peut-être associés à des activités de production alimentaire, tandis que d’autres espaces internes étaient utilisés comme pièces de stockage où ont été trouvés de grands récipients de stockage tels que des pithoi et des amphores. En plus des structures résidentielles, des ateliers de potier et de métallurgie ont été détectés. Un grand nombre de fosses circulaires ont également été fouillées sur le site. Elles sont considérées comme des fosses à ordures, car elles contenaient de grandes quantités de poteries brisées, des restes de faune et d'autres objets. Leur datation correspond à celle des maisons rectangulaires (milieu du 6e - début du 5e siècle av. J.-C.).

Kastri

Le village de Kastri est situé sur le sommet plat de la colline qui porte son nom, près de l’actuel village de Theologos, dans le sud de l’intérieur de l’île de Thassos. Il n’existe aucune information historique concernant la région de Theologos au cours du premier âge du Fer, et les mentions dans les sources littéraires anciennes sur les habitants de l’île avant l’arrivée des premiers colons grecs, en provenance de Paros au 7e siècle av. J.-C., sont très peu nombreuses. Le site a été fouillé pour la première fois en 1971-1980 par le Service archéologique grec sous la direction du Dr Ch. Koukouli-Chrysanthaki. Les fouilles ont mis en évidence les vestiges architecturaux de deux phases d’habitation. La première date du Néolithique tardif I et II, tandis que la seconde s’étend de la fin de l’âge du Bronze au début de l’âge du Fer, période à laquelle le village a été définitivement abandonné. Les structures rectangulaires en pierre découvertes sur le site appartiennent à la dernière phase d’habitation. De ces structures, un seul bâtiment, la Maison I, a été identifié. Un mur en pierre a également été découvert sur les côtés nord et ouest de la colline. Il a probablement fonctionné comme un mur de soutènement, bien qu’il soit possible qu’il ait également marqué la limite du village.

L'étude zooarchéologique

L’étude zooarchéologique comprend l’enregistrement de plusieurs aspects des restes fauniques, à savoir l’identification des parties du corps, l’espèce, l’âge et le sexe, la pathologie, la biométrie, la taphonomie (traces de rongeurs, de digestion, de combustion ou de facteurs environnementaux), la boucherie et le type de fragmentation. Ces données sont importantes pour pouvoir traiter les axes de recherche de cette étude en relation avec la gestion des animaux productifs (espèce, âge, sexe, pathologie), les techniques de cuisson et les pratiques de consommation (boucherie, exposition au feu), les stratégies de rejet (facteurs post-dépositionnels) et l'exploitation des ressources fauniques naturelles (espèces sauvages). L'enregistrement a été effectué sur la base de données SYSLAT, et chaque aspect a été étudié sur la base des publications et atlas pertinents, y compris une collection de référence d'os d'animaux pour l'identification des espèces et des parties du corps, tandis que les restes présentant des caractéristiques taphonomiques intéressantes ont été documentés numériquement. Pour finir, les données ont été quantifiées en utilisant le NISP (nombre de spécimens identifiés) et le MinAU (unités anatomiques minimales). Le premier a été utilisé dans l'analyse des variables taphonomiques telles que le bris, la boucherie, les traces de rongeurs et de combustion, et le second pour les variables de représentation anatomique, l'abondance taxonomique, le sexe et les catégories d'âge.

L'analyse des données zooarchéologiques des trois sites commence par l'étude des facteurs qui ont abouti à la constitution de l'assemblage archéologique (méthodes de, de fouille, de prélèvement et de stockage), puis de ceux qui ont formé l'assemblage faunique : environnement et dégâts dus aux carnivores, traces de boucherie et de combustion pour l'assemblage des d'animaux morts et enfin variables d'âge et de sexe liées à la gestion des animaux vivants.

Argilos

La recherche zooarchéologique à Argilos s'est concentrée sur l'assemblage faunistique des secteurs sud-est, de Koutloudis et de la route nationale dans les quatre premières phases d'habitation, couvrant la période de l'âge du Fer à l'ère classique (7e - 4e siècle av. J.-C.). L'assemblage provient de 1,045 unités stratigraphiques et comprend 18,549 spécimens, dont 12,748 NISP (4,088 MinAU) ont été identifiés au niveau de l'espèce, du genre, de la sous-famille, de la classe et de la catégorie de taille des mammifères. L'assemblage des échantillons a été affecté par des facteurs taphonomiques pré- et post-dépositionnels, à savoir la méthode de prélèvement et de fouille, l'activité des carnivores, les facteurs environnementaux et le traitement des carcasses.

L'analyse zooarchéologique a montré que l'assemblage était composé de faune à la fois domestique et sauvage. La première comprend sept espèces, à savoir le mouton, la chèvre, le bœuf, le porc, le chien, l'âne et le cheval, et certains spécimens d'oiseaux non déterminés correspondent probablement au poulet. Les moutons et les chèvres prédominent dans toutes les phases, les moutons étant plus nombreux que les chèvres. Les moutons semblent avoir été exploités principalement pour la laine et les chèvres pour la viande, sans qu’il y ait de preuve d’une exploitation laitière intensive. Ces modes d’exploitation semblent assez constants d'une phase à l'autre, bien que la production de laine ait pu être plus intensive pendant la période classique. Le bœuf, sauf pendant la phase IV, est la troisième espèce la plus abondante et était principalement exploité pour la production de viande et la traction. Ce dernier point est confirmé par les traces pathologiques sur une première phalange de bovin. Le dernier des animaux productifs, le porc, est la deuxième espèce la plus abondante dans la plupart des périodes, sauf pendant la phase III, où il est troisième, derrière les bovins. Le porc était élevé principalement pour la viande, bien que la graisse ait également pu être une priorité.

Les pratiques de traitement des dépouilles après abattage révèlent des modes de consommation communs aux quatre espèces productives et à toutes les phases d’habitation. Les similitudes suggèrent que les techniques de boucherie et de cuisson étaient probablement similaires pour les dépouilles de taille moyenne (par exemple, les moutons) et de grande taille (par exemple, les bœufs). En ce qui concerne les techniques de cuisson, le rôtissage sur un feu ouvert n’était qu'occasionnel ; par conséquent, la plupart des viandes devaient être bouillies. Dans le premier cas, la bête était parfois rôtie en morceaux (bovins), parfois entière (porcs), éventuellement à la broche. Outre la viande, la moelle était systématiquement extraite dans les quatre phases, en particulier dans le cas des bovins.

En ce qui concerne les autres animaux domestiques, le chien est systématiquement présent dans toutes les phases, comme animal de troupeau et de garde, comme compagnon de chasse ou comme animal de compagnie. La présence du chien est documentée non seulement par des restes osseux de cette espèce, mais aussi par des os portant des marques de morsure et par certains spécimens digérés. Les os de chien ont été trouvés mêlés à ceux des animaux consommés, et certains d’entre eux portent des traces de découpe et de combustion, suggérant la cuisson et la consommation. Les restes de chien sont peu nombreux, ce qui indique une consommation à petite échelle et occasionnelle, mais on ne sait pas si elle se produisait dans le cadre d’événements particuliers, ou peut-être en réponse à une pénurie de nourriture.

Les équidés sont peu représentés dans l'assemblage. L’âne est présent dans toutes les phases, tandis que le cheval n’apparaît qu'à la période classique. Il est possible que les ânes aient été principalement utilisés pour des tâches ingrates (par exemple le transport et les travaux agricoles) et les chevaux peut-être pour la chasse, mais il n’y a pas de preuves zooarchéologiques à Argilos pour appuyer cette hypothèse. Comme pour le chien, des os d’équidés ont été trouvés parmi ceux des espèces de consommation courante. Certains portent des marques de découpe, et l’âne porte également des traces de cuisson, qui indiquent toutes deux une consommation. La chair des équidés était donc apparemment considérée comme comestible, mais leur faible représentation dans l’assemblage suggère une consommation occasionnelle.

La faune sauvage comprend sept espèces de mammifères terrestres, à savoir le cerf, le chevreuil, le daim, le lièvre, le sanglier, le loup et le renard roux, et une espèce de reptile : la tortue. La liste a été complétée par la présence de la faune aquatique, qui comprend à la fois des coquillages et des poissons d’eau salée et d’eau douce. La variété des espèces de l’assemblage indique que les habitants d’Argilos avaient accès aux ressources naturelles environnantes. Les mammifères sauvages terrestres sont représentés principalement par le cerf, le lièvre et le sanglier. Le cerf rouge était la principale espèce de gibier présente dans toutes les phases et semble avoir été chassé de manière plus intensive à l’époque classique, où la présence du cheval peut être associée à une augmentation de la chasse. Après la chasse, la dépouille semble avoir été amenée intacte à l’intérieur du village, où elle était dépecée et cuisinée. La faible proportion d’espèces chassées suggère que la viande des quatre principales espèces domestiques était relativement abondante. Le renard roux et le loup, bien que ce dernier ait apparemment été consommé, peuvent avoir été tués pour leur fourrure ou pour protéger le bétail, tandis que la chasse aux grands animaux, tels que le cerf et le sanglier, peut avoir été entreprise pour afficher son statut plutôt que pour obtenir un complément de ressources alimentaires.

La récolte des bois de cerfs abattus était un autre aspect de l’exploitation des ressources naturelles. A Argilos, les bois de cervidés étaient utilisés comme matière première pour l’artisanat. Un atelier possible a été révélé dans la pièce L8 du Building L dans le secteur de Koutloudis, qui aurait été utilisé pendant la période classique tardive. Outre les bois de cerf, les os et les dents d’espèces domestiques et sauvages étaient utilisés pour la fabrication d’objets, mais à petite échelle.

Les restes d’os d’animaux trouvés dans les trois secteurs de fouille constituaient une partie des déchets alimentaires de la ville. Ils ont été trouvés à l’intérieur de la ville, tant à l'intérieur qu'à l'extérieur des bâtiments, dans toutes les phases d’occupation. Les ossements trouvés à l’intérieur des bâtiments ont probablement été inclus dans les remblais des sols réalisés et réparés au cours des différentes périodes d’utilisation des pièces. Il s’agit principalement de spécimens de petite taille et fragmentés, bien que certains portent également des marques de morsure et d’altération, indications de leur environnement de dépôt initial. Cependant, certaines pièces ont pu être abandonnées temporairement et transformées en dépotoirs.

Outre les pièces abandonnées, les routes et les canaux à ciel ouvert ont également produit des déchets osseux. Les spécimens provenant des routes étaient pour la plupart fragmentés, ayant été exposés aux morsures de chiens, aux piétinements humains et aux aléas climatiques. Les canaux à ciel ouvert, l’un dans le secteur SE et l’autre dans le secteur Koutloudis, ont reçu une plus grande quantité de déchets et ont probablement fonctionné comme des dépotoirs permanents. Cependant, de grandes quantités de déchets alimentaires de la période archaïque ont également été jetées dans une décharge découverte dans le secteur de la route nationale. Comme cette décharge ne concerne que les deux premières phases, on ne sait pas si elle faisait partie des principaux points de rejet des déchets alimentaires d’Argilos avant d'être abandonnée. Il est possible que certaines décharges aient reçu des déchets provenant d'activités domestiques et d’autres les reliefs de repas collectifs jetés dans le cadre d’événements publics de grande envergure.

En conclusion, il apparaît qu'à Argilos la gestion des animaux domestiques, l’exploitation des ressources naturelles, les pratiques culinaires et le comportement en matière de rejets sont restées largement stables au cours du temps.

Karabournaki

Les dépôts d’os d’animaux étudiés à Karabournaki provenaient de deux fosses et de 16 structures semi-souterraines en forme de ruches découvertes dans le site et couvrant la période allant du premier âge du Fer à l’époque classique (8e - 3e siècle av. J.-C.). L’assemblage complet comprenait 1,614 NISP (592 MinAU) provenant de 89 unités stratigraphiques. L’assemblage mortuaire était composé à la fois de faune domestique et d’une petite gamme de faune sauvage.

La première comprend les quatre principales espèces productives, à savoir les ovins, les caprins, les bovins et les porcins. Les restes de caprins dominent dans presque tous les contextes, les moutons étant plus nombreux que les chèvres. Ils étaient exploités principalement pour leur viande et leur laine (respectivement, leur poil), sans aucune preuve d'une exploitation laitière intensive. Les bovins étaient la deuxième espèce la plus abondante dans la plupart des contextes. Le profil de l'âge à la mort suggère une gestion orientée vers la viande, éventuellement combinée à la traction. Le porc était élevé principalement pour sa viande, avec une préférence dans ce cas pour les porcelets.

La boucherie comprenait le dépouillement, le démembrement et le filetage sur place pour les principales espèces domestiques. Le rôtissage est la seule pratique culinaire documentée et était utilisé pour les quatre espèces domestiques productives. Dans le cas des caprins et des bovins, toutes les unités anatomiques étaient rôties, ce qui suggère que ces animaux étaient rôtis entiers. En plus de la consommation de la chair, les os étaient exploités en les découpant pour en extraire la moelle. Cette pratique semble avoir été plus étendue pour les bovins que pour les caprins et les porcins. En outre, certains os, à savoir l'astragale, le métapode et le calcanéum, principalement chez les caprins, mais aussi chez les bovins, étaient utilisés comme matière première pour la fabrication d'objets.

Les données sur les autres animaux domestiques, à savoir le chien et l'âne, sont rares, et il n'est donc pas possible de tirer des conclusions sûres quant à leur utilisation. Cependant, il semble que ces deux espèces ont été consommées, bien que leur faible représentation suggère que cette consommation n'était probablement qu'occasionnelle. La présence de chiens est également documentée par des marques de morsure sur les os d'autres espèces, mais leur impact sur l'état de conservation de la faune a été limité en partie par l'enfouissement rapide de la plupart des déchets osseux et en partie par l'enlèvement par l'homme de la moelle avant le rejet. En ce qui concerne les espèces de gibier, le cerf rouge prédomine, suivi du lièvre et du chevreuil. En plus de la consommation de sa viande, ses bois étaient ramassés et utilisés comme matière première pour la production d'artefacts. Le colvert était également chassé, tandis que les restes de carapace de tortue sont probablement liés à des intrusions ultérieures dans des terriers. L'exploitation de la faune sauvage s'étendait également aux poissons et aux crustacés d'eau salée et d'eau douce. Les preuves de la consommation de la faune terrestre et marine indiquent que les habitants de Karabournaki exploitaient largement le milieu environnant, tant pour la nourriture que pour les matières premières.

L'origine des dépôts d'os d'animaux, à l'intérieur des fosses et des structures, est variée. La majorité des ossements représentent des déchets provenant de la boucherie primaire, de la préparation et de la consommation de nourriture, tandis que certains matériaux fortement brûlés ont peut-être été utilisés comme combustible et que certains spécimens portent des traces de travail. Les restes osseux de chaque contexte varient également en termes de quantité, d'espèces, de parties anatomiques et de traces d'altération pré- et post-dépôt, mais le large éventail chronologique de chaque remplissage suggère que le contenu provient d'événements multiples, et probablement divers, au fil du temps.

Après leur abandon, les structures semi-souterraines en forme de ruche étaient les principaux réceptacles des restes osseux, et peu de spécimens ont été trouvés dans les fosses. Certains ossements ont été rejetés directement à l'intérieur des structures, tandis qu'un très petit nombre d'entre eux ont été, après avoir été rejetés, exposés à la surface suffisamment longtemps pour présenter des signes évidents d'altération. Une partie plus importante de l'assemblage a été exposée, au moins temporairement, aux morsures de chiens (et peut-être au piétinement des humains), mais dans l'ensemble, l'état de conservation de l'assemblage suggère que la plupart des os rejetés ont été enfouis assez rapidement, tandis que plusieurs groupes de spécimens d'os articulés indiquent une perturbation limitée après l'incorporation, au moins dans certaines de ces décharges. La localisation des décharges dans le quadrillage de la ville et la composition de leur contenu suggèrent que les restes osseux provenaient très probablement des unités domestiques voisines, bien que les quelques spécimens travaillés puissent également provenir d'ateliers où ils auraient servi d'outils, tels que les ateliers de poterie et de métallurgie identifiés lors des fouilles.

Kastri

Les dépôts d'os d'animaux de Kastri datent du premier âge du Fer (10^{e}-8e siècle av. J.-C.) et proviennent de l'intérieur de la maison (maison I) et de la zone située au nord, à l'ouest et au nord-ouest de celle-ci. L'assemblage de l'échantillon provient de 116 unités stratigraphiques et comprend 4,403 spécimens, dont 3,141 NISP (1,262 MinAU) ont été identifiés au niveau de l’espèce, du genre, de la sous-famille, de la classe et des catégories de taille des animaux. Les facteurs taphonomiques post-dépôt, à savoir la méthode de prélèvement et de fouille, l’activité des carnivores, le piétinement et les facteurs liés à la végétation et au sol, ont affecté de manière significative la préservation de l’assemblage.

Le bétail de Kastri était composé de moutons, de chèvres, de bovins et de porcs, avec une prédominance de la chèvre. Les schémas de mortalité des moutons et des chèvres indiquent une économie mixte avec une plus grande importance accordée à la viande, notamment pour la chèvre, et une importance moindre aux produits secondaires tels que la laine et le lait, surtout de chèvre, exploités à petite échelle. Les bovins, malgré les maigres données, devaient être exploités pour la viande, tandis que le porc, outre la viande — surtout des jeunes animaux — était exploité également pour sa graisse, mais à petite échelle.

En plus des domestiques productifs, le chien, l’âne et le cheval étaient également présents, tandis que la faune terrestre sauvage était représentée par le cerf rouge, le lièvre et la tortue. Les espèces sauvages sont des indicateurs de chasse, mais leur faible représentation dans l’assemblage suggère leur contribution limitée au régime alimentaire des populations de Kastri.

Les marques de boucherie sur les moutons, les chèvres, les bovins, les porcs et les lièvres suggèrent que ces espèces étaient certainement consommées, et il en va de même pour le cerf rouge. Quant au chien, à l'âne et au cheval, bien que leurs ossements se retrouvent parmi ceux des espèces consommées, leur consommation est incertaine. Enfin, les restes de tortue pourraient correspondre à une intrusion ultérieure. Concernant les espèces consommées, toute la séquence de traitement des carcasses, à savoir le dépouillement, le démembrement et le filetage, du moins pour les principales espèces productives, semble avoir eu lieu au sein de l’établissement de Kastri. Le mode de cuisson pourrait consister principalement en ébullition et, dans une moindre mesure, en rôtissage, dont on ne trouve des traces que parmi les caprins, qui ont très probablement été rôtis dans leur ensemble. De plus, les os longs, principalement ceux des bovins, étaient brisés pour en extraire la moelle. Certains os étaient utilisés comme matière première pour la fabrication d’objets, tandis que d’autres pouvaient également servir de combustible pour la cuisson et/ou le chauffage.

Les restes de boucherie et de consommation ont été jetés partout à l'intérieur du site, parfois dans des zones ouvertes auxquelles les chiens avaient accès.

Synthèse

L'exploitation des animaux en Macédoine

Les ensembles de données primaires de restes osseux d’animaux récupérés à Argilos, Karabournaki et Kastri sont comparés aux données publiées disponibles pour la Macédoine, y compris les assemblages de faune provenant de contextes domestiques, de sanctuaires et de cimetières, ceci afin d’éclairer les particularités de chaque assemblage en termes de gestion de la faune domestique et sauvage. Les analyses paléo-environnementales et isotopiques pertinentes ont déclenché une discussion animée sur la mesure dans laquelle l’environnement a affecté les stratégies d’élevage et d’alimentation des animaux dans cette région.

Restes fauniques dans les sites d'habitat

En Macédoine, les assemblages fauniques des habitats de l’âge du Fer ancien proviennent de Kastanas (couches 9 et 10) et de Kastri, et ceux de l’époque archaïque et classique d’Argilos, de Karabournaki et de Kastanas (couches 1-8), et certaines observations préliminaires sont également disponibles pour l’âge du Fer à Assiros. L’analyse montre une hétérogénéité dans la composition des quatre principales espèces domestiquées entre les sites de l’âge du Fer (Kastri, Kastanas 8-9) et ceux des époques archaïque et classique (Argilos, Karabournaki, Kastanas 1-8), ainsi qu’entre les sites contemporains (par exemple Kastanas 9-10 et Kastri), ce qui est très probablement lié à la fois à la localisation et aux priorités de gestion des animaux de chaque site.

Le bétail est dominant à Karabournaki, suivi par Argilos, Kastanas et Kastri. La différence de fréquence des bovins entre Argilos et Karabournaki, deux sites côtiers contemporains, tient probablement au fait que ce dernier se trouvait dans un paysage mieux adapté au pâturage des bovins (c’est-à-dire fait de zones humides étendues). Les données relatives à la mortalité du bétail à Argilos et à Karabournaki suggèrent cependant dans les deux cas une gestion principalement destinée à la reproduction et à la traction, cette dernière suggestion étant renforcée par l’identification de pathologies compatibles avec un stress de traction sur une première phalange de bétail de l’Argilos classique.

L'élevage du bétail pour le labourage implique une grande surface de terre à cultiver, ce qui correspond à l'emplacement de Karabournaki et explique son pourcentage plus élevé de bétail par rapport à Argilos. Argilos a peut-être intensifié l'utilisation du bétail à la période classique, où le pourcentage de bovins est plus élevé. D'après les données isotopiques et palynologiques, c'est à cette époque que le bétail d'Argilos aurait eu accès à la zone marécageuse voisine du delta du Strymon. Étant donné que l'exploitation des produits laitiers du bétail n'était pas une priorité et que le porc, faute de produits secondaires, était la principale source de viande, on peut peut-être expliquer les changements dans la gestion du bétail à Argilos par l'intensification de la culture de blé, d'orge, de vesce amère et de lentilles attestée par l'archéobotanique. Le labourage par le bétail est également probable à Karabournaki, Assiros et Kastanas, où la culture des céréales est attestée par de riches vestiges archéobotaniques, dont certains ont été trouvés dans des pièces de stockage.

Les plantes cultivées ont évidemment été très importantes dans le régime alimentaire de l'homme de l'âge du Fer à la période classique en Macédoine. Outre les riches vestiges archéobotaniques susmentionnés d'Assiros et de Kastanas, l'analyse isotopique des squelettes humains des cimetières de l'âge du Fer de Kastri, à savoir Tsiganadika, Vrisoudes, Kentria et Larnaki, indique un régime principalement basé sur les plantes. À Argilos, l'analyse isotopique des restes de chiens provenant de dépôts classiques suggère que les céréales et les légumineuses récoltées puis laissées de côté par l'homme ont pu jouer un rôle important dans le régime alimentaire des chiens, reflétant indirectement des aspects du régime alimentaire humain. De plus, l'analyse isotopique des restes humains provenant des sites du premier âge du Fer d'Agios Dimitrios en Phthiotide, en Grèce centrale, et de Karitsa et Makriyalos en Macédoine, suggère un régime à base de plantes et une faible consommation de protéines animales par rapport aux périodes précédente et suivante, respectivement l'âge du Bronze et la période archaïque. Outre l'analyse isotopique des populations humaines et animales, les sources littéraires soulignent l'importance de la consommation de produits d'origine végétale par rapport à celle de produits d'origine animale.

Dans tous les sites de l'âge du Fer de la Macédoine classique, les moutons sont plus nombreux que les caprins, à l'exception de Kastri où la chèvre domine. Le pourcentage élevé de chèvres à Kastri s'explique probablement par le fait que la chèvre est mieux adaptée que les autres animaux domestiques au terrain accidenté de Thassos. Cela serait conforme aux indications de la présence possible de chèvres sauvages à Kastri. À Argilos, le mouton paraît avoir été élevé principalement pour la laine, surtout pendant la période classique, et la chèvre pour la viande, et une différence similaire de gestion entre les deux espèces est encore plus nette à Karabournaki. Enfin, à Kastri, c'est principalement la laine des moutons et la viande des agneaux et des chèvres adultes qui étaient exploitées. Dans le cas de Kastanas, où les priorités de gestion pour les moutons et les chèvres ne peuvent être distinguées, la mortalité combinée des caprins suggère un mélange de production de viande et de fibres.

La production de fibres est également confirmée par la découverte de nombreux poids de métiers à tisser dans tous les sites. Bien que l’on ne sache pas si ces derniers étaient des centres de production ou si les textiles étaient simplement produits à l’échelle domestique (et pour un usage domestique), il existe au moins à Argilos des indications d’une production textile à grande échelle depuis la période classique. Dans les sources littéraires, on trouve des références à des variétés de moutons à la laine recherchée et à l’intérêt de l’élite pour les textiles de luxe, où il est dit qu'afin d’améliorer la laine et de sélectionner certaines caractéristiques, les races régionales de moutons étaient croisées avec d’autres types.

Quant au lait caprin, l’élevage laitier dans les colonies de l’âge du Fer à l’époque classique était tout au plus une faible priorité, comme pour les bovins. En plus de la viande, des fibres, de la traction et peut-être des produits laitiers, les quatre espèces domestiques communes étaient également exploitées pour leurs excréments. Par ailleurs, des parties du squelette des espèces domestiques, y compris le chien et les équidés, étaient également exploitées comme matières premières. Outre les moutons, les chèvres, les bœufs et les porcs, les poules devaient également être exploitées comme source de protéines à travers leur viande et leurs œufs. La présence de poules n’est attestée à ce jour qu’à Kastanas classique et probablement à Argilos, ce qui est conforme à la théorie selon laquelle ces animaux sont apparus en Grèce au milieu du premier millénaire avant J.-C. en provenance d’Asie du Sud-Est.

L’hétérogénéité de la composition taxonomique entre les sites du Fer Ancien en Macédoine est conforme à celle des sites de l’âge du Fer dans le reste de la Grèce continentale (par exemple à l'agora d'Athènes, Messène, Nichoria et Oropos) et dans les îles de la mer Égée (Knossos, Profitis Ilias de Gortyne, Vronta et Kastro Kavousi en Crète ; Zagora à Andros). Le régionalisme évident des sites du premier âge du Fer dans des formes de la culture matérielle telles que la céramique et l'architecture peut également avoir affecté les stratégies pastorales, entraînant l'hétérogénéité observée dans la composition taxonomique. Il existe en effet des régions où les sites présentent une composition taxonomique similaire, mais où certains sont cependant dissemblables. Le régionalisme n'est donc, au mieux, qu'une explication partielle de la composition taxonomique des assemblages du premier âge du Fer en Égée.

Les processus taphonomiques peuvent également avoir contribué aux différences de composition taxonomique entre les sites du premier âge du Fer. En particulier sur les sites qui ont été définitivement abandonnés au cours du premier âge du Fer, les processus post-abandon ont affecté de manière significative la préservation et la possibilité d'identifier les ossements animaux proches de la surface, déformant ainsi la composition taxonomique, par exemple à Nichoria. Toutefois, ce n'est pas le cas pour tous les établissements du premier âge du Fer (par exemple, Kastri).

Pour la même période, l'hétérogénéité observée dans les stratégies d'élevage va de pair avec une forte diversité des enregistrements archéobotaniques dans les sites du premier. Ce phénomène peut résulter des multiples aspects de la géographie physique, mais aussi des économies politiques locales, le début du premier âge du Fer étant une période de transformations environnementales et culturelles majeures. Culturellement, les populations humaines étaient plus dispersées et mobiles et moins unifiées qu'auparavant, elles ont donc dû modifier leurs stratégies agropastorales pour s'adapter aux diverses niches environnementales régionales. L'hétérogénéité de la composition taxonomique du début de l'âge du Fer semble persister, et pourrait s'être intensifiée aux périodes archaïque et classique dans toute la mer Égée.

La faune sauvage des sites de Macédoine, de l'âge du Fer ancien à la période classique, comprenait une grande variété d'animaux terrestres et marins. Les espèces de mammifères terrestres identifiées sont le cerf, le daim, le chevreuil, le sanglier, le castor, le lynx, le loup, le lion, la martre, le blaireau, le lièvre, le renard roux, le chat sauvage, l'écureuil et le putois. Leur exploitation était plus importante au premier âge du Fer (Kastanas 9-10) qu'aux époques archaïque et classique. Les animaux sauvages étaient chassés et collectés principalement à des fins de consommation alimentaire, comme le suggèrent les traces de boucherie et de combustion. En plus d’offrir une source complémentaire de protéines, certaines espèces étaient également exploitées pour les matières premières que sont la fourrure, la peau, les os, les bois et les valves de coquillages. Les carnivores, tels que le lion, le loup et le renard roux, ont pu être chassés principalement pour leur fourrure ou pour protéger le bétail. L’utilisation des matières premières que sont les os, les bois et les coquillages est confirmée archéologiquement par des traces de travail (par exemple, les bois de l'atelier de la salle L8 du bâtiment L) et la découverte d’artefacts associés. La composition des espèces est la suivante : le cerf rouge est la principale espèce de gibier sur tous les sites, suivi d’une série de grands animaux (daims, sangliers) et de petits animaux (lièvres) dans des proportions différentes selon les sites. Les différences dans la représentation des espèces, tant terrestres que marines, sur chaque site sont principalement liées à leur emplacement et au potentiel de leur milieu naturel à chaque période.

Restes fauniques des sanctuaires

Les données zooarchéologiques des sites religieux de la région de Macédoine ne sont disponibles que pour les dépôts de faune archaïque et classique du sanctuaire rupestre de Nea Irakleitsa et du sanctuaire archaïque d’Hercule sur l’île de Thassos. Quelques observations préliminaires existent en outre pour le sanctuaire archaïque d’Athéna sur l’Acropole d’Oisyme. Les différences entre les sanctuaires dans la composition des espèces peuvent être liées aux protocoles sacrificiels de chaque contexte rituel plutôt qu’à l’abondance locale des différentes espèces de bétail. Une image similaire se dégage de nombreux assemblages provenant de sanctuaires, de temples, d’autels ou de contextes rituels (par exemple, les sanctuaires d’Apollon à Érétrie, d’Apollon et d’Artémis à Kalapodi, d’Athéna à Tégée, d’Artémis à Éphèse, etc.) de tout le bassin égéen datant de la période géométrique (premier âge du Fer) à la période classique. L’hétérogénéité de la composition taxonomique des assemblages de sanctuaires est en partie liée à la préférence rituelle pour des espèces particulières associées à différentes divinités. Cependant, il existe également des différences entre les sanctuaires d’une même divinité.

Le type d’espèces et le nombre d’animaux à sacrifier dépendaient non seulement de la divinité, mais aussi de la personne qui sacrifiait, de l’occasion et de la disponibilité des ressources. La diversité des animaux sacrifiés est également visible dans les peintures de vases, les reliefs votifs et les inscriptions : les bovins sont les mieux représentés dans les peintures de vases attiques, les porcs sur les reliefs votifs et les moutons sur les inscriptions sous forme de calendriers sacrificiels et de lois sacrées. Dans la peinture sur vases, la prédominance des bovins, la plus précieuse et la plus prestigieuse des viandes, représente probablement les grands sacrifices civiques ; dans les reliefs votifs, les porcs, l'animal le moins coûteux, représente principalement des offrandes privées par des individus ou des familles ; et les calendriers sacrificiels et les lois sacrées, dominées par les moutons, concernent les sacrifices communaux ou étatiques locaux et enregistrent ce qui devait être sacrifié dans des sanctuaires particuliers à des occasions particulières. Ainsi, la composition taxonomique des victimes sacrificielles dans chaque sanctuaire de l'Égée reflète également, dans une large mesure, la nature de l'occasion (privée ou publique) et, dans les deux cas, le statut économique des individus ou des institutions responsables du sacrifice.

Restes fauniques des cimetières

Des dépouilles fauniques ont également été découvertes dans des cimetières de la région de Macédoine, à savoir Akanthos, la zone industrielle de Drama, Ivani Prionia, Kentria Thassos, Larnaki Thassos, Mikro Livadi Mavropigi et Tsiganadika Thassos, couvrant la période du premier âge du Fer à l'époque classique. Les cimetières de Thassos datent du premier âge du Fer et, selon le fouilleur, ces cimetières desservaient le site de Kastri. Ivani Prionia (datant des périodes archaïque et classique) et Mikro Livadi Mavropigi (datant de l'époque archaïque) sont situées en Macédoine occidentale. Le cimetière d'Akanthos date de la période classique et se trouve dans la péninsule de Chalcidique, tandis que le cimetière découvert dans la zone industrielle de la ville de Drama, en Macédoine orientale, date de l'époque archaïque.

Les découvertes zooarchéologiques des cimetières du début de l'âge du Fer à Thassos comprennent les restes des quatre principales espèces domestiquées, un spécimen d'équidé et une variété de mollusques marins. La plupart des espèces portent des traces de consommation. Cependant, la découverte d'un fémur droit de bovin dans certaines sépultures implique des offrandes funéraires d'animaux à des fins rituelles. Si l'on considère que les fémurs étaient l'une des parties préférées des animaux offerts dans le sacrifice olympique, les fémurs trouvés dans les cimetières de Kastri impliquent un traitement similaire, mais dans un contexte funéraire. Cela peut indiquer que la pratique de l'offrande des cuisses date du premier âge du Fer et concerne les croyances d'un groupe de population plus large.

Contrairement aux restes fauniques des cimetières du premier âge du Fer, ceux des cimetières archaïques et classiques de la Chalcidique et de la Macédoine occidentale et orientale représentent des sépultures d'animaux. Dans le cimetière archaïque de Mikro Livadi Mavropigi, onze sépultures d'équidés, huit de chiens, quatre de porcs, trois de bovins et un de moutons ou de chèvres ont été découvertes, tandis que dans le cimetière archaïque et classique d'Ivani Prionia a livré cinq sépultures de chiens, trois de moutons ou de chèvres et des os épars de bovins et de porcs. À Akanthos (période classique), six sépultures de chevaux et quatre de chiens ont été découvertes et une sépulture de chien vient de la zone industrielle de Drama (époque archaïque). Bien que les sépultures d'équidés et de chiens soient attestées en Macédoine depuis l'âge du Bronze ancien et moyen, celles des principaux animaux domestiques productifs trouvés dans les cimetières d'Ivani Prionia et de Mikro Livadi Mavropigi sont peu communes. En outre, dans certaines sépultures de Mikro Livadi Mavropigi, on trouve des indications d'éventuels actes rituels, comme dans les cas d'enterrement de bovins, où l'on observe un réarrangement de la patte avant amputée.

Au-delà de la Macédoine, on trouve des sépultures d'animaux dans toute la Grèce continentale et les îles de la mer Égée dès l'âge du Bronze tardif. Dans les cimetières des époques géométrique à classique, les sépultures d'animaux, principalement de chevaux et, dans une moindre mesure, de chiens, semblent avoir accompagné les sépultures humaines, tandis que dans certains cas, des restes osseux d'autres espèces telles que le porc et le bovin ont également été trouvés. Les chevaux étaient un symbole de statut social, d'où l'importance de leur inhumation aux côtés des humains. En ce qui concerne les chiens, l'objectif exact de leurs sépultures n'est pas clair. Il se peut qu'ils aient fait partie de cérémonies de purification ou que cela reflète leur relation étroite avec les humains, accompagnant ainsi leurs propriétaires dans la mort. Dans la plupart des cas mentionnés ci-dessus, les sépultures de chiens ont été trouvées à côté de sépultures de chevaux.

Modes de consommation et gestion des rejets

Les données relatives aux modes de consommation, dans les sites d'Argilos, Karabournaki, Kastanas and Kastri au premier âge du Fer, à l'époque archaïque et à l'époque classique, ne concernent que les observations macroscopiques du matériel faunique (représentation anatomique, fragmentation des os, marques de boucherie et traces de combustion), étant donné que les preuves archéologiques connexes, telles que l'étude des récipients de cuisson, ne sont pas encore disponibles.

D'après la représentation anatomique, le traitement des dépouilles des principaux animaux domestiques, à savoir les moutons, les chèvres, les bovins et les porcs, a eu lieu dans les villages de Kastri, Karabournaki et Argilos, tandis qu'à Kastanas, seul le porc était abattu sur place. En revanche, on ne sait pas si la mise à mort des animaux susmentionnés a eu lieu juste à côté des boucheries et des marchés de viande ou à la périphérie des villes. Cependant, la viande mise sur le marché pourrait aussi être un reste de sacrifice rituel. D'après les sources littéraires, la viande consommée par les Grecs anciens provenait de victimes sacrifiées dans le cadre des sacrifices olympiques. Tous les principaux animaux domestiques, à savoir le mouton, la chèvre, le bovin et le porc, étaient généralement sacrifiés. Les principaux morceaux offerts aux dieux étaient les os de la cuisse et la queue. Comme ils étaient brûlées sur un autel, on s'attend à ce que les restes des repas sacrificiels, tels que les os du fémur, des vertèbres caudales et du sacrum, soient présents en petites quantités ou pas du tout (débris de consommation dans le site). La supériorité numérique du fémur par rapport au tibia, deux os longs de la patte arrière des caprins, des bœufs et des porcs, à Argilos, Karabournaki et Kastri, suggère fortement que les restes alimentaires à Argilos pourraient avoir été des restes de sacrifices rituels. En effet, Argilos, une polis grecque, partageait des valeurs et des protocoles communs avec les Grecs du Sud en ce qui concerne les cérémonies rituelles.

Les pratiques de dépeçage, de démembrement et de filetage sont couramment observées chez les quatre espèces, bien qu'à des fréquences différentes. Des traces de hache ont également été observées chez les quatre espèces et sur la quasi-totalité du squelette. Aux époques archaïque et classique, elles étaient plus répandues chez les bovins, ce qui est probablement lié à la nécessité de réduire la taille morceaux destinés à la cuisson, les bovins étant beaucoup plus grands que les autres espèces. De plus, les os des bovins contiennent de plus grandes quantités de moelle que ceux des espèces plus petites et il est donc possible qu'ils aient été débités plus intensivement pour l'extraction de la moelle.

Concernant les techniques de cuisson, sur les quatre sites la viande a plus souvent été bouillie que rôtie sur un feu ouvert. Le faible nombre de marques de combustion noires suggère que le rôtissage n’était pratiqué que de temps en temps pour les quatre espèces domestiques. Cependant, dans les quelques cas de caprins, de bovins et, dans une moindre mesure, de porcs portant des traces d'exposition au feu, il semble que la bête était rôtie entière (par exemple les moutons) ou en morceaux (par exemple les bovins), probablement sur une broche. Les faibles incidences de traces de rôtissage suggèrent que cette pratique n’était pas courante et qu’elle était peut-être liée à des événements particuliers. De plus, si elle n'était pas cuisinée fraîche immédiatement, la viande devait être conservée par salage ou séchage, éventuellement combinés au fumage. La cuisson et la consommation pouvaient donc également inclure de la viande non fraîche, ce qui ne peut être distingué par l'étude zooarchéologique. L’implication d’animaux tels que les bovins, qui produisent de grandes quantités de viande, suggère que ces événements impliquaient probablement des repas à grande échelle (rituels collectifs). Ainsi, qu’ils soient cérémoniels ou non, ces repas sont plus susceptibles d’avoir eu lieu dans un contexte communautaire plutôt que domestique.

Les techniques de traitement et de cuisson des viandes semblent avoir été communes aux principales espèces domestiques et aux chiens, aux équidés et aux mammifères sauvages portant des traces de consommation. En ce qui concerne ces derniers, le grand gibier, tels que les cerfs rouges, était probablement ramené intact dans les villages d’Argilos et de Karabournaki, tandis qu’à Kastanas, seules les parties fournissant de la viande étaient ramenées. Des marques de découpe sur des spécimens de chiens ont été identifiées à Kastanas, Karabournaki et Argilos, sur des ânes à Argilos et Karabournaki, et sur des chevaux à Argilos. La faible proportion d’os de chiens et d’équidés trouvés sur tous les sites indique que leur consommation était occasionnelle. La chair des équidés était considérée comme comestible dans le monde grec ancien, et la consommation de chiens est confirmée par les sources littéraires de certaines tribus, comme les Thraces dans les régions de Macédoine et de Thrace. Cependant, la consommation d’équidés et de chien, si elle n’est pas un fait isolé, peut aussi être liée à des occasions particulières, probablement dans des contextes religieux ou médicaux. Outre Argilos, Karabournaki et Kastanas, des spécimens épars d’équidés et de chiens portant des traces de consommation ont été trouvés dans de nombreux sites et sanctuaires du premier millénaire dans le bassin égéen, respectivement à Érétrie, Kastro Kavousi et Kalabal Tepe, et les sanctuaires d'Apollon à Delphes et Érétrie, d'Athéna à Tegée, de Poséidon à Isthmia et Tenos, et d'Hercule à Thassos.

Gestion des déchets

La gestion des déchets se réfère à la manière dont les habitants géraient leurs déchets au sein du tissu urbain. Les données concernent principalement les agglomérations d’Argilos et de Karabournaki et sont basées sur la distribution spatiale des restes d’os d’animaux et leurs traces taphonomiques post-dépositionnnelles.

Les restes fauniques d’Argilos et de Karabournaki ont été déposés dans de nombreux dépotoirs spécifiques dans la ville, à l'intérieur de bâtiments à Argilos ou dans des structures semi-souterraines à Karabournaki. En plus, on trouve des cas de création de dépotoirs dans le sol, comme la décharge dans le secteur de la route nationale à Argilos et les fosses à Karabournaki. Cependant, il existe également des cas d’ossements épars — en général peu nombreux et de petite taille — trouvés à l’intérieur de bâtiments à Argilos. Ces ossements pourraient être arrivés là par hasard, comme composants du remblai de terre lors de la construction ou de la réparation des sols.

Les restes osseux trouvés à l’intérieur des dépotoirs proviennent de divers processus, à savoir la boucherie, la cuisine, la consommation et la production artisanale. Les déchets de boucherie sont confirmés par la présence de pièces anatomiques rejetées au cours de la première phase de traitement de la dépouille — certaines d’entre elles portant des traces de dépeçage — et concernent les parties peu charnues, telles que les métapodes et les phalanges. Les déchets de cuisson sont représentés par des os brûlés de diverses parties anatomiques, qui étaient probablement utilisés comme combustible pour la cuisson et le chauffage. Les déchets de consommation concernent la majeure partie des os, dont certains portent des marques de découpe et des traces de feu noire, tandis que les déchets de production artisanale renvoient aux os et aux bois de cervidés utilisés comme matière première et qui portent des marques de sciage. Les restes osseux de Kastri paraissent provenir de processus similaires, bien que l'on ne dispose pas encore d'informations sur la nature des contextes de dépôt.

La variété implicite des origines des dépôts pour les os d'animaux à Argilos et Karabournaki suggère que, dans la plupart des cas, le contexte de dépôt a reçu des déchets de sources différentes. L'étude archéobotanique à Karabournaki aboutit également à cette interprétation. D'après les données taphonomiques, les dépôts d'os des deux sites impliquent un enfouissement aussi bien immédiat que différé. La découverte d'éléments articulés qui évoquent un enfouissement avant la décomposition des tissus mous ou la perturbation par des agents externes illustre le premier cas. Cependant, des spécimens portant des marques de morsures de chiens et des traces d'altération suggèrent aussi un enfouissement différé quelque temps après la mise au rebut. L'incidence des traces d'altération est très faible sur les deux sites, ce qui démontre que les ossements ne sont pas restés longtemps dans des espaces en plein air exposés aux conditions climatiques (pluie, soleil, etc.). Les os rongés et altérés suggèrent que les spécimens concernés ont été déposés dans les points de rejet plus tard, probablement lors du nettoyage des espaces ouverts où ils semblent avoir été initialement jetés. Ces espaces ouverts peuvent avoir été privés ou publics, et l'exposition des restes au piétinement humain ne peut donc être exclue.

La plus grande partie des déchets osseux semble provenir des activités domestiques (par exemple, la cuisine, les repas) et, dans une moindre mesure, des boucheries et des ateliers. Outre la consommation domestique, on ne peut exclure les occasions de production de déchets lors de repas à grande échelle, qui auraient pu avoir lieu dans un espace commun dans le cadre d'un événement public, rituel ou non. Compte tenu de la localisation des points de collecte des déchets dans l'agglomération d'Argilos, les créateurs de déchets (unités domestiques, boucheries, ateliers) se trouvaient probablement dans leur voisinage immédiat. À Karabournaki, bien que les assemblages étudiés ne concernent que les dépotoirs, le lien entre la zone résidentielle et les dépotoirs devrait être similaire. Cependant, le statut de propriété (privé ou public) des pièces, bâtiments et structures abandonnés, ainsi que celui des décharges et des fosses à Argilos et Karabournaki, est inconnu. De plus, la question se pose de savoir qui était responsable de la gestion des déchets, que ce soit la ville ou les habitants individuels.

Conclusions

Les recherches sur les restes d’os d’animaux provenant d’Argilos, de Karabournaki et de Kastri ont permis d’étudier pour la première fois dans son ensemble la question de l’élevage — un domaine crucial de l’économie primaire — et la relation entre les hommes et les animaux à travers l’exploitation et la consommation de ces derniers en Macédoine du premier âge du Fer à l’époque classique. Les nouvelles données ont été combinées avec des données déjà publiées en Macédoine afin de combler les lacunes dans notre connaissance de l’élevage en Grèce du Nord au cours des sept premiers siècles du premier millénaire avant J.-C., car les recherches zooarchéologiques précédentes en Macédoine se sont surtout concentrées sur le matériel des sites du Néolithique et de l’âge du Bronze. En tant que telle, cette étude contribuera aux discussions en cours sur l’élevage, la mobilité des animaux et l’exploitation des ressources naturelles au cours du premier millénaire avant J.-C. dans le bassin égéen.

Les résultats de l’analyse zooarchéologique en Macédoine, du début de l’âge du Fer à la période classique, suggèrent un modèle d’exploitation animale plutôt commun dans les sites continentaux d’Argilos et Karabournaki, tandis que la gestion animale à Kastanas et Kastri sur Thassos semble avoir été différente. Le modèle continental comprend une stratégie de gestion basée sur la viande pour les chèvres, un certain accent sur la production de laine pour les moutons, et une gestion orientée vers la viande, éventuellement combinée à la traction, pour les bovins. Enfin, le porc était exploité pour sa viande et dans certains cas également pour sa graisse. Outre ces animaux domestiques les plus courants, dans les sites continentaux, les équidés et les chiens étaient également consommés, mais très probablement de manière occasionnelle, tandis que le poulet devait également être exploité à Kastanas et probablement à Argilos à l'époque classique.

La gestion des animaux à Kastri paraît avoir été adaptée aux conditions environnementales particulières de sa situation insulaire les proportions de chèvre et de mouton étaient presque égales. Les deux espèces étaient élevées principalement pour la viande et accessoirement pour les fibres, tandis que la présence de chèvres sauvages est également possible. Les bovins étaient exploités pour la reproduction et peut-être la traction et les jeunes porcs, probablement élevés dans les forêts, étaient utilisés pour la viande.

Les données zooarchéologiques concernant l'exploitation des principaux animaux domestiques en Macédoine semblent à plusieurs égards refléter ce qui est décrit dans les sources littéraires. Selon les historiens, les moutons étaient exploités principalement pour leur laine, tandis que les bovins étaient surtout utilisés comme animaux de trait. En outre, la production laitière dans la Grèce classique était principalement destinée à la fabrication de fromage, le lait étant rarement consommé frais. Les sources écrites soulignent l'importance du porc dans le régime alimentaire grec en tant que principale source de viande, la viande des autres espèces communes étant consommée principalement dans des contextes sacrificiels. Étant donné que l'histoire de la consommation de viande dans la Grèce antique a souvent été décrite dans le cadre de pratiques religieuses et de contextes culturels d'élite, il n'est pas impossible que les restes d'animaux provenant de dépôts de l'âge du Fer à l'époque classique en Macédoine représentent, au moins en partie, les repas privés de foyers aisés. La volaille et les œufs constituaient une source supplémentaire de protéines animales domestiques, qui pouvaient être consommées également par les foyers pauvres. Même si les habitants de Macédoine consommaient de la viande, le régime alimentaire était principalement végétal, comme le montre la signature isotopique des restes humains de Grèce centrale et de Macédoine, ce qui est conforme aux sources littéraires qui témoignent d'un régime à base de céréales plutôt que de viande.

Bien que l'étude de la faune marine soit encore en cours, on peut déjà constater qu'une grande variété de faunes sauvages terrestres et marines fournissait une source d'alimentation complémentaire. Le « menu » était composé de mammifères terrestres et la liste était complétée par diverses espèces d'oiseaux et des espèces d'eau douce et d'eau salée. L'exploitation des animaux sauvages était apparemment la plus importante à Kastanas, suivie par Argilos, Karabournaki et Kastri. La composition des espèces sauvages de chaque village et le niveau d'exploitation de ces ressources fauniques, tant pour la nutrition que pour les matières premières, reflétaient le potentiel environnemental local (par exemple, la proximité d'étendues d'eau douce et salée, l'accès à différents types de végétation). En dehors de Kastanas, le gibier ne représentait qu'une très faible part de l'apport en viande dans le régime. Par exemple, dans l'Argilos classique, même si les bois de cerfs rouges semblent avoir été ramassés régulièrement, il n'y avait pas d'abattage ni de consommation de la viande.

Les différences entre les sites dans la composition des espèces domestiques et sauvages et dans les stratégies de gestion des animaux reflètent probablement des ajustements aux conditions sociales, économiques et environnementales locales plutôt que des contrastes entre les populations locales et les colons de la Grèce du Sud. Argilos, une *polis* grecque, et Karabournaki, habité par une population locale, semblent avoir eu des modèles de gestion animale plus similaires que Kastanas et Kastri, tous deux habité par des populations locales. Les différences observées dans la gestion des animaux étaient donc plus probablement liées au type de peuplement qu'à l'origine des habitants. Argilos et Karabournaki, deux agglomérations côtières, étaient des centres urbains probablement tournés vers l'extérieur. Dans le cas d'Argilos, où l'on dispose de plus de données, la production de laine pour le travail textile à grande échelle et la fabrication d'artefacts en bois de cerf sont, comme on pouvait s'y attendre, attestées dans l'agora, le cœur d'une *polis* organisée où l'artisanat jouait un rôle important dans l'économie et la structure sociale de la ville. On peut supposer la même chose pour Karabournaki, où des ateliers artisanaux de poterie et de travail du métal ont également été identifiés. Contrairement à Argilos et Karabournaki, Kastanas et Kastri étaient des agglomérations rurales, avec des modèles économiques différents qui, dans le cas de Kastri, étaient fortement influencés par l'environnement local.

L'évolution de la végétation, due au changement climatique (en particulier à la fin de l'âge du Bronze et au début du premier âge du Fer) et à l'activité humaine (notamment l'abattage des arbres pour le bois et le défrichement des forêts pour créer des terres ouvertes à la culture et au pâturage), a également affecté les stratégies d'élevage et d'alimentation des animaux, et donc les choix alimentaires des hommes. Par exemple, le changement de végétation dans le delta du Strymon a affecté la stratégie d'alimentation du bétail d'Argilos, qui, à l'époque classique/hellénistique, passait plus de temps à paître dans les marais autour du delta que dans les champs qui les nourrissaient à l'époque archaïque.

Les stratégies d'élevage des périodes archaïque et classique font l'objet d'un débat considérable entre historiens et archéologues. Une question cruciale concerne la mesure dans laquelle la relation entre l'agriculture ou l'arboriculture et l'élevage était une symbiose ou une simple coexistence. Deux modèles opposés ont été proposés concernant l'élevage dans l'Antiquité. Le premier suppose que l'agriculture de plaine était dominée par l'alternance de cultures céréalières et de jachères labourées à nu au printemps. Ce régime aurait créé une abondance de pâturages d’hiver, mais une pénurie de pâturages d’été dans les plaines, renforçant ainsi la transhumance saisonnière des moutons et des chèvres : les caprins paissaient du printemps à l’automne dans les pâturages de montagne et retournaient en hiver dans les plaines.

Le second modèle privilégie la rotation des céréales et des légumineuses sur les terres arables, réduisant la disponibilité des pâturages d’hiver dans les basses terres et supprimant ainsi la raison d’être de la transhumance. Les données zooarchéologiques, isotopiques et palynologiques de la région de Macédoine suggèrent qu’au cours des périodes archaïque et classique, bien que la mobilité sur de courtes distances ait pu être pratiquée, la plupart des troupeaux de moutons paissaient probablement sur des terres cultivées, ou à proximité. À Argilos, les bovins paissaient dans les champs cultivés pendant la période archaïque, et dans les zones humides voisines pendant l’ère classique, tandis que les chèvres accompagnaient très probablement les moutons et que les porcs étaient apparemment élevés à proximité du village. À Kastri, les stratégies d’élevage étaient probablement différentes de celles des sites continentaux, en réponse à l’environnement insulaire : les porcs étaient peut-être élevés dans des zones forestières, et de même la présence d'os de chèvres semi-sauvages implique que cette espèce au moins pouvait également être élevée en liberté à distance du village. De nombreuses sources anciennes mentionnent directement ou indirectement la gestion des troupeaux, et viennent en général à l'appui du modèle de symbiose entre l’agriculture et l’élevage, associé à des déplacements à petite échelle vers les hautes-terres voisines. Le type d’élevage pratiqué était sans doute influencé par le type de site (urbain ou rural), la disponibilité de terres arables, le statut des propriétaires de bétail (agriculteur, éleveur spécialisé, sanctuaire ou État) et les besoins du marché local.

Les techniques de cuisson, les pratiques de consommation et la gestion des déchets semblent avoir suivi des principes communs dans les quatre sites. Pour ce qui est des pratiques culinaires, la viande était plus souvent bouillie que rôtie directement sur le feu, ce qui est conforme à la conception des Grecs classiques selon laquelle l’ébullition était supérieure au rôtissage. Les repas étaient principalement consommés dans un contexte domestique, mais des repas à grande échelle, cérémoniels ou non, avaient probablement lieu dans un contexte communautaire. Dans le cas des repas cérémoniels, la consommation de viande à Argilos semble également liée aux sacrifices d'animaux, dans le contexte du sacrifice olympique, ce qui implique l'absence de pratiques communes avec les villages locaux de Karabournaki et Kastri en relation avec l'abattage et la consommation d'animaux.

Concernant la gestion des déchets, la majeure partie des déchets alimentaires osseux étaient déposée directement dans des dépotoirs spécifiques (par exemple, des pièces abandonnées, des fosses, des décharges) après le traitement et la consommation des bêtes, ce qui implique des dispositions intracommunautaires similaires entre les sites. De plus, la pratique funéraire commune du dépôt de chevaux et de chiens dans les cimetières humains suggère l'existence de certaines conceptions partagées concernant l'importance de ces animaux dans les sociétés archaïques et classiques de la Grèce du Nord.

Certaines questions sur l'organisation inter- et intracommunautaire des sites concernant la gestion des rejets, à partir des traces taphonomiques et de la distribution spatiale des ossements animaux, n'ont pas été complètement résolues, surtout parce que les fouilles et l'étude de la culture matérielle associée sont toujours en cours à Argilos, Karabournaki et Kastri. L'obtention future de données stratigraphiques et chronologiques complètes et l'achèvement de l'étude faunistique pour Argilos (par exemple, le secteur de l'Acropole) et Karabournaki (par exemple, les structures résidentielles) permettront toutefois d'approfondir l'étude de l'utilisation possible des pièces, des bâtiments et des structures (par exemple, les installations de cuisine, les espaces rituels) grâce aux restes d'ossements animaux. De plus, il sera possible de mettre en relation les données zooarchéologiques avec les principaux événements historiques du premier âge du Fer, de l'époque archaïque et de l'époque classique (par exemple, la colonisation grecque, l'ascension de la maison royale macédonienne des Téménides, les guerres contre les Perses et la guerre du Péloponnèse) qui ont provoqué des changements et des développements importants dans les structures sociales, économiques et politiques des sociétés locales. En outre, les données provenant de l'étude des céramiques de cuisson à Argilos, Karabournaki et Kastri et leurs potentielles analyses chimiques contribueront également de manière significative à l'étude des pratiques culinaires, par exemple sur l'importance des produits laitiers dans le régime alimentaire. Enfin, l'étude des oiseaux, des reptiles et des restes de microfaune issus de la flottation donnera plus d'informations sur les espèces consommées, les pratiques de chasse, les micro- et macro-environnements et le climat.

Au cours de l’analyse, de nouvelles questions sont apparues concernant le régime alimentaire des animaux domestiques communs, aspect central de leur gestion. Pour répondre à ces nouvelles questions, une analyse 2-D des micro-usures dentaires des dents mandibulaires est proposée pour les trois sites, afin de déterminer le régime alimentaire des animaux domestiques et de mettre en lumière les différences potentielles entre eux, entre les trois sites et entre les phases d’occupation de chaque site. En outre, l’achèvement de l’analyse isotopique en cours à Argilos, qui comprend le carbone ($\delta^{13}C$), l’azote ($\delta^{15}N$), l’oxygène ($\delta^{18}O$) et le strontium ($^{87}Sr/^{86}Sr$), contribuera de manière significative à l’exploration des régimes alimentaires à long terme des animaux, car l’analyse des micro-portraits dentaires ne reflète le régime alimentaire que dans les jours précédant immédiatement la mort. L’analyse isotopique pourrait également fournir des informations sur la mobilité des animaux et donc sur l’exploitation du milieu naturel en termes d’utilisation de l’espace ainsi que sur les différents types de couverts végétaux utilisés comme pâturages. Cela permettra, nous l'espérons, d'apporter quelques réponses aux questions concernant la transhumance en Macédoine au cours du premier millénaire av. J.-C. Enfin, les données provenant de l’étude en cours des plantes et des restes de la faune marine d’Argilos et de Karabournaki permettront également de mieux comprendre l’exploitation des animaux sauvages et de l’environnement naturel, ainsi que l’utilisation des terres, y compris l’implication possible des animaux domestiques dans les processus de culture et d’élevage tel que le labourage et l’utilisation de leurs excréments pour la fumure.

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Prologue

My present study started in 2016 at the University of Montpellier and finished in 2021 at the University of Montreal, with the continuous support of my supervisors, Dr. Armelle Gardeisen and Prof. Jacques Perreault, from the very first to the last day of my doctoral research. Thus, I would like to thank both, for believing in me, for providing support in times of despair and during the coronavirus pandemic, and for their help with continuing and completing my research which took place in Greece, France, and Canada. In all three countries, a number of individuals and institutes contributed to my research that I would also like to thank.

Starting in Greece, I would like to thank the excavators of Karabournaki in Thessaloniki, Prof. H. Manakidou and Dr. D. Tsiafaki, for providing the material for the study and facilitating my work in many ways. I must also thank Dr. Ch. Koukouli-Chrysanthaki and Dr. Z. Bonias, as well as the directors of the Ephorate of Antiquities of Serres and Kavala, Dr. D. Malamidou and Dr. S. Dadaki, for allowing me to study the animal bones from Argilos and Kastri Thassos and making this process as easy as possible at the museums of Amphipolis and Limenas Thassos. Many thanks to the students of the Aristotle University of Thessaloniki namely Gavrou Sotiria, Kiosepara Maria, Kyriakoudi Sofia and Pantoudi Eleni for helping with washing the material from Karabournaki and Argilos. Furthermore, I would like to give special thanks to the guards and the staff of Amphipolis and Limenas Thassos museum, who made sure that I enjoyed the best possible working conditions. I would also like to thank the French School in Athens for hosting me in their premises in Limena Thassos during my study of Kastri, as well as the Greek–Canadian archaeological mission, who hosted me in their premises in Asprovalta during my study of Argilos. Many thanks are also due to Dr. D. Mylona and Dr. V. Isaakidou for our friendly and constructive discussions, the archaeologist V. Chondrogiannis for providing valuable information regarding the dates of the stratigraphic units of Kastri, Dr. R. Christidou, who offered me the necessary guidance on the study of the worked bones from Argilos, and the Malcolm H. Wiener Laboratory for Archaeological Science at the American School of Classical Studies at Athens for providing access to stereoscopes for microscopical analysis.

In France, I would like to warmly thank the Labex ARCHIMEDE programme IA- ANR-11-LABX-0032-01 for financing my studies at the University of Montpellier and my work in Greece, and funding my training at the Institut Català de Paleoecologia Humana i Evolució Social (IPHES) in Tarragona, Spain, and in the laboratory De la Préhistoire à l'Actuel: Culture, Environnement et Anthropologie (PACEA), UMR 5199, in Bordeaux, France. Moreover, many thanks are due to the staff of the zooarchaeological laboratory of the Archéologie des Sociétés Méditerranéennes, ASM - UMR 5140, and its director, Dr. A. Gardeisen, for offering me access to the animal bones reference collection and related atlases and publications, as well as for the AniMed seminars which enriched my knowledge in my field. In Canada, I would like to thank the Department of History for funding my studies at the University of Montreal, and the staff of the Laboratoire d'Archéologie Méditerranéenne and its director, Prof. J. Perreault, for providing an ideal working environment.

Many thanks are due to my family, as well as Angeliki Karathanou, who offered me emotional support and have been patient and loving. Finally, I would like to thank my friends Elena, Michalis, Ken, Didier, Simone, Harris, Real, Giota, Tobias and Silvie for supporting me throughout the demanding period of my doctoral research.

Chapter 1. Background and context of research

1.1. Introduction

During the first millennium BC the land of north Greece was part of ancient Thrace and Macedonia, a region with shifting borders through the course of history. The present study concerns geographically the nowadays geographic region (department) of Macedonia in north Greece (hereafter 'region of Macedonia/Macedonian region') (**Fig. 1.1**) which include the administrative region of Western Macedonia (regional units of Florina, Grevena, Kastoria and

Fig. 1.1. The map of Greece. The nowadays geographical region (department) of Macedonia in North Greece marked with red (from https://en-academic.com/dic.nsf/enwiki/1294092)

Key: 1: Administrative region of Western Macedonia, 2: Administrative region of Central Macedonia, 3: The Eastern Macedonian regional units from the administrative region of Eastern Macedonia and Thrace

Kozani), the administrative region of central Macedonia (regional units of Chalkidiki, Imathia, Kilkis, Pella, Pieria, Serres and Thessaloniki), and part of the administrative region of Eastern Macedonia and Thrace (only the Eastern Macedonian regional units namely Drama, Kavala and Thassos). Thus, the use of the term 'region of Macedonia' in the text does not refer to the historical Macedonia, the land and the kingdom of ancient Macedonia, or the modern country of Republic of North Macedonia, but to the nowadays demarcation of Macedonian region within the Greek borders. (**Fig. 1.1**)

The fertile plains of the area under study had provided an ideal environment for habitation since the Prehistoric era.[1] From the early 20th century AD, a multitude of excavations, field surveys and collective research have taken place, exploring and outlining the course of human presence and activity in the region of Macedonia.[2] Numerous settlements dating from the Early Neolithic to the Late Bronze Age have been detected along the coast and in the hinterland,[3] while human presence is attested in the region since the Lower Palaeolithic.[4] From the Early Iron Age to the Classical era (1100/1050–323 BC; **Table 1.1**), the region of Macedonia, which was inhabited by various population groups (e.g. Thracians, Greeks) experienced significant changes and developments in its social, economic and political structures.

The Early Iron Age is characterized by a higher density of habitation sites compared to the previous period. These sites were either located around the Late-Bronze-Age mounds or founded as new settlements on natural trapezoidal plateaus, known as *trapezes*. At the same time, another form of settlement emerged – these were small, remote sites with shallow deposits, possibly of an agricultural and pastoral nature. Settlements developed a complex inter-communal hierarchy within this social and political landscape, while significant intra-communal inequalities and hierarchical relationships arose. During the Early Iron Age, southern Aegean island and mainland settlements are said to have experienced invasions, local uprisings, natural disasters and civil wars, leading to the depopulation of the Aegean.[5] Among numerous important transformations, the

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[1] French 1967; Blake and Knapp 2005; Gimatzidis 2014: 303-312.

[2] E.g., Andreou 2001; Andreou and Kotsakis 1986; Andreou et al. 1996; Gimatzidis 2010; Heurtley 1939; Kotsakis 2008; Kotsakis 2014; Koukouli-Chrysanthaki 2014; Soueref 2004; Stefani et al. 2014; Tiverios 1997; Tiverios 2009.

[3] Andreou et al. 1996.

[4] Kokkoros and Kanelis 1960: 534-537.

[5] Snodgrass 2000: 304-313.

emergence of the Greek *polis*-state was most notable.[6] From the Archaic period onwards (7th c. BC), contact between the southern and the northern Aegean intensified, and colonies were founded on the coastline of the Macedonian region and the island of Thassos.

Archaeological - Historical periods	**Phase**	**Date (BC)**
Stone Age	Neolithic	6500-3200/3000
Bronze Age	Early	3200/3000-2100/2000
	Middle	2100/2000-1600
	Late	1600-1050
Geometric (Early Iron Age)	Protogeometric	1050/1025-900
	Early	900-850
	Middle	850-760
	Late	760-700
Archaic	Early	700-575
	Middle	575-530
	Late	530-490/80
Classical	Early	490/80-450
	Middle	450-400/380
	Late	400/380-323
Hellenistic	Early	323-275
	Middle	275-150
	Late	150-31

Table 1.1. Archaeological and historical timescale in the Aegean basin (mid-7th-1st millennium BC)

The influence of the southern Greek *metropoleis* over the colonies contributed to the formation of tribal entities, chiefdoms, and kingdoms in Macedonian region. Commercial activity also increased, as indicated by the numerous imports of ceramic vessels from across the entire Aegean and eastern Mediterranean region.[7] The intra- and inter-communal organization of the settlements also changed. Public spaces were integrated within a settlement grid, although there was a clear separation between spaces of a communal or an artisanal nature. At an inter-communal level, loose groups that included clusters of sites were formed, sharing common identities and a shared concept of “belonging”.[8] This situation began to change in the 4th c. BC, when new political, economic, social, and cultural conditions led to the incorporation of the entire region under study into the Macedonian Kingdom. All the aforementioned changes took place in a geographical area where

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[6] Coldstream 2003; Dickinson 2009.

[7] Soueref 2003; 2011; Tiverios 1997; 2004; 2009.

[8] Koukouli-Chrysanthaki 2014.

the natural landscape was also changing, as evident from the available palaeoenvironmental data.[9] The climatic changes that occurred during the Late Bronze Age and the start of the Early Iron Age, along with human activity through cultivation, herding and lumbering, altered the landscape, mostly at the low and medium altitudes where known settlements were located, affecting the vegetation and the wild faunal ecosystems.

1.2. Scope of the research

The examination of the crucial changes that occurred in the first millennium BC and afterwards in the region of Macedonia incorporates many different methods and approaches, zooarchaeology among them. Zooarchaeology is the study of animal remains from archaeological sites with the aim of understanding all aspects of past human-animal interaction.[10] It focusses on reconstructing past activities of subsistence and the procurement of animal foods and raw materials, past hunting and herding practices (including animal domestication) and the use of animal remains as palaeoenvironmental indicators.[11] To this day, zooarchaeological research in the region of Macedonia has focused mostly on materials from Neolithic and Bronze Age sites (**Table 1.2**, **Fig. 1.2**).[12] Hence, understanding of the Early Iron Age, Archaic and Classical periods in the region of Macedonia remains rather fragmentary. The publication of the zooarchaeological assemblage from Kastanas[13] and the preliminary study of that from Assiros[14] are the only available sources of information for habitation sites for the first millennium BC. However, zooarchaeological publications and reports concerning the Early Iron Age and the Archaic and Classical periods are available from cemeteries and sanctuaries across the Macedonian region, namely those of Akanthos, the Drama Industrial Area, Herakleion Thassos, Ivani Prionia, Kentria Thassos, Larnaki Thassos, Mikro Livadi Mavropigi, Nea Irakleitsa, Oisyme and Tsiganadika Thassos (**Table 1.2**, **Fig. 1.2**). The often limited or insufficient collection of bones during the excavation of habitation

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[9] E.g., Al-Omari 1999; Athanasiadis and Gerasimidis 1986; 1987; Athanasiadis et al. 1993a; 1993b; 2000; Atherden et al. 2000; Bottema 1974; Gerasimidis 1995; 2000; Gerasimidis and Athanasiadis 1995; Gerasimidis et al. 2002; Greig and Turner 1974; Glais et al. 2016; 2017.

[10] Grayson 1973: 432; Klein and Cruz-Uribe 1984: 1; Reitz and Wing 1999: 1.

[11] Higgs and Jarman 1975: 1-7; Renfrew and Bahn 2001: 489; Trigger 1989: 270.

[12] Gardeisen 2010.

[13] Becker 1986.

[14] Halstead and Jones 1980.

sites is one of the main reasons for the absence of zooarchaeological reports for the first millennium BC in the region of Macedonia, together with a lack of interest, until recently, on the part of excavators and specialists. In contrast with the region of Macedonia, the importance of animal husbandry in the Archaic and Classical societies in south Greece is a subject of many studies by both historians and archaeologists, based on literary sources (e.g. Aristotle, Athenaios, Hesiod, Xenophon),[15] epigraphy[16] and bioarchaeological records.[17] There is therefore a need for further zooarchaeological study of Early Iron Age, Archaic and Classical assemblages to sustain an interdisciplinary understanding of these eras in the Macedonian region. (**Table 1.2**, **Fig. 1.2**)

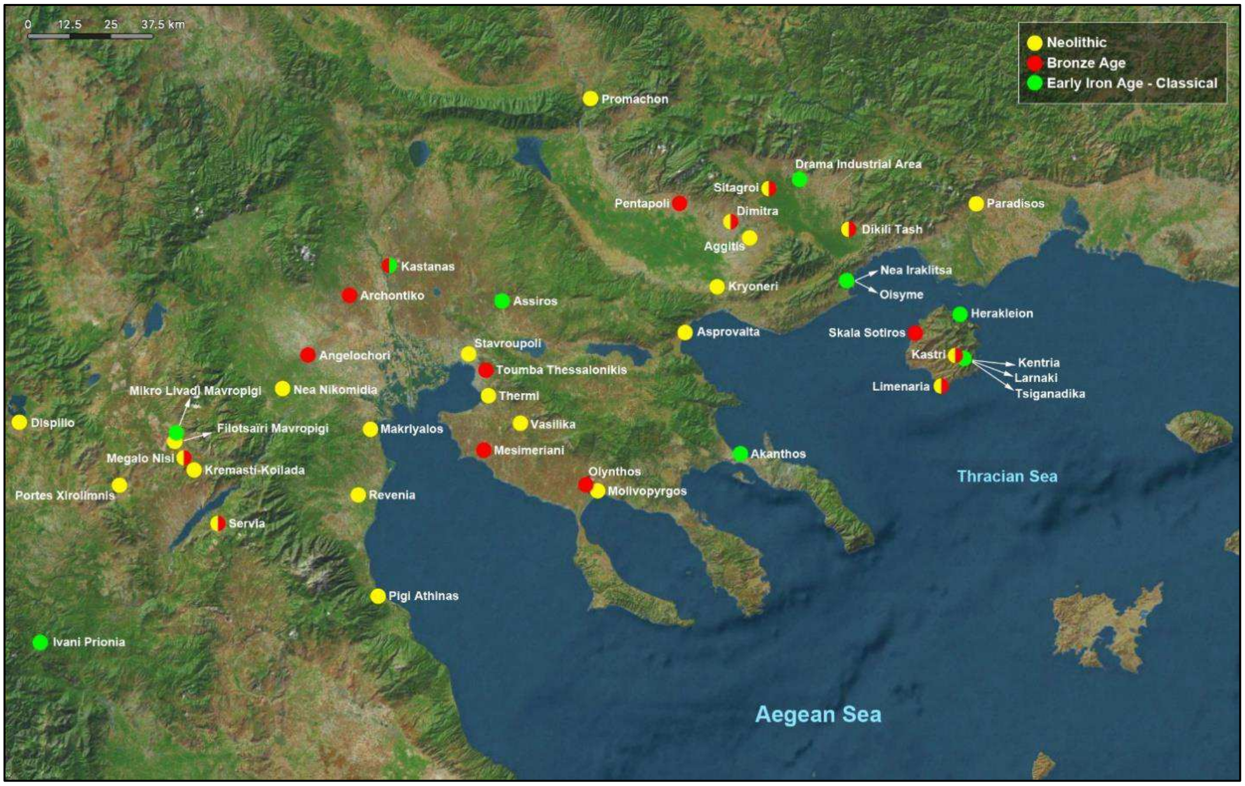

Fig. 1.2. Map of the Macedonian region showing Neolithic to Classical sites with studied faunal remains (terrestrial mammals) (©Apple Maps)

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[15] E.g., Chandezon 2006; Georgoudi 1974; Hodkinson 1988; 1992; Skydsgaard 1988.

[16] E.g., Chandezon 2003.

[17] E.g., Halstead 2012.

Type of site	Site	Period	Reference
Habitation	Aggitis	LN	Trantalidou et al. 2006
	Angelochori	LBA	Creuzieux 2013; Konstantinidou 2010
	Archontiko	EBA	Creuzieux 2013; Kostopoulos 2000
	Asprovalta	LN	Samartzidou 2002
	Assiros	EIA	Halstead and Jones 1980
	Dimitra	MN-LN, LBA	Yannouli 1994; 1997; Koufos 1997; Dove 1997
	Dikili Tash	MN-EBA	Julien 1992; Helmer 1997
	Dispilio	EN-LN	Cosmetatou-Phoca 2007; Samartzidou 2014
	Filotsairi Mavropigi	EN	Michalopoulou 2016
	Kastanas	EBA-CL	Reichstein 1979; Becker 1986
	Kremasti-Koilada	LN	Tzevelekidi 2011
	Kryoneri	LN	Cantuel 2010; Mylona 1997
	Limenaria Thassos	LN-EBA	Webb 2012
	Makriyalos	LN	Mainland and Halstead 2002
	Megalo Nisi	LN-EBA	Greenfield and Fowler 2003; 2005
	Mesimeriani	EBA	Yannouli 2002a
	Molivopirgos	EN-MN	Heurtley 1927-8
	Nea Nikomidia	EN	Higgs 1962
	Olynthos	EBA-LBA	Becker 2008
	Paradisos	LN	Larje 1987
	Pentapoli	EBA	Yannouli 1994
	Portes Xirolimnis	EN	Michalopoulou 2016
	Promachon	LN	Theodorogianni and Trantalidou 2013; Kazantzis 2015
	Revenia	EN	Isaakidou et al. 2018
	Servia	EN-EBA	Watson 1979
	Sitagroi	EN-EBA	Bökönyi 1986
	Skala Sotiros Thassos	EBA	Yannouli 1994
	Stavroupoli	LN	Yannouli 2002b; 2004
	Thermi	LN	Yannouli 1989; 1990; 1992; Gkotsinas 2009
	Toumba Thessalonikis	MBA-LBA	Konstantinidou 2001; 2009; Nikolaïdou 2010; Vasileiadou 2009
	Vasilika	MN-LN	Yannouli 1994
Cemetery	Akanthos	CL	Trakasopoulou-Salakidou 1996
	Drama Industrial Area	ARCH	Koukouli-Chryssanthaki 1979
	Ivani Prionia	ARCH-CL	Karamitrou-Mentesidi 2007
	Kentria Thassos	EIA	Halstead and Jones 1992
	Larnaki Thassos	EIA	Halstead and Jones 1992
	Mikro Livadi Mavropigi	ARCH	Gkotsinas 2019a
	Tsiganadika Thassos	EIA	Halstead and Jones 1992
Sanctuary	Herakleion (Thassos)	ARCH	Gardeisen 1996
	Nea Irakleitsa	ARCH-CL	Gkotsinas 2020
	Oisyme	ARCH	Gkotsinas (unpublished)

Table 1.2. Zooarchaeological studies (terrestrial mammals) in the Macedonian region by type of site (alphabetically)

Key: EN: Early Neolithic, MN: Middle Neolithic, LN: Late Neolithic, EBA: Early Bronze Age, MBA: Middle Bronze Age, LBA: Late Bronze Age, EIA: Early Iron Age, ARCH: Archaic period, CL: Classical period

This doctoral research aims to address these gaps, investigating – for the first time as a whole – the issue of animal husbandry and the relationship between people and animals through the latter's exploitation and consumption in the Macedonian region from the Early Iron Age to the Classical era. Thus, dietary choices through time, cooking techniques, consumption practices, discard strategies, the exploitation of natural faunal resources and farming practices are explored. The latter will try to investigate the scale and mobility of livestock husbandry and the degree of integration between herding and arable farming. Moreover, this study will try to explore some fundamental questions surrounding the role of livestock within the settlements founded by southern Greeks, known as Greek *polis*, and those founded by local populations, in order to identify the structure of their political economies and detect any differences. Thus, husbandry patterns will be investigated in relation to the household, the market, and sanctuaries. In addition, the question of whether all the meat consumed by the inhabitants of Early Iron Age to Classical Macedonia was obtained virtually from ritual sacrifices will be investigated.[18]

To investigate the above issues, animal bone assemblages are studied from three settlements, namely Argilos, Karabournaki and Kastri Thassos (hereafter 'Kastri'). The first is a Greek *polis* and the other two are local settlements. Argilos and Karabournaki are located in the coastline of the Macedonian region and Kastri in the island of Thassos. Their study explores aspects of the economy relating to the management of domestic animals and its effects on the socio-political organization of these settlements. The data from these three sites are combined with those from previously published studies of settlements, cemeteries, and sanctuaries from the Aegean basin to develop a synthesis of the exploitation of animals in the region of Macedonia from the Early Iron Age to the Classical era that may serve as a foundation for future investigation in the wider area of north Aegean and Balkan hinterland.

In regard to the structure of the thesis, the research is presented in four chapters. **Chapter 1** details the scope of this research and gives a general introduction to Early Iron Age, Archaic and Classical Macedonian region in terms of natural geography, paleoenvironment and political geography. **Chapter 2** outlines the methodology followed for the recording and analysis of the three assemblages, and **Chapter 3** presents results from the zooarchaeological study of the settlements

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[18] E.g., Ekrorg 2007; Jameson 1988.

of Argilos, Karabournaki and Kastri.[19] Finally, **Chapter 4** summarizes the results of the three sites in combination with previously published faunal studies from the region and the Aegean basin from the Early Iron Age, Archaic and Classical eras, while new questions and proposals for future research are set out.

1.3. The Macedonian region during the first millennium BC

The region of Macedonia in north Greece is in the southern part of the Balkan Peninsula, forming a land and sea passageway linking Anatolia and the Near East with the Balkans and Central Europe. It had been a crossroads for the diffusion of cultures since prehistory, while during the first millennium BC., it became an "apple of discord" both between indigenous tribes and between locals and foreigners due to its fertile lands and abundant natural resources.

The following sections briefly present the natural geography and paleoenvironment, as well as the political geography of the area around the sites under study (hereafter 'area under study'), namely Argilos, Karabournaki and Kastri, in order to better understand the context in which these sites were established and developed. The paleoenvironment is presented through available palynological analyses, and the political geography is presented following the main historical phases of the ethnic groups, indigenous or not, that lived within the area under study during the first millennium BC. until their conquest by the Macedonians under King Philip II, according to available literary sources and inscriptions.

1.3.1. Natural geography

As mentioned above, for the sake of a better understanding of the wider environmental and anthropogenic landscape within which the sites under study, Argilos, Karabournaki and Kastri, were established and developed, the study area is limited to the Aegean part of the Macedonian region and more specific between the plain of Thessaloniki-Giannitsa to the west, the Nestos River

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[19] The three sites under study in both Chapter 2 and Chapter 3 are presented alphabetically (Argilos, Karabournaki, Kastri).

to the east, the mountains Voras, Kerkini, Orvilos and Falakro to the north and the Aegean Sea to the south, including the island of Thassos. The coastline includes gulfs, in which smaller bays and coves are formed, two inhabited islands, Thassos and Ammouliani, and many more uninhabited islets. The peninsula of Chalkidici is also located here, bordered by the Koroni and Volvi lakes to the north and culminating in three smaller peninsulas to the south, Kassandra, Sithonia and Athos. The natural terrain of this region is characterized by a sequence of mountains and plains, valleys, rivers, lakes, and marshes. Three main drainage basins are formed, the plains of Thessaloniki-Giannitsa, Serres and Drama-Tenaghi Philippi, delineated by large mountains (such as Vermio, Krousia and Menoikio) and crossed by large rivers (such as Axios and Strymon). (**Fig. 1.3**)

The westernmost plain is Thessaloniki–Giannitsa, which is almost entirely surrounded by mountains except to the south-southeast, where it opens up to the Thermaic Gulf. The flow of the River Axios, which rises in the Balkan hinterland and runs into the Thermaic Gulf, is relatively smooth, creating a natural communication route between the Aegean coast and the central Balkans. The settlement of Karabournaki is located on its namesake cape on the eastern shore of the Thermaic Gulf, at the southeast end of the plain of Thessaloniki, where the Anthemous valley opens up to the east. Moving eastward, the next plain is Serres, traversed by the River Strymon, which flows into the Strymonic Gulf. Just before its mouth, the river once crossed Lake Achinos, now drained.[20] The city of Argilos is located four kilometres west of the Strymon delta, on the coastline south of Mount Kerdyllia. The plains of Drama and Tenaghi Philippi come next, surrounded by mountains, the northernmost of which, Mount Symvolo, prevents direct access to the coast and the gulf of Kavala. The plain of Drama is formed within the basin of the River Aggitis, a tributary of the River Strymon. The point where the two rivers meet is a natural crossing between the Strymon lowland and the plain of Drama. The plain of Tenaghi Philippi, located just south of the plain of Drama, was created through the drainage of an extensive swamp[21]. Finally, the island of Thassos lies just to the southeast of the Gulf of Kavala. It is fairly mountainous with few plains, mostly around the coast on its eastern and western sides. The site of Kastri is located to the south, on its namesake hill in the interior of the island. (**Fig. 1.3**)

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[20] The lake was also called Achinos and was drained in the early 20th c. AD.

[21] The swamp was drained in the 1930s.

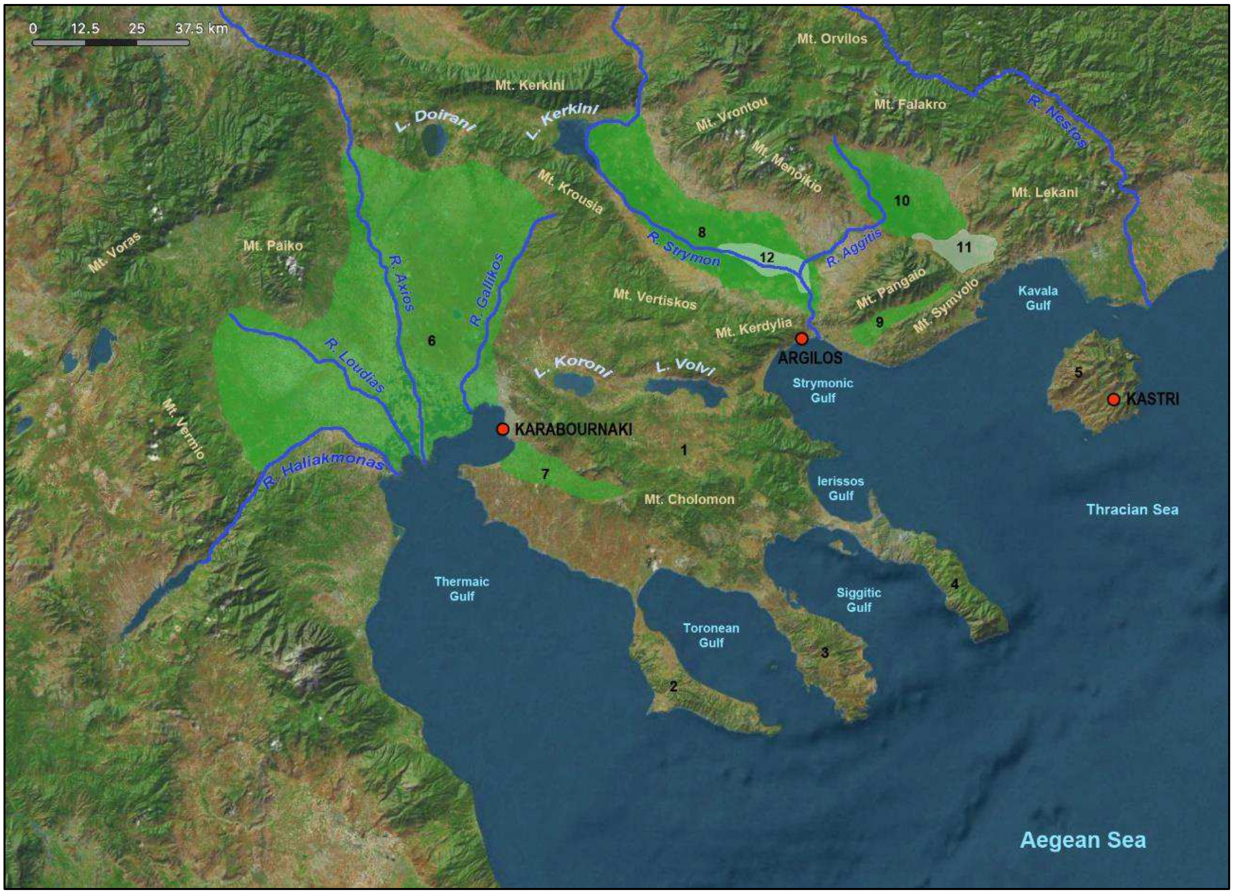

Fig. 1.3. The natural geography of the area under study (©Apple Maps)
Key: 1: Chalkidici, 2: Kassandra, 3: Sithonia, 4: Athos, 5: Thassos island, 6: Thessaloniki-Giannitsa plain, 7: Anthemous valley, 8: Serres plain, 9: Pieria valley, 10: Drama plain 11: Tenaghi Philippi, 12: Achinos Lake (drained)

1.3.2. Palaeoenvironment

The composition of the vegetation in the area under study is the result of evolutionary processes that took place within the aforementioned time frame. The factors affecting those changes can be internal, external or a combination of both.

Internal factors include processes intrinsic to the vegetation itself, in direct association with natural parameters, such as the climate, soil and flora. Climate is one of the most crucial regulators of natural vegetation, and its impact varies on both a local and a global scale. In the Aegean basin, climate is determined by the interaction of the Siberian High and the Azores High,[22] and displays

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[22] Zerefos et al 2011: 30.

great diversity due to the complex relief of the area under study. More specifically, there are three climatic zones in the area: the Mediterranean zone, the Continental zone and a transitional zone between them (**Fig. 1.4**), which is greatly affected by the geomorphology of the land.[23] The respective vegetation zones are also determined by the climate. There are five major zones, each one contains two subzones, which are differentiated according to altitude and characterized by specific plant species. The zone at the lowest altitude is the Quercetalia ilicis, which reaches up to 600 m. followed by the Quercetalia pubescentis, lying between 600–800 m. Then follows the Fagetalia at 800–1,600 m., the Vaccinio-Picetalia at 1,600–1,700 m. and finally, the Astragalo-Acantholimonetalia at 1,700–2,900 m.[24] (**Fig. 1.5**, **Table 1.3**). The dominant plant species in each zone and their degrees of occurrence are not always standard through time. Such changes are recorded in pollen diagrams, the study and interpretation of which can help reconstruct the paleovegetation of the period.

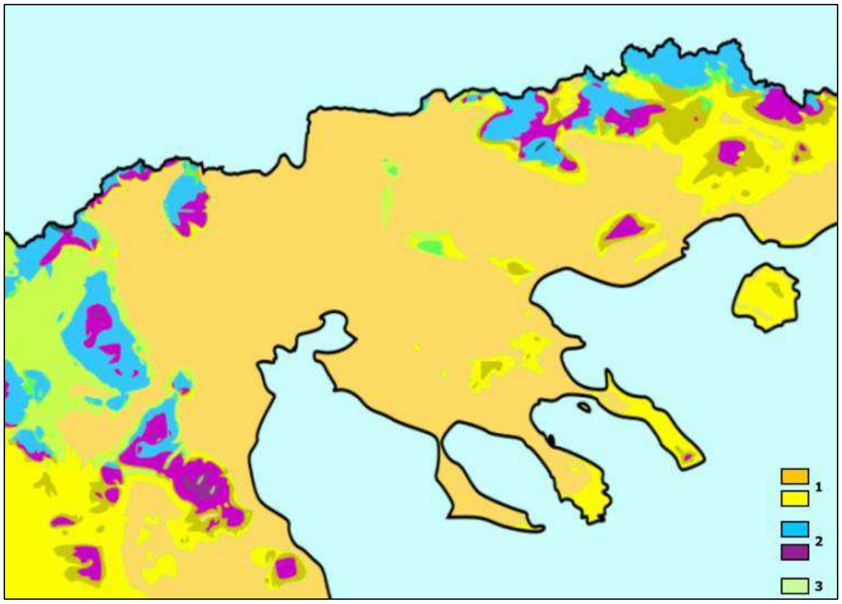

Fig. 1.4. The climatic zones of in the area under study (Hylke et al. 2018)
Key: 1: Mediterranean, 2: Continental, 3: Mediterranean-Continental

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[23] Pavlopoulos and Kouli 2010: 36.
[24] Athanasiadis 1986; Ntafis 1973.

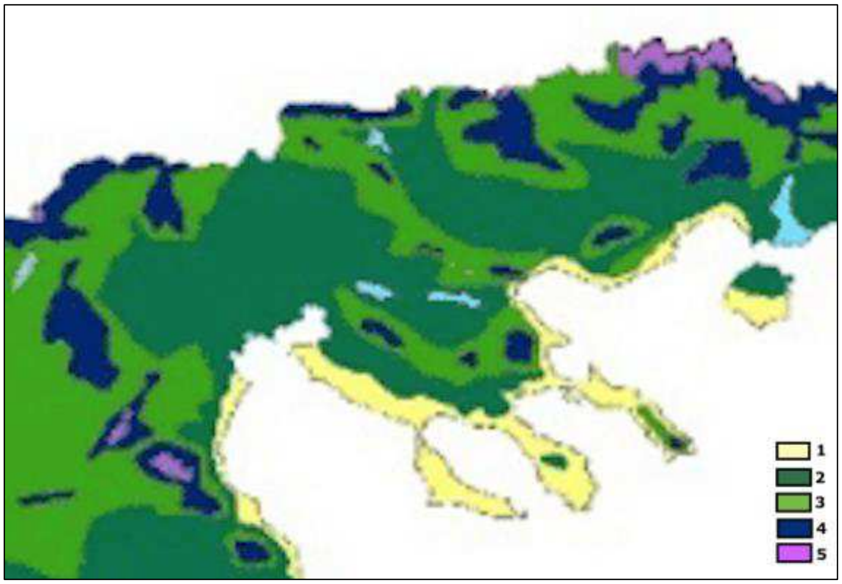

Fig. 1.5. The vegetation zones in the area under study (Spanos et al. 2018)

Key: 1: Quercetalia ilicis, 2: Quercetalia pubescentis, 3: Fagetalia, 4: Vaccinio-Picetalia, 5: Astragalo-Acantholimonetalia

Altitude (meters)	Vegetation Zones	Subzones
0-600	Quercetalia ilicis	Oleo-Ceratonion
		Quercion ilicis
600-800	Quercetalia pubescentis	Ostryo-Carpinion orientalis
		Quercion frainetto-cerris
800-1,600	Fagetalia	Fagion sylvaticae
		Abietion cephalonicae
1,600-1,700	Vaccinio-Picetalia	Pinion heldreichii
		Vaccinio-Piceion
1,700-2,900	Astragalo-Acantholimonetalia	Astragalo-Daphnion
		Junipero-Daphnion

Table 1.3. The vegetation zones and their subzones per altitude in the Aegean basin

External factors include human activity, which can accelerate, decelerate, stop or alter the natural development of plants either directly or indirectly.[25] Such activities (e.g. agriculture, pastoralism, logging and land clearance through burning) may be detected in pollen diagrams through the presence of species called anthropogenic indicators (e.g. cereal-type plants).

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[25] Gerasimidis 1995: 172-173.

There are fifteen pollen diagrams from the area under study (**Fig. 1.6**), representing all vegetation zones, except for the highest one, Astragalo-Acantholimonetalia. These palynological diagrams show the development of vegetation in the sample area and its surroundings, which was dependent on the prevalent geomorphological and climatic conditions. The lower altitude diagrams often contain elements of the diagrams of the neighbouring mountains though the opposite is not true.[26] For this reason most of the diagrams are grouped by plain (Thessaloniki-Giannitsa, Serres, Drama-Tenaghi Philippi), while in two cases they are grouped geographically (Chalkidici Peninsula) (**Table 1.4**). The palynological data is presented here from west to east and only the data related to the first millennium BC and the transition from the second to the first millennium BC are given.

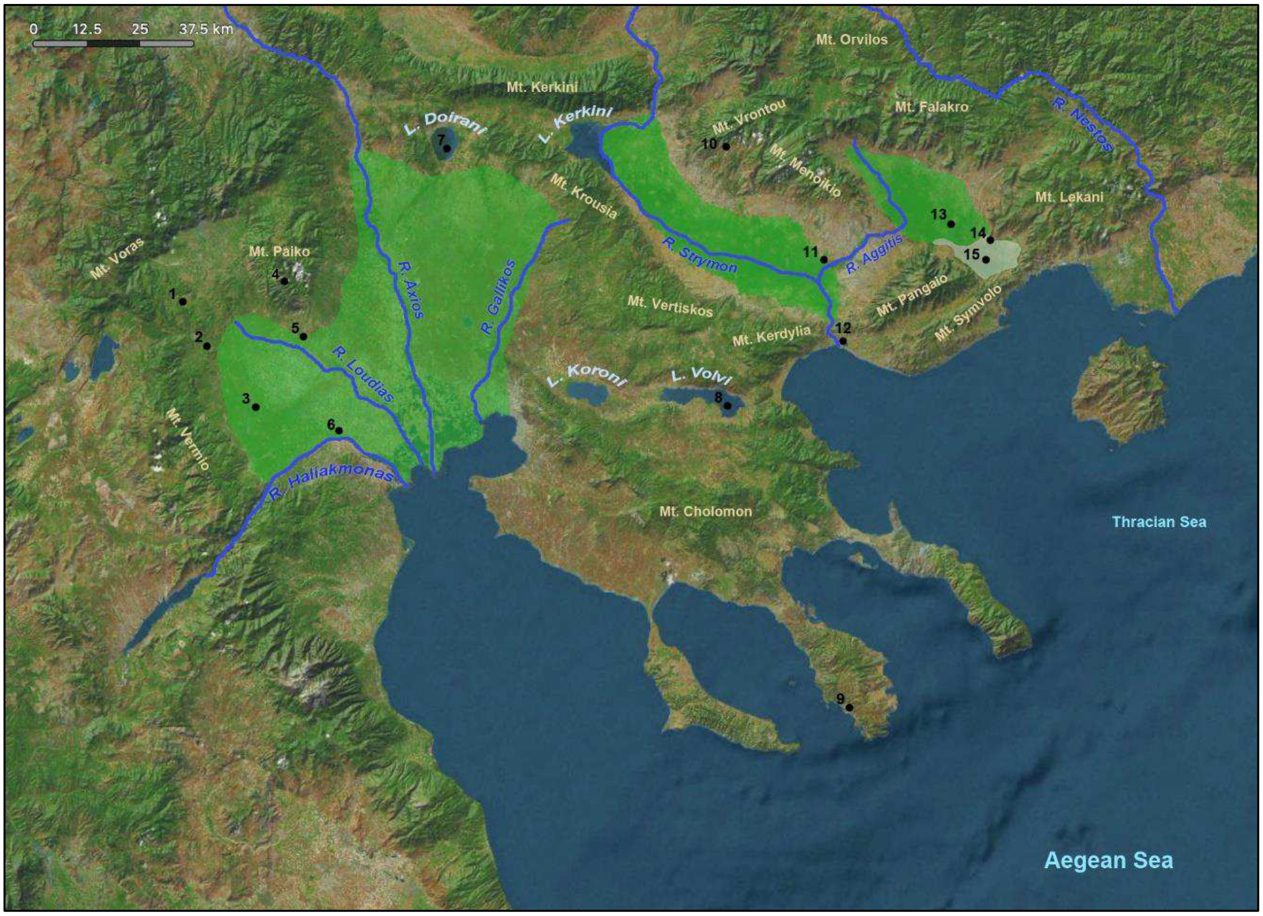

Fig. 1.6. The location of pollen samples in the area under study (©Apple Maps)

Key: 1: Voras, 2: Edessa, 3: Angelochori, 4: Paiko, 5: Giannitsa, 6: Nisi, 7: Doirani, 8: Volvi, 9: Tristinika, 10: Lailias, 11: Aggitis, 12: Strymon delta 13: Xeropotamos, 14: Dikili Tash, 15: Tenaghi Philippi

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[26] Gerasimidis 1995: 183.

Area	Pollen diagrams	Reference
Plain of Thessaloniki-Giannista	Angelochori	Kouli 2010
	Giannitsa	Bottema 1974; Athanasiadis et al. 1993a; 1993b
	Edessa	Bottema 1974; Athanasiadis et al. 1993a; 1993b
	Nisi	Lawson 2001
	Mount Paiko	Athanasiadis and Gerasimidis 1987; Gerasimidis and Athanasiadis 1995; Gerasimidis et al. 2002
	Mount Voras	Athanasiadis and Gerasimidis 1986; Al-Omari 1999
	Lake Doirani	Athanasiadis et al. 2000
Plain of Serres	Aggitis (lower valley)	Atherden et al. 2000
	Strymon delta	Lespez et al. 2016
	Lailias (Mount Vrontou)	Gerasimidis 1995; 2000
Plain of Tenaghi Philippi	Tenaghi of Philippi	Van der Hammen et al. 1965; Wijmstra 1969; Greig and Turner 1974
	Dikili Tash	Glais et al. 2017
	Xeropotamos	Lespez 2003; Glais et al. 2016
Chalkidici Peninsula	Lake Volvi	Bottema 1982
	Tristinika	Panajiotidis and Papadopoulou 2016

Table 1.4. The pollen diagrams in the area under study

1.3.2.1. Plain of Thessaloniki-Giannitsa

The data derived from the palynological analyses of Angelochori,[27] Giannitsa,[28] Edessa,[29] Nisi,[30] Mounts Paiko[31] and Voras[32] and Lake Doirani[33] (above, **Fig. 1.6**), covering all the vegetation zones, apart from the one at the highest altitude (Astragalo-Acantholimonetalia).

During the 1st millennium BC, human intervention in the natural vegetation increased in the plain of Thessaloniki-Giannitsa and the low altitude areas, with characteristic examples being the introduction of chestnut (*Castanea*) and walnut (*Juglans*), which were not native species, and plane trees (*Platanus*),[34] shortly before or after the beginning of the 1st millennium BC. At the same time, the dominance of juniper (*Juniperus*) in the region of Giannitsa is seen because of increased grazing leading to decreased forest vegetation.[35] Interventions are also noticeable at the higher

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[27] Kouli 2010.
[28] Bottema 1974; Athanasiadis et al. 1993a; 1993b.
[29] Bottema 1974; Athanasiadis et al. 1993a; 1993b.
[30] Lawson 2001.
[31] Athanasiadis and Gerasimidis 1987; Gerasimidis and Athanasiadis 1995; Gerasimidis et al. 2002.
[32] Athanasiadis and Gerasimidis 1986; Al-Omari 1999.
[33] Athanasiadis et al. 2000.
[34] Athanasiadis 1975; Bottema 1974.
[35] Gerasimidis 1995: 190.

altitudes of Mount Voras,[36] Mount Paiko[37] and Lake Doirani.[38] The arboreal vegetation of the Late Bronze Age gradually decreased and was replaced by oak forests and non-arboreal species. The pollen diagrams of Mount Paiko show that the ratio between arboreal and non-arboreal vegetation during the Early Iron Age and the Archaic period was 59:41. The prevalence of oak and non-arboreal vegetation appears to have been the result of human intervention in the environment.[39] This intervention was apparently related to pastoral activity, [40] as non-arboreal species such as Gramineae, Leguminosae, Compositae and Labiatae are common in grazing grounds. [41] Cultivation might have been more limited, on the other hand, judging by the low levels the relevant pollen record, though the poor dispersal of cereal pollen may act as a serious bias. In any case, human activity seems reduced during the Classical era, as indicated by the subsequent recovery of the arboreal vegetation over species-indicators of grazing and cultivation.

1.3.2.2. Plain of Serres

Data on the paleovegetation of this region are provided by the pollen diagrams of the Strymon delta[42] and the lower valley of the Aggitis[43] to the south of the plain of Serres, belonging to the first vegetation zone (Quercetalia pubescentis) and from the area of Lailias (Mount Vrontou)[44] in the third zone (Fagetalia) (above, **Fig. 1.6**).

According to the pollen diagram of the lower Aggitis valley, a shallow limnic and marshy environment existed at the confluence of the two rivers Aggitis and Strymon during the Late Bronze Age and the Early Iron Age. The vegetation around this environment was characterized by riparian forests of willows (*Salix*) and alders (*Alnus*). The previous dominance of oak and Ostryo-Carpinion vegetation[45] in the low areas beyond the riparian zone subsided in favour of non-

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[36] Athanasiadis and Gerasimidis 1986.
[37] Athanasiadis and Gerasimidis 1987.
[38] Athanasiadis et al. 2000.
[39] Gerasimidis et al. 2002: 179.
[40] Gerasimidis et al. 2002: 179.
[41] Behre 1990; Birks 1986; Bottema and Woldring 1990.
[42] Atherden et al. 2000.
[43] Lespez et al. 2016.
[44] Gerasimidis 1995: 193; 2000: 33.
[45] Ostryo-Carpinion is a subzone of Quercetalia pubescentis with deciduous vegetation (above, Table 1.3).

arboreal vegetation, while the presence of species with leaves that thrive in dry, hot conditions, such as olives (*Olea europea*), and also of pines (*Pinus sylvestris*), which are spread along the nearby slopes, is also attested. Non-arboreal vegetation includes increased levels of anthropogenic indicators, such as Cerealia, anthropozoogenous and anthropic–nitrophilous taxa[46] and traces of fire, indications of agro-pastoral activities in the area. The changes in arboreal vegetation and the dominance of evergreen arboreal species are signs of drier climatic conditions compared to previous eras, possibly due to the decrease in humidity that commenced during the Bronze Age.[47] The changes outlined, in association with the increased human activity in the area, confirm the hypothesis of an overall dryness of the local environment.[48] In regard to Strymon delta, from the Late bronze Age to the Early Iron Age (Strymon 1 core, **Fig. 1.7**), trees, mainly kermes oaks (*Quercus coccifera*) and pines (*Pinus sylvestris*), and shrubs are dominate, followed by non-arboreal species, such as cereals, grasses (Poaceae) and weeds (e.g. Fabaceae, Brassicaceae and Plantaginaceae), with grasses and weeds in low values.[49] The consistent presence of cereals suggest their cultivation, while pasture indicators are scarce. Of the cultivable trees, olive (*Olea europea*) makes up 30% of the total pollen, while chestnut (*Castanea*), walnut (*Juglans*) and plane (*Platanus*) are present but in small amounts. During the Classical/Hellenistic period, there is a decline in cereals and olives, a regeneration of trees, especially oaks (*Quercus robur*) and pines trees, an increase of the Chenopodiaceae and an expansion of the saltmarsh vegetation.[50]

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[46] The anthropozoogenous (e.g. Chenopodiaceae, Plantago lanceolata type, Urtica dioica type) and anthropic–nitrophilous (e.g. Aster type, Boraginaceae, Cichorioideae) taxa refer to plants associated with grazing pressure in close relationship with anthropogenic activities such as livestock farming.

[47] Finné et al. 2011.

[48] Lespez et al. 2016.

[49] Atherden et al. 2000: 13.

[50] Atherden et al. 2000: 17.

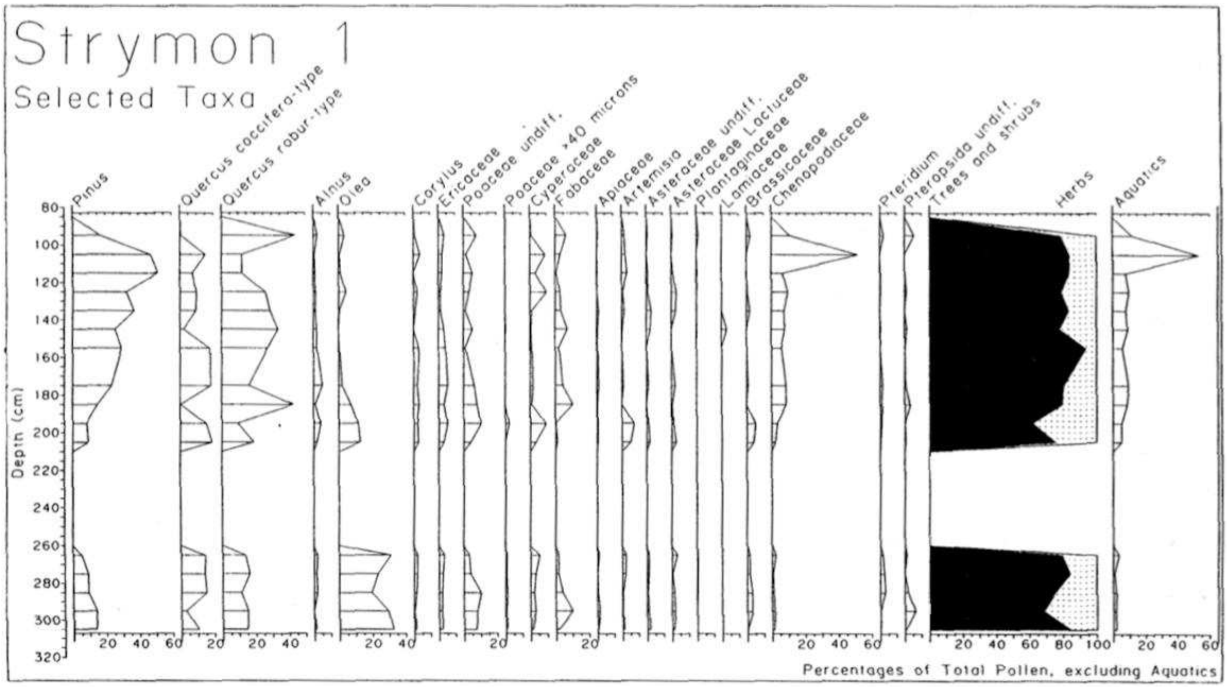

Fig. 1.7. Pollen diagram from Strymon delta; Strymon 1 core: Late Bronze Age-Hellenistic period (Atherden et al. 2000, Fig. 2.7)

To the north of the plain, at the site of Lailias on the western slopes of Mount Vrontou, vegetation at higher altitudes during the Late Bronze Age was represented almost entirely by arboreal species, with conifers dominating (*Pinus*, *Abies*), while deciduous species (*Tilia, Corylus*), which had dominated during the 3rd and 4th millennia BC, occupyied the lower altitudes.[51] The low levels of non-arboreal vegetation and the absence of species associated with human activity suggest that any changes that occurred in forest vegetation from the Late Bronze Age onwards were due to climatic changes[52] rather than human presence. The composition of vegetation would remain the same until the late 4th c. BC.

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[51] Gerasimidis 2000: 35.
[52] Gerasimidis 2000: 35.

1.3.2.3. Plain of Drama-Tenaghi Philippi

The available palynological diagrams derive from the Tenaghi of Philippi,[53] Dikili Tash[54] and Xeropotamos,[55] all situated within the first vegetation zone, Quercetalia ilicis (above, **Fig. 1.6**).

Analysis of the diagrams from Tenaghi and Dikili Tash (**Fig. 1.8**) reveals that during the Late Bronze Age and the Early Iron Age, vegetation around Tenaghi differed from that of previous periods. The arboreal vegetation of alder (*Alnus*) and oak forests (*Quercus*) that once covered the margins of the marsh[56] was reduced and replaced by mostly non-arboreal species, such as hydrophilic plants and grasses (Poaceae). Plants associated with cultivation, for example, cereals, also decreased, as did the levels of coprophilous plants, indicative of pastoral practices in the area.[57] Incidents of fire were also detected. Furthermore, the small percentage of pine (*Pinus sylvestris*) and other species that prefer a hot, dry climate possibly derived from the vegetation zones of the nearby slopes.[58]

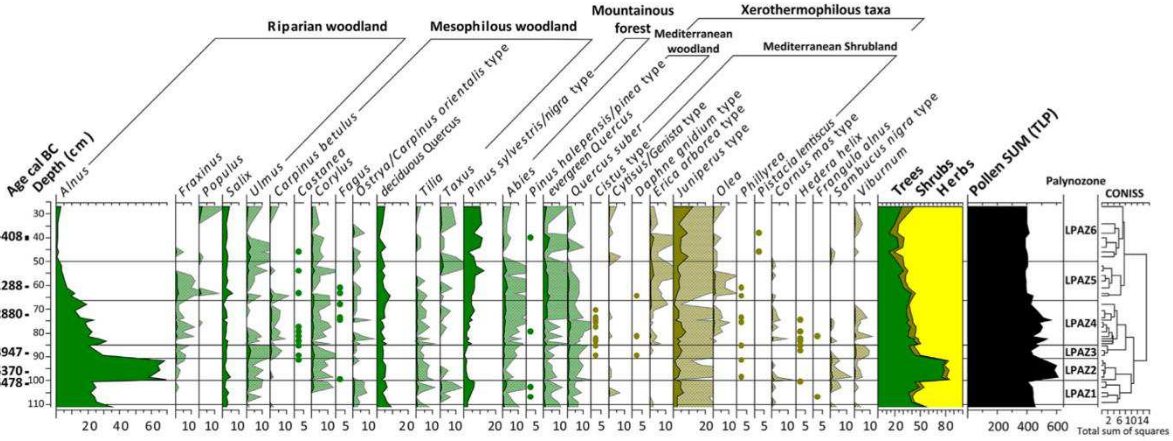

Fig. 1.8. Pollen diagram from Dikili Tash; Dik4 core (Glais et al. 2017, Fig. 6)

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[53] Van der Hammen et al. 1965; Wijmstra 1969; Greig and Turner 1974.
[54] Glais et al. 2017.
[55] Lespez 2003; Glais et al. 2016.
[56] Turner and Greig 1975: 196-8.
[57] Glais et al. 2017: 14.
[58] Turner and Greig 1975: 196-198; Glais et al. 2017: 14.

The changes that occurred during the Late Bronze Age and Early Iron Age are most likely attributable to environmental and climatic factors rather than human intervention.[59] The presence of pine and species suited to dry, hot conditions, including olive,[60] in the surrounding area appears to have been encouraged by the intense dryness that occurred between 1450–850 BC, which was one of the hottest periods of the Holocene,[61] known also as the "1200 cal BCE event".[62] The increase in hydrophilic species and grasses at the expense of the riparian arboreal species could possibly be due to a seasonal shift in the limits of the lake-marsh as a result of an increase in the volume of water that reached it.[63] This is possibly associated with the phenomenon of the "Mediterraneanization" of the Aegean climate which occurred after 2500 BC: summers became drier, and winters had more frequent and more violent rainfalls.[64] These changes caused overflows and floods, and this was possibly the reason why agricultural and pastoral exploitation of the margins of the marsh reduced, as suggested by the low levels of anthropogenic indicators. Hence, agro-pastoral activities must have taken place on drier ground, such as low hills or the foothills of the mountains.[65] Finally, the fire incidents detected on the marsh shores and the nearby hillocks must be associated with attempts to create grazing grounds.[66]

The palynological data from Xeropotamos, at the western end of the plain, also support the assumption of a gradual decline in agricultural and pastoral activities, as they indicate an expansion of agricultural and grazing grounds to the low hills and slopes.[67] This expansion led to land clearance for the creation of open spaces, which, in association with the precipitation indicators, appear to be the reasons for soil erosion and the increase in sediment accumulation documented in the valley around the prehistoric site of Dikili Tash at the time.[68] This situation appears to continue during the Archaic era and as late as the Hellenistic era, with the riparian forests of alder and oak almost disappearing, while pines appeared at higher altitudes.[69] The levels of cultivated species

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[59] Turner and Greig 1975: 197; Gerasimidis 1995: 188.
[60] Turner and Greig 1975: 197.
[61] Finné et al. 2011.
[62] Kaniewski et al. 2013.
[63] Glais et al. 2017: 14.
[64] Kuhnt et al. 2008.
[65] Glais et al. 2017: 14.
[66] Lespez 2008; Marinova et al. 2012.
[67] Lespez 2003; Glais et al. 2016.
[68] Glais et al. 2017: 14.
[69] Glais et al. 2017: 15.

and coprophilous species in the area around the marsh would remain low throughout the Archaic era until Classical and Hellenistic times, when a systematic exploitation of its margins is attested for the first time since the Late Bronze Age.[70]

1.3.2.4. Chalkidici Peninsula

Information on the region's paleovegetation relates to the second vegetation zone (Quercetalia pubescentis) at Lake Volvi[71] and the first vegetation zone (Quercetalia ilicis) at the site of Tristinika in Sithonia[72] (above, **Fig. 1.6**).

According to the palynological diagram from Lake Volvi at the north end of the peninsula, a gradual decrease in Ostryo-Carpinion vegetation[73] on the plain around the lake is attested from the Late Bronze Age onwards. A similar decrease is noted in the oak and pine forests of the nearby higher areas. Arboreal vegetation was gradually replaced by non-arboreal vegetation in both the medium and higher altitude regions. This vegetation included anthropogenic indicators (*Artemisia, Plantago*, cerealia-type)[74] for agro-pastoral activities in the nearby region. Human activity is also confirmed through the presence of walnut trees from the outset of the Early Iron Age and through the cultivation of olive trees which intensified in the Classical era.[75]

Based on the palynological data from Tristinika (**Fig. 1.9**), from the Late Bronze Age to the end of the Classical era, the surrounding landscape contained extensive open areas with phrygana, heaths and maquis, limited pine forests and cultivated species such as olives, cereals and grapevines (*Vitis*). This environment was the result of the constant management of vegetation through controlled burning, a practice that renews food resources for goats and sheep, which favours the secondary vegetation of phrygana (*Cistus*, *Sarcopoterium*) and heaths (*Erica*). The

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[70] This systematic exploitation is possibly linked to information given by Theophrastus on the attempts of the ancient Macedonians to drain the swamp water in order to create more arable land.

[71] Bottema 1982

[72] Panajiotidis and Papadopoulou 2016

[73] Ostryo-Carpinion is a subzone of Quercetalia pubescentis with deciduous vegetation (above, Table 1.3).

[74] Bottema 1982: 263-264.

[75] Bottema 1982: 265.

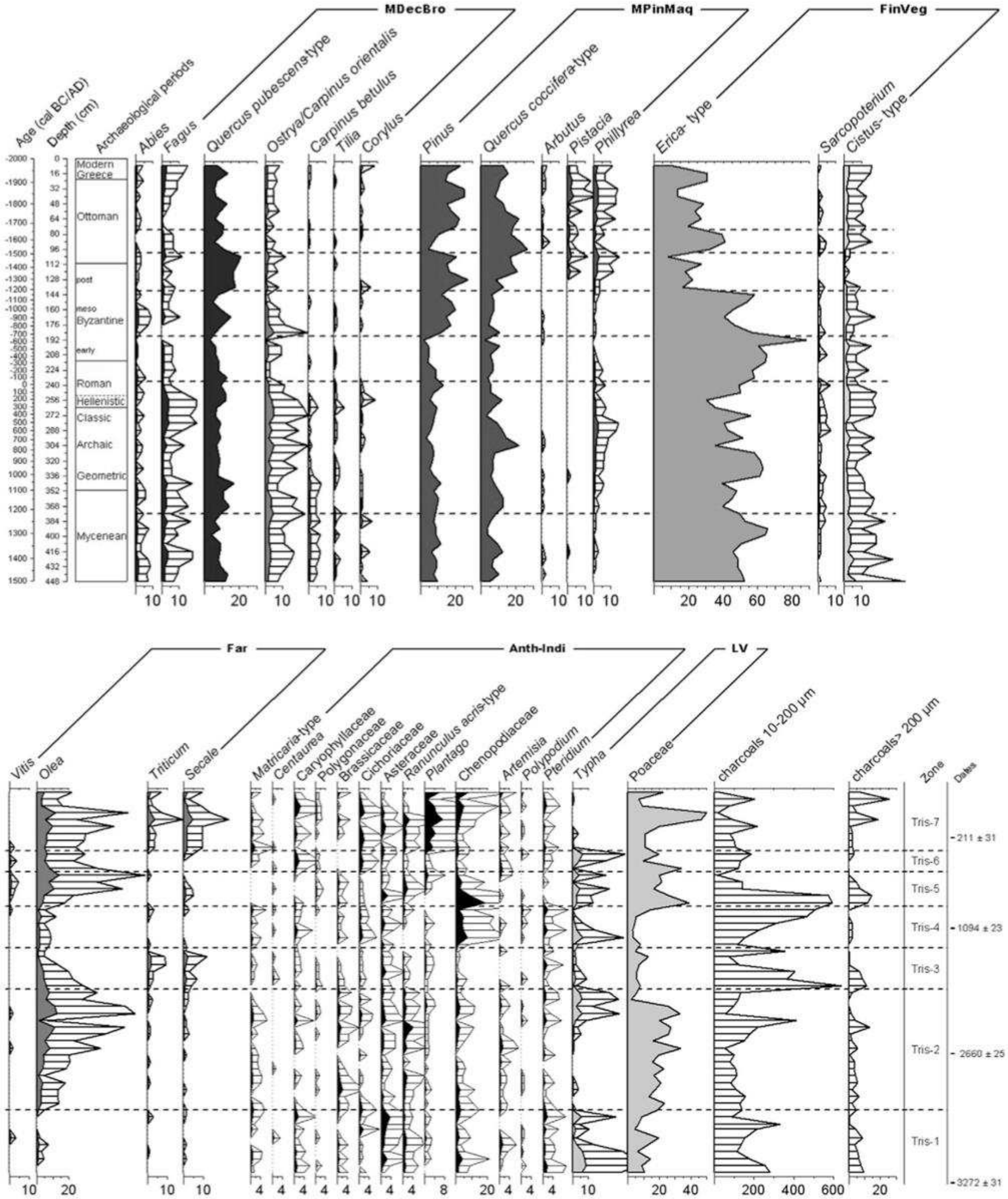

Fig. 1.9. Pollen diagram from Tristinika, Sithonia (Panajiotidis and Papadopoulos 2016, Fig. 3)

remarkable dominance of *Erica* in the pollen diagram points towards the regular burning of maquis patches throughout the entire period studied.[76] The maquis elements are composed mainly of kermes oak (*Q. coccifera*) and, to a lesser extent *Phillyrea*, which are well adapted to both fire and grazing. The intense overgrazing created degraded dry heathlands, as indicated by the presence of

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[76] Panajiotidis and Papadopoulou 2016: 143.

Pteridium and *Polypodium.*[77] Furthermore, the sharp reduction of *Typha latifolia* at the end of the Late Bronze Age and of *Fagus* at the end of the Early Iron Age and during the Archaic period, indicates a reduction in humidity. This reduction is probably related to the cold/dry interval[78] which lasted from the end of the Late Bronze Age and throughout the Early Iron Age. Both taxa re-emerge from the Classical era onwards, a period assumed to have experienced relatively warmer and wetter conditions.[79] Despite the favourable dry climatic conditions, the presence of pine woodlands decreased, probably due to continuous grazing pressure and exploitation for wood and resin.[80] In relation to the cultivated taxa, the presence of olive is first noted in the Late Bronze Age, while its systematic cultivation started in the Early Iron Age period and became widespread from the Archaic period onwards. Cereals (*Triticum/Secale*) first appeared during the Late Bronze Age, but their systematic cultivation started in the Archaic period, when more sedentary settlements were established in the area. Finally, there are few signs of *Vitis* cultivation, meaning that the area around Tristinika was only occasionally used for such cultivation as the pollen of *Vitis* is rarely dispersed outside a vineyard.[81]

Summary

To sum up, the changes in vegetation were the result of climate change on the one hand, taking place mostly during the Late Bronze Age and the beginning of the Early Iron Age, and human activity on the other hand. Ostryo-Carpinion vegetation and oak forests dominated the environment at low and medium altitudes, while land at higher altitudes was covered by conifer forests of pine and fir. The ever-increasing needs of the inhabitants to meet their dietary requirements and exploit the natural environment to obtain raw materials brought gradual changes in vegetation, sometimes even altering the landscape itself. The Ostryo-Carpinion and oak forests were gradually cleared through burning to create open land for cultivation and herding, while the conifer forests offered plentiful timber.

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[77] Behre 1981.
[78] Drake 2012: 4-5.
[79] Reale and Dirmeyer 2000.
[80] Panajiotidis and Papadopoulou 2016: 143.
[81] Athanasiadis et al. 1993b.

1.3.3. Political geography

The area under examination has been inhabited by various population groups throughout history.[82] Ancient sources define some of them as Thracians and others as Paeonians, while Macedonians were also present, along with Greeks from further south. Some of those groups were, at times, organized in tribes and kingdoms, without always having a fixed geographical distribution.[83] Some of the aforementioned groups had settled the region since prehistoric times, while others arrived later as a result of wider population relocations and movements that took place in the area during the 1st millennium BC.[84] The most important events that determined those movements were the second Greek colonization (8th –5th c. BC),[85] the rise of the Macedonian royal house of the Temenids (700–310 BC),[86] the Persian Wars (499–449 BC) and the Peloponnesian War (431–404 BC).

1.3.3.1. Southern Greek settlers

The earliest presence of southern Greek colonists in the region of Macedonia (ancient Thrace at that time),[87] the Chalkidici Peninsula and the island of Thassos occurred in the 8th c. BC.[88] Social, economic and political circumstances[89] in the southern Greek world resulted in a wave of colonization involving the organized relocation of groups of people from cities of the southern mainland and the Aegean islands towards new lands around the Mediterranean and Black seas, including the northern Aegean coastline and islands.[90] In the area under study, colonization was led by the Euboean cities of Eretria and Chalkis, with the Corinthians, Andrians, Parians, and later on, the Athenians following. (**Fig. 1.10**)

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[82] Zanni et al. 2007.
[83] Samsaris 1976: 54.
[84] Gillies 1825.
[85] Tsetskhlandze 2008; Tsetskhlandze et al. 2004.
[86] Edson 1970: 17-44; Lane Fox 2011.
[87] Fol et al. 1986; Lemos 2002; Loukopoulou 1989; 2004; Pelekidis 2000: 98-114; Triantafyllos 2000: 35-97.
[88] Johansen 1994; Mossé 1984; Vokotopoulou 2001: 739-762; Besios et al 2012.
[89] Boardman 1999: 229-230; Crawford and Whitehead 1983: 52-53; Malkin 1987: 2-3.
[90] E.g., Wilcken 1976: 118-126; Schuller 2001: 36-39.

The Eretrians and Chalcidians eventually settled almost the entirety of the three peninsulas of Chalkidici.[91] The Eretrians colonized the peninsula of Kassandra and the Toronean Gulf (Aphytis, Mekyverna, Mende, Sane, Sermyle)[92] and the peninsula of Athos (Palaiochorion, Kleones, Dion, Olophyxos, Akrothooi), while the Chalcidians colonized the peninsula of Sithonia and the Siggitic Gulf (Torone, Siggos, Sithone, Sarte, Assa)[93]. (**Fig. 1.10**)

The Corinthians also colonized Chalkidici, founding Potidaia on the isthmus of the Kassandra Peninsula, while on the isthmus of the Athos Peninsula, the Andrians founded Sane[94] on the Siggitic Gulf side and Akanthos on the Ierissos Gulf side. The Andrians also founded Stageira and Argilos on the west and north sides of the Strymonic Gulf[95]. Finally, the Parians colonized the island of Thassos[96]. Later, during the 5th c. BC, Athens implemented its own colonizing policy in the area through the institution of *klerouchia*,[97] settling Athenian citizens in the cities of Brea,[98] west of the River Strymon, and Eion and Ennea Odoi to its east. (**Fig. 1.10**)

Some of the new settlements developed into *metropoleis*, founding colonies of their own. Hence, Mende on the Kassandra Peninsula founded Neapolis on the edge of the Toronean Gulf, and Eion at the mouth of the Strymon River, and Argilos founded two settlements in the hinterland, Kerdyllion to its east and Tragilos to its northwest. Finally, the Thassians founded the cities of Galipsos, Oisyme, Neapolis, Akonisma, Apollonia, Antisara, Pistyros, Krenides and Stryme (east of the area under study) on the mainland coast opposite. (**Fig. 1.10**)

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[91] d'Agostino and Bats 1998.

[92] Vokotopoulou 1990: 79-86; Vokotopoulou and Christidis 1995: 5-11.

[93] Whitbread et al. 1997: 88-91.

[94] There were two colonies with the name Sane, one in Kassandra peninsula founded by the Eretrians and one in Athos peninsula founded by the Andrians.

[95] Tarabusly 1998; Romiopoulou 1999: 126-131.

[96] Martin 1893; Lazaridis 1958; Kohl et al. 2004: 57-71.

[97] *Klerouchia* was the distribution of land outside of Attica to landless Athenians (*klerouchoi)* by lottery. The *klerouchoi* lived in their new land permanently as settlers, while retaining their civil rights.

[98] Plutarch Pericles 11.

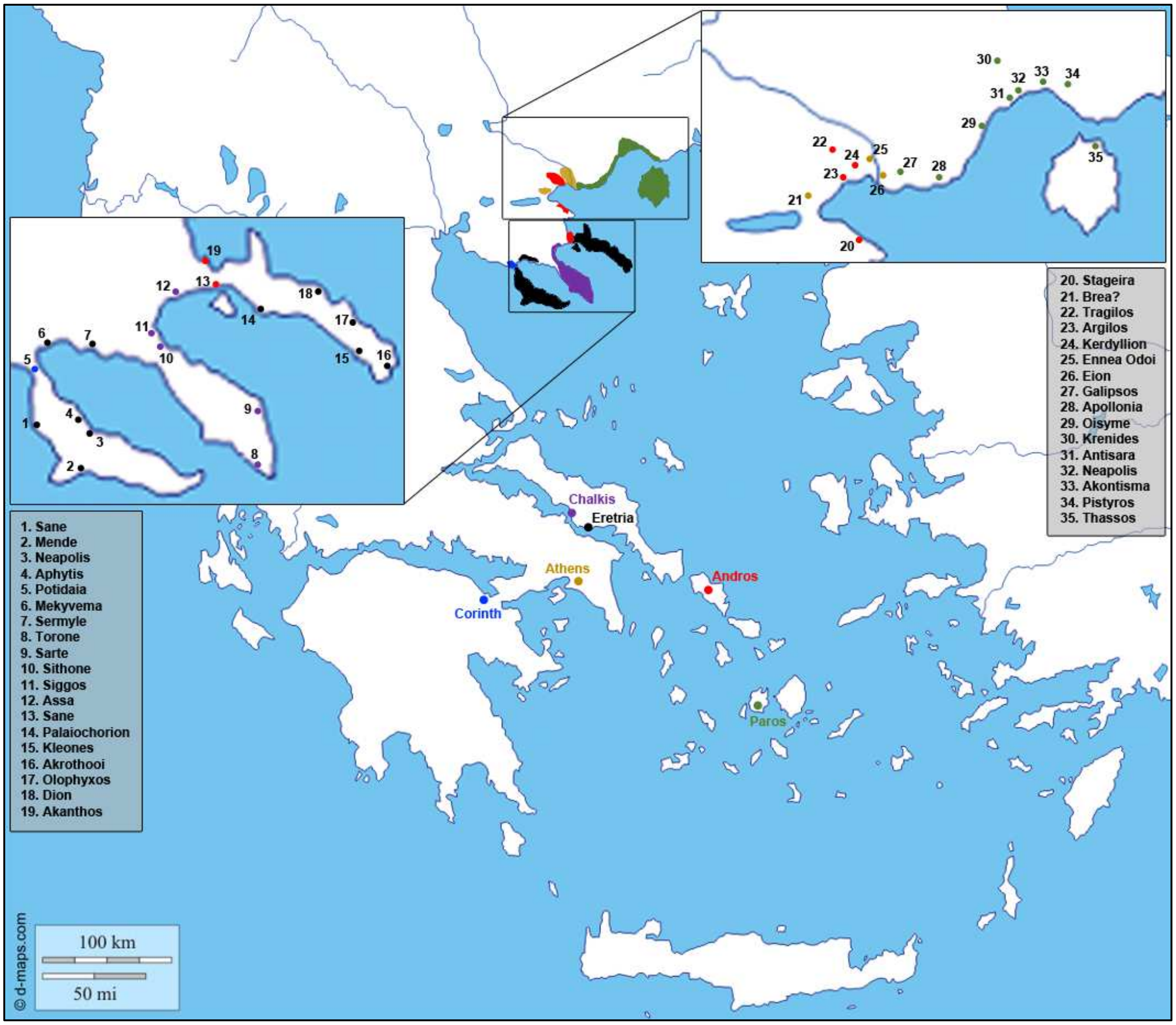

Fig. 1.10. South Greek *Metropoleis* and their colonization area in the area under study during the second Greek colonization wave (©d-maps.com)

1.3.3.2. Other ethnic groups

The most widely known population groups that occupied the region under study were the Pieres, Vottiaioi, Visaltes, Edonians and Krestonians. Other, smaller groups were the Tyntenoi, Almopes, Satres, Vissoi, Panaoi, Sapaioi and Dionysioi.[99] Some of these groups later disappeared, while others survived until the Macedonian conquest, some of them even forming states and lending their ethnonyms to specific geographical regions. The following sections present the main tribes that occupied the region under study.

Visaltes

The Visaltes, a Thracian tribe, occupied the west bank of the River Strymon (**Fig. 1.11**). This area was called Visaltia,[100] as was its capital.[101] The Visaltes exploited the fertile valley of the Strymon[102] and the lush mountain forests, and they mined for silver on Mount Dysoron (Krousia).[103] In the mid-7th c. BC, the Andrians founded Argilos on the coast of Visaltia, while in the late 6th c. BC, Argilos itself founded two more colonies in the interior of Visaltia, Kerdyllion to the east and Tragilos to the northwest (below, 3.1.1.1). The colonization does not appear to have been violent, and the Visaltes were quick to initiate contact with those settlements, apparently enjoying a benevolent relationship with them. This contact brought trading opportunities but also affected the Visaltes by introducing them to Greek culture. Their Hellenization is apparent in the Greek inscription “ΒΙΣΑΛΤΙΚΟΝ” on their coinage.[104] In contrast, in 446/5 BC, the Athenians took the Visaltian settlement of Brea by force, giving it to Athenian *klerouchous* (settlers).[105] In 342 BC, Visaltia ultimately lost its autonomy to the Macedonian King Philip II.

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[99] There is no general consensus on the ethnic ‘origin’ of each of these population groups in the relevant literature. Traditionally though, most of these are considered to be either Thracian or Paionian tribes.

[100] Vavritsas 2000: 71-74.

[101] Isaac 1986.

[102] Livius XLV, 30, 3; Strabo VII, 33.

[103] Hammond 1981: 118; Herodotus V, 17, 2.

[104] Svoronos 1919: 100-102, 105-115.

[105] Vartsos 1972: 103.

Mygdonians

The Mygdonians were a Thracian Edonian tribe, occupying an area defined by the River Axios to the west, Lake Doirani to the north, the mountains Krousia and Vertiskos to the east and the Anthemous Valley to the south. The area was called Mygdonia, opening up to the Thermaic and Strymonic gulfs (**Fig. 1.11**). The area's economy was based on agriculture, while gold nuggets from the River Gallikos[106] were also collected. The settlements of Mygdonia included Therme,[107] Apollonia,[108] Arethousa,[109] Sindos[110] and Chalastra. Many researchers have identified the settlement of Karabournaki with ancient Therme (below, 3.2.1.1).

Edonians

The Edonians, a Thracian tribe, occupied the land between the eastern bank of the River Strymon and the River Nestos (**Fig. 1.11**). This region was called Edonida and was coveted and fought over among the Thracians and the southern Greeks for its fertile lands, timber and its mineral resources from Mount Pangaio[111] and the region of Asyloi (Krenides).[112] Mount Pangaio was also covered by dense forests,[113] which supplied the region's ship-builders with timber for ships and oars.[114] In the coastal zone of Edonida was the Thassian Peraia,[115] named after a series of settlements founded by Thassian colonists along the coastline and in the hinterland from the 7th to the early 5th c. BC.[116] The last colony founded by the Thassians was Krenides in 361 BC, in the hinterland of Edonida, expanding the borders of the Thassian Peraia, which was then termed "Thassian Epirus" on the new settlement's coinage.[117] The Thassian colonies were divided into cities and trading posts

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[106] The ancient name of the river was Echedoros, which means *ο έχων δώρα* (bearing gifts), as gold nuggets were found on its banks.
[107] Herodotus VII, 124.
[108] Xenophon Hellenica 5.2.11.
[109] Plutarch 31.5.
[110] Herodotus VII, 123.3.
[111] Herodotus VII, 112; Strabo VII, 34.
[112] Strabo VII, 34.
[113] Thucydides IV, 108, 1.
[114] Thucydides IV, 100, 3.
[115] Herodotus VI, 46, 3; Thucydides I, 101, 3.
[116] Lazaridis 1971: 15-16, 29-32, 34-36, 51-58.
[117] Bon 1936: 173; Koukouli-Chrysanthaki 1980: 310-311.

depending on their size[118] and they fell under the economic and cultural system of the colonial state of the metropolis. Apart from Thassos, the Athenians also founded colonies in the land of the Edonians. The Athenians clashed with the Edonians for the capture of the cities of Eion in 476 BC[119] and Ennea Odoi in 437/6 BC.[120] The Athenians installed Athenian *klerouchou*s at Eion,[121] and Ennea Odoi was renamed Amphipolis[122] and reinforced by colonists from neighbouring Argilos and from Chalkis.[123] When the Macedonians appeared in Edonida, under King Philip II,

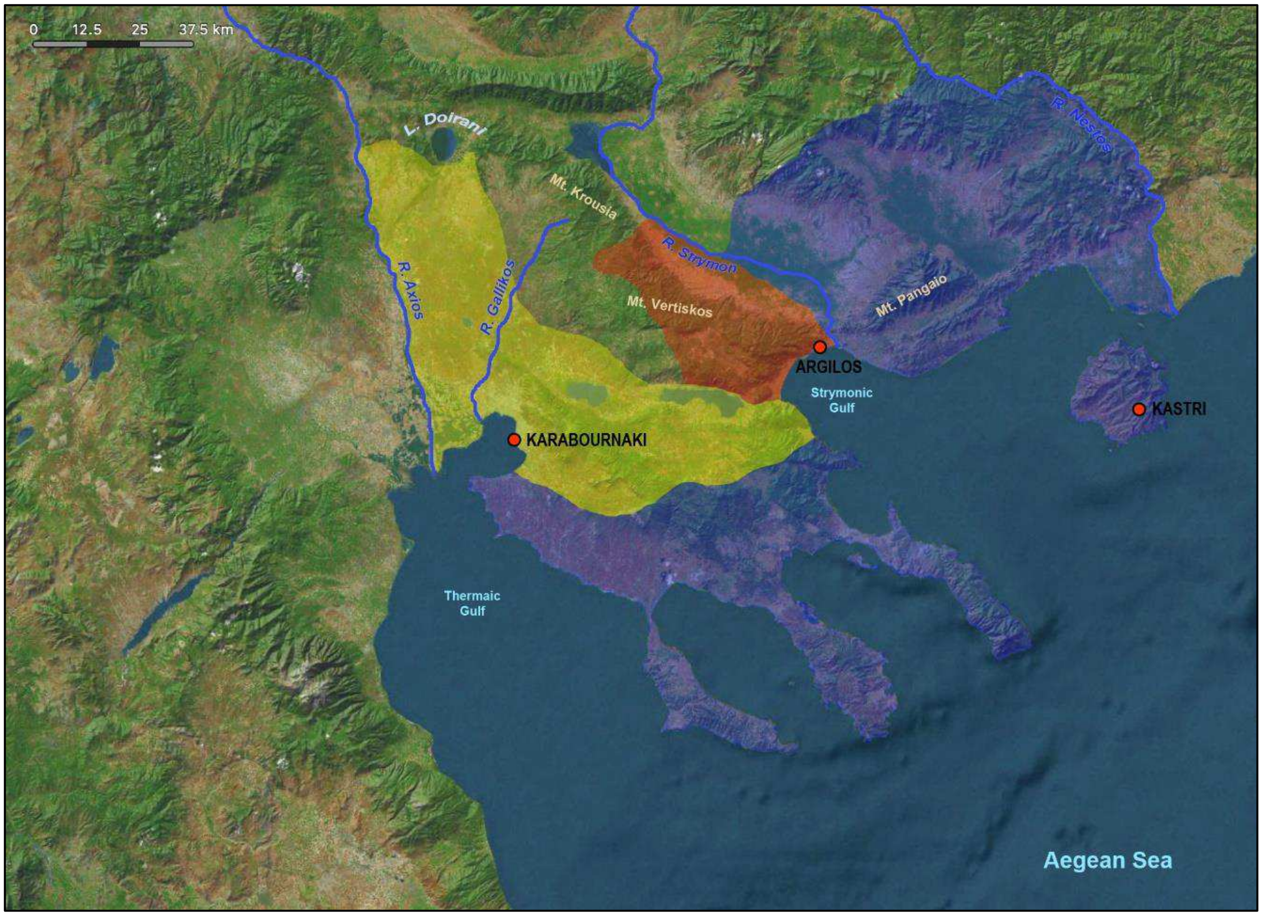

Fig. 1.11. The regions occupied by the Mygdonians (yellow), Visaltes (red) and Edonians (purple) in the area under study (©Apple Maps)

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[118] Bonia 2009: 28-29.
[119] Aeschylus, Persians, 867.
[120] Malamidou 2008: 185-196; Thucydides IV, 102.
[121] Eion was the port of Ennea Odoi and later on, of Amphipolis.
[122] Bakalakis 1970: 289-291; Perdrizet 1922: 42-47; Diodorus XII, 32, 3.
[123] Lazaridis 1972: 19-20; Aristotle, Politics V, 1303b, 1306a.

its state was dismantled, and the colonies of Thassos and Athens fell under Macedonian control, while the colony of Krenides was renamed Philippi.[124]

Another Edonian tribe, the Sithonians, resided on the peninsulas of Sithonia and Athos until they were driven out by the Macedonian king Alexander I,[125] although a small number remained as late as the years of the Peloponnesian War.[126] Apparently, Edonians also resided on the island of Thassos but were expelled in the 7th c. BC by the Parian incomers.[127] The older name of Thassos was Odonis, probably due to its Edonian inhabitants (below, 3.3.1.1).[128]

Summary

In sum, at the dawn of the first millennium BC, the area under study was occupied by various population groups, among them the Visaltes, Mygdonians and Edonias. These groups faced a series of challenges, mostly during the Archaic and Classical era, where the regional conflicts, the Macedonian conquest, the southern Greek and Thassian colonization, and the immigration of the local populations formed a new political, cultural, economic, and social reality.

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[124] Plin. H.N., XVII, 30.

[125] Thucydides II, 99, 4.

[126] For the Thracian tribes of Chalkidici, see Pappa et al. 1998: 31-32; Vokotopoulou 1988: 118-119; 2001: 747; Touratsoglou 1999: 274.

[127] Apollodorus II, 5, 9, 13.

[128] Apollodorus II, 5, 9, 13.

Chapter 2. Methodology

This chapter presents the methodology followed for the identification, recording and analysis of the assemblages derived from Argilos, Karabournaki and Kastri. The methodology was based on the protocols implemented by the Lab-Unit, *Archéologie des Sociétés Méditerranéennes* ASM – UMR5140 and the SYSLAT database.[129] However, in some cases (e.g. quantification method) the methodology was modified to address the particularities of the studied assemblages, such as the small sample sizes and high fragmentation levels. The following sections present the methodological tools used for this study based on the structure of the SYSLAT database.[130]

2.1. The SYSLAT database

The SYSLAT database cataloguing system records: a) the archaeological data for each excavation unit (stratigraphic unit, dating, etc.) in the US tab; b) the zooarchaeological data regarding identification of faunal remains (body part, species, etc.) and the taphonomic data of each faunal remains (gnawing, burning, etc.) in the OS tab; and c) the quantification of the recorded specimens (NISP, MNI) in the FAUNA tab. All of the above mentioned is presented in detailed below.

2.1.1. The archaeological data

The US tab (US: *Unité Stratigraphique* = Stratigraphic Unit) of the SYSLAT database is extremely detailed, offering the opportunity to record a variety of data and information following the principles of the Harris matrix.[131] The fields related to the stratigraphic unit (sector, stratigraphic relations, entity, ensemble and fact) and its dating (TPQ-TAQ,[132] phase and period) have been

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[129] SYSLAT-Terminal, *Système d'Information Archéologique*, UMR5140, LabEx Archimede, SIA Project, University Paul-Valery, Montpellier 3, France.

[130] SYSLAT uses terms in both English and French.

[131] Harris 1989.

[132] TPQ: *Terminus post quem* (date after which), TAQ: *Terminus ante quem* (date before which).

used for the present zooarchaeological study. These fields provide the main archaeological and chronological information necessary for the statistical analysis of the data and their spatial (horizontal) and temporal (vertical) examination, both intra- and inter-communally. However, the excavation system, the method of recording the excavation units and the dating range of the contexts differ significantly across the three sites studied; thus, the method of recording the above data for each site is presented in detail below. Moreover, the amount of US entries recorded for each site differs significantly: 1,045 US in Argilos, 89 US Karabournaki and 116 US in Kastri (below, 3.1.2.1; 3.2.2.1; 3.3.2.1). This is due to: a) the size of the excavated area of each settlement and b) the availability of the chronological and contextual data at the time of the zooarchaeological study (below, 3.1.2; 3.2.2; 3.3.2). Although the entries in Karabournaki and Kastri are much less compared to Argilos, which could create any biases when comparing them in Chapter 4, the total number of their recorded bones (1,614 and 3,141 respectively; bellow, 3.2.2.1; 3.3.2.1), is statistically acceptable for any analysis.[133]

2.1.1.1. Stratigraphic units

In Argilos, the excavation grid is organised into squares of 5x5 m, and the excavation, until now, is conducted in four sectors (Acropolis, Southeast, Koutloudis, National Road; below, 3.1.1.3). The axes of the grid are numbered, and each square receives a four-digit identifier, resulting from combining the axis numbers for its location. The first two digits correspond to the vertical axis and the last two digits to the horizontal one (**Fig. 2.1**).

The excavation system follows the Harris matrix and the data (label) of each excavation unit (excavation bag) contains the year, the square and the unit (lot) number which is unique for each square (e.g. 01375618 = year: [20]01, square: 3756, unit: 18). The year signifies the excavation year, the square number the excavation point inside the grid – in this case, the vertical axis number 37 and the horizontal axis number 56 – and the unit signifies the excavation layer (lot) based on the stratigraphic variations inside the excavation square. For the SYSLAT database, this same excavation unit code is used for the SYSLAT ‘US’ field but with the year written using four instead

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[133] Van de Veen and Fieller 1982.

of two digits (e.g. 2001375618), as in SYSLAT, 'US' field cannot start with the number zero. In the case of balk excavations, the English letter N (north balk) or E (east balk) usually appears in the excavation unit labels between the square number and the unit (e.g. 033756E42). However, as the SYSLAT 'US' field cannot accept letters, the letters N or E appear only in the SYSLAT 'Sector' field. (**Fig. 2.2**)

The SYSLAT 'stratigraphic relations' fields record the units which are above and below the unit under examination, while in the 'Another Entity' field of SYSLAT the sector of each excavation unit recorded. Finally, in the SYSLAT context description fields, an 'entity' is a large unit, an 'ensemble' is something smaller inside an entity, and a 'fact' is a very specific context inside an ensemble, for example, entity: Building E, ensemble: Room E2 (SE corner), fact: bathtub. (**Fig. 2.2**)

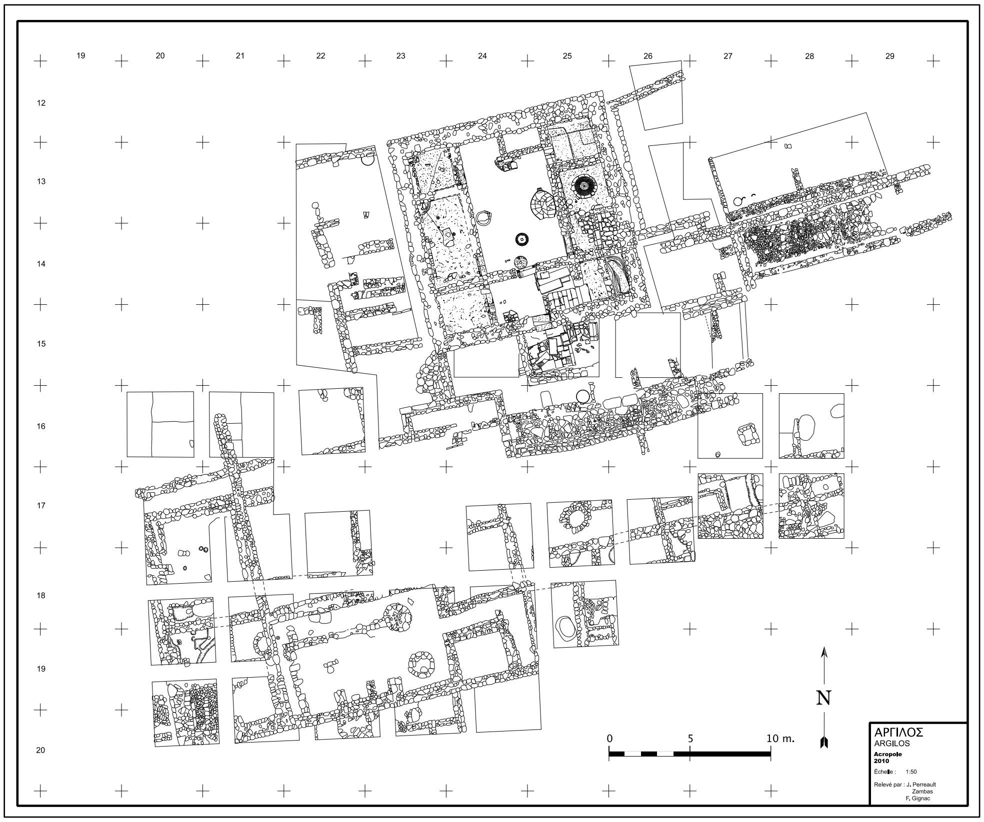
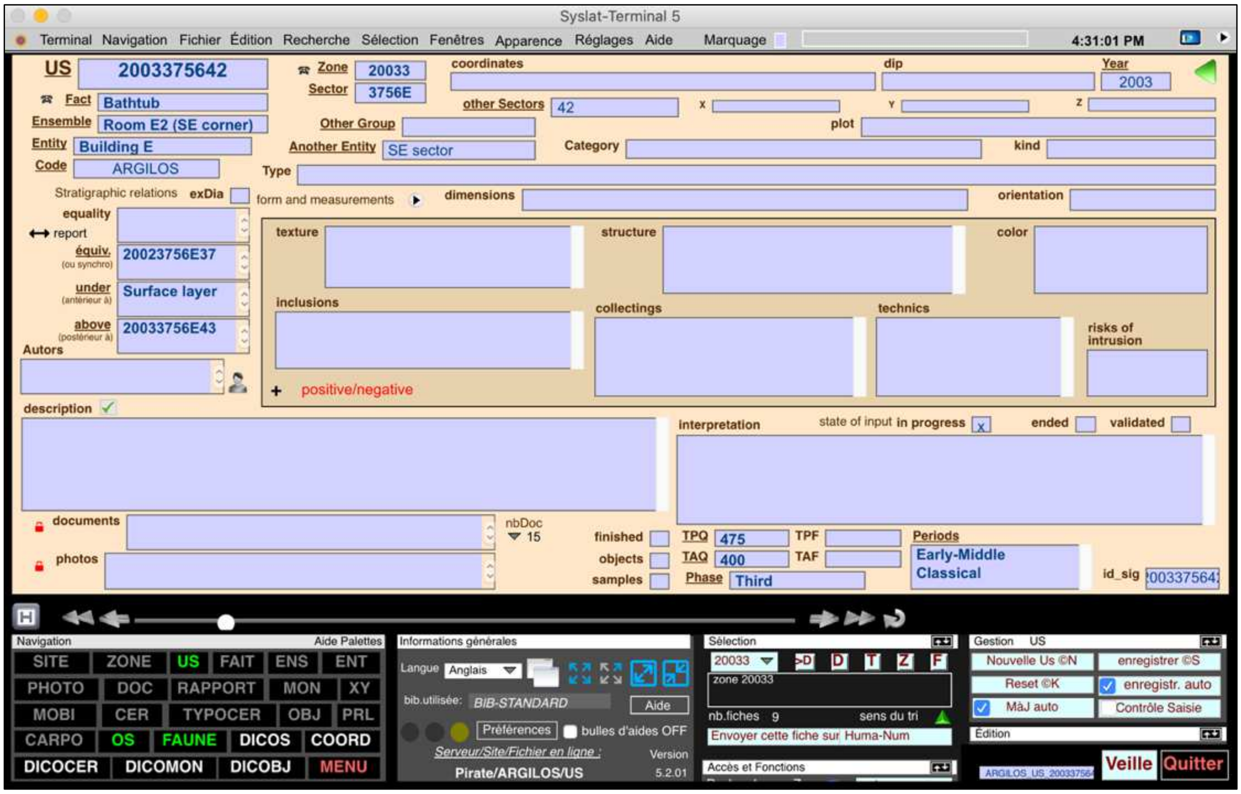


Fig. 2.1. An example of the vertical and horizontal numbered axes of the Acropolis sector excavation grid at Argilos (Argilos excavation archives)



US 2003375642
Zone 20033
Sector 3756E
Year 2003
Fact Bathtub
other Sectors 42
Ensemble Room E2 (SE corner)
Other Group
Entity Building E
Another Entity SE sector
Code ARGILOS
équiv. (ou synchro) 20023756E37
under (antérieur à) Surface layer
above (postérieur à) 20033756E43
state of input in progress ☒ ended ☐ validated ☐
nbDoc 15
TPQ 475
TAQ 400
Phase Third
Periods Early-Middle Classical
id_sig 00337564
Langue Anglais
bib.utilisée: BIB-STANDARD
Version 5.2.01
Pirate/ARGILOS/US
Sélection 20033
zone 20033
nb.fiches 9
Gestion US

Fig. 2.2. Example of an Argilos US tab (SYSLAT-Terminal)

In Karabournaki, the ongoing excavation is taking place in four sectors of the excavation grid namely 22, 23, 26 and 27, which is separated into squares of 20x20 m, numbered serially from 1 to 100. Each of these squares is also separated into four trenches of 5x5 m (including a 1 m balk which remains unexcavated), which are named clockwise according to the Greek numerical system (α, β, γ and δ). (**Fig. 2.3**)

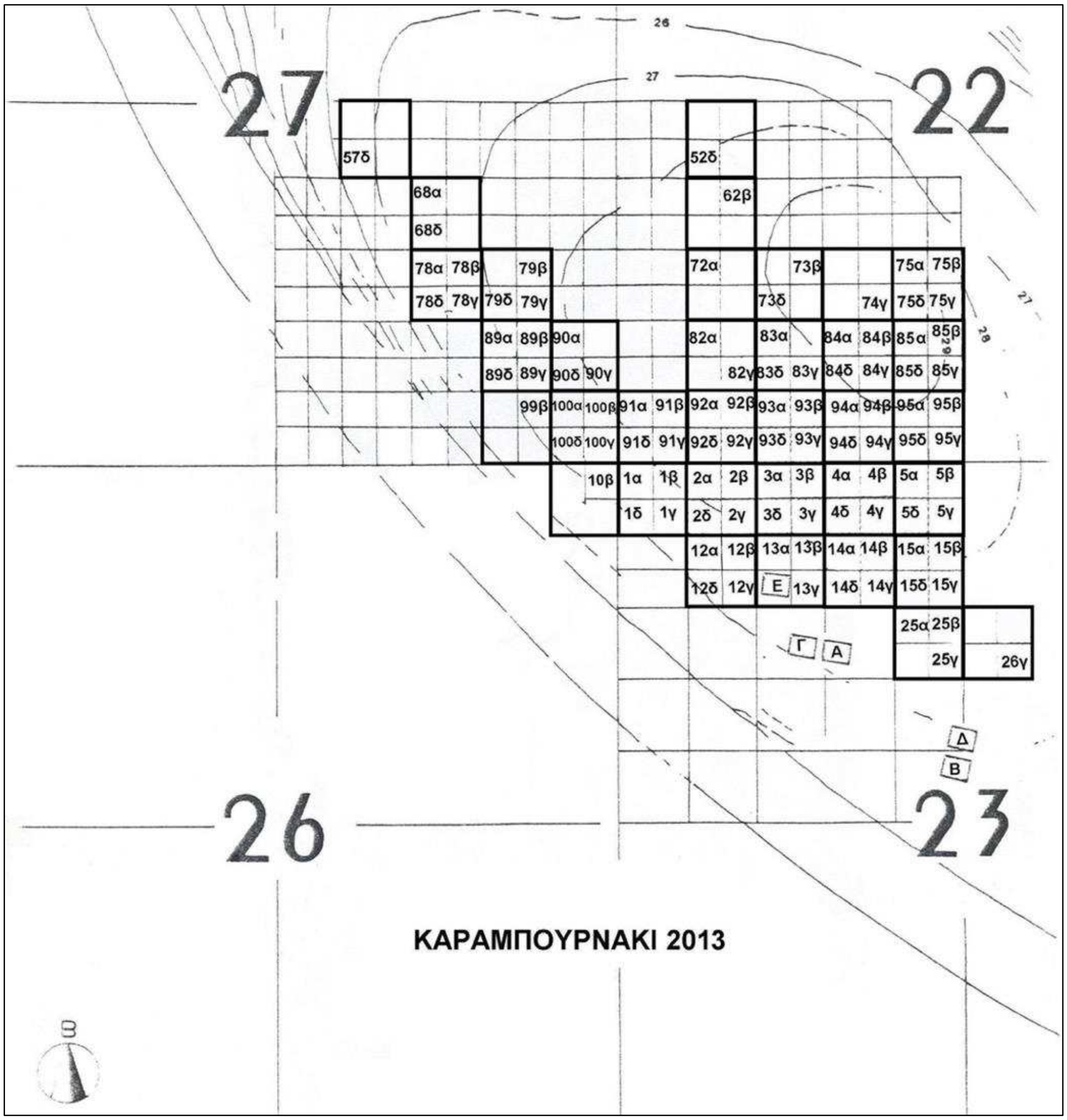


Fig. 2.3. Excavation grid in Karabournaki; the excavated trenches in the sectors 22, 23, 26 and 27 are marked. The trenches A, B, Γ, Δ and E in sector 23 were dug during the first excavation year (1994), when there was no excavation grid (Karabournaki excavation)

The excavation system is based on the vertical removal of horizontal layers, the thickness of which is usually 10 or 20 cm and is arbitrarily selected by the excavators. Each excavation unit (excavation bag) contains the excavation date, the trench number, the depth in metres and, in the case of the pits and beehive shaped semi-subterranean structures (hereafter ‘structures’), that are the only contexts analysed in this study (below, 3.2.2.1), their location (north, south, east, west, central) inside the trench (e.g. 17/07/2009, 2284β, structure NW corner, 1.17–1.30 m = excavation date: 17/07/2009, sector: 22, square: 84, trench: β, structure position inside the square: NW corner, layer depth: 1.17–1.30 m). In the first place, in order to simplify the names of the studied contexts, each structure and pit is converted to a unique name code.[134] More specifically, the studied pits and structures from the Sector 22 trenches were arbitrarily designated as A and followed by a serial number (e.g. A01, A02) assigned randomly. The studied pits and structures from the Sector 23 trenches were called B01, B02, etcetera, and those from the Sector 27 trenches C01, C02 and so on (**Table 2.1**). In addition, to assign the information of each excavation unit a unique code for the SYSLAT 'US' field, it was necessary to digitalize it. In the case of the trenches, the four first digits (sector and square) remain while the Greek letter codes were assigned numbers (α = 1, β = 2, γ = 3, δ = 4). For the rest of the excavation data (e.g. date, depth) a unique serial number (AZO: *Αριθμός Ζωοαρχαιολογικής Ομάδας* = Number of Zooarchaeological Units) of four digits, starting with 0001, assigned randomly for all the stratigraphic units (excavation bags). Thus, based on the example of **Table 2.2**, the stratigraphic unit: 17/07/2009, 2284β, structure NW corner, 1.17–1.30 m is introduced to SYSTAL 'US' field as: 228420001 (**Fig. 2.4**). Moreover, the excavation date is recorded on the 'Another Entity' field and the depth on the 'Other Group' field of SYSLAT (**Fig. 2.4**).

Sector	Context	Code
22	2284 β NE Structure	A01
	2284 β NW Structure	A02
	2284 β S Structure	A03
	2291 δ SE Structure	A04
23	2312 γ NW Structure	B01
	2312 δ NE Structure	B02
	2312 δ SE Structure	B03
27	2778 γ NW Structure	C01
	2778 δ SE Structure	C02
	2778 δ NE Structure	C03
	2779 γ SE Structure	C04
	2779 δ NW Structure	C05
	2789 α Pit	C06
	2789 β S Structure	C07
	2789 γ SW Structure	C08
	2789 δ NW Structure	C09
	2789 δ SW Pit	C10
	2789 δ Central Structure	C11

Table 2.1. The conversion into serial codes of the studied pit and structure excavation units in Karabournaki

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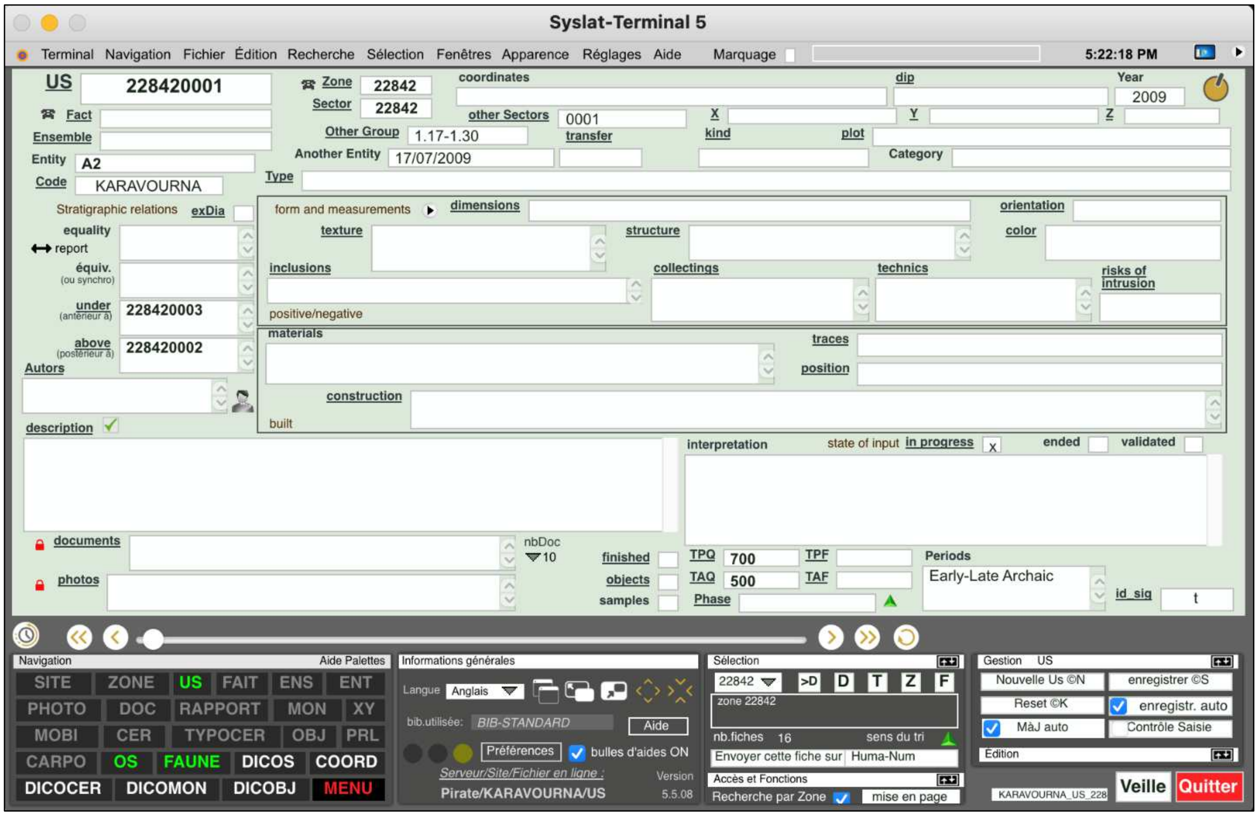
[134] The studied material was derived from specific trenches of the sectors 22, 23 and 27; below, 3.2.2.1.

Code	Context	Depth	Excavation date	AZO
A02	2284 β NW Structure	1,17-1,30	17/07/2009	1
		1,36-1,51	22/07/2009	2
		0,80-1,17	16/07/2009	3
C01	2778 γ NW Structure	west paria	15/07/1998	4
		west paria	14/07/1998	5
		3,35-3,70	13/07/1998	6
		2,50-3,05	08/07/1998	7
		3,35-3,70	10/07/1998	8
		3,05-3,35	09/07/1998	9
C04	2779 γ SE Structure	1,71-2,12	10/07/2001	10

Table 2.2. An example of the first 10 AZO in Karabournaki

As for Argilos, the SYSLAT 'Stratigraphic relations' fields record the layers inside the pit or structure which are above and below the layer under examination (**Fig. 2.4**). In the SYSLAT context description fields, the 'Entity' corresponds to the code of the specific pit or structure of **Table 2.1**, the 'Ensemble' to a particular part inside the pit or structure, if it exists, while the 'Fact' field was not used (**Fig. 2.4**).



5:22:18 PM

US 228420001

Zone 22842

Sector 22842

Year 2009

other Sectors 0001

Other Group 1.17-1.30

Entity A2

Another Entity 17/07/2009

Code KARAVOURNA

under (antérieur à) 228420003

above (postérieur à) 228420002

state of input in progress ☒ ended ☐ validated ☐

nbDoc 10

TPQ 700

TAQ 500

Periods Early-Late Archaic

id_sig t

Langue Anglais

bib.utilisée: BIB-STANDARD

☑ bulles d'aides ON

Serveur/Site/Fichier en ligne : Pirate/KARAVOURNA/US

Version 5.5.08

Sélection 22842

zone 22842

nb.fiches 16

Envoyer cette fiche sur Huma-Num

Recherche par Zone ☑

☑ enregistr. auto

☑ MàJ auto

KARAVOURNA_US_228

Fig. 2.4. Example of a Karabournaki US tab (SYSLAT-Terminal)

At Kastri, the excavation grid consisted of 15 squares of 5x5 m, numbered from 1 to 15. Each of these squares was divided into 16 trenches of 1x1 m, with the vertical axis following the western Arabic numeral system (1–29) and the horizontal axis the Greek system (A–IE), (**Fig. 2.5**). The excavation system was based on the vertical removal of horizontal layers in each trench and balk, with the thickness of the layers either decided arbitrarily by the excavator or determined by the architectural remains. The findings from each layer, both artefacts and faunal remains, corresponded to an excavation unit. Each unit was described by the following information: excavation date, square, trench, layer number,[135] layer depth and soil or architectural description, if any (e.g. excavation date: 26/07/1978, square: 13, trench: 28–29/A–B, layer: 1st, depth: 0.70–0.90 m). Additionally, during the study of pottery, a serial three-digit code was created by the excavator for cataloguing purposes. As pottery and faunal remains from the same layer belong to

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[135] Based on the excavation system, as the first layer was considered to be the one immediately after the surface layer (surface layer: 0 layer).

the same excavation unit, sharing the same excavation information, the pottery code has also been used for the SYSLAT 'US' field, with the addition of the digit '1' in front of each code to be compatible with SYSLAT protocol[136] (e.g., pottery code: 793 = SYSLAT US: 1793), (**Fig. 2.6**).

The SYSLAT 'Stratigraphic relations' fields record the layers which are above and below the layer under examination (**Fig. 2.6**). For the SYSLAT context description fields, only the 'Entity' and 'Ensemble' have been used in the case of House I (spaces A and B) as the study of the architectural remains and the space organisation is in progress (below, 3.3.1.3). Finally, as for Karabournaki, the depth of each excavation unit recorded at the 'Other Group' field of SYSLAT.

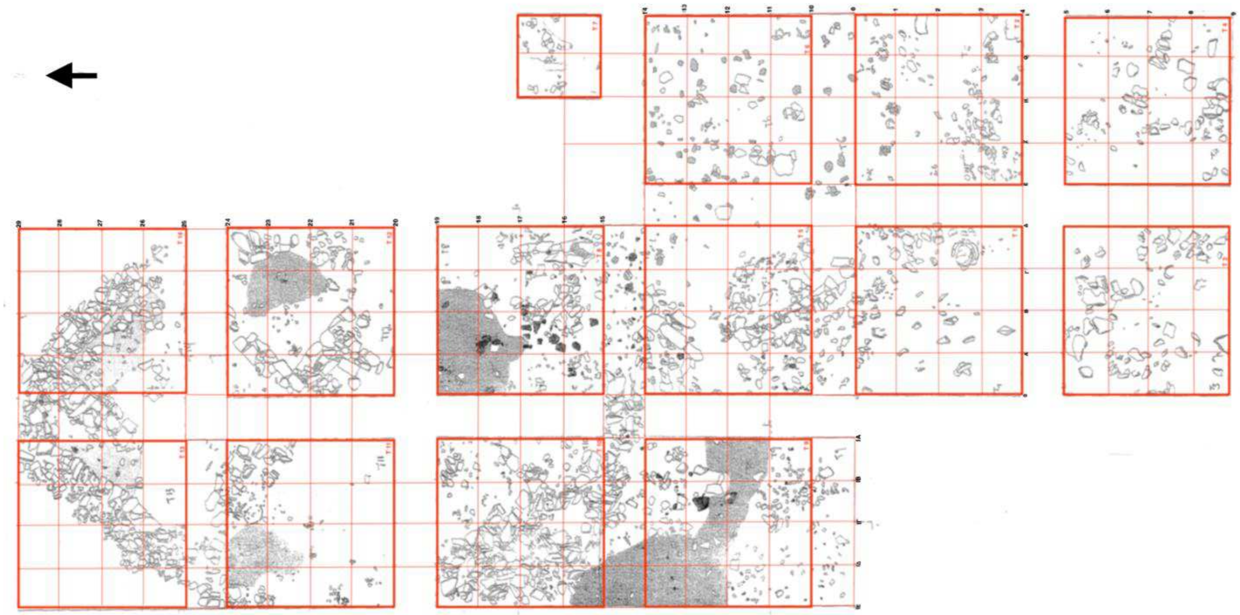

Fig. 2.5. Kastri excavation grid; vertical and horizontal axes in all the trenches are marked and numbered; for practical reason the plan has been inverted (Kastri excavation archives)

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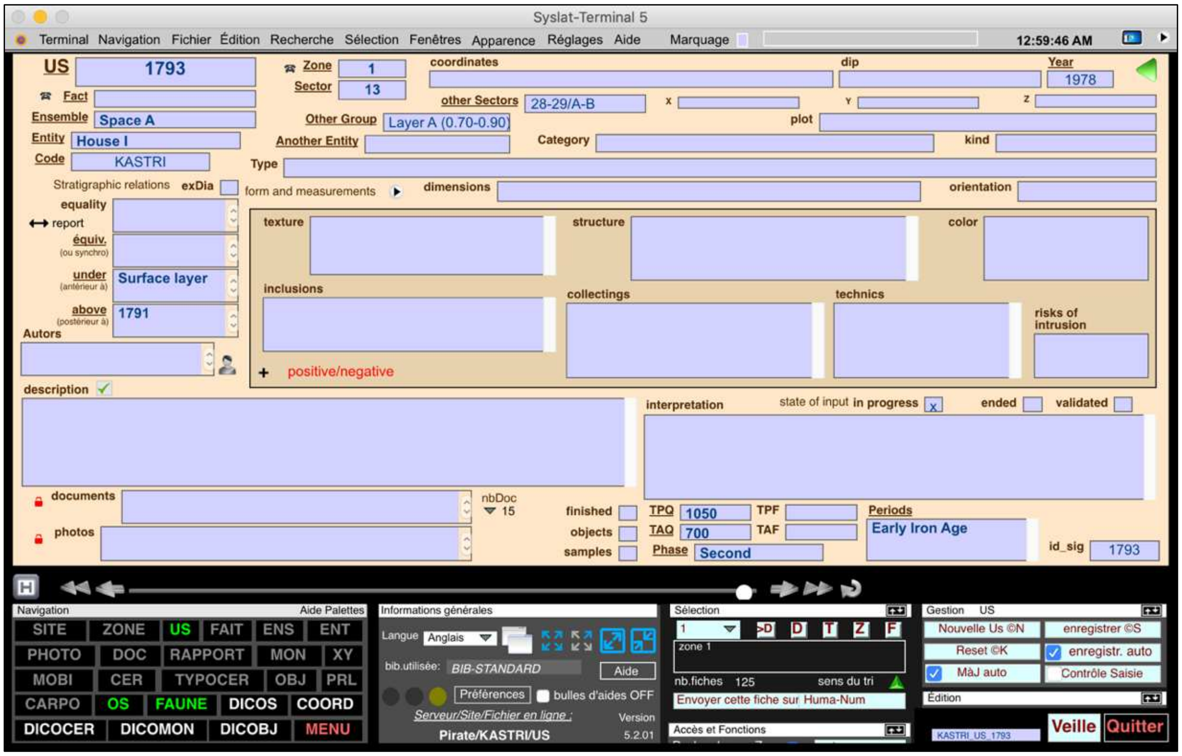
[136] According to SYSLAT protocol, the US number must be bigger than 1000.



US 1793
Zone 1
Sector 13
Year 1978
other Sectors 28-29/A-B
Ensemble Space A
Other Group Layer A (0.70-0.90)
Entity House I
Code KASTRI
under Surface layer
above 1791
state of input in progress ☒
nbDoc 15
TPQ 1050
TAQ 700
Phase Second
Periods Early Iron Age
id_sig 1793
Langue Anglais
bib.utilisée: BIB-STANDARD
nb.fiches 125
Pirate/KASTRI/US
Version 5.2.01
KASTRI_US_1793

Fig. 2.6. Example of a Kastri US tab (SYSLAT-Terminal)

2.1.1.2. Dating

Dating (SYSLAT 'TPQ-TAQ' and 'Phase' fields) was determined by the site excavators and the relevant publications (below, 3.1.1.3, 3.2.1.3, 3.3.1.3). In Argilos the range of studied stratigraphic units' dates varies from 25 to 150 years, and the dating was organised based on the first four habitation phases of the site (Phase I, II, III and IV; **Table 2.3**; below, 3.1.1.3), (above, **Fig. 2.2**). However, some stratigraphic units with large date ranges (100 and 150 years) are related to both habitation Phase III and IV. Thus, all these stratigraphic units were merged into the same group, called Phase III-IV (**Table 2.3**). In Karabournaki the nature of the archaeological deposits inside the pits and the structures did not allow for a close dating (below, 3.2.2). Thus, the studied stratigraphic units correspond to five broad, overlapping chronological groups, spanning the Early Iron Age to Classical times (**Table 2.4**; above, **Fig. 2.4**). Finally, in Kastri all the recorded stratigraphic units belonged to the second and last habitation phase of the settlement, dated to the Early Iron Age (above, **Fig. 2.6**).

Habitation Phase	Century	Date (BC)	Historical Phase[1]
I	mid-7th–mid-6th c. BC	655–550	Early Archaic–Middle Archaic
II	mid-6th–1st quarter of 5th c. BC	550–500/475	Middle Archaic–Late Archaic/Early Classical
III	1st quarter of 5th–4th quarter of 5th c. BC	500/475–425/400	Late Archaic/Early Classical–Middle Classical
IV	4th quarter of 5th–mid-4th c. BC	425/400–357	Middle Classical/Late Classical–Late Classical
III-IV	5th c. BC–mid-4th c. BC	500-357	Classical

Table 2.3. Argilos habitation phases and dating

[1] Based on Table 1.1

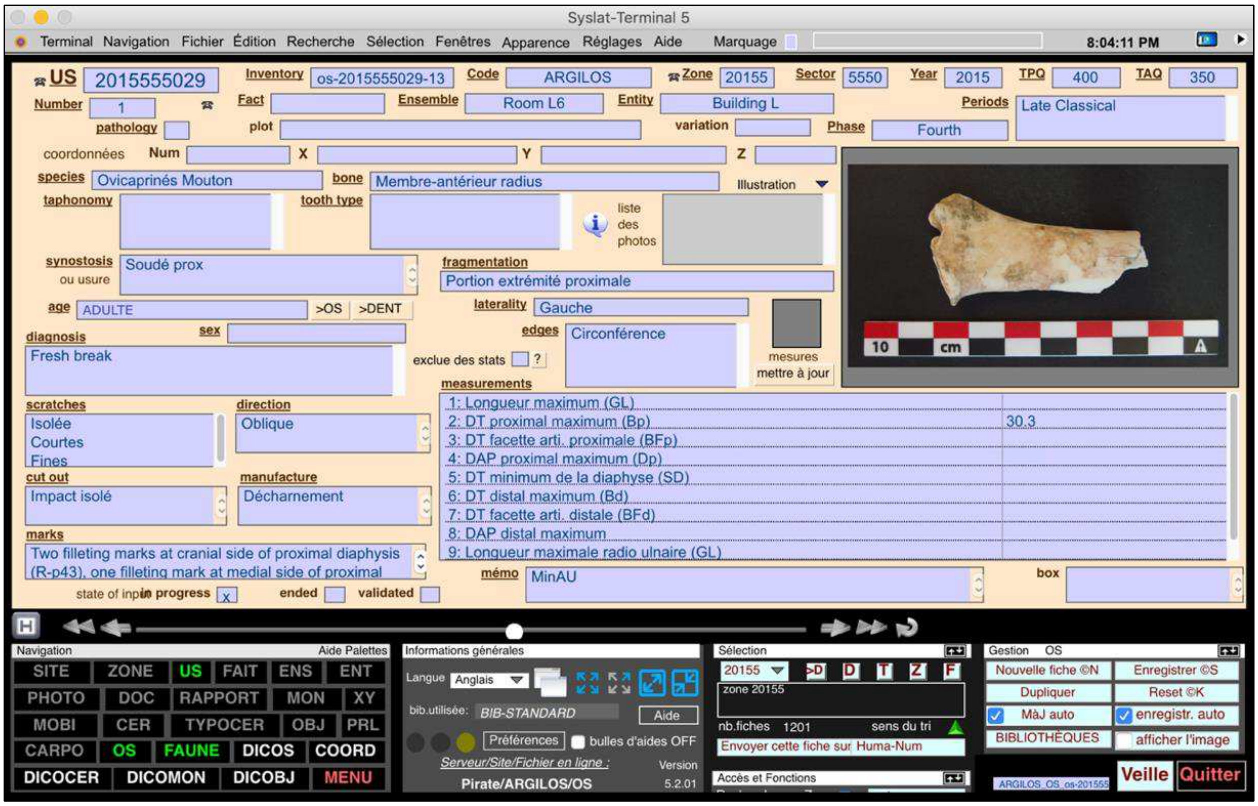
Context code[1]	Century	Date (BC)	Historical Phase
B01, B02	8th–6th c. BC	800–500	Early Geometric–Late Archaic
A01	7th c. BC	700–600	Early Archaic
A03	TAQ: 7th c. BC	<600	
A02, C03, C04, C05, C06, C08, C09, C11	7th–6th c. BC	700–500	Archaic
C10	6th c. BC	600–500	
C01	7th–1st half of 5th c. BC	700–450	Early Archaic–Middle Classical
C02	6th–5th c. BC	600–400	
A04, C07	4th quarter of 6th–1st half of 5th c. BC	525/500–450	Late Archaic–Early/Middle Classical
B03	4th quarter of 6th–3rd quarter of 5th c. BC	525/500–450/425	

Table 2.4. Karabournaki dates by pit and structure

[1] Based on the conversions of Table 2.1

2.1.2. The zooarchaeological data

The OS (OS = bone) tab of SYSLAT documents all aspects of faunal remains: identification of body parts, species, age and sex; recording of pathology, biometry, taphonomy (gnawing, digestion, burning, environmental factors), butchery and fragmentation; and photographic documentation (**Fig. 2.7**). These data are crucial to the research questions of this study in relation to the management of productive animals (species, age, sex, pathology), the cooking techniques and consumption practices (butchery, burning), the discard strategies (post-depositional factors) and the exploitation of the natural faunal resources (wild species). The presentation of the methodological tools for these aspects follows the structure of the OS tab in the SYSLAT database (**Fig. 2.7**).



US: 2015555029
Inventory: os-2015555029-13
Code: ARGILOS
Zone: 20155
Sector: 5550
Year: 2015
TPQ: 400
TAQ: 350
Number: 1
Ensemble: Room L6
Entity: Building L
Periods: Late Classical
Phase: Fourth
species: Ovicaprinés Mouton
bone: Membre-antérieur radius
synostosis ou usure: Soudé prox
fragmentation: Portion extrémité proximale
age: ADULTE
laterality: Gauche
edges: Circonférence
diagnosis: Fresh break
scratches: Isolée, Courtes, Fines
direction: Oblique
cut out: Impact isolé
manufacture: Décharnement
marks: Two filleting marks at cranial side of proximal diaphysis (R-p43), one filleting mark at medial side of proximal
state of inpin progress ☒ ended ☐ validated ☐
mémo: MinAU

measurements:

1: Longueur maximum (GL)	
2: DT proximal maximum (Bp)	30.3
3: DT facette arti. proximale (BFp)	
4: DAP proximal maximum (Dp)	
5: DT minimum de la diaphyse (SD)	
6: DT distal maximum (Bd)	
7: DT facette arti. distale (BFd)	
8: DAP distal maximum	
9: Longueur maximale radio ulnaire (GL)	

Langue: Anglais
bib.utilisée: BIB-STANDARD
Serveur/Site/Fichier en ligne : Pirate/ARGILOS/OS
Version 5.2.01
20155
zone 20155
nb.fiches 1201
sens du tri
Envoyer cette fiche sur Huma-Num
Gestion OS
☑ MàJ auto
☑ enregistr. auto
☐ afficher l'image
ARGILOS_OS_os-201555

Fig. 2.7. Example of an Argilos OS tab (SYSLAT-Terminal)

2.1.2.1. Body part and species

In terrestrial mammals every specimen[137] was identified to the level of body part and species or subfamily when possible, based on its state of preservation, or otherwise classified into one of the three general animal size categories (small, medium and large) or as unidentifiable. Due to limited knowledge in the identification of bird bones, the remains of birds were identified to the level of animal class as birds (Aves), without further identification to body part, while the tortoise specimens were only identified to the level of genus (**Table 2.5**). The aquatic faunal remains, including fish and shellfish, and the land snail remains are not included in this study as they are being studied by Dr. D. Mylona for Argilos (fish), Dr T. Theodoropoulou for Argilos (shellfish) and Karabournaki (fish and shellfish), and Prof. L. Karali for Kastri (shellfish).

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[137] Every bone, tooth, horncore/antler and carapace fragment was defined as a specimen irrespective of the state of preservation and the level of identification.

The identification of body parts and the determination of the bones and teeth of terrestrial mammals in terms of species and subfamily was done according to Schmid,[138] Barone[139] and Hillson,[140] as well as with the help of comparative collections of modern-day domesticated and wild animals (below, 2.1.3). The classification of the birds and the reptiles was based on Cohen and Serjeantson[141] and Holman,[142] respectively. The identified mammals from the three studied sites are sheep (*Ovis aries*), goat (*Capra hircus*), cattle (*Bos taurus*), pig (*Sus domesticus*), dog (*Canis familiaris*), horse (*Equus caballus*), donkey (*Equus asinus*), red deer (*Cervus elaphus*), fallow deer (*Dama dama*), roe deer (*Capreolus capreolus*), boar (*Sus scrofa*), wolf (*Canis lupus*), red fox (*Vulpes vulpes*) and hare (*Lepus europaeus*), (**Table 2.5**).

The distinction between sheep and goat followed Boessneck[143] and Prummel and Frisch[144] for the cranial and postcranial bones, Payne[145] for the deciduous teeth and Halstead, Collins and Isaakidou[146] for the permanent ones. Furthermore, the distinction between sheep, goat and roe deer, as well as checking for any presence of wild ibex (*Capra ibex*) and chamois (*Rupicapra*), were based on Fernandez.[147] When distinction between sheep and goat was not possible, the specimens were identified to subfamily, namely Caprinae. The identification of red deer and fallow deer was based on Lister,[148] the distinction between horse and donkey on Eisenmann,[149] and the distinction between dog and red fox as well as checking for any presence of badger (*Meles meles*) and cat (*Felis catus*) were based on Johnson.[150]

Differentiation between wild and domesticated animals in the cases of pig – boar and dog – wolf was not always possible. Even though the wild species tend to be larger than the equivalent

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[138] Schmid 1972.
[139] Barone 1986.
[140] Hillson 1986; 1992.
[141] Cohen and Serjeantson 1996.
[142] Holman 1998.
[143] Boessneck 1969.
[144] Prummel and Frisch 1986.
[145] Payne 1985.
[146] Halstead et al. 2002.
[147] Fernandez 2001.
[148] Lister 1996.
[149] Eisenmann 1986.
[150] Johnson 2015.

domesticated ones,[151] sexual dimorphism may confuse matters.[152] Thus, biometrical data were used cautiously, while comparison of metrical data from the sites under study with other nearby archaeological populations was conducted.[153] Additionally, the identification of anatomical differences, such as thicker diaphyseal bone walls and stronger muscle attachments, which would be expected for wild taxa, were also taken into account.

	Animals	**Identification Level**				
		Species	**Genus**	**Subfamily**	**Class**	**Size Category**
Mammals	cattle	*Bos taurus*				Large
	horse	*Equus caballus*				
	donkey	*Equus asinus*				
	red deer	*Cervus elaphus*				
	fallow deer	*Dama dama*				
	boar	*Sus scrofa*				
	sheep	*Ovis aries*		Caprinae		Medium
	goat	*Capra hircus*				
	roe deer	*Capreolus capreolus*				
	pig	*Sus domesticus*				
	wolf	*Canis lupus*				
	dog	*Canis familiaris*				Small
	red fox	*Vulpes vulpes*				
	hare	*Lepus europaeus*				
Reptiles	tortoise		*Testudo*			
Birds	indeterminate birds				Aves	

Table 2.5. The identification level of the recorded animals

The body parts of terrestrial mammals which were very fragmented or otherwise difficult to identify to species-genus or subfamily (e.g. ribs, vertebrae and skull bones) were classified into three general animal size categories: small, medium and large, following Gardeisen.[154] The small category includes the carnivores (red fox, dog) and hare; the medium category sheep, goat, roe deer, pig and wolf; and the large category cattle, horse, donkey, boar and red and fallow deer (above, **Table 2.5**). This distinction concerned only fragments that were most likely to have

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[151] Higham 1968.
[152] Payne and Bull 1988.
[153] See 2.1.2.5.
[154] Gardeisen 1997.

belonged to adults (based on fusion, bone thickness, etc.), while those that probably belonged to very young animals, as well as those that were highly fragmented, were considered to be unidentifiable, to limit any bias that could arise from the relationship between age and size. The specimens from the general animal size categories were used cautiously with regard to determining the butchery and cooking techniques and discard strategies. All the above data, the species and body parts identification, were recorded in the 'species', 'bone' and 'tooth type' fields of the SYSTALS's OS tab (above, **Fig. 2.7**).

2.1.2.2. Ageing

The determination of the age at death of the productive domesticate animals (cattle, sheep, goat and pig) offers, in conjunction with the sex composition (below, 2.1.2.3), information about animal management. This information is extracted through the reconstruction of mortality profiles and associated with the production of primary and secondary products (meat, milk, wool/hair, fat) as these can be recognized through contemporary management studies on productive domesticated animals and ethnographic parallels[155] (**Fig. 2.8**).

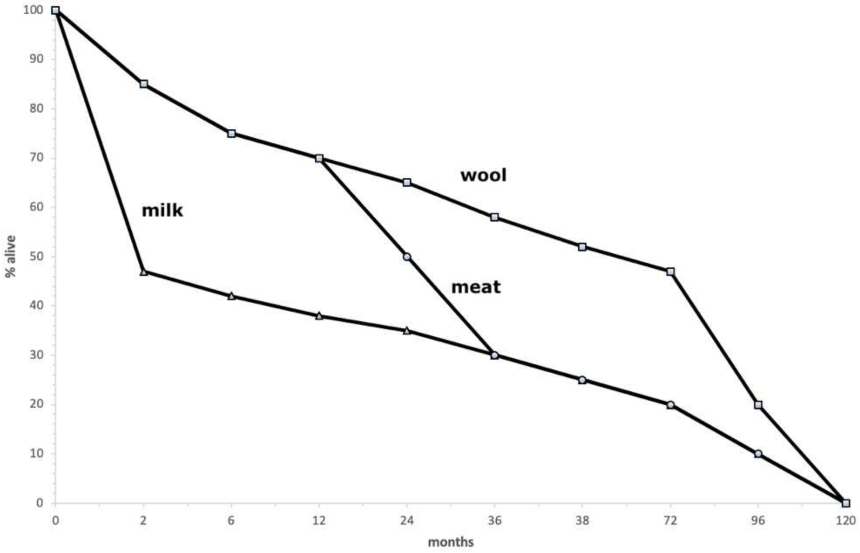

Fig. 2.8. Model curves for milk, meat and wool used to interpret the mortality profiles of sheep and goat (after Payne 1973: 282-284, Figs 1-3)

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[155] Payne 1973.

A classification of neonatal (foetal and newborn – up to one month after birth) was made on the basis of the size and surface texture of the unfused bones and the presence of mandibles with unworn deciduous premolars.[156] The determination of the age of post-neonatal (older than newborn) specimens was estimated from the stage of eruption and wear of the occlusal surface of mandibular cheek teeth and the degree of epiphyseal fusion of postcranial bones (long bones, scapula and pelvis). The recording of the wear of the occlusal surface of the teeth of sheep, goat, (sheep and goat hereafter 'caprines'), cattle, pig, red deer and equids followed the principles of SYSLAT as show in **Fig. 2.9**. However, due to very small number of teeth in the assemblages under study, and the multiplicity of age stages distinguished in SYSLAT (**Fig. 2.9**), the recorded data presented a very fragmentary picture. Moreover, in the case of caprines, cattle and pig the data from the sites under study were also compared with the data from Kastanas, where the age stages distinguished are very few. Thus, for the purposes of this study a recording system that distinguishes fewer age stages than SYSLAT but more than the one applied at Kastanas was used. The teeth of caprines cattle and pig, apart from SYSLAT's recording system, were also recorded following the protocols of Payne[157] and Deniz and Payne[158] for recording tooth eruption and wear and for distinguishing age stages in caprines and Halstead's adaptation thereof for cattle and pig[159] (**Table 2.6**). The mandibles of all four species that could not be attributed to a particular age stage (multi-staged mandibles) were proportionally assigned to each stage following Payne 1973.[160] Moreover, in regard to the comparison of the eruption stages of the mandibular teeth between the sites under study (Argilos, Karabournaki and Kastri) and Kastanas (below, 4.1.1.1), the age groups for Kastanas were converted as follows: for caprines, Kastanas age group I was matched with Payne's age stage A, II with B, III with C, IV with D, V with E and VI with F;[161] for cattle, Kastanas age group I was matched with Halstead's wear stages A-C, II and III with D, and IV with E+;[162] and for pig, Kastanas age group I was matched with Halstead's wear stage A, II with B, III with C, IV with D, V with E and VI with F[163] (**Table 2.7**). Finally, the age determination of

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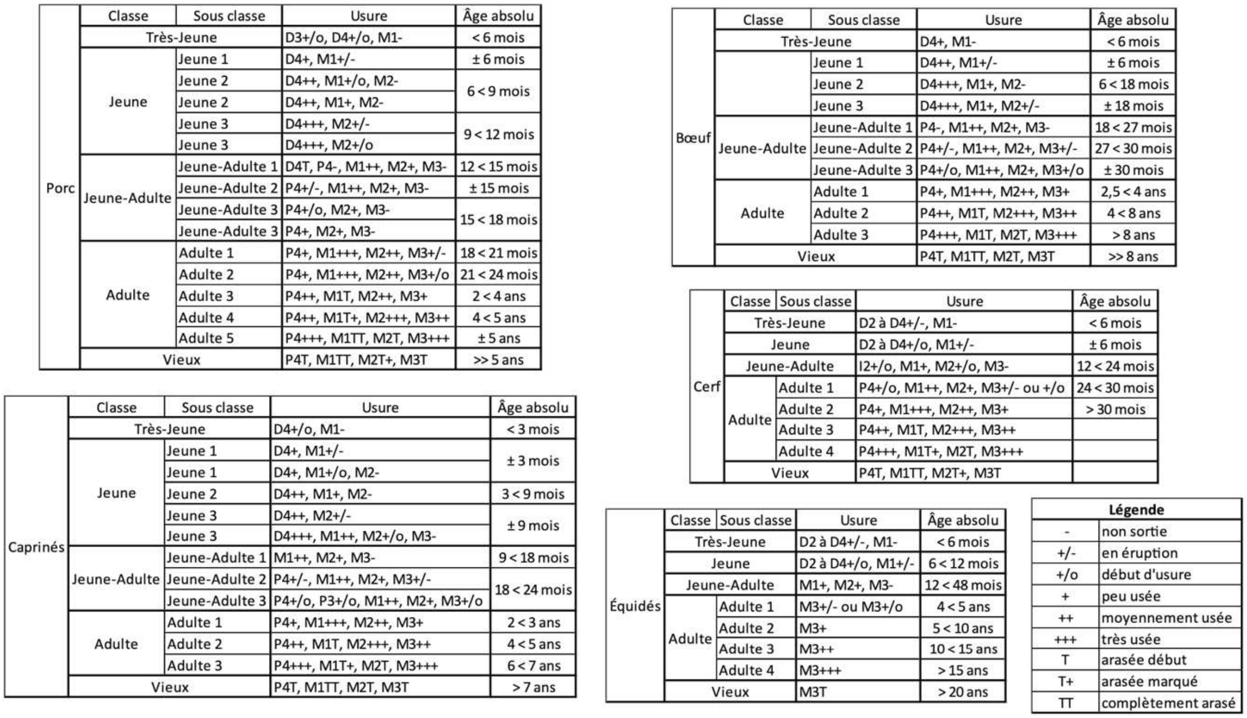
[156] Prummel 1987a; 1987b.
[157] Payne 1973.
[158] Deniz and Payne 1982.
[159] Halstead 1985 (for cattle); 2020 (for pig).
[160] Payne 1973.
[161] Becker 1986: 49, Table 15.
[162] Becker 1986: 31, Table 5.
[163] Becker 1986: 64, Table 24.

postcranial bones through the degree of epiphyseal fusion (fused, unfused or fusing) based on SYSLAT principles followed Barone[164] and Gardeisen[165] (**Fig. 2.10**).



	Classe	Sous classe	Usure	Âge absolu
Porc	Très-Jeune		D3+/o, D4+/o, M1-	< 6 mois
	Jeune	Jeune 1	D4+, M1+/-	± 6 mois
		Jeune 2	D4++, M1+/o, M2-	6 < 9 mois
		Jeune 2	D4++, M1+, M2-	
		Jeune 3	D4+++, M2+/-	9 < 12 mois
		Jeune 3	D4+++, M2+/o	
	Jeune-Adulte	Jeune-Adulte 1	D4T, P4-, M1++, M2+, M3-	12 < 15 mois
		Jeune-Adulte 2	P4+/-, M1++, M2+, M3-	± 15 mois
		Jeune-Adulte 3	P4+/o, M2+, M3-	15 < 18 mois
		Jeune-Adulte 3	P4+, M2+, M3-	
	Adulte	Adulte 1	P4+, M1+++, M2++, M3+/-	18 < 21 mois
		Adulte 2	P4+, M1+++, M2++, M3+/o	21 < 24 mois
		Adulte 3	P4++, M1T, M2++, M3+	2 < 4 ans
		Adulte 4	P4++, M1T+, M2+++, M3++	4 < 5 ans
		Adulte 5	P4+++, M1TT, M2T, M3+++	± 5 ans
	Vieux		P4T, M1TT, M2T+, M3T	>> 5 ans

	Classe	Sous classe	Usure	Âge absolu
Bœuf	Très-Jeune		D4+, M1-	< 6 mois
		Jeune 1	D4++, M1+/-	± 6 mois
		Jeune 2	D4+++, M1+, M2-	6 < 18 mois
		Jeune 3	D4+++, M1+, M2+/-	± 18 mois
	Jeune-Adulte	Jeune-Adulte 1	P4-, M1++, M2+, M3-	18 < 27 mois
		Jeune-Adulte 2	P4+/-, M1++, M2+, M3+/-	27 < 30 mois
		Jeune-Adulte 3	P4+/o, M1++, M2+, M3+/o	± 30 mois
	Adulte	Adulte 1	P4+, M1+++, M2++, M3+	2,5 < 4 ans
		Adulte 2	P4++, M1T, M2+++, M3++	4 < 8 ans
		Adulte 3	P4+++, M1T, M2T, M3+++	> 8 ans
	Vieux		P4T, M1TT, M2T, M3T	>> 8 ans

	Classe	Sous classe	Usure	Âge absolu
Caprinés	Très-Jeune		D4+/o, M1-	< 3 mois
	Jeune	Jeune 1	D4+, M1+/-	± 3 mois
		Jeune 1	D4+, M1+/o, M2-	
		Jeune 2	D4++, M1+, M2-	3 < 9 mois
		Jeune 3	D4++, M2+/-	± 9 mois
		Jeune 3	D4+++, M1++, M2+/o, M3-	
	Jeune-Adulte	Jeune-Adulte 1	M1++, M2+, M3-	9 < 18 mois
		Jeune-Adulte 2	P4+/-, M1++, M2+, M3+/-	18 < 24 mois
		Jeune-Adulte 3	P4+/o, P3+/o, M1++, M2+, M3+/o	
	Adulte	Adulte 1	P4+, M1+++, M2++, M3+	2 < 3 ans
		Adulte 2	P4++, M1T, M2+++, M3++	4 < 5 ans
		Adulte 3	P4+++, M1T+, M2T, M3+++	6 < 7 ans
	Vieux		P4T, M1TT, M2T, M3T	> 7 ans

	Classe	Sous classe	Usure	Âge absolu
Cerf	Très-Jeune		D2 à D4+/-, M1-	< 6 mois
	Jeune		D2 à D4+/o, M1+/-	± 6 mois
	Jeune-Adulte		I2+/o, M1+, M2+/o, M3-	12 < 24 mois
	Adulte	Adulte 1	P4+/o, M1++, M2+, M3+/- ou +/o	24 < 30 mois
		Adulte 2	P4+, M1+++, M2++, M3+	> 30 mois
		Adulte 3	P4++, M1T, M2+++, M3++	
		Adulte 4	P4+++, M1T+, M2T, M3+++	
	Vieux		P4T, M1TT, M2T+, M3T	

	Classe	Sous classe	Usure	Âge absolu
Équidés	Très-Jeune		D2 à D4+/-, M1-	< 6 mois
	Jeune		D2 à D4+/o, M1+/-	6 < 12 mois
	Jeune-Adulte		M1+, M2+, M3-	12 < 48 mois
	Adulte	Adulte 1	M3+/- ou M3+/o	4 < 5 ans
		Adulte 2	M3+	5 < 10 ans
		Adulte 3	M3++	10 < 15 ans
		Adulte 4	M3+++	> 15 ans
	Vieux		M3T	> 20 ans

Légende	
-	non sortie
+/-	en éruption
+/o	début d'usure
+	peu usée
++	moyennement usée
+++	très usée
T	arasée début
T+	arasée marqué
TT	complètement arasé

Fig. 2.9. The system of recording the wear of the occlusal surface of the teeth of caprines, cattle, pig, red deer, and equids in SYSLAT-Terminal (after Gardeisen 1997, Valenzuela and Gardeisen 2005, and Riglet 1977)

Although tooth eruption and wear are dependent on breed and abrasiveness of diet,[166] teeth give a relatively precise age of an individual, thus providing a great number of narrowly bound age stages.[167] In contrast, epiphyseal fusion, which is also dependent on breed, nutrition, sex and, especially, castration,[168] offers rather limited data as it does not distinguish between different stages of adulthood.[169] However, teeth are just one body part and so may be misleading if heads of old or young animals are selectively discarded in different places, while fusion data are drawn from many body parts and so are much less vulnerable to this. Furthermore, both dental and

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[164] Barone 1986.
[165] Gardeisen 1997.
[166] Payne 1972a; Silver 1969.
[167] Klein and Cruz-Uribe 1984: 43.
[168] Davis 2000; Noddle 1984; Payne 1972a; 1984.
[169] Klein and Cruz-Uribe 1984: 43; Uerpmann 1973: 312-313.

epiphyseal fusion evidence for age at death are likely affected by post-depositional biases such as retrieval method and fragmentation. For example, mandibles of young animals are more susceptible to fragmentation,[170] creating some bias against young animals. Similarly, unfused bones tend to be destroyed more easily than fused ones, also creating a bias against younger age groups.[171] Thus, although teeth have big advantages, as they offer more precise ageing and allow subdivision of different stages of adulthood, because of the aforementioned possible limitations, in this study both methods are considered in combination. The fusion state of the bones and the eruption-wear state of the tooth was recorded in the 'synostosis' field and the age of the bone and tooth in the 'age' field of the OS tab of SYSLAT database (above, **Fig. 2.7**).

Wear stage	**Caprines**[1]			**Cattle**[2]			**Pig**[3]		
	Mandibular teeth eruption-wear[4]	Age (mo.)	SYSLAT[5]	Mandibular teeth eruption-wear[4]	Age (mo.)	SYSLAT[5]	Mandibular teeth eruption-wear[4]	Age (mo.)	SYSLAT[5]
A	d4U	0-2	P	d4U	0-1	P	d4U	0-2	P
B	d4W, M1U	2-6	TJ, j1, j2	d4W, M1U	1-6	TJ	d4W, M1U	2-6	TJ, j1
C	M1W, M2U	6-12	j2, j3, ja1	M1U, M2U	6-18	j1, j2, j3	M1W, M2U	6-12	j2, j3
D	M2W, M3U	12-24	ja1, ja2, ja3	M2W, M3U	18-30	ja1, ja2, ja3	M2W, M3U	12-24	ja1, ja2, ja3, a1, a2
E	M3W, M3.3U	24-36	a1	M3W, M3.3U	30-60	a1, a2	M3W, M3.3U	24-30	a3
F	M3.3W, M3<11G	36-48	a1	M3.3W, M3<g	young adult	a2	M3.3W	>30	a3
G	M3=11G, M2=9A	48-72	a2, a3, a4, a5	M3=g	adult	a3, a4, a5	M3.3WW	adult	a4
H	M3=11G, M2>9A	72-96		M3=h/j	old adult		M3.3WWW	old adult	a5
I	M3>11G	96-120	V	M3>j	senile	V	M3.3WWWW	senile	V

Table 2.6. Wear stages of mandibular cheek teeth in caprines, cattle and pig

[1] After Payne (1987), [2] After Halstead (1985), [3] After Halstead (2020), [4] The notation of eruption stage proposed by Ewbank et al. (1964), [5] The correspondence age stages of SYSLAT (based on Fig. 2.9)

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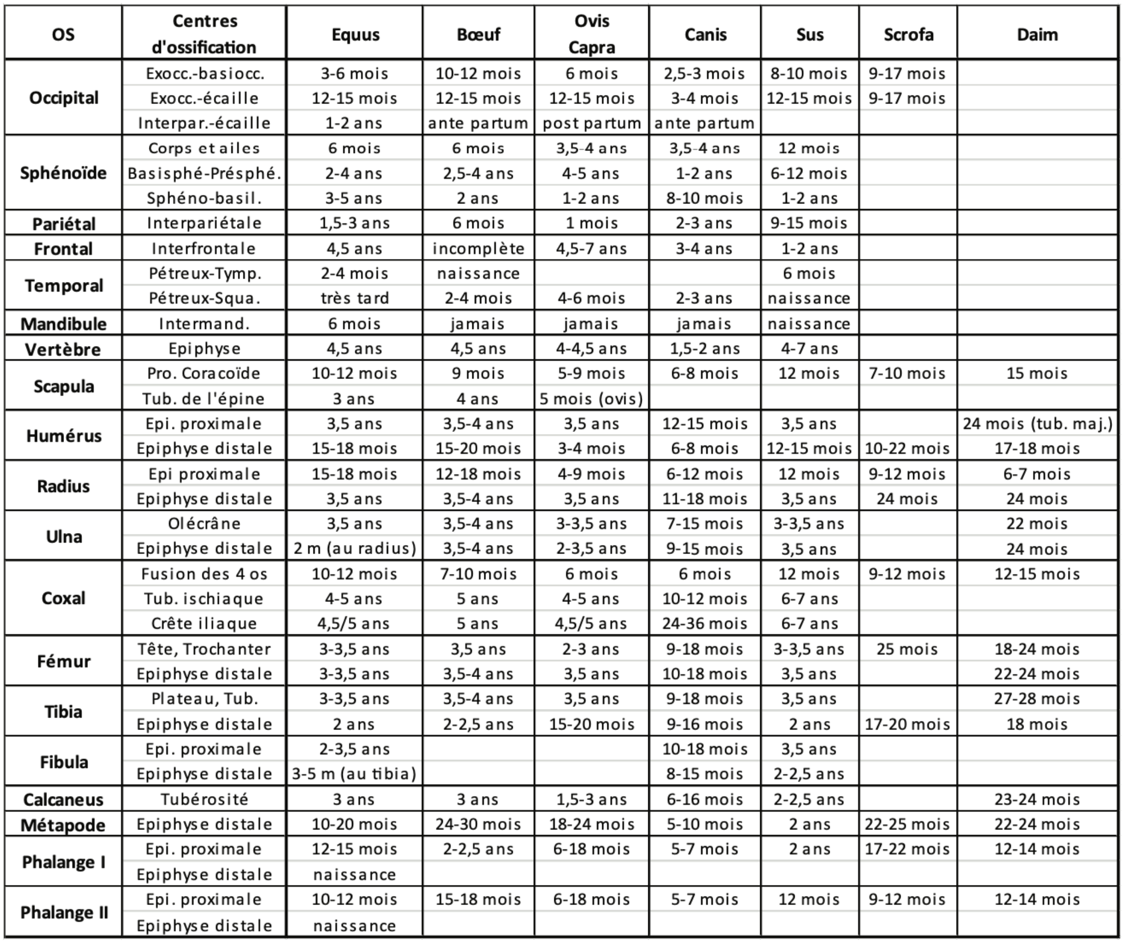
[170] Binford and Bertram 1977; Munson and Garniewicz 2003.

[171] Klein and Cruz-Uribe 1984: 43.

Caprines		Cattle		Pig	
Kastanas Age group[1]	Wear stage[2]	Kastanas Age group[1]	Wear stage[3]	Kastanas Age group[1]	Wear stage[4]
I	A	I	A	I	A
II	B		B	II	B
III	C		C	III	C
IV	D	II	D	IV	D
V	E	III	D	V	E
VI	F	IV	E+	VI	F

Table 2.7. Conversion of Kastanas age groups to Payne (1987) and Halstead (1985; 2020) wear stages of mandibular cheek teeth in caprines, cattle and pig

[1] Becker (1986), [2] After Payne (1987), [3] After Halstead (1985), [4] After Halstead (2020)



OS	Centres d'ossification	Equus	Bœuf	Ovis Capra	Canis	Sus	Scrofa	Daim
Occipital	Exocc.-basiocc.	3-6 mois	10-12 mois	6 mois	2,5-3 mois	8-10 mois	9-17 mois	
	Exocc.-écaille	12-15 mois	12-15 mois	12-15 mois	3-4 mois	12-15 mois	9-17 mois	
	Interpar.-écaille	1-2 ans	ante partum	post partum	ante partum			
Sphénoïde	Corps et ailes	6 mois	6 mois	3,5-4 ans	3,5-4 ans	12 mois		
	Basisphé-Présphé.	2-4 ans	2,5-4 ans	4-5 ans	1-2 ans	6-12 mois		
	Sphéno-basil.	3-5 ans	2 ans	1-2 ans	8-10 mois	1-2 ans		
Pariétal	Interpariétale	1,5-3 ans	6 mois	1 mois	2-3 ans	9-15 mois		
Frontal	Interfrontale	4,5 ans	incomplète	4,5-7 ans	3-4 ans	1-2 ans		
Temporal	Pétreux-Tymp.	2-4 mois	naissance			6 mois		
	Pétreux-Squa.	très tard	2-4 mois	4-6 mois	2-3 ans	naissance		
Mandibule	Intermand.	6 mois	jamais	jamais	jamais	naissance		
Vertèbre	Epiphyse	4,5 ans	4,5 ans	4-4,5 ans	1,5-2 ans	4-7 ans		
Scapula	Pro. Coracoïde	10-12 mois	9 mois	5-9 mois	6-8 mois	12 mois	7-10 mois	15 mois
	Tub. de l'épine	3 ans	4 ans	5 mois (ovis)				
Humérus	Epi. proximale	3,5 ans	3,5-4 ans	3,5 ans	12-15 mois	3,5 ans		24 mois (tub. maj.)
	Epiphyse distale	15-18 mois	15-20 mois	3-4 mois	6-8 mois	12-15 mois	10-22 mois	17-18 mois
Radius	Epi proximale	15-18 mois	12-18 mois	4-9 mois	6-12 mois	12 mois	9-12 mois	6-7 mois
	Epiphyse distale	3,5 ans	3,5-4 ans	3,5 ans	11-18 mois	3,5 ans	24 mois	24 mois
Ulna	Olécrâne	3,5 ans	3,5-4 ans	3-3,5 ans	7-15 mois	3-3,5 ans		22 mois
	Epiphyse distale	2 m (au radius)	3,5-4 ans	2-3,5 ans	9-15 mois	3,5 ans		24 mois
Coxal	Fusion des 4 os	10-12 mois	7-10 mois	6 mois	6 mois	12 mois	9-12 mois	12-15 mois
	Tub. ischiaque	4-5 ans	5 ans	4-5 ans	10-12 mois	6-7 ans		
	Crête iliaque	4,5/5 ans	5 ans	4,5/5 ans	24-36 mois	6-7 ans		
Fémur	Tête, Trochanter	3-3,5 ans	3,5 ans	2-3 ans	9-18 mois	3-3,5 ans	25 mois	18-24 mois
	Epiphyse distale	3-3,5 ans	3,5-4 ans	3,5 ans	10-18 mois	3,5 ans		22-24 mois
Tibia	Plateau, Tub.	3-3,5 ans	3,5-4 ans	3,5 ans	9-18 mois	3,5 ans		27-28 mois
	Epiphyse distale	2 ans	2-2,5 ans	15-20 mois	9-16 mois	2 ans	17-20 mois	18 mois
Fibula	Epi. proximale	2-3,5 ans			10-18 mois	3,5 ans		
	Epiphyse distale	3-5 m (au tibia)			8-15 mois	2-2,5 ans		
Calcaneus	Tubérosité	3 ans	3 ans	1,5-3 ans	6-16 mois	2-2,5 ans		23-24 mois
Métapode	Epiphyse distale	10-20 mois	24-30 mois	18-24 mois	5-10 mois	2 ans	22-25 mois	22-24 mois
Phalange I	Epi. proximale	12-15 mois	2-2,5 ans	6-18 mois	5-7 mois	2 ans	17-22 mois	12-14 mois
	Epiphyse distale	naissance						
Phalange II	Epi. proximale	10-12 mois	15-18 mois	6-18 mois	5-7 mois	12 mois	9-12 mois	12-14 mois
	Epiphyse distale	naissance						

Fig. 2.10. Epiphyseal fusion stages of the domestic species, boar and fallow deer (SYSLAT-Terminal, after Barone 1986 cited in Gardeisen 1997)

2.1.2.3. Sexing

The determination of the sex of the productive domesticate animals (cattle, sheep, goat and pig) is important as it helps, in conjunction with the age at death (above, 2.1.2.2), to investigate the managerial patterns for domesticated herds. Sex determination is based on the measurements and morphological features of specific anatomical parts of adult specimens only, to avoid uncertainty of identification created by the effects of younger age on bones.[172] Moreover, assuming that there is a balanced sex ratio at birth, restricting sex to ´adults´ can shed light to selective culling by sex thereafter. Measurements are taken from skeletal parts that are known to differ in size or build between male and female animals to detect differences in bone size based on sexual dimorphism.[173] However, some factors can distort the measurements, such as the presence of castrated animals, the age and genotype of the animal,[174] its environment, the nutritional quality of its diet and the diseases that might accelerate or decelerate bone development.[175]

Morphological features refer to the differentiations found in specific anatomical parts of the female and male animals, such as skulls, metapodials, pelvis, canines and horncores. These features are also affected by the presence of castrated animals, as well as by differences between the various breeds of a species. Moreover, the durability of the anatomical parts suitable for determination of sex is likely affected by post-depositional bias. For example, bovid horncores can be greatly affected by taphonomic processes as male horncores are more durable than female ones, thus creating bias against females.[176] The combination of using certain morphological features as criteria, taking measurements and considering age can provide more reliable information regarding the sex composition of a population.[177] Thus, in this study, taking into account the available data and the state of preservation of the studied assemblages, the determination of sex was based mainly on morphological differences found in specific anatomical parts, namely, pelves for cow,[178] sheep

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[172] Albarella 1997: 45; Greenfield 2002: 68-69; Klein Cruz-Uribe 1984: 39-41.

[173] Klein and Cruz-Uribe 1984: 39-41; Greenfield 2002: 68.

[174] The genotype is the group of genes that comprise the DNA of each organism.

[175] Payne and Bull 1988: 29; Moran and O’Connor 1994: 274.

[176] Klein and Cruz-Uribe 1984: 40.

[177] Klein and Cruz-Uribe 1984.

[178] Grigson 1982.

and goat,[179] and canines and canine alveolar cavities for pig.[180] Measurements concerned only scapula (SLC), humerus (Bd), radius (Bp) and metacarpal (Bd) of caprines, while age was also considered as, in the case of morphological differences in pig, for example, the canines develop as the individual grows.[181] The sex was recorded in the 'sex' field, while the possible measurements at the field 'measurements' of the OS tab of SYSLAT database (below, 2.1.2.5).

2.1.2.4. Pathology

Pathology refers to traces of disease in bones and teeth, and skeletal trauma. Diseases may be associated with genetic abnormalities (e.g. chondrodystrophia, dyschondroplasia); illnesses and inflammations (e.g. osteitis, osteoperiostitis, periodontitis, tartar); diet and other forms of environmental stress (e.g. osteoporosis, hypoplasia);[182] or the application of mechanical pressure by humans through ploughing or transportation (e.g. osteoarthritis, exostosis).[183] Skeletal wounds can be caused by accidents and human treatment. The detection of pathology offers information about the animals' health, living conditions and diet. In this study pathology was detected macroscopically through alterations on the bones and teeth of the animals, and recorded in the 'pathology' field and in more detail in the 'diagnosis' field of SYSLAT's OS tab following Baker and Brothwell[184] and Bartosiewicz et al.[185]

2.1.2.5. Biometry

Biometrical data can potentially be used for a range of analyses, such as the distinction between domestic and wild animals of the same species,[186] the distinction between related taxa[187] and the

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[179] Boessneck 1969.
[180] Schmid 1972.
[181] Grigson 1982; Klein and Cruz-Uribe 1984; Uerpmann 1973.
[182] Baker and Brothwell 1980: 47-53; Chaplin 1971: 108-112.
[183] Baker and Brothwell 1980: 78, 96, 114-115; Chaplin 1971: 113-117; Groot 2005: 52-55; Johannsen 2005: 40-41.
[184] Baker and Brothwell 1980.
[185] Bartosiewicz et al. 1997.
[186] Payne and Bull 1988; Rowley-Conwy 1995; Albarella et al. 2006.
[187] Albarella 2002; Albarella and Payne 2005.

identification of sex.[188] However, metrical data can be affected by several factors, including breed, age, sex, environment (anthropogenic and natural) and diet, while the measuring process itself can differ between researchers, giving different results. In this study all possible measurements were taken for all the body parts (Appendix II, **Table II.1**.) using specialized equipment (below, 2.2), and were recorded in the 'measurement' field of OS tab of SYSLAT database following von de Driesch[189] with additions from Gardeisen[190] (above, **Fig. 2.7**).

2.1.2.6. Taphonomy

Taphonomy describes the changes that affect depositions through time, as well as the nature and results of the processes that occur in organic remains after a living organism dies,[191] in other words, the transition from the life assemblage to death, deposit, fossil and finally, to the sample assemblage (**Fig. 2.11**). The life assemblage is defined as the group of living beings in the natural environment and includes all animals that people come into contact with. The death assemblage is the population of animals that are exploited by people, and later, through various pre-depositional processes, discarded inside or outside the settlement (deposited assemblage). What remains, after deposition in the ground and the interference of various post-depositional factors, is the fossil assemblage, of which the researcher often has access to only a part (sample assemblage), depending on the extent of each excavation and the retrieval methods used.[192] Both biotic and abiotic factors affect the material, acting both pre- and post-depositionally, and their detection is possible via the traces they leave on the surfaces of the specimens. Biotic transformation factors include humans (butchering, burning, trampling and excavation-retrieval methods), animals (gnawing, digesting and trampling) and plants (root erosion). Abiotic factors include those related to climate (sun, rain and temperature) and soil components. The detection and identification of the taphonomic factors in this study were facilitated by reference to relevant studies and the use of specialized equipment (below, 2.2). The taphonomic factors are discussed below, with the

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[188] Rowley-Conwy 1998.
[189] von den Driesch 1976.
[190] Gardeisen 1997.
[191] Gifford 1981: 466; Lyman 1994: 1; Reitz and Wing 1999: 110.
[192] Klein and Cruz-Uribe 1984: 3-8; Reitz and Wing 1999: 110-112.

exception of butchery and fragmentation caused by biotic factors, which are analysed in separate sections, in accordance with the structure of the 'OS' tab of the SYSLAT database (above, **Fig. 2.7**).

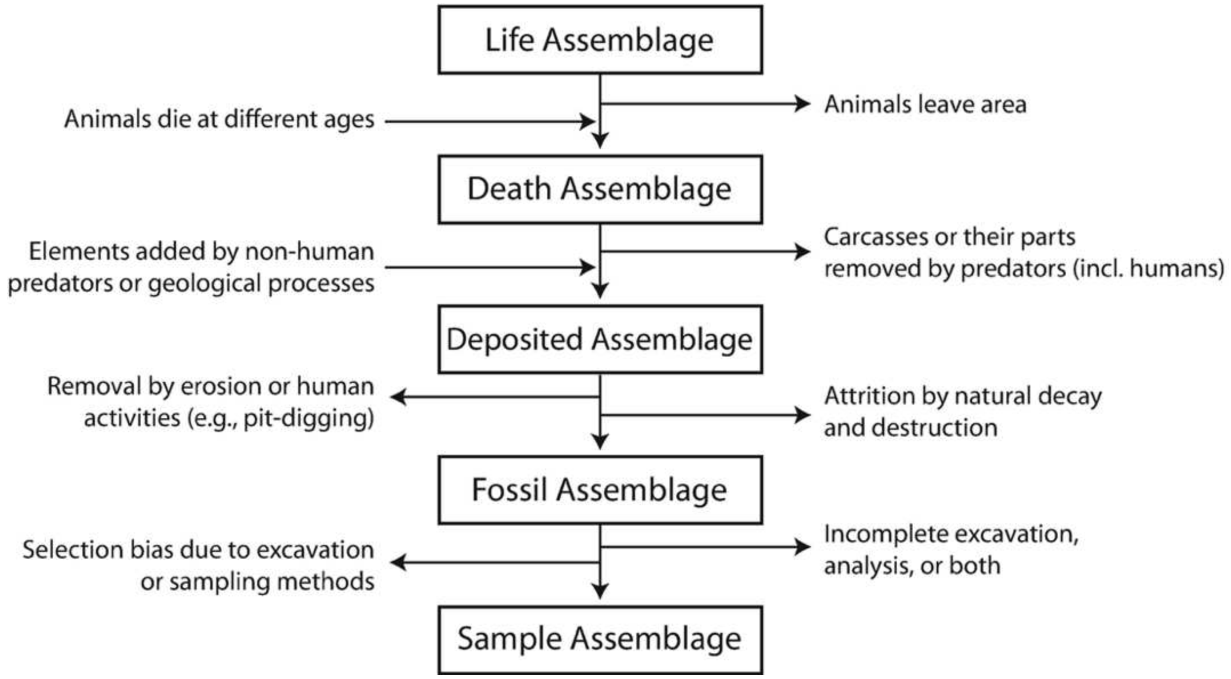

Fig. 2.11. The route of the assemblage from the initial living animal population to the study sample (Banning 2020)

a) Gnawing

Gnawing marks are caused post-depositionally by animals, which are often attracted to bones deposited on the ground and left uncovered to eat any flesh or marrow remaining and also the bone itself (antlers included). These marks are made mostly by carnivores and rodents, though also by ruminants and pigs; while humans can leave bite marks, these are made pre-depositionally during consumption.

Carnivores make marks with distinct morphology, namely, punctures, pits, furrows and scores. The action of rodents is detectable through the characteristic thin parallel lines they leave on the bone surface, which is usually dry and without fat,[193] while wearing down their constantly growing

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[193] Cáceres et al. 2011.

frontal incisors or ingesting minerals.[194] Pigs and ruminants are also attracted to discarded bones, but only under certain circumstances associated with the absorption of calcium and phosphorus (osteophagy) due to the lack of these two minerals in the ground and, therefore, the diet of these animals.[195] Gnawing of bone remains greatly affects not only breakage, dispersal and the state of preservation but also the loss of the deposited assemblage. Additionally, loss of part of the bone, breakage and bite marks can also distort or even erase other pre-depositional traces, such as cut marks. Apart from taphonomic information, animal gnawing also provides important details on the strategies used by humans to discard animal remains within their living space. In this study the traces of carnivore- and rodent-type gnawing were recorded in the 'taphonomy' field of SYSLAT's OS tab and distinguished based on Lyman,[196] while the possible presence of gnawing marks made by pigs, ruminants and humans could not be identified.

b) Digestion

Carnivores consume not only the soft tissues and marrow left on or in bones but also the bones themselves, which enter the animal's digestive system and are subject to the process of digestion. After digestion, any bones that survived the process exit the system through defecation. Whether the bones survive depends on the species and age of the animal they belonged to.[197] Although digested bones can also come from bird activity (e.g. owls), in this study the presence of digested bones confirms carnivore activity and its influence on the formation of the deposited assemblage. The digested specimens were recorded in the 'taphonomy' field of SYSLAT's OS tab.

c) Burning

Burning traces on animal remains, whether caused intentionally or accidentally by humans, are mainly pre-depositional. The traces are categorized into two main groups: those made by exposure to low temperatures and those to high temperatures.

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[194] Kibii 2009.
[195] Kierdorf 1994: 209; Lyman 1994: 395; Reitz and Wing 1999: 134.
[196] Lyman 1994.
[197] Payne and Munson 1985: 33-35; Reitz and Wing 1999: 135.

Low temperatures cause charring and blackening of the burnt specimens, while the distribution and colour of the burn traces illuminates how they were caused. For example, burns only found on certain parts of a bone signify that the bone was covered with meat (fleshed bone), with some of its parts exposed during cooking over an open fire (roasting). These parts could be the cutting or dissection points, or the points where flesh was thin and hence likely to recede during cooking.[198]

The exposure of bones to high temperatures causes oxidization of the carbon they contain, producing a whitish or blue colour.[199] In this case it is not possible to discern whether the bones were fleshed or not as the incident could have occurred due to the use of bones as fuel, intentional incineration or another exposure, accidental or otherwise, of the deposit to fire.

Burning can have a serious impact on the bones' physiology, depending on their strength and the length of exposure. As well as changing colour, the bones also shrink. Burning also disturbs their durability, affecting the degree of preservation during and after burning.[200] Burns, especially those made by high temperatures, can also decay, or cause the loss of other pre- or post-depositional traces (e.g. bites and cuts). The presence of low-temperature burning traces is mainly related to cooking practices, which, in combination with butchery marks and the type of fragmentation, can contribute to the reconstruction of consumption patterns. Furthermore, high-temperature burning traces might shed light on ritual practices and recycling patterns (e.g. use of bones as fuel) as well as episodes of destruction caused by human or natural factors within the settlement. In this study burning traces were recorded as uniformly or partly burned in the 'taphonomy' field, and the colouring and anatomical location of the burnt specimen were described in detail[201] in the 'diagnosis' field of SYSLAT's OS tab.

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[198] Lyman 1994: 387.

[199] Shipman et al. 1984: 307-325.

[200] Reitz and Wing 1999: 133.

[201] The relative terminology for the description of the anatomical location follows Barone (1986).

d) Environment

The environment is comprised of biotic and abiotic factors which affect the faunal remains post-depositionally, forming the assemblage available for recovery during excavation. The environment can affect the organic and inorganic components of the bone and tooth deposits through weather and chemical factors, such as sunlight, water, temperature and plant and soil components. Some of these factors affect faunal remains exposed on the surface (e.g. sunlight), others those covered by soil (e.g. vegetation roots, soil chemical composition) and some factors affect both buried and exposed remains (e.g. water, temperature).

The degree of these factors' interference with faunal remains varies depending on the remains' structure and size, the species and age of the animal they come from, the characteristics of the natural environment they are exposed within, and the length of exposure.[202] These factors all leave specific traces on the surface of bones. Such traces include cracking (sunlight, water, temperature); rounding of the edges (water); spiral grooves on the periosteum of the bone and the crown and root of the tooth (vegetation root); discolouration (soil chemical elements)[203] and encrustation (soil mineral contents and pH level).[204] These traces sometimes change the appearance of or heavily decay the surface of the bone or tooth, making their identification difficult or impossible,[205] while also potentially affecting the observation of or causing the loss of other pre- or post-depositional traces, such as cut- and bite-marks. Furthermore, their presence is indirectly linked to human strategies for discarding animal remains within their living spaces, shedding light on the discard and depositional environment. The alterations on the surfaces of the faunal remains caused by environmental factors in this study were identified macroscopically[206] and recorded in the 'taphonomy' field of OS tab in SYSLAT database.

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[202] Behrensmeyer 1978: 159-160; Lyman 1994: 358, 361-365.

[203] For example, Iron (Fe) and Manganese (Mn).

[204] Encrustation is a hard, thick layer on the surface of a specimen that has built up over a long period of time.

[205] Behrensmeyer 1978: 151.

[206] Biotic factors such as bacterial activity are mostly detectable microscopically, and therefore, their possible effects on the preservation of the study materials were not considered.

2.1.2.7. Butchery

Animal exploitation by humans to obtain primary products (meat, leather, fat, bones) requires the killing of animals by butchering them.[207] Other processing stages follow the death of the animal, depending on the method of slaughter, the most characteristic being skinning, dismembering and filleting.[208] Each of these stages, according to the relevant experimental studies, leaves cut marks at certain anatomical locations on bone surfaces. However, interpreting butchery techniques from anatomical location can be controversial since different functions could result in the same types of cut marks.[209] Apart from the anatomical location, the morphology of the cut marks also helps identify the butchery technique and the cutting tool, in terms of the material it was made of (metal, stone), as well as its type (cleaver, knife, etc.). The detection and preservation of butchery marks can be influenced by taphonomic factors such as gnawing, weathering and fragmentation, as well as the skill and experience of the butcher, leading to the differential preservation of butchery marks by taxon, body part, sex, age and function.[210] The study of cut marks in combination with the anatomical representation and bone fragmentation can give evidence regarding carcass processing and consumption.

In this study butchery marks were described in relation to the type of cut (skinning, dismemberment and filleting) following Binford;[211] the anatomical location on the surface of the bone following Binford[212] and Bez;[213] and the technique used and the cutting tool morphology following Greenfield.[214] In addition to butchery marks, traces related to bone modification (including of antler), such as sawing, peeling and chopping, were also recorded. These traces are indicators of the use of bones as a raw material to produce artefacts (e.g. tools, objects), in the context of recycling practices and, in the case of shed antlers, in the exploitation of the natural environment. All the above data were recorded in the OS tab fields ‘scratches’, ‘direction’, ‘cut

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[207] Davis 1987: 24.
[208] Reitz and Wing 1999: 128.
[209] Capaldo 1998.
[210] Dominguez-Rodrigo and Yravedra 2009.
[211] Binford 1981.
[212] Binford 1981.
[213] Bez 1995.
[214] Greenfield 1999.

out' and 'manufacture', while in the 'marks' field the location and the type of the butchery marks were described in detail (above, **Fig. 2.7**).

2.1.2.8. Fragmentation

The faunal assemblage can contain complete and broken specimens. In the latter case, the breakage could have occurred either in antiquity (old breaks), caused by pre- or post-depositional factors, such as chopping, gnawing and trampling, or during excavation or recovery processing (fresh breaks). In this study the type of fragmentation was recorded in detail in the 'fragmentation', 'laterality' and 'edges' fields of the SYSLAT's OS tab, describing its exact origination and anatomical location on the surviving shaft of the bone anatomy (diaphysis, epiphysis, medial, lateral, etc.)[215] as well as the anatomical side (right, left), if possible, while if the break was fresh a relative note was made in the field 'diagnosis'(above, **Fig. 2.7**). The typology of old breaks in long bones was analysed following Binford 1981,[216] offering insights into the taphonomic factors that caused the breakage, as well as into discard management practices.

2.1.3. Quantification

The quantification methods used in zooarchaeology for data analysis vary by researcher, based on the peculiarities of the study material and the research questions. The most common methods are number of identified specimens (NISP), minimum number of individuals (MNI), minimum number of elements (MNE) and minimum animal units (MAU). Each has advantages and limitations, mainly regarding the representation of the taxonomic abundance of the sample assemblage, as the taphonomic factors, both pre- and post-depositional, cause breakages which can lead to over- or under-estimation of the relative abundance of body parts and taxa.[217] The SYSLAT database uses NISP (NR: *nombre de restes*) and MNI (NMI: *nombre minimum d'individus*).

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[215] The relative terminology for the description of the anatomical location follows Barone (1986).
[216] Binford 1981.
[217] For reviews see Grayson (1984) and Ringrose (1993).

Following the principles of NISP,[218] all the faunal remains were recorded as single specimens (**Table 2.8** and **Table 2.9**). In this study every bone, tooth and carapace fragment were defined as a single specimen, with the exception of the joining fragments (fresh breaks), which were all recorded as one specimen irrespective of the number of relevant fragments. NISP was used in the analysis of taphonomic variables such as breakage, butchery, gnawing and burning, as it allows access to the maximum available data, especially for small assemblages and assemblages with limited taphonomic traces, such as Karabournaki and Kastri (below, Chapter 3).

With respect to the taxonomic abundance, the minimum number of individuals (MNI) was calculated based on age, in the FAUNA tab, following the principles of SYSLAT. However, due to the high fragmentation of the assemblages under study, the available data for the determination of age (e.g. long bones epiphyses) were few, creating biases in the abundance of the taxa. Thus, for the purposes of this study, the specimens were calculated also with the method of minimum anatomical units (MinAU), an alternative form of MAU,[219] in the 'mémo' field in the OS tab of SYSLAT (above, **Fig. 2.7**). MinAU calculates the diagnostic zones of specific body parts presented in **Table 2.8** and **Table 2.9** and has less 'restrictions' than MNI. The MinAU zones are relatively durable, readily identifiable, informative on parameters such as age and biometry and maximize the available data with relative security. Thus, apart from taxonomic abundance, MinAU was also used for the anatomical representation and the analysis of sex and age data. In regard to the calculation methodology, to facilitate MinAU quantification, bone groups which were stratigraphically close were checked for notional "joins" between fragments, namely, articulated specimens (**Table 2.10**) and joining fragments (old and fresh breaks). Any found were calculated as a single specimen, regardless of the amount discovered. Moreover, the final assessment of MinAU was based on the visual comparison of specimens and involved the distribution of anatomical-taxonomic groups (e.g. pig humeri) into subgroups (left/right, proximal/distal, medial/lateral and fused/unfused) to detect specimens that might be derived from the same anatomical unit. When two or more specimens were identified as possibly being derived from the same anatomical unit of the same individual animal, only the most complete or the one providing the most information regarding sex and/or age contributed to the MinAU. Similarly, if two

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[218] Lyman 1994: 100.

[219] Binford 1984: 50-51.

specimens of phalanx II could be derived from the same foot, only one contributed to the MinAU.[220] The recording protocol and the diagnostic zones of MinAU are described in detailed by Halstead.[221]

Long Bones		**NISP**	**MinAU**
Humerus	proximal diaphysis-epiphysis	x	x
	diaphysis shaft	x	
	distal diaphysis-epiphysis	x	x
Radius	proximal diaphysis-epiphysis	x	x
	diaphysis shaft	x	
	distal diaphysis-epiphysis	x	x
Ulna	proximal diaphysis-epiphysis	x	x
	diaphysis shaft	x	
	distal diaphysis-epiphysis	x	
Metacarpal I		x	
Metacarpal II		x	
Metacarpal III	proximal diaphysis-epiphysis	x	x
	diaphysis shaft	x	
	distal diaphysis-epiphysis	x	x
Metacarpal IV	proximal diaphysis-epiphysis	x	x[1]
	diaphysis shaft	x	
	distal diaphysis-epiphysis	x	x[1]
Metacarpal V		x	
Femur	proximal diaphysis-epiphysis	x	x
	diaphysis shaft	x	
	distal diaphysis-epiphysis	x	x
Tibia	proximal diaphysis-epiphysis	x	x
	diaphysis shaft	x	
	distal diaphysis-epiphysis	x	x
Fibula		x	
Metatarsal I		x	
Metatarsal II		x	
Metatarsal III	proximal diaphysis-epiphysis	x	x
	diaphysis shaft	x	
	distal diaphysis-epiphysis	x	x
Metatarsal IV	proximal diaphysis-epiphysis	x	x[1]
	diaphysis shaft	x	
	distal diaphysis-epiphysis	x	x[1]
Metatarsal V		x	
Phalanx I		x	x
Phalanx II		x	x
Phalanx III		x	x

Table 2.8. Recording protocol for terrestrial mammal long bones for NISP and MinAU

[1] In equids the fourth metacarpal and metatarsal are not recorded

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[220] Halstead 2020: 1080-1086.

[221] Halstead 2020: 1080-1086.

Bones			NISP	MinAU
Short	Carpal	Capitato-trapezoid	x	
		Pisiform	x	
		Scaphoid	x	
		Lunate	x	
		Hamate	x	
		Pyramidal	x	
		Capitate	x	
		Trapezoid	x	
	Tarsal	Calcaneus	x	x
		Talus	x	x
		Navico-cuboid	x	
		Navicular	x	
		Cuneiforme lateral	x	
		Cuneiforme medial	x	
		Cuboid	x	
		Scapho-cuboid	x	
Flat	Skull bones	Frontal	x	x[1]
		Parietal	x	
		Occipital	x	
		Nasal	x	
		Lacrimal	x	
	Scapula		x	x[2]
	Pelvis		x	x[3]
	Sternum		x	
	Ribs		x	
Irregular	Skull bones	Temporal	x	
		Sphenoid	x	
		Ethmoid	x	
		Mandible	x	x[4]
		Maxilla	x	
		Zygomatic	x	
		Palatine	x	
	Hyoid		x	
	Vertebrae	Cervical	x	
		Thoracic	x	
		Lumbar	x	
		Sacral	x	
		Caudal	x	
	Sacrum		x	
Sesamoid	Sesamoids (e.g. digits)		x	
	Patella		x	

Table 2.9. Recording protocol for terrestrial mammal short, flat, irregular and sesamoid bones for NISP and MinAU

[1] Only horncore (base and tip) and antler; [2] Only articular area and collum; [3] Only acetabulum region; [4] Only canine, premolar, and molar tooth row

Articulations	
Humerus distal	Radius proximal
Ulna proximal	
Radius distal	Carpals
Metacarpal proximal	
Tibia distal	Talus
Calcaneus	
Metatarsal proximal	Tarsals
Phalanx I	Phalanx II
Phalanx III	

Table 2.10. Articulation combinations checked for the assessment of MinAU

In conclusion, NISP, although significantly affected by fragmentation, was chosen as it is an ideal method for quantifying the frequencies of taphonomic traces in small assemblages such as Karabournaki and Kastri. In addition, as NISP is the most widely used quantification method in zooarchaeology, it allows comparison with other studies, while, as the excavations of both Argilos and Karabournaki are in progress, facilitating the easy and simple addition of new records. In contrast, although MinAU is not a very common method, it was chosen to quantify the relative abundance of body parts and taxa, and ageing and sexing data, and it is an ideal method for spatial (horizontal) and temporal (vertical) examination, on both intra- and inter-site levels.

2.2. Laboratories and equipment

The present study is a research program of *Archéologie des Milieux et des Ressources* of the Lab Unit *Archéologie des Sociétés Méditerranéennes* (ASM) – UMR5140 and occurred in Greece, France and Canada. More specifically, the identification and recording of the study material took place at the Karabournaki research centre of the Aristotle University of Thessaloniki, Greece; the premises of the Greek-Canadian archaeological mission of Argilos in the Archaeological Museum of Amphipolis, Greece (**Fig. 2.12**); the Archaeological Museum of Thassos, Greece; and the Zooarchaeological Laboratory of the Lab-Unit ASM – UMR5140 in Montpellier, France.

To facilitate the laboratory work, apart from anatomy atlases and relevant articles (above, 2.1.2.1), the reference collection of the ASM – UMR5140 Lab and the author's portable comparative collection of modern-day domesticated and wild animals were also employed for a more reliable identification of the bones. The author's collection includes entire skeletons of juvenile and adult sheep, goat, cow, and boar; an adult domestic dog, domestic cat, red fox, hare, badger and tortoise; a juvenile donkey; and elements of an adult horse, red deer, fallow deer and wolf. In addition, the macroscopic examination of the bones for the observation of taphonomic traces was conducted with the use of a 10x magnifying glass. For measurements, electronic callipers, a measuring box, and tape measure in millimetres were used, while a digital camera was employed for photographic documentation. Each photo was uploaded in the depicted specimen at the SYSLAT's OS tab sheet (above, **Fig. 2.7**). The analysis of the data was conducted via the statistical tools of the SYSLAT database and Microsoft Excel for Macintosh and took place at the *Laboratoire d'Archéologie Méditerranéenne* (LAM) at the University of Montreal, Canada. All activities were supported financially by Labex ARCHIMEDE, program IA-ANR-11-LABX-0032-01, Montpellier, France, and the department of History at the University of Montreal, Canada.

Fig. 2.12. Studying animal bones from Argilos in the Museum of Amphipolis, Greece (©A. Gkotsinas)

Chapter 3. Zooarchaeological case studies

Chapter 3 presents alphabetically the three case studies, Argilos, Karabournaki and Kastri, located in the region of Macedonia (**Fig. 3.1**). Information on each site is presented in two parts. The first provides a general introduction to the site concerning its location and the historical framework provided through ancient sources. Additionally, the history of archaeological research and the general organization and date of the settlement, based on the archaeological data, are briefly presented. The second part relates to the zooarchaeological study, including the presentation of the assemblage and the analysis of the recorded data in relation to taphonomy, carcass processing and animal exploitation. Finally, a synthesis at the end of the presentation of each site summarizes the zooarchaeological analysis.

Fig. 3.1. The location of the studied sites (©Apple Maps)

3.1. Argilos

3.1.1. The settlement of Argilos

The ancient city of Argilos was built on two hills, collectively called Palaikastro, on the northern coastline of the Strymonic Gulf, 4 km west of the River Strymon and to the south of the Kerdyllia Mountain[222] (**Fig. 3.2**).

Fig. 3.2. The location of Argilos (©Apple Maps)

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[222] Today ancient Argilos belongs to the municipality of Amphipolis in the regional unit of Serres.

3.1.1.1. The historical framework

Argilos is the oldest Greek colony on the coast of ancient Bisaltia (above, Chapter 1: **Fig. 1.11**).[223] It is one of the four colonies[224] founded by immigrants from the island of Andros in the mid-7th c. BC (655/4 BC).[225] The city's history, according to the archaeological remains and historical data, commences with its founding in the 7th c. BC. Excavation has shown a strong Thracian element in the city, either as a result of intense trade with the local population or due to the presence of a pre-colonial Thracian settlement at the location.[226] During the 6th and 5th c. BC, the residential grid was developed, and the city occupied the entire hills, from summit to shore. In the late 6th c. BC, the city founded a colony, Kerdyllion, east of the metropolis, and may also have taken part in the foundation of Tragilos, in the hinterland of ancient Bisaltia (above, Chapter 1: **Fig. 1.10**).[227] Argilos minted its own coinage[228] and traded widely with Chalcidice[229] (**Fig. 3.3**), the coast of Ionia,[230] the island of Thassos, Attica[231] and Corinth,[232] as indicated by the imported pottery found on site[233] (**Fig. 3.4**).

Fig. 3.3. Tetradrachm from Akanthos (500-478 BC) found in Argilos (Liampi 2005: 272)

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[223] Bonias and Perreault 1998: 173-196; Bonias and Perreault 2008: 17-35; Perreault 2005: 40-44; Perreault and Bonias 2007a: 38-45.

[224] The other three were Stageira, Akanthos and Sane, on the Peninsula of Chalkidici (above, Chapter 1: Fig. 1.10).

[225] Thucydides IV, 103, 3.

[226] Bonias and Perreault 1997b: 666-667; Bonias and Perreault 2011.

[227] Bonias and Perreault 1997b: 665.

[228] Liampi 1994; 2005.

[229] Perron 2006a; 2006b.

[230] Perron 2012: 139-150.

[231] Giroux 2006: 55-57; Lavallée 2006.

[232] Neeft 2012: 189-196.

[233] Perreault and Bonias 2006: 173-182.

Fig. 3.4. Attic red-figure kylix (510-490 BC) found in Argilos (Giroux 2006: 57, pl. V)

During the second Persian invasion of Greece, the Persian king Xerxes, after crossing the river Strymon, stopped at Argilos, and forced the inhabitants to join his army, without occupying the settlement.[234] In 453 BC the city joined the first Athenian League with an annual allied tax of ten and a half talents. In 437 BC Athens founded Amphipolis on the eastern bank of the River Strymon, inviting the citizens of Argilos to participate in the settlement and reducing the allied tax they paid to the Delian League.[235] The founding of Amphipolis would signal the beginning of the city of Argilos's demise, as it lost control of the trade routes with the ancient Thracian hinterland and the nearby mines of Mount Pangaion. In 422 BC, as the Peloponnesian war raged, the Argilians sided with the Spartans in their victorious siege of Amphipolis.[236] After the war, the city must have been independent, or at least it was in 360/359 BC, when it was mentioned in a list of Thearodokes[237] from the sanctuary of Asclepius in Epidauros.[238] Finally, in 357 BC the city was occupied by the Macedonians under King Philip II and it was probably settled by Macedonian aristocrats until the end of the 3rd c. BC.[239] The city was then permanently abandoned, and no traces of use are found on site, apart from a World War II pit on the summit of the hill,[240] and the later tilling and cultivation of the lower southeastern slope during the 1970s.[241]

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[234] Herodotus VII, 115.
[235] Perdrizet 1922: 46.
[236] Thucydides IV, 103, 2.
[237] The lists of Thearodokes were inscribed lists from sanctuaries, which mentioned the names of the cities that offered gifts to the relevant gods, e.g. to Asclepius in Epidauros and Apollo in Delphi.
[238] Perlman 1984.
[239] Bonias and Perreault 1997b: 673.
[240] Bonias and Perreault 2001: 541.
[241] Bonias and Perreault 1997a: 466.

3.1.1.2. Archaeological research

The site was first identified by P. Perdrizet,[242] while it also drew the attention of G. Hirschfeld,[243] P. Collart and P. Devambez in 1930[244] and later of D. Lazaridis.[245] Rescue excavations of the eastern cemetery by the local Ephorate of Antiquities took place in 1980 and 1992. Systematic excavations began in 1992, organised by the Greek Archaeological Service and the Canadian Archaeological Institute, first via the University of Concordia and then the University of Montreal, under Dr. Z. Bonias and Prof. J. Perreault; the excavation of the site is still ongoing.[246]

To date, the excavation has revealed architectural remains of the city and small finds spanning the 7th to the late 3rd c. BC. Part of the settlement is now interrupted by the old national road from Thessaloniki to Kavala that runs along the coast, while parts of the habitation layers of the settlement on the slope of the east hill have been disturbed during modern cultivation.

3.1.1.3. Settlement organization

The ancient city layout was almost triangular, with a maximum height of 80 m and an area of 12 hectares. The northern, eastern and western slopes of the Palaikastro hill are steep and delineated by seasonal streams. In contrast, the south–southeastern slope is gentler and reaches the sea.[247] The excavation is being conducted in four sectors, namely, Acropolis, Southeast, Koutloudis and National Road (**Fig. 3.5**).

The city's public and private buildings were *intra muros* and apparently occupied the slopes of the two hills, from the summit (Acropolis sector) to the coast (National Road sector).[248] The excavators revealed five habitation phases (**Table 3.1**). The first phase covers the period from the foundation of the city, the mid-7th c. to the mid-6th c. BC. The second habitation phase spans the

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[242] Perdrizet 1894: 434-436.
[243] Hirschfeld 1895: 718.
[244] Collart and Devambez 1931: 191-192.
[245] Lazaridis 1972.
[246] Perreault 1995: 77-83; 1996; 1997; Perreault and Bonias 1998: 37-48.
[247] Bonias and Perreault 1997a: 465; 1996: 663.
[248] Bonias and Perreault 1997b: 670.

mid-6th c. to the first quarter of the 5th c. BC, the third phase spans the first to the fourth quarter of the 5th c. BC, and the fourth phase runs from the fourth quarter of the 5th c. to the mid-4th c. BC. The fifth and final phase covered the period from the mid-4th c. to the end of the 3rd c. BC, when the city was abandoned.

Fig. 3.5. Argilos – general view of the site. The locations in white are the excavation sectors (©Apple Maps)

Habitation phase	Century	Date (BC)
I	mid-7th– mid 6th c. BC	655–550
II	mid-6th–1st quarter of 5th c. BC	550–500/475
III	1st quarter of 5th–4th quarter of 5th c. BC	500/475–425/400
IV	4th quarter of 5th–mid-4th c. BC	425/400–357
V	mid-4th–end of 3rd c. BC	357–250

Table 3.1. Argilos habitation phases and dating (BC)

The excavation on the Acropolis, at the summit of the hill, has revealed numerous architectural traces of various phases and uses. The earliest structures date to the mid-6th c. BC, while the latest date to the 3rd c. BC. The best-preserved and documented structure is Building A, which was revealed at the centre and highest point of the Acropolis sector (**Fig. 3.6**). It was a fully equipped craft workspace that produced olive oil[249] (**Fig. 3.7** and **Fig. 3.8**), dating to the last quarter of the 4th c. BC, and remained in use until the end of the 3rd c. BC.[250] Apart from the various buildings, paved roads were also discovered, with Road 1 (R1) being the central road of the settlement, traversing the whole settlement from the Acropolis to the National Road sector (**Fig. 3.6**).

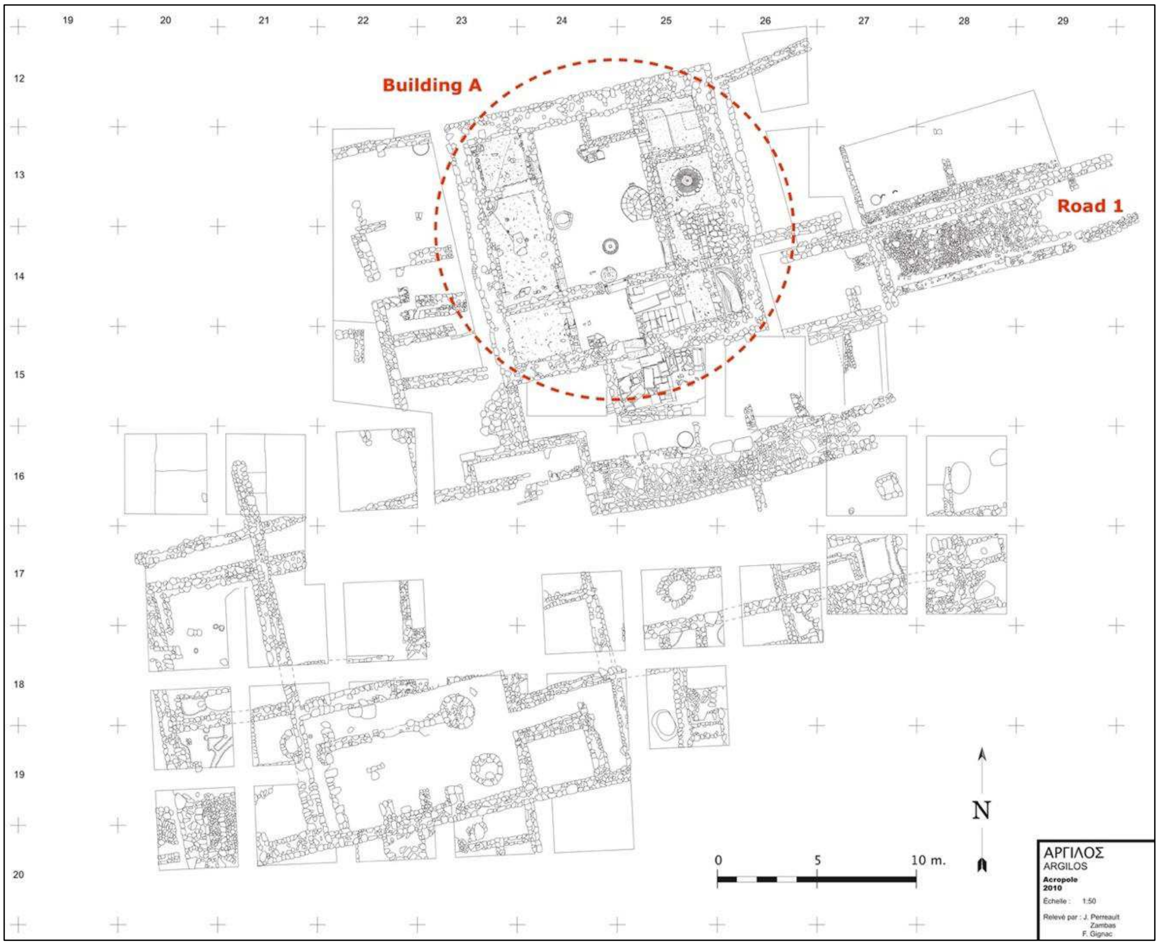

Fig. 3.6. Acropolis sector in Argilos (Argilos excavation archives)

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[249] Bonias and Perreault 2001: 547.

[250] Bonias and Perreault 1997b: 673.

Fig. 3.7. View of the olive crusher inside the Building A in Acropolis sector at Argilos (©argilos.net)

Fig. 3.8. Pithos from the Building A in Acropolis sector at Argilos. The pithos, located in the courtyard of the building, was used to hold the olives before putting them in the press. The semicircular stones at the back were part of the mill (©argilos.net)

The Southeast sector (hereafter 'SE sector') was excavated on the south-southeastern slope of the eastern hill (above, **Fig. 3.5**). The residential buildings revealed were situated mainly on either side of a large paved road, 5 m. wide, running east–south (**Fig. 3.9**). This road is probably part of the R1 road, found in the Acropolis sector, which crosses the entire city. Four buildings, A, D, E and F, were discovered on the north side of road R1, preserved in relatively good condition (**Fig. 3.10**).

Building A, to the east, had at least two construction phases. The first dates approximately to the second half of the 6th c. BC, when the rectangular Space A1 was built, and the second to the transition from the 6th to the 5th c. BC, when two smaller spaces, A2 and A3, were added to the north end of Space A1 (**Fig. 3.9** and **Fig. 3.11**). The architectural examination of the tripartite house has indicated that it had a second storey, equal in size to the ground floor.[251] Building D is located directly to the west of and in direct contact with Building A, and may be part of the same building. It has two spaces (D1 and D2) and its plan is rectangular (**Fig. 3.9**). Its first construction phase dates to the mid-6th c. BC and a second phase to the final quarter of the 5th c. BC; the building was abandoned in the mid-4th c. BC. Building E, which was found next to Building D, comprises three spaces[252] (**Fig. 3.9**). Its first habitational phase also dates to the mid-6th c. BC and its last, which is limited to Space E3, to the first half of the 4th c. BC.[253] Building F is found to the west of Building E, and separated from it by an open channel (E–F) that perhaps served to drain water coming down the slope (**Fig. 3.9**). Building F consists of five spaces (F1, F2, F3, F4 and F5) with habitation phases that correspond to those of the other buildings. The area to the south of Road R1 was heavily destroyed due to modern cultivation activities,[254] and thus Building G was only fragmentarily preserved (**Fig. 3.9**). Like the other buildings, its first habitation phase dated from the middle to the end of the 6th c. BC, the second continued until the final quarter of the 5th c. BC and the third until the mid-4th c. BC when the SE sector was abandoned.

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[251] Bonias and Perreault 1997b: 668; 2000: 111-112.
[252] Turcotte 2006.
[253] Bonias and Perreault 2002: 112.
[254] Perreault and Bonias 2007b: 84.

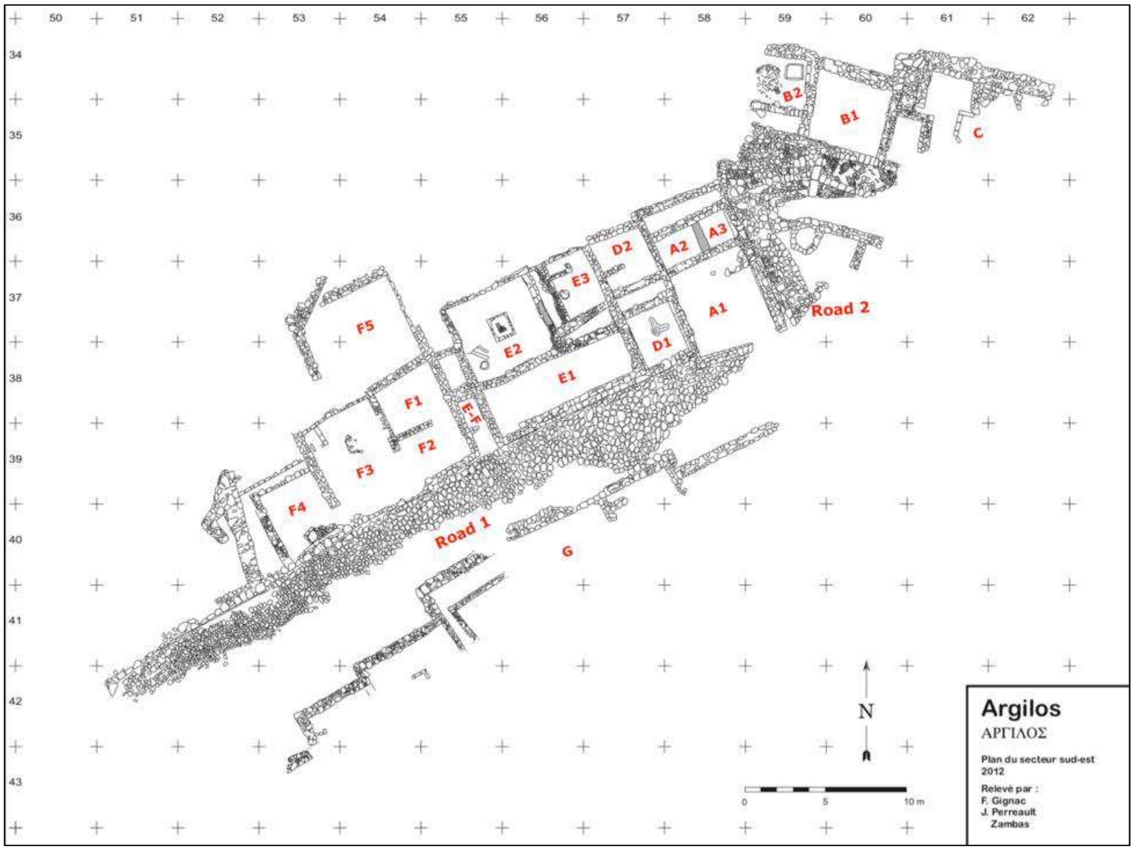

Fig. 3.9. South East (SE) sector at Argilos (Argilos excavation archives)

Fig. 3.10. The main road (R1) in front of the buildings A, D, E and F, of the SE sector at Argilos as viewed from the East (©argilos.net)

A narrower road (Road 2) was discovered along the east wall of Building A (**Fig. 3.9** and **Fig. 3.11**). It runs to the north before stopping in front of a wall and turning to the east, following the slope of the hill where it culminates in steps.[255] Directly to the north of the steps, buildings B (spaces B1 and B2) and C were excavated (**Fig. 3.9**). The first phase of these buildings dates to the late 6th and early 5th c. BC and the final one to the late 5th c. BC. Their use was interrupted in the mid-4th c. BC.

Fig. 3.11. Building A at the intersection of roads 1 and 2 in SE sector at Argilos as viewed from the East (©argilos.net)

In the Koutloudis sector (above, **Fig. 3.5**), four buildings, H, L, Q and P, have been discovered to date, delineated by horizontal and vertical roads that seem to follow a Hippodamian grid, forming rectangular plots (**Fig. 3.12**). Of the aforementioned buildings, only H and L have been fully excavated. Building H, to the north of the sector, is bordered by two horizontal roads, one to the north (Road 5) and one to the south (Road 4), a vertical open-air channel to the west (hereafter 'SWH1': Space West of room H1) and a vertical road to the east (Road 3), (**Fig. 3.12**). It consists of twelve rectangular rooms (H1–H12) placed in line along its length, some of which contained further subdivisions. Building L, located south of Building H, is similar in dimensions and partitioning of space (rooms L1–L12), (**Fig. 3.12**). It was built in the mid-6th c. BC and has two habitation phases. The first ran from the first quarter to the end of the 5th c. BC, and the second from the late 5th to the middle of the 4th c. BC, while some spaces within may have been used as

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[255] Bonias and Perreault 1997b: 668.

late as the second half of the 4th c. BC. All rooms have entrances, opening outwards, with a threshold on their south wall. The excavators have identified the rooms as workshops and shops, at least in their later phase of their use.[256] For example, 40 loom weights were recorded from the Classical layers of Room L7 which most probably served as a weaving workshop, while the press-bed found in Room L4 was probably linked to an olive oil workshop (**Fig. 3.13**). East of Building H, Building Q was discovered (**Fig. 3.12**). Though only the first two rooms have been revealed so far (rooms Q1 and Q2), which might have belonged to a private residence, the building seems to continue to the east, as do the roads that run parallel to it, and its spatial layout appears similar to those of buildings H and L. South of Building Q, the first two rooms of Building P were discovered; this building also appears to continue to the east in perfect architectural accordance with Building Q (**Fig. 3.12**). West of Building H, a rectangular room has been excavated, which might have been part of a larger building that extends to the west, in accordance with the Hippodamian grid system. The same is also true of the room found west of Building L (**Fig. 3.12**).

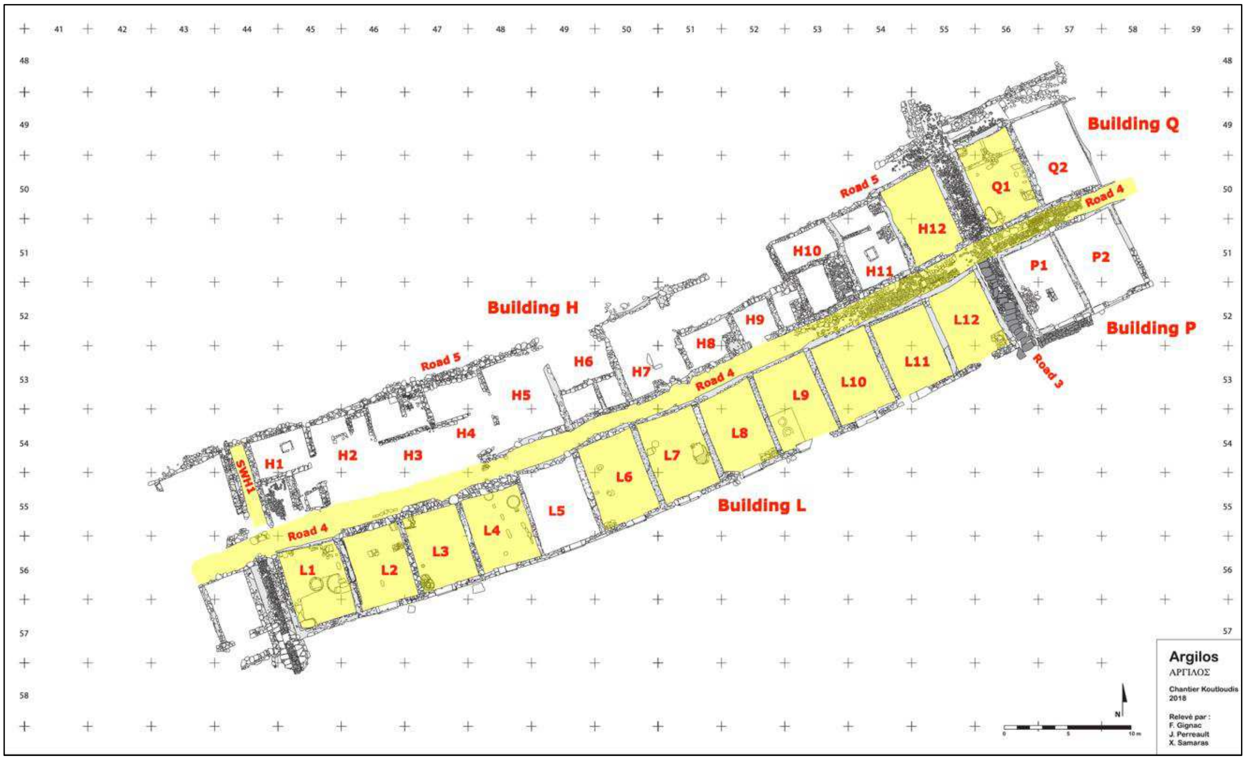

Fig. 3.12. Koutloudis sector at Argilos; the studied areas are highlighted in yellow (Argilos excavation archives)

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[256] Perreault and Bonias 2021: 15.

Fig. 3.13. Press-bed in Room L4 of Building L in Koutloudis sector at Argilos, as viewed from the North (Perreault and Bonias 2021: 13, Fig. 2.6)

South of the Koutloudis sector and the old Thessaloniki–Kavala national road lies the National Road sector (hereafter 'NR sector'), (above, **Fig. 3.5**). There, parts of two parallel ancient roads and a dump have been revealed, along with parts of structures of unknown use (**Fig. 3.14** and **Fig. 3.15**). Part of the city wall, 2.3 m wide, was found on the western edge of the NR sector and probably related to the fortification of the city. The exterior face of the wall was built with large rectangular stone plinths, while the interior was built with smaller stones.[257] The wall runs north to south, possibly following the brow of the west side of the hill.[258] A square tower, arguably dating to the 4th c. BC and possibly associated with the city's defence, is located on the southern and highest part of the west hill, approximately 50 m above sea level.[259] The structures in the NR sector were in use from the 6th to the mid-4th c. BC, while earlier strata have yielded local domestic pottery, as well as imported wares from the eastern Aegean and the Cyclades that date to the second

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[257] Ouellet 2014.

[258] Bonias and Perreault 1997a: 466; 1997b: 671.

[259] Bonias and Perreault 1997a: 466.

half of the 7th c. BC,[260] making them the oldest datable finds in the city.[261] Finally, traces of piers can be seen in the water, apparently belonging to the city's port structures.[262]

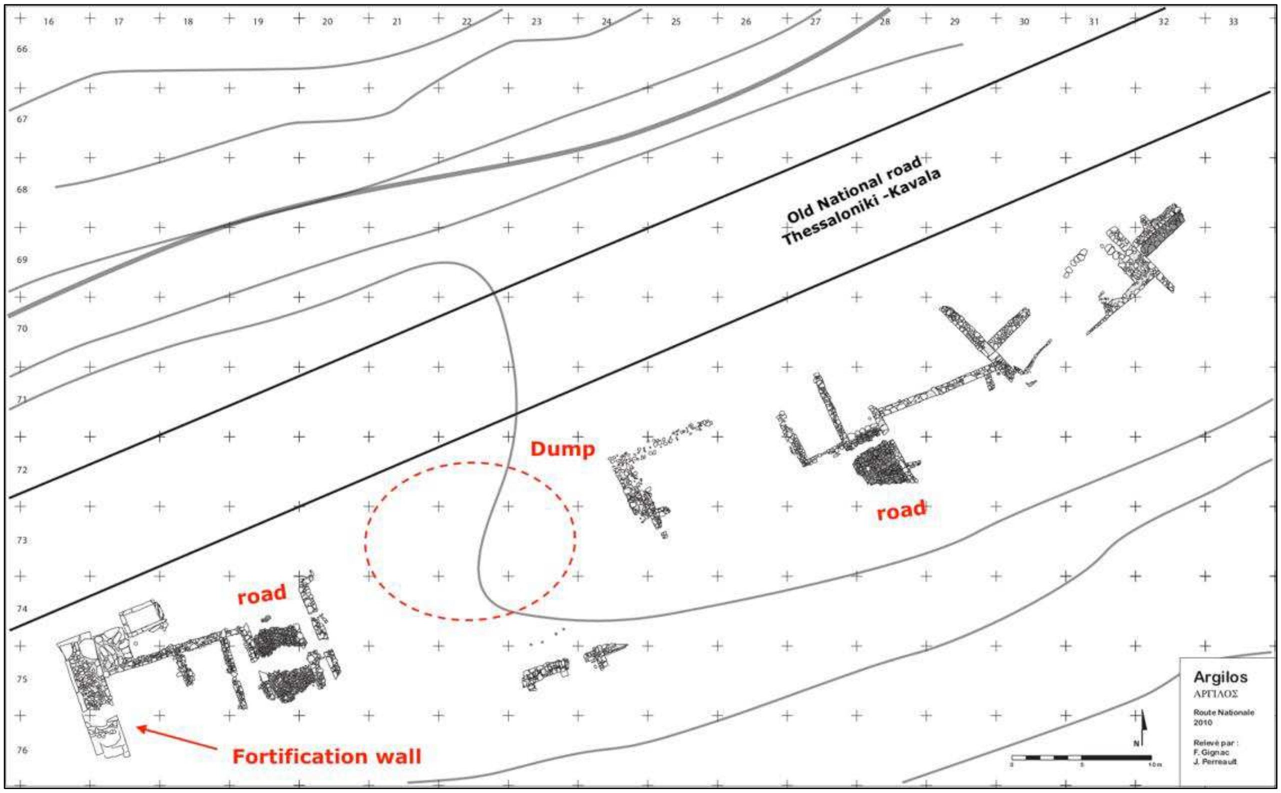

Fig. 3.14. National Roar (NR) sector at Argilos (Argilos excavation archives)

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[260] Bonias and Perreault 2002: 113.

[261] Sherds dated to the last quarter of the 7th c. BC were also found in the Acropolis sector but in disturbed layers; Bonias and Perreault 1997a: 472.

[262] Bonias and Perreault 1997a: 466.

Fig. 3.15. Part of the NR sector at Argilos, with the dump (red arrow) visible on the first level as viewed from the North (©argilos.net)

The city's cemeteries are *extra muros*, to the east of the coastal area.[263] The excavations have revealed late Archaic and early Classical graves,[264] while two Macedonian tombs, A and B, have been found in close proximity, with the latter being very well preserved and safely dated to the 3rd c. BC (**Fig. 3.16** and **Fig. 3.17**).

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[263] Bonias and Perreault 1997a: 465; 1996: 664.
[264] Grammenos and Tiverios 1984: 1-47.

Fig. 3.16. The entrance of the Macedonian Tomb A near Argilos (©argilos.net)

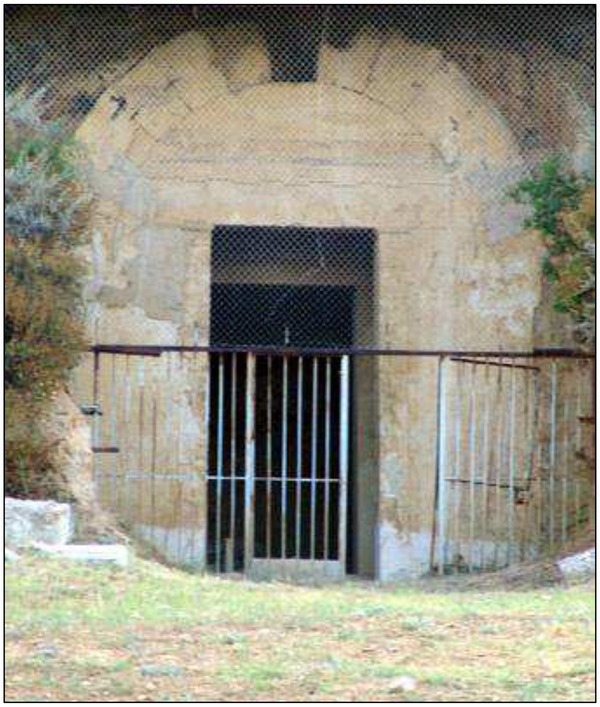

Fig. 3.17. The entrance of the Macedonian Tomb B near Argilos (©argilos.net)

3.1.2. The zooarchaeological study

The zooarchaeological remains from Argilos include both terrestrial and aquatic faunal remains. The latter, which include salt- and freshwater fish and shellfish,[265] are not included in this study. The present study concerns only the terrestrial faunal remains dated to the first four habitation phases (phases I–IV), which cover the Archaic and Classical eras (above, **Table 3.1)**. However, part of the material derived from stratigraphic layers whose chronological range spans the Classical period, which corresponds with the third and fourth habitation phases of the city, and this material was assigned to a mixed category, namely Phase III-IV (above, 2.1.1.2). The recorded bone remains derived from the SE, Koutloudis and NR sectors, while the Acropolis sector was excluded, because the dating documentation is not yet complete. As regards the SE sector, all excavated stratigraphic units were recorded, namely the interiors of buildings A, B, C, D, E, F and G, the roads R1 and R2 and the open space between buildings E–F (above, **Fig. 3.9**), covering the excavation seasons from 1992 to 2013. However, in parts of the SE sector the stratigraphic study is still in progress, and thus the spatial distribution of the material within the buildings is not available. In the Koutloudis sector, where the excavation is ongoing, the study includes only the material from Building L (rooms 1–4 and 6–12), Room H12 of Building H, Room Q1 of Building Q, Road R4 and SWH1, collected in the excavation seasons between 2012 and 2017 (above, **Fig. 3.12**; the studied areas are highlighted in yellow). Thus, the animal bones from Building H (rooms H1-H11), Room L5 of Building L, Room Q2 of Building Q, rooms P1 and P2 of Building P and roads 3 and 5 were not recorded because there was no sufficient time. Finally, in the NR sector, the studied faunal remains were derived from a dump and the area next to it (above, **Fig. 3.14**), which contained the majority of the bones revealed in this sector, excavated between 1994 and 2010. The unstudied bones related with unspecified structures, northeast of the dump, and was excluded because the dating documentation is not yet complete. To sum up, the zooarchaeological study in Argilos focuses on three out of the four excavation sectors, the faunal remains excavated during the excavation seasons 1992-2017, and the recording does not include the total of the bones collected.

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[265] Colangelo 2007: 52; Mylona 2020 (Unpublished report, Argilos excavation archives).

The terrestrial faunal analysis aims to explore animal exploitation, consumption practices and discard management in Argilos through time. Thus, the following sections present, analyse, and compare the species composition, taphonomy, carcass processing, mortality patterns and management strategies for all four phases, concluding with a synthesis of animal management at Argilos.

3.1.2.1. The assemblage and species representation

The sample assemblage is derived from 1,045 stratigraphic units and includes 18,549 specimens, of which 12,748 NISP (4,088 MinAU), (**Table 3.2**), were identified to the level of species, genus, subfamily, class or animal size category. The identified taxa are sheep (*Ovis aries*), goat (*Capra hircus*), cattle (*Bos taurus*), pig (*Sus domesticus*), dog (*Canis familiaris*), donkey (*Equus asinus*), horse (*Equus caballus*), red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), fallow deer (*Dama dama*), hare (*Lepus europaeus*), boar (*Sus scrofa*), wolf (*Canis lupus*), red fox (*Vulpes vulpes*), tortoise (*Testudo* sp.) and birds (*Aves* sp.).

The analysis was conducted by habitation phase: Phases I, II, III, IV and III–IV. For the overall taxonomic presentation of the assemblage, specimens were quantified in terms of NISP and for the species composition of the mammalian fauna, MinAU was used (above, 2.1.3). In the case of sheep and goat, specimens identified only to the level of sheep/goat have been assigned to these two species proportionately. The wild species, due to their very low representation in parts of the assemblage, are combined in the taxonomic diagrams as ‘wild’. Finally, the assemblage from the Koutloudis sector is presented contextually, whereas the assemblages from the SE and National Road sectors are mostly presented as a whole for the reasons set out in the previous section.

Habitation phase[1]	Sector and Context		No. Stratigraphic Units		NISP	
I	NR		167		3,399	
II	SE[2]		92	112	702	1,033
	Koutloudis	L6	5		16	
	NR		15		315	
III	SE[2]		229	251	1,825	2,533
	Koutloudis	Room L1	15		647	
		Room L3	2		19	
		Room L11	5		42	
IV	SE[2]		118	334	636	4,496
	Koutloudis	Room H12	14		429	
		Room L1	5		26	
		Room L2	8		41	
		Room L3	22		236	
		Room L4	14		169	
		Room L6	34		514	
		Room L7	24		462	
		Room L8	21		376	
		Room L9	10		573	
		Room L10	11		86	
		Room L11	12		99	
		Room L12	18		210	
		Room Q1	14		79	
		Road 4	5		101	
		SWH1	4		459	
III-IV	SE[2]		181		1,287	
Total			1,045		12,748	

Table 3.2. The habitation phases, sectors-contexts, stratigraphic units and NISP of the recorded specimens at Argilos

[1] Based on Table 3.1; [2] Includes buildings A, B, C, D, E, F and G, roads R1 and R2 and the space between buildings E–F

a) Phase I

The material from the first phase is derived from 167 stratigraphic units excavated in the NR sector (above, **Table 3.2**). In total, 3,399 NISP (846 MinAU) bones and teeth of domesticated and wild taxa were recorded. The domesticated animals are sheep, goat, cattle, pig, dog, donkey and horse, and the wild animals are red deer, roe deer, hare, boar and tortoise (Appendix I, **Table I.1**). Due to preservation state, boar (6 NISP) was identified based only on the thickness of the diaphyseal bone walls, the presence of strong muscle attachments in the postcranial specimens (**Fig. 3.18** and **Fig. 3.19**), and the size of the mandibular canines.

Fig. 3.18. Right ulna proximal diaphysis identified as boar based on its size (Argilos, NR sector, Phase I) (©A. Gkotsinas)

Fig. 3.19. Right tibia distal diaphysis and epiphysis identified as boar based on its size (Argilos, NR sector, Phase I) (©A. Gkotsinas)

As observed in **Table 3.3**, mammals identified to taxon make up 70% of the assemblage, tortoise 2%, birds 1% and indeterminate taxa 27%. Within the indeterminate material, the dominance of medium-sized animals (78%; **Table 3.4**) matches the dominance of the identified medium-sized species, namely sheep, goat, pig and roe deer (80% NISP, 82% MinAU; **Table 3.5**). Second in abundance are the large-sized indeterminate (12%; **Table 3.4**) and identified animals, namely cattle, horse, donkey, red deer, and boar (18% NISP, 15% MinAU; **Table 3.5**), and third are the small-sized indeterminate (10%; **Table 3.4**) and identified species, in Phase I represented by dog and hare (2% NISP, 3% MinAU; **Table 3.5**). The indeterminate and identified datasets diverge most clearly in the scarcity of identified dog and hare bones relative to indeterminate small-sized specimens. In principle, this discrepancy might be due to a difference in treatment of carcasses of different size, with the trunk (indeterminate ribs, vertebrae) of small species more frequently introduced to the site and the identified limb bones more frequently discarded off-site. In practice, such anatomically selective behaviour is more commonplace with large animals, so the apparent discrepancy between the datasets should probably be attributed to over-attribution of indeterminate specimens (perhaps especially those derived from young medium-sized animals) to the small-sized category.

	NISP	NISP %
Identified mammals	2,382	70.1
Tortoise	56	1.6
Birds	41	1.2
Size classes (mammals)	920	27.1
Total	3,399	100.0

Table 3.3. Taxonomic composition of Phase I at Argilos (Appendix I: Table I.1, NISP)

	NISP	NISP %
Small sized	94	10.2
Medium sized	719	78.2
Large sized	107	11.6
Total	920	100.0

Table 3.4. Composition of mammal size categories of Phase I at Argilos (Appendix I: Table I.1, NISP)

	NISP	NISP %[1]	MinAU	MinAU %[1]
Sheep[1]	95	36.0	90	39.5
Sheep/Goat	1,357	-	387	-
Goat[1]	74	28.0	53	23.2
Cattle	392	16.5	113	13.4
Pig	382	16.0	165	19.5
Dog	35	1.5	20	2.4
Donkey	2	0.1	2	0.2
Horse	1	0.0	-	0.0
Red deer	34	1.4	8	0.9
Roe deer	1	0.0	1	0.1
Hare	3	0.1	1	0.1
Boar	6	0.3	6	0.7
Total	2,382	100.0	846	100.0

Table 3.5. Species composition (mammals) of Phase I at Argilos (Appendix I: Table I.1, NISP-MinAU)

[1] Percentages of sheep and goat include sheep/goat assigned proportionately (NISP-MinAU)

In terms of MinAU, the species distribution was as follows: sheep (39%), followed by goat (23%), pig (19%), cattle (13%), dog (2%) and donkey (<1%), while horse is not represented in the MinAU quantification. The wild mammals represent only 2%, the most prevalent being red deer, followed by boar, then hare and roe deer (**Fig. 3.20**).

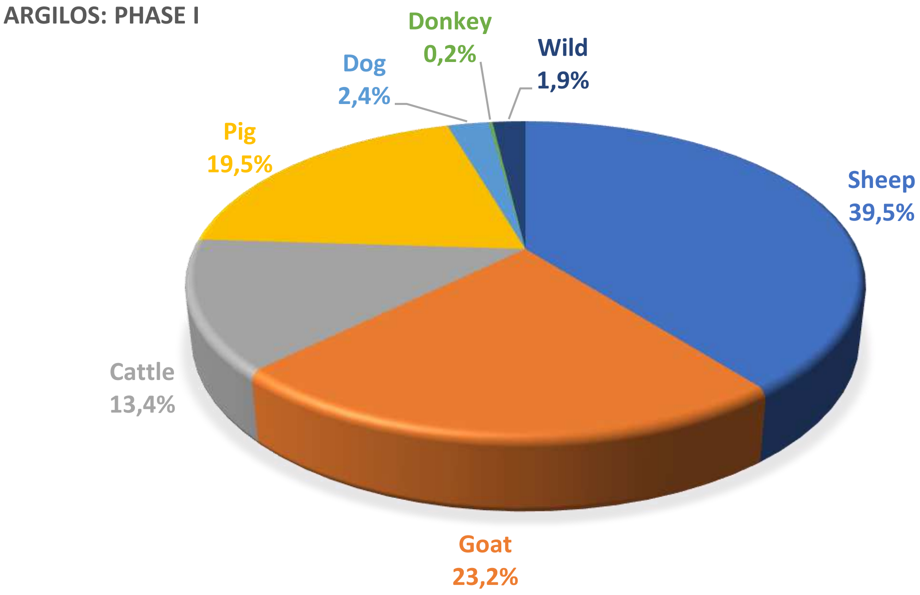

Fig. 3.20. Argilos, Phase I: Species representation (Table 3.5, MinAU 846)

b) Phase II

The faunal remains from the second phase were derived from 112 stratigraphic units, comprising 92 from the SE sector, 5 from the Koutloudis sector and 15 from the NR sector (above, **Table 3.2**). In total, 1,033 NISP (309 MinAU) specimens were recorded, of which 702 NISP (205 MinAU) were found in the SE sector from the interior of houses B, E, F and G and from roads R1 and R2; 16 (2 MinAU) were found in Room L6 of the Koutloudis sector; and 315 (102 MinAU) came from the NR sector (above, **Table 3.2**). Of the recorded specimens, 63% were of domesticated species, namely sheep, goat, cattle, pig, dog and donkey; 2% were of wild mammals, namely red deer, roe deer, fallow deer and hare; 2% were of tortoise and 1% of birds; and 32% were indeterminate specimens of small-, medium-, and large-sized animals (**Table 3.6**). The indeterminate specimens are mostly attributed to medium-sized animals (74%; **Table 3.7**), which corresponds with the predominance of sheep, goat, pig and roe deer (78% NISP, 77% MinAU; **Table 3.8**). Small-sized (15%; **Table 3.7**) and then large-sized (11%; **Table 3.7**) specimens follow among the indeterminate material. As in Phase I, the percentages of identified large species (cattle, donkey, red deer, fallow deer: 18% NISP, 19% MinAU; **Table 3.8**) better match the indeterminate data than do those for identified small-sized species (dog, hare: 3% NISP, 4% MinAU; **Table 3.8**).

	NISP	NISP %
Identified mammals	673	65.2
Tortoise	24	2.3
Birds	8	0.8
Size classes (mammal)	328	31.7
Total	1,033	100.0

Table 3.6. Taxonomic composition of Phase II at Argilos (Appendix I: Table I.2, NISP)

	NISP	NISP %
Small sized	50	15.2
Medium sized	241	73.5
Large sized	37	11.3
Total	328	100.0

Table 3.7. Composition of mammal size categories of Phase II in Argilos (Appendix I: Table I.2, NISP)

	NISP	NISP %[1]	MinAU	MinAU %[1]
Sheep[1]	36	45.0	36	43.0
Sheep/Goat	364	-	127	-
Goat[1]	13	16.3	11	13.3
Cattle	108	16.0	51	16.5
Pig	113	16.8	62	20.1
Dog	15	2.2	8	2.6
Donkey	3	0.4	2	0.6
Red deer	12	1.8	6	1.9
Roe deer	1	0.1	1	0.3
Fallow deer	1	0.1	1	0.3
Hare	7	1.0	4	1.3
Total	673	100.0	309	100.0

Table 3.8. Species composition (mammals) of Phase II at Argilos (Appendix I: Table I.2, NISP-MinAU)
[1] Percentages of sheep and goat include sheep/goat assigned proportionately (NISP-MinAU)

In terms of MinAU, the species distribution of the domesticated mammals was as follows: sheep (43%), followed by pig (20%), cattle (16%), goat (13%) dog (3%) and donkey (<1%). Among the wild mammals (4%), red deer again dominated (2%), followed by hare, and roe and fallow deer (**Fig. 3.21**).

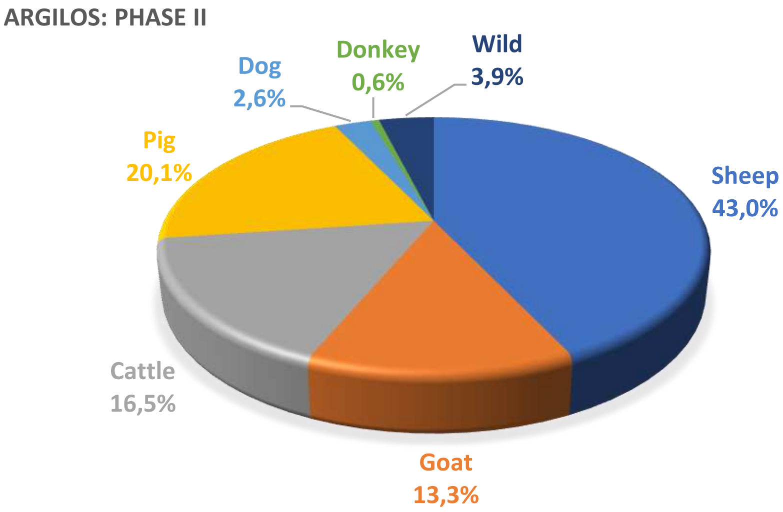

Fig. 3.21. Argilos, Phase II: Species representation (Table 3.8, MinAU 309)

c) Phase III

The zooarchaeological remains from Phase III are derived from 251 stratigraphic units, of which 229 are from the SE sector and 22 from the Koutloudis sector. The material from the SE sector came from the interiors of buildings A, B, C, D, E and G, roads R1 and R2 and the open space between the buildings E–F, and the material from the Koutloudis sector came from rooms L1, L3 and L11 of Building L (above, **Table 3.2**).

In total 2,533 (791 MinAU) specimens were recorded: 1,825 (525 MinAU) from the SE sector and 708 (266 MinAU) from the Koutloudis sector (above, **Table 3.2**). Fourteen domestic and wild species were identified, namely sheep, goat, cattle, pig, dog, donkey and horse, red deer, roe deer, fallow deer, hare, boar and wolf (**Table 3.9)**. The distinction between pig and boar in the case of a single pelvis was based on a comparison with metrical data from Middle Bronze Age-Early Iron

Age Kastanas (**Table 3.10**). For the other two elements, canine and hamate, the distinction was based on non-metrical evaluation of size: large and robust specimens were attributed to boar. Finally, the distinction between dog and wolf was also based on a comparison of measurements for the two identified elements, femur and tibia, as listed in **Table 3.11**. The identified mammals make up 67% of the recorded specimens, while tortoise and unidentified bird bones represent 1% and 3% of the recorded specimens respectively, and indeterminate specimens constitute 29% of the total sample (**Table 3.12**). As in Phase I, the indeterminate specimens are heavily dominated by medium-sized animals (70%), followed by large- (26%) and then small-sized (4%) (**Table 3.13**). In contrast to Phases I and II, however, these percentages are for this phase similar to those for identified specimens of the corresponding size (**Table 3.9**): medium-sized animals (sheep, goat, pig, roe deer and wolf) make up 72% and 73% of identified NISP and MinAU, respectively; large animals (cattle, donkey, horse, red deer, fallow deer and boar) make up 24% of NISP and 21% of MinAU; and small animals (dog and hare) make up 4% of NISP and 5% of MinAU.

	NISP	NISP %[1]	MinAU	MinAU %[1]
Sheep[1]	113	37.7	108	39.8
Sheep/Goat	791	-	289	-
Goat[1]	56	18.7	43	15.8
Cattle	332	19.5	129	16.3
Pig	262	15.4	138	17.4
Dog	39	2.3	25	3.2
Donkey	19	1.1	11	1.4
Horse	1	0.1	1	0.1
Red deer	47	2.8	24	3.0
Roe deer	3	0.2	2	0.3
Fallow deer	1	0.1	1	0.1
Hare	32	1.9	17	2.1
Boar	3	0.2	2	0.3
Wolf	2	0.1	1	0.1
Total	1,701	100.0	791	100.0

Table 3.9. Species composition (mammals) of Phase III at Argilos (Appendix I: Table I.3, NISP-MinAU)

[1] Percentages of sheep and goat include sheep/goat assigned proportionately (NISP-MinAU)

Measurement (mm)	Argilos						Kastanas		
	Pig			Boar			Boar		
	No.[1]	min	max	No.[1]	min	max	No.[1]	min	max
Metacarpal III									
GL	5	61.0	66.4	1	96.0		18	88.3	103.4
Bp	13	12.3	18.2	2	22.0	22.5	16	25.3	28.7
SD	11	6.9	12.2	1	17.1		-	-	-
Bd	4	12.3	15.7	1	22.3		17	20.5	25.1
Metacarpal IV									
Bp	17	10.7	17.1	1	21.0		18	17.2	23.5
Pelvis									
LA	3	26.7	33.2	1	41.6		16	40.3	43.6
Phalanx I									
GL	34	17.5	31.8	3	43.2	43.6	55	39.0	50.0
Bp	38	7.9	18.0	3	20.2	22.2	50	18.6	24.3
SD	40	5.4	13.0	4	15.3	17.2	-	-	-
Bd	43	6.2	15.5	6	18.0	20.4	54	17.2	22.2
Phalanx II									
GL	16	12.0	24.8	5	25.8	28.6	16	26.1	31.8
Bp	16	9.3	19.1	5	19.6	20.9	16	19.3	23.0
SD	16	6.6	15.1	5	15.8	17.2	-	-	-
Bd	17	6.7	16.7	4	16.9	19.4	16	16.2	21.2
Phalanx III									
MBS	8	7.6	10.9	3	15.1	16.6	-	-	-
Ld	6	14.5	25.4	3	35.7	37.7	4	35.5	38.5
DLS	8	17.0	27.5	3	36.6	46.1	4	37.4	43.2

Table 3.10. Metrical data (mm) for pig and boar from Argilos, all phases (Appendix II: Table II.14), with comparative data for boar Kastanas, all phases (Becker 1986: 364-365, Table XXX)

[1] Number of specimens

Measurement (mm)	Argilos						Kastanas		
	Dog			Wolf			Wolf		
	No.[1]	min	max	No.[1]	min	max	No.[1]	min	max
Maxilla									
Length M1-M2	-	-	-	1	35.4		11	22.0	23.2
Mandible									
Length M1	9	18.6	22.0	1	28.6		1	26.2	
Breadth M1	8	6.9	8.8	1	12.5		1	10.6	
Height of MD in front of M1	7	16.5	22.9	1	32.4			-	-
Ulna									
DPA	5	17.0	26.1	2	31.6	32.4	-	-	-
BPC	4	8.3	15.5	2	22.4	23.1	-	-	-
Tibia									
Bd	2	21.1	22.2	1	29.4		-	-	-

Table 3.11. Metrical data (mm) for dog and wolf from Argilos, all phases, with comparative data for wolf from Kastanas, all phases (Becker 1986: 145, Table 64)

[1] Number of specimens

	NISP	NISP %
Identified mammals	1,701	67.2
Tortoise	30	1.2
Birds	65	2.6
Size classes (mammals)	737	29.1
Total	2,533	100.0

Table 3.12. Taxonomic composition of Phase III at Argilos (Appendix I: Table I.3, NISP)

	NISP	NISP %
Small sized	32	4.3
Medium sized	516	70.0
Large sized	189	25.6
Total	737	100.0

Table 3.13. Composition of mammal size categories of Phase III at Argilos (Appendix I: Table I.3, NISP)

The representation of the species in terms of MinAU is as follows. Of the domestic species, sheep dominate (40%), followed by pig (17%), cattle (16%), goat (16%), dog (3%) and donkey (1%). Horse is represented by only one specimen. Among wild species (6%), red deer again dominates (3%), followed by hare (2%). Roe deer and boar have two specimens each and fallow deer and wolf one each (**Fig. 3.22**).

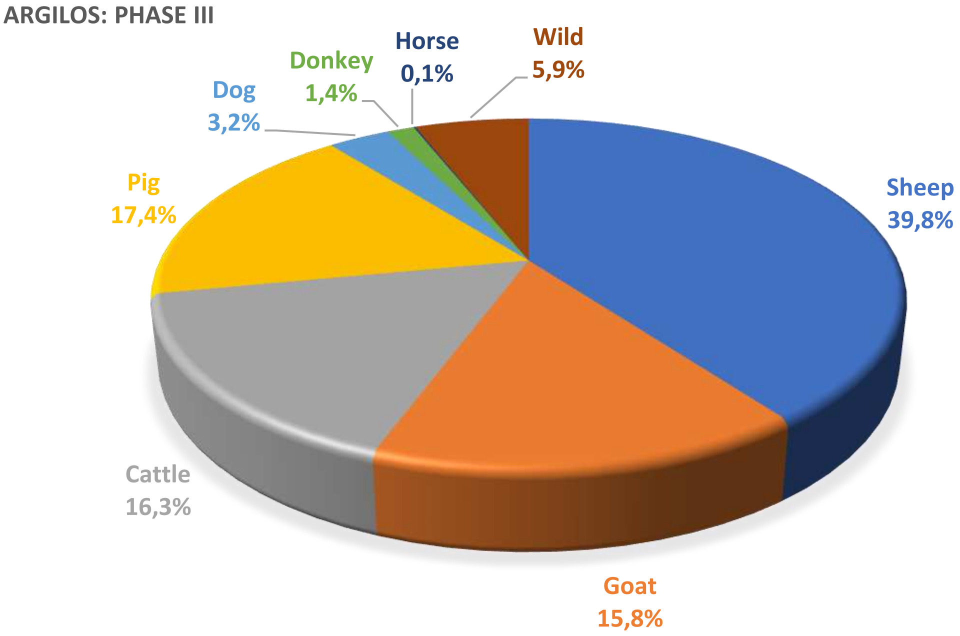

Fig. 3.22. Argilos, Phase III: Species representation (Table 3.9, MinAU 791)

d) Phase IV

Overall, 4,496 (1,718 MinAU) specimens were recorded from 334 stratigraphic units of Phase IV. In total, 118 stratigraphic units derived from the interiors of buildings A, D, E, F and G, roads R1 and R2 and the open space between the buildings E–F of the SE sector (636 NISP, 231 MinAU); and 216 from buildings H, L and Q, road R4 and SWH1 of the Koutloudis sector (3,860 NISP; 1,505 MinAU). In Building H, the recorded bones are from Room H12; in Building L, from rooms L1–L4 and L6–L12; and in Building Q, from Room Q1 (above, **Table 3.2**).

Fourteen mammalian species were identified, namely sheep, goat, cattle, pig, dog, donkey, horse, red deer, roe deer, fallow deer, hare, boar, wolf and red fox, while tortoise and birds are also represented (**Table 3.14**). The identification of boar (30 NISP) was based on both metrical data (above, **Table 3.10**) and visual appreciation of size, whereas the identification of wolf (2 NISP) was based only on metrical data (above, **Table 3.11**; below, **Fig. 3.23**). The identified mammals dominate (65%), tortoise contribute 2% and birds also 2%, while indeterminate specimens make up 32% of the material (**Table 3.14**). The high percentage of indeterminate medium-sized animals (76%; **Table 3.15**) is consistent with the dominance of sheep, goat, pig, roe deer and wolf (70% NISP, 71% MinAU; **Table 3.16**) in the assemblage. Similarly, the percentage of indeterminate large animals (23%; **Table 3.15**) corresponds with the representation of large species, namely cattle, donkey, horse, red deer, fallow deer and boar (24% NISP, 24% MinAU; **Table 3.16**), while the percentage of indeterminate small sized animals (<1%) is much lower than those of dog, red fox and hare together (6% NISP, 5% MinAU; **Table 3.15** and **Table 3.16**).

	NISP	NISP %
Identified mammals	2,935	65.3
Tortoise	68	1.5
Birds	73	1.6
Size classes (mammals)	1,420	31.6
Total	4,496	100.0

Table 3.14. Taxonomic composition of Phase IV at Argilos (Appendix I: Table I.4, NISP)

	NISP	NISP %
Small sized	8	0.6
Medium sized	1,083	76.3
Large sized	329	23.2
Total	1,420	100.0

Table 3.15. Composition of mammal size categories of Phase IV at Argilos (Appendix I: Table I.4, NISP)

	NISP	NISP %[1]	MinAU	MinAU %[1]
Sheep[1]	196	38.5	182	40.7
Sheep/Goat	1,328	-	707	-
Goat[1]	83	16.3	67	15.0
Cattle	588	20.0	330	19.2
Pig	452	15.4	266	15.5
Dog	112	3.8	50	2.9
Donkey	12	0.4	11	0.6
Horse	10	0.3	5	0.3
Red deer	58	2.0	40	2.3
Roe deer	2	0.1	1	0.1
Fallow deer	3	0.1	2	0.1
Hare	57	1.9	34	2.0
Boar	30	1.0	19	1.1
Wolf	2	0.1	2	0.1
Red fox	2	0.1	2	0.1
Total	2,935	100.0	1,718	100.0

Table 3.16. Species composition of Phase IV at Argilos (Appendix I: Table I.4, NISP-MinAU)

[1] Percentages of sheep and goat include sheep/goat assigned proportionately (NISP-MinAU)

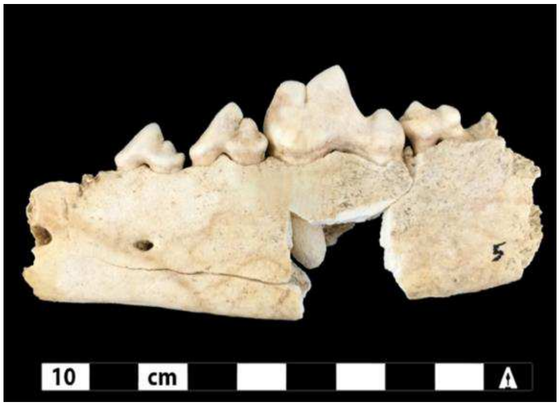

Fig. 3.23. Fragment of a left mandible identified as wolf based on its size (Argilos, Koutloudis sector, Room L7, Phase IV) (©A. Gkotsinas)

The representation of species in terms of MinAU is as follows. Sheep dominate (41%), followed by cattle (19%), pig (15%), goat (15%), dog (3%), red deer (2%), hare (2%), boar (1%), donkey (<1%) and horse (<1%); wolf, red fox, roe deer and fallow deer each constitute <1% (**Fig. 3.24**).

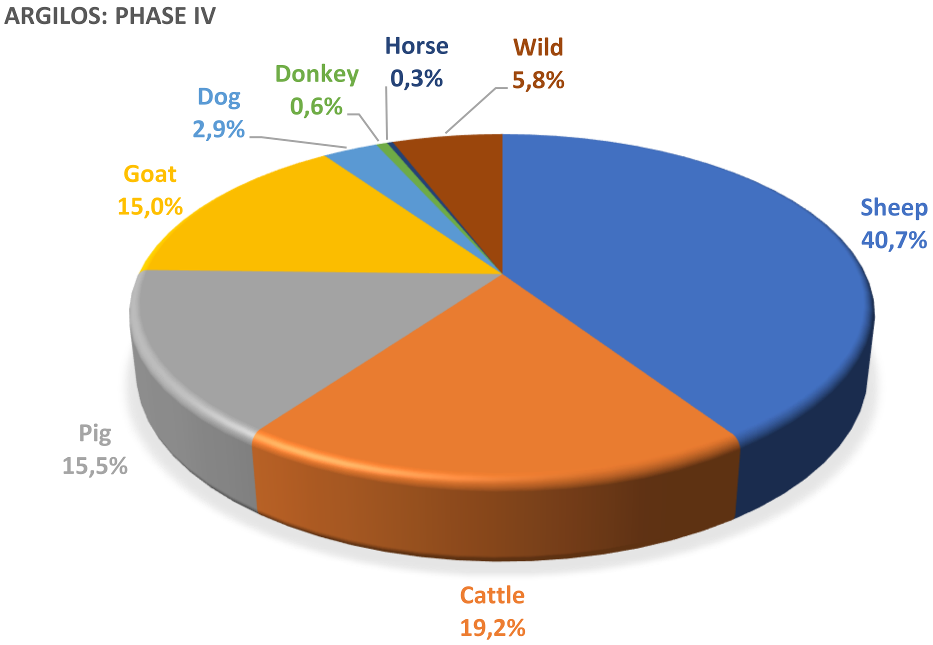

Fig. 3.24. Argilos, Phase IV: Species representation (Table 3.16; MinAU 1,718)

e) Phase III-IV

Phase III-IV contains animal bones from 181 stratigraphic units, derived from buildings A, B, D, E, F and G, roads R1 and R2, and the open space between the buildings E–F of SE sector (above, **Table 3.2**). In total, 1,287 (424 MinAU) specimens were recorded. The domestic and wild taxa identified were sheep, goat, cattle, pig, dog, donkey, horse, red deer, roe deer, hare, wolf, tortoise and birds. The identification of a single wolf specimen (maxillary) was based on metrical data (above, **Table 3.11**). The identified mammals constitute 72% of the assemblage, tortoise accounts for 1%, birds also 1%, and the indeterminate specimens constitute 25% (**Table 3.17**). Of the indeterminate specimens, medium-sized dominate (79%), followed by large- (14%) and then small-sized (7%), (**Table 3.18**). These figures are fairly comparable with those for identified specimens of medium (sheep, goat, pig, roe deer and wolf: 75% NISP; 77% MinAU; **Table 3.19**), large (cattle, donkey, horse and red deer: 22% NISP, 21% MinAU; **Table 3.19**) and small size (dog and hare: 3% NISP; 3% MinAU; **Table 3.19**).

	NISP	NISP %
Identified mammals	929	72.2
Tortoise	15	1.2
Birds	16	1.2
Size classes (mammals)	327	25.4
Total	1,287	100.0

Table 3.17. Taxonomic composition of Phase III-IV at Argilos (Appendix I: Table I.5, NISP)

	NISP	NISP %
Small sized	22	6.7
Medium sized	259	79.2
Large sized	46	14.1
Total	327	100.0

Table 3.18. Composition of mammal size categories of Phase III-IV at Argilos (Appendix I: Table I.5, NISP)

	NISP	NISP %[1]	MinAU	MinAU %[1]
Sheep[1]	46	35.4	44	37.0
Sheep/Goat	461	-	172	-
Goat[1]	29	22.3	23	19.3
Cattle	167	18.0	66	15.6
Pig	155	16.7	83	19.6
Dog	18	1.9	8	1.9
Donkey	8	0.9	6	1.4
Horse	7	0.8	3	0.7
Red deer	20	2.2	12	2.8
Roe deer	5	0.5	4	0.9
Hare	12	1.3	3	0.7
Wolf	1	0.1	-	0.0
Total	929	100.0	424	100.0

Table 3.19. Species composition (mammals) of Phase III-IV at Argilos (Appendix I: Table I.5, NISP-MinAU)

[1] Percentages of sheep and goat include sheep/goat assigned proportionately (NISP-MinAU)

In terms of MinAU, sheep dominate (37%), followed by pig (20%), goat (19%), cattle (16%), red deer (3), dog (2%), donkey (1%), roe deer (1%), horse and hare (1% each). Wolf is not represented in the MinAU quantification (**Fig. 3.25**).

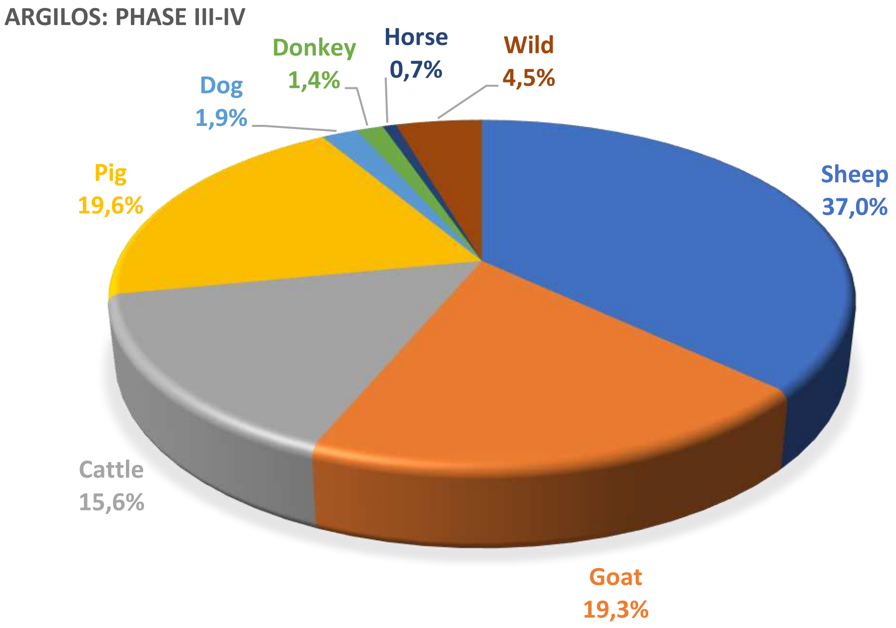

Fig. 3.25. Argilos, Phase III-IV: Species representation (Table 3.19, MinAU 424)

Summary

The analysed component of the assemblage from Argilos comprises 12,748 NISP (4,088 MinAU) specimens derived from 1,045 stratigraphic units from the SE, Koutloudis and NR sectors. Of these stratigraphic units, 167 date from the first habitation phase (Phase I), 112 from the second (Phase II), 251 from the third (Phase III), 334 from the fourth (Phase IV) and 181 from Phase III-IV. **Fig. 3.26** illustrates the distribution of the recorded specimens in each of the phases. Phase IV (35%) dominates, followed by Phase I (27%), Phase III (20%), Phase III-IV (10%) and Phase II (8%).

The uneven distribution between the four habitation phases is probably due to excavation history. The dominance of Phase IV is probably related to the fact that, in the Koutloudis sector, with some exceptions only the last occupation layers (dated to the fourth phase) of the rooms under study have been excavated. Moreover, Phase I, although represented only in the NR sector, predominates over Phases II and III perhaps because its sub-assemblage is derived mainly from a dump where animal bones were probably discarded systematically, whereas the materials from Phases II and III derive mostly from the interiors of the buildings and the streets of the SE sector.

The percentages of identified specimens from each of the three excavation sectors are consistent with these observations. Thus, the dominance of Phase IV is matched by the dominance of the Koutloudis sector, and the percentage of animal bones in the NR sector is almost equal to that in Phase I (**Fig. 3.26** and **Fig. 3.27**).

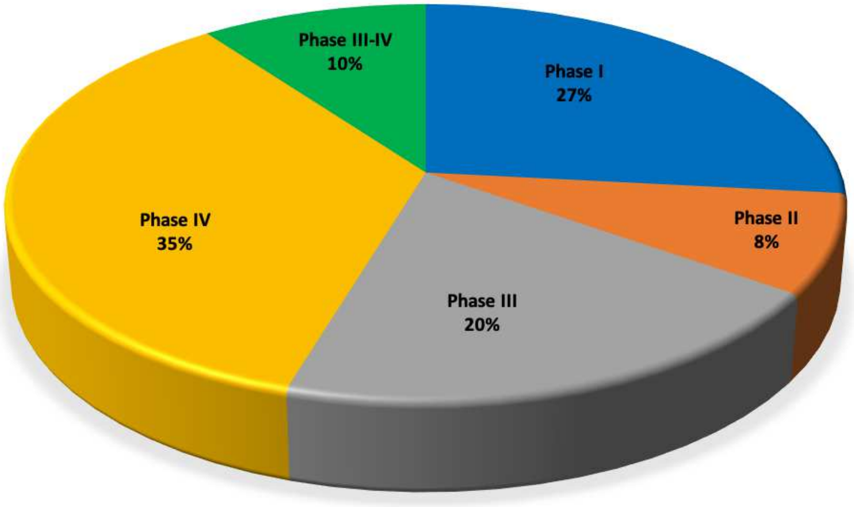

Fig. 3.26. Distribution of the recorded specimens by habitation phase at Argilos (Table 3.2; NISP 12,748)

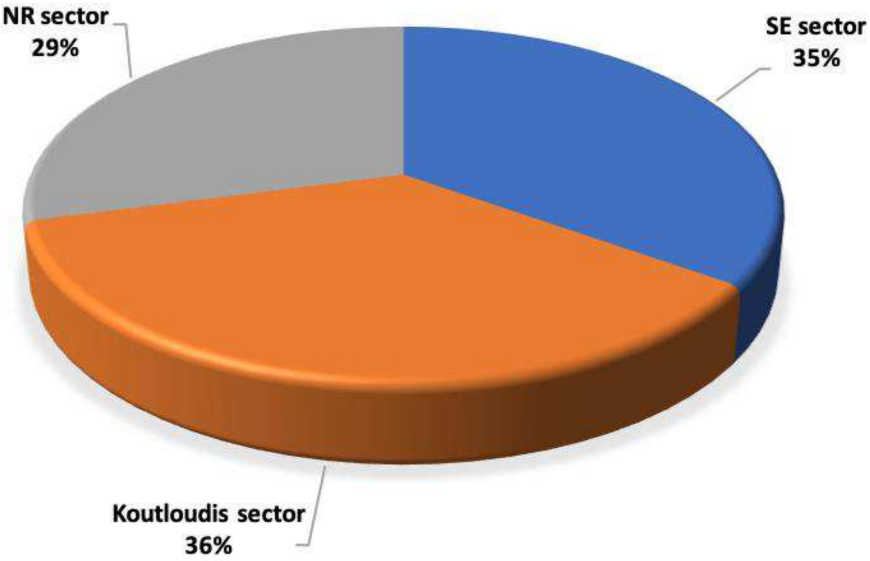

Fig. 3.27. Distribution of the recorded specimens by sector at Argilos (Table 3.2; NISP 12,748)

Sixteen species of domestic and wild fauna were identified, while indeterminate birds were also present. The domestic species are sheep, goat, cattle, pig, dog, donkey, and horse; and the wild taxa are red deer, roe deer, fallow deer, hare, boar, wolf, red fox and tortoise (**Table 3.20**). In regard to the birds, although these were identified only to the level of class, some most probably belong to *Gallus* sp.[266] The species distribution within the habitation phases of Argilos in terms of MinAU is presented in **Table 3.21** and **Fig. 3.28**. Sheep dominate in all phases and their percentages are very similar across phases, ranging from 40% to 43%. Second place is occupied variously by goats (ranging between 13% and 23%), cattle (13%-19%) or pigs (16%-20%), each of which makes up 17%-18% of the assemblage on average. The less common domesticated species fluctuate modestly over time: dog between 1.9% and 3.2% and donkey between 0.2% and 1.4%, while horse is represented rarely and only in the third and fourth habitation phases. The game species consist mostly of red deer followed by hare, boar, roe deer, fallow deer, wolf and red fox. Present from the first habitation period at a low level (2%), they increased in frequency in Phases II, III and IV (4%–6%).

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[266] Colangelo 2007: 52.

	Phase I		Phase II		Phase III		Phase IV		Phase III-IV		Total	
	NISP	NISP %[1]	NISP	NISP %[1]	NISP	NISP %[1]	NISP	NISP %[1]	NISP	NISP %[1]	NISP	NISP %[1]
Sheep[1]	95	34.7	36	43.0	113	35.7	196	36.7	46	34.3	486	36.7
Sheep/Goat	1,357	-	364	-	791	-	1,328	-	461	-	4,301	-
Goat[1]	74	26.9	13	15.6	56	17.7	83	15.5	29	21.6	255	19.2
Cattle	392	15.8	108	15.3	332	18.5	588	19.1	167	17.4	1,587	17.6
Pig	382	15.4	113	16.0	262	14.6	452	14.7	155	16.1	1,364	15.1
Dog	35	1.4	15	2.1	39	2.2	112	3.6	18	1.9	219	2.4
Donkey	2	0.1	3	0.4	19	1.1	12	0.4	8	0.8	44	0.5
Horse	1	0.0	-	0.0	1	0.1	10	0.3	7	0.7	19	0.2
Red deer	34	1.4	12	1.7	47	2.6	58	1.9	20	2.1	171	1.9
Roe deer	1	0.0	1	0.1	3	0.2	2	0.1	5	0.5	12	0.1
Fallow deer	-	0.0	1	0.1	1	0.1	3	0.1	-	0.0	5	0.1
Hare	3	0.1	7	1.0	32	1.8	57	1.9	12	1.3	111	1.2
Boar	6	0.2	-	0.0	3	0.2	30	1.0	-	0.0	39	0.4
Wolf	-	0.0	-	0.0	2	0.1	2	0.1	1	0.1	5	0.1
Red fox	-	0.0	-	0.0	-	0.0	2	0.1	-	0.0	2	0.0
Tortoise	56	2.3	24	3.4	30	1.7	68	2.2	15	1.6	193	2.1
Bird	41	1.7	8	1.1	65	3.6	73	2.4	16	1.7	203	2.3
Total	2,479	100.0	705	100.0	1,796	100.0	3,076	100.0	960	100.0	9,016	100.0

Table 3.20. Taxonomic composition by habitation phase at Argilos (Appendix I: Tables I.1-I.5, NISP)

[1] Percentages of sheep and goat include sheep/goat assigned proportionately (NISP)

	Phase I		Phase II		Phase III		Phase IV		Phase III-IV		Total	
	MinAU	MinAU %[1]	MinAU	MinAU %[1]	MinAU	MinAU %[1]	MinAU	MinAU %[1]	MinAU	MinAU %[1]	MinAU	MinAU %[1]
Sheep[1]	90	39.5	36	43.0	108	39.8	182	40.7	44	37.0	460	40.1
Sheep/Goat	387	-	127	-	289	-	707	-	172	-	1,682	-
Goat[1]	53	23.2	11	13.3	43	15.8	67	15.0	23	19.3	197	17.1
Cattle	113	13.4	51	16.5	129	16.3	330	19.2	66	15.6	689	16.9
Pig	165	19.5	62	20.1	138	17.4	266	15.5	83	19.6	714	17.5
Dog	20	2.4	8	2.6	25	3.2	50	2.9	8	1.9	111	2.7
Donkey	2	0.2	2	0.6	11	1.4	11	0.6	6	1.4	32	0.8
Horse	-	0.0	-	0.0	1	0.1	5	0.3	3	0.7	9	0.2
Red deer	8	0.9	6	1.9	24	3.0	40	2.3	12	2.8	90	2.2
Roe deer	1	0.1	1	0.3	2	0.3	1	0.1	4	0.9	9	0.2
Fallow deer	-	0.0	1	0.3	1	0.1	2	0.1	-	0.0	4	0.1
Hare	1	0.1	4	1.3	17	2.1	34	2.0	3	0.7	59	1.4
Boar	6	0.7	-	0.0	2	0.3	19	1.1	-	0.0	27	0.7
Wolf	-	0.0	-	0.0	1	0.1	2	0.1	-	0.0	3	0.1
Red fox	-	0.0	-	0.0	-	0.0	2	0.1	-	0.0	2	0.0
Wild	16	1.8	12	3.8	47	5.9	100	5.8	19	4.4	194	4.7
Total	846	100.0	309	100.0	791	100.0	1,718	100.0	424	100.0	4,088	100.0

Table 3.21. Species composition (mammals) by habitation phase at Argilos (Appendix I: Tables I.1-I.5, MinAU)

[1] Percentages of sheep and goat include sheep/goat assigned proportionately (MinAU)

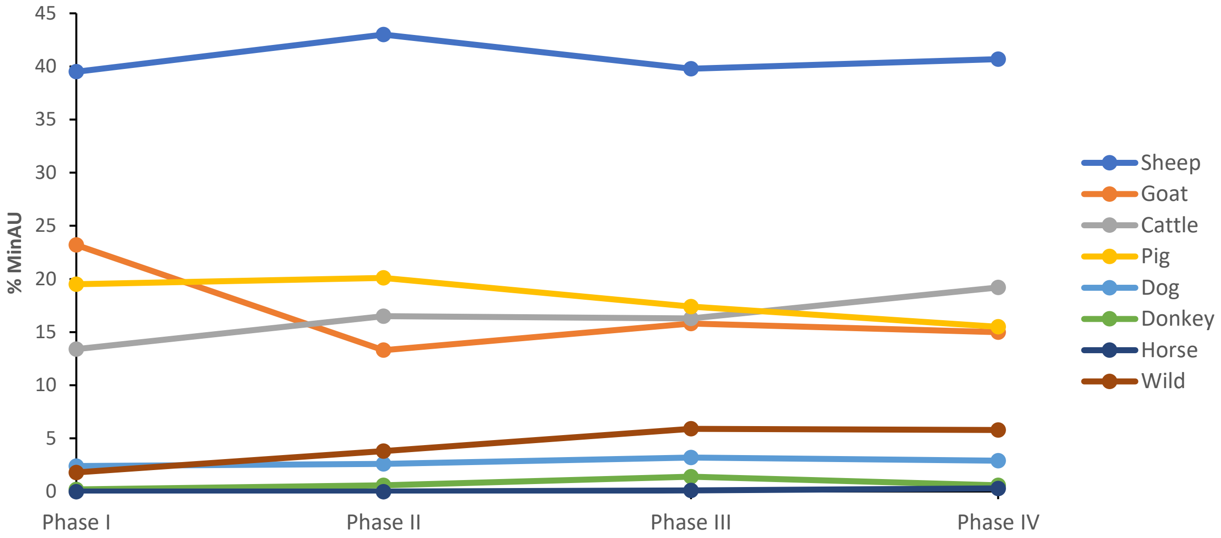

Fig. 3.28. Species distribution by phase at Argilos (excluding Phase III-IV; Appendix I: Tables I.1-I.5; MinAU 4,088)

The representation of tortoise and birds in terms of NISP fluctuates between 0.8% and 2.6% through the habitation phases (**Table 3.22**), but the easily identified fragments of tortoise carapace could belong to a single animal, leading to an overestimation of the presence of this taxon in the assemblage.

	Phase I		Phase II		Phase III		Phase IV		Phase III-IV		Total	
	NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %
Identified mammals	2,382	70.1	673	65.2	1,701	67.2	2,935	65.3	929	72.2	8,620	67.6
Tortoise	56	1.6	24	2.3	30	1.2	68	1.5	15	1.2	193	1.5
Birds	41	1.2	8	0.8	65	2.6	73	1.6	16	1.2	203	1.6
Size classes (mammals)	920	27.1	328	31.7	737	29.1	1,420	31.6	327	25.4	3,732	29.3
Total	3,399	100.0	1,033	100.0	2,533	100.0	4,496	100.0	1,287	100.0	12,748	100.0

Table 3.22. Taxonomic composition by habitation phase at Argilos (Appendix I: Tables I.1-I.5, NISP)

Variation in the percentages of indeterminate mammal specimens of different sizes varies between phases within the following ranges: 70%–78% for medium-sized animals, 11%–26% for large animals and 1%–15% for small animals (**Table 3.23**). The indeterminate specimens are consistently dominated by medium-sized animals, in frequencies close to those for the combined identified medium-sized species: principally sheep, goat and pig. The percentages of indeterminate and identified specimens are less mutually similar in the case of large- and especially small-sized animals, but the latter discrepancy may be due to misattribution of indeterminate specimens to size categories rather than differential carcass treatment.

	Phase I		**Phase II**		**Phase III**		**Phase IV**		**Phase III-IV**		**Total**	
	NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %
Small sized	94	10.2	50	15.2	32	4.3	8	0.6	22	6.7	206	5.5
Medium sized	719	78.2	241	73.5	516	70.0	1,083	76.3	259	79.2	2,818	75.5
Large sized	107	11.6	37	11.3	189	25.6	329	23.2	46	14.1	708	19.0
Total	920	100.0	328	100.0	737	100.0	1,420	100.0	327	100.0	3,732	100.0

Table 3.23. Composition of mammal size categories by habitation phase at Argilos (Appendix I: Tables I.1-I.5, NISP)

In sum, the taxonomic composition of the assemblage varies over time relatively modestly.

3.1.2.2. Taphonomy: Post-depositional factors

When exploring human behaviour in relation to the exploitation of domesticated and wild animals (life assemblage), consumption practices (death assemblage) and discard strategies (deposited assemblage), the detection of any biotic or abiotic factors that could alter or destroy the assemblage after its deposition (faunal assemblage) or during its recovery (sample assemblage) is crucial to avoid making incorrect inferences. Moreover, the examination of post-depositional alterations could shed light on the depositional environment, natural diagenetic processes and excavation methods (above, 2.1.2.6). The taphonomic analysis in this study was conducted in reverse chronological order, beginning with any factors that shaped the sample assemblage (retrieval, excavation and storage methods) and then those that shaped the faunal assemblage (environment and carnivore attrition) in each habitation phase.

Before exploring the formation of the sample assemblage, the final stage of alteration of the data set under consideration must be noted: namely, its zooarchaeological examination by the present author. The assemblage was quantified in terms of NISP or MinAU and, for some analyses, particular body parts, species and age groups were excluded. Due to the state of preservation, the number of identified sheep and goat specimens is small, whereas numerous specimens were identified to the subfamily Caprinae (sheep/goat). Moreover, due to their similarity in size and structure, these two species are expected to be affected similarly by post-depositional processing. Thus, for firm conclusions to be drawn regarding assemblage formation processes, sheep, goat and sheep/goat were treated as one taxon, namely caprines. Tortoise and birds were excluded from the analysis of post-depositional factors, while the indeterminate small, medium and large animals (indeterminate species) were used selectively as a control for the small, medium and large identified species, respectively.

3.1.2.2.1. Formation of the sample assemblage

In the following sections, retrieval methods, excavation techniques and storage conditions are explored to investigate the formation of the sample assemblage.

3.1.2.2.1.1. Retrieval method

The zooarchaeological remains from all the excavation seasons were mostly collected by hand, with occasional application of coarse dry-sieving. Fine wet-sieving was used selectively in the archaeobotanical study. No remains of any terrestrial fauna recovered by wet-sieving were studied. As Payne (1972b) has shown (**Fig. 3.29**), partial recovery can cause biases against the representation of small anatomical elements, age groups and species.

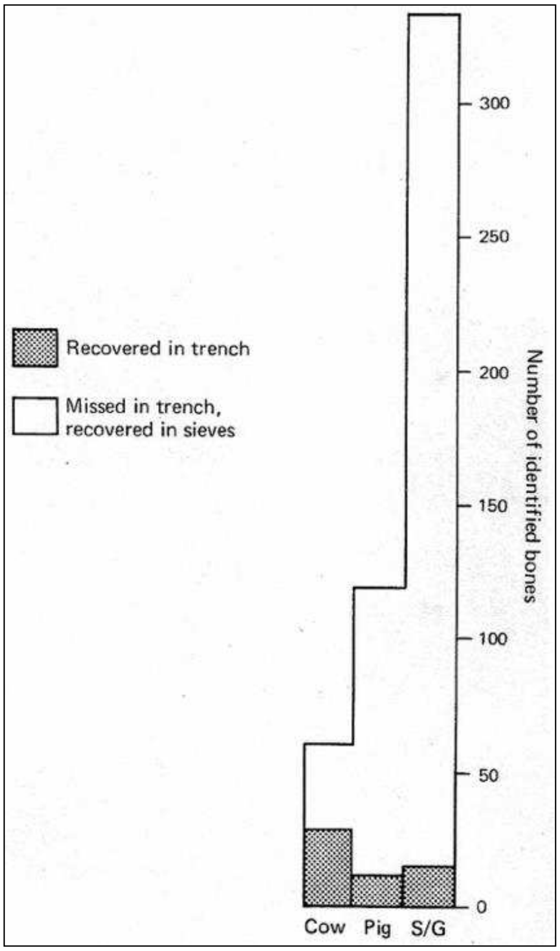

Fig. 3.29. Effect of recovery on assemblages and interpretation (Payne 1972b)

To explore the possibility that retrieval was anatomically biased, for the total assemblage (all habitation phases) the frequency of the smaller (ulna, calcaneum, talus, phalanges) and larger (scapula, humerus, radius, pelvis, femur, tibia, metapodials) limb bones in a complete skeleton was compared with their respective percentages for the main domesticates only, namely caprines, cattle and pig, as the data for other taxa are too sparse for any meaningful analysis. Similarly, the indeterminate specimens were also excluded as they comprised indeterminate long bone, rib and vertebrae fragments that effectively preclude the analysis in question. Additionally, to explore whether any underrepresentation of small limb bones is due to recovery method or to discard practices in antiquity, the representation of the small limb bones was compared with that of the adjacent large bones of the main domesticates: proximal ulna with proximal radius; talus and calcaneus with distal tibia and proximal metatarsal; and phalanges 1–3 (fore- and hind-limbs) with distal metapodials (metacarpal, metatarsal and indeterminate metapodial).[267]

In the first set of adjacent specimens, any underrepresentation of ulna is likely to be a result of recovery bias or differential preservation (as the ulna fuses later than proximal radius), since the ulna and radius are not usually separated during butchery.[268] In the second and third sets, any underrepresentation of talus/calcaneus and the phalanges, respectively, could be a result of recovery bias or alternatively of discard practices.[269] The removal of the extremities during initial carcass dressing might affect just the phalanges, or also the metapodials or the entire foot including talus/calcaneum.[270] Of course, if the entire foot including talus and calcaneum was discarded in carcass dressing, then the metapodials should also be correspondingly under-represented.

To prevent the overestimation of some body parts in the above analyses, the assemblage was quantified in terms of MinAU and, in the case of the relative abundance of small and large limb bones, neonatal specimens were excluded so that the underrepresentation of small bones is not complicated by differences between taxa in the frequency of very young animals.

Phases I, II, III, IV and III-IV

As **Table 3.24** shows, the post-neonatal small limb bones are underrepresented for caprines and pig, whereas in cattle they are closer to what is expected for a complete skeleton. This may be due to the greater ease of detection, during collection by hand, of small body parts from cattle than of their much smaller counterparts from caprines and pig. Alternatively, small body parts, such as phalanges, may be underrepresented for reasons other than retrieval if they were separated from the rest of the carcass during butchery and discarded at an off-site location. **Table 3.25** explores this possibility for caprines and pig with reference to the second and third anatomically adjacent sets.

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[267] Cf. Payne 1985: 222, Table 2.
[268] Cf. Binford 1978: 74.
[269] Cf. Binford 1978.
[270] Tzevelekidi et al. 2014.

	Caprines			Cattle			Pig		
	Large[1]	Small[2]	Small %	Large[1]	Small[2]	Small %	Large[1]	Small[2]	Small %
Expected (whole skeleton)	28	18	39.1	28	18	39.1	28	18	39.1
Argilos: I-IV	1,308	499	27.6	420	219	34.3	384	152	28.4

Table 3.24. Abundance of small and large limb bones of caprines, cattle and pig in all phases at Argilos (neonatal excluded; MinAU 2,982)

[1] Scapula, humerus, radius, pelvis, femur, tibia, metapodials (metacarpal, metatarsal, metacarpal/ metatarsal); [2] Ulna, talus, calcaneus, phalanx I, phalanx II, phalanx III

		Caprines	Pig
1st set	**Radius proximal**	164	22
	Ulna proximal	47	36
2nd set	**Tibia distal**	171	46
	Talus	174	18
	Calcaneus	85	24
	Metatarsal proximal	90	22
3rd set	**Metapodial distal**	158	67
	Phalanx I	169	49
	Phalanx II	57	18
	Phalanx III	23	10

Table 3.25. Abundance of small and large limb bones in the three articulated sets for caprines and pig in all phases at Argilos (neonatal excluded; MinAU 1,450)

As regards the second set, in caprines the ratio of distal tibia to talus is close to parity, but the calcaneus and proximal metatarsal are underrepresented to a similar degree, consistent with the frequent discard of the rear foot, distally of the talus, during carcass dressing. On the same grounds, the rear foot of the pig (but distally of the distal tibia) seems often to have been discarded elsewhere. In regard to the third set of articulated specimens, in both caprines and pig the fairly similar numbers of distal metapodial and phalanx I contrast with the strong underrepresentation of the smaller phalanx II and phalanx III, implying loss of the latter during retrieval. The presence in all three common taxa of articulating or matching bones, such as radius with ulna, distal tibia with talus, and metapodials with phalanges (**Table 3.26**; **Fig. 3.30, Fig. 3.31, Fig. 3.32, Fig. 3.33, Fig. 3.34, Fig. 3.35** and **Fig. 3.36**), confirms that these anatomically adjacent bones did indeed sometimes ‘travel’ together through butchery and discard, consistent with the above interpretation.

	Caprines	Cattle	Pig
Humerus distal/Radius proximal	1	-	-
Radius proximal/Ulna proximal	10	4	1
Carpals	-	1	-
MC proximal/Carpals	1	-	-
MC proximal/Carpals/Phalanges	-	-	1
Tibia distal/Talus	2	2	-
Tarsal bones	1	1	-
Phalanx I-II/ II-III	2	1	1

Table 3.26. Articulated specimens of caprines, pig and cattle in all phases at Argilos (MinAU 29)

Fig. 3.30. Matching left radius and ulna of pig (Argilos, NR sector, Phase I), (©A. Gkotsinas)

Fig. 3.31. Matching left distal tibia and talus of cattle (Argilos, NR sector, Phase II), (©A. Gkotsinas)

Fig. 3.32. Matching proximal left radius and ulna of a sheep (Argilos, SE sector, Phase III), (©A. Gkotsinas)

Fig. 3.33. Matching left calcaneus and talus of a goat (Argilos, SE sector, Phase III), (©A. Gkotsinas)

Fig. 3.34. Right carpals (hamate, capitate), metacarpals (II, III, IV, V) and first phalanges of pig (Argilos, SE sector, Phase III), (©A. Gkotsinas)

Fig. 3.35. Matching right distal tibia diaphysis and epiphysis, talus and calcaneus of a newborn cattle (Argilos, SE sector, Phase III), (©A. Gkotsinas)

Fig. 3.36. Matching right tibia and talus of goat (Argilos, SE sector, Phase III-IV), (©A. Gkotsinas)

In sum, the smaller limb bones are underrepresented compared to larger ones in caprines and pig, probably as a result both of archaeological recovery losses (especially phalanx II-III) and of frequent off-site discard of much of the (at least rear) foot.

3.1.2.2.1.2. Excavation and storage

To explore potential bias due to damage of the assemblage during and after excavation (digging, processing, storage conditions), the frequency of fresh breaks was examined. To avoid the inflation of fresh breaks, the more fragile bones, such as skull, ribs, vertebrae, scapula and pelvis, as well as the neonatal specimens, were excluded from this analysis. Similarly, to avoid the underestimation of fresh breaks, the very small and compact elements, such as phalanges and carpal and tarsal bones, which are usually preserved whole, are also excluded. Thus, the distribution of fresh breaks was based only on long bones from all habitation phases, quantified in terms of NISP, including only the three main domestic taxa, namely caprines, cattle and pig. Because the purpose of this analysis is to explore loss of information due to breakage, freshly broken bones were reconstructed, where possible (**Fig. 3.37**and **Fig. 3.38**), and recorded as single specimens (broken or unbroken, as appropriate), (above, 2.1.3).

Fig. 3.37. Example of long bone reconstruction (Argilos, Koutloudis sector, Room L9, Phase IV), (©A. Gkotsinas)

Fig. 3.38. Example of a deer scapula reconstruction (Argilos, Koutloudis sector, Room L9, Phase IV), (©A. Gkotsinas)

Phases I, II, III, IV and III-IV

According to **Table 3.27**, the percentage of fresh breaks in long bones is high (21%) for all phases, thus significantly affecting the formation of the sample assemblage. Cattle is least affected, followed by caprines and then pig, probably because cattle bones are most robust, while bones of pig may have been more fragile than those of caprines because they tended to be slaughtered at a younger age (below, 3.1.2.5.3).

Habitation phase		Caprines		Cattle		Pig		Total	
		NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %
I	**New break**	153	17.6	18	13.0	19	18.8	190	17.2
	Total[1]	867	-	138	-	101	-	1,106	-
II	**New break**	39	19.0	10	21.7	11	32.4	60	21.1
	Total[1]	205	-	46	-	34	-	285	-
III	**New break**	90	19.9	19	15.7	17	22.1	126	19.4
	Total[1]	453	-	121	-	77	-	651	-
IV	**New break**	183	27.0	51	23.1	54	34.8	288	27.4
	Total[1]	677	-	221	-	155	-	1,053	-
III-IV	**New break**	63	21.2	7	7.0	14	31.1	84	19.0
	Total[1]	297	-	100	-	45	-	442	-
All phases	**New break**	528	21.1	105	16.8	115	27.9	748	21.1
	Total[1]	2,499	-	626	-	412	-	3,537	-

Table 3.27. Incidence of freshly broken long bones of caprines, cattle and pig in all phases at Argilos (neonatal excluded; NISP)

[1] Includes all long bones, complete and fragmented (old and fresh breakages)

Such damage during and/or after excavation is likely to have deflated the number of complete or almost complete bones, thus potentially distorting fragmentation patterns as evidence for carcass processing (below, 3.1.2.3), and also to have reduced the availability of biometric data. Additionally, it is likely to have contributed to retrieval losses, since the resulting smaller fragments are more likely to have been missed.

3.1.2.2.2. Formation of the faunal assemblage

The formation of the faunal assemblage may be influenced by environmental factors, carnivore activity and human trampling, affecting the preservation of the assemblage after its deposition (above, 2.1.2.6). The following sections explore the impact of these factors on the formation of the faunal assemblage.

3.1.2.2.2.1. Environmental attrition

The environment can modify the assemblage in such a way as to obscure the identification of other post- and pre-depositional traces, such as gnawing. Environmental attrition can be caused by weather conditions (sun, rain) and soil factors (encrustation, root etching). Weather and soil conditions also contribute to the discolouration of bones, mainly caused by the presence of minerals, and thus may make recognition of burning traces difficult (above, 2.1.2.6). To evaluate the environmental contribution to the formation of the faunal assemblage, the specimens bearing relevant traces were quantified in terms of NISP, excluding loose teeth (except in the case of discolouration), as it was unlikely that any relevant marks could be detected on the surface of the teeth, and neonatal specimens, due to the difficulties in distinguishing marks such as root etching on an undeveloped bone surface. The analysis included caprines, cattle and pig as well as the medium and large- sized indeterminate taxa, while, in examining spatial distribution in Phase IV, all the identified and indeterminate mammalian specimens are considered. The frequencies of environmental traces for all the habitation phases combined are presented, while any differences between the phases are also mentioned.

Phases I, II, III, IV and III-IV

As shown in **Table 3.28**, the environment, in the form of vegetation, played a significant role in the formation of the faunal assemblage. Vegetation (root etching, **Fig. 3.39**) affected 20% of the assemblage, followed by weathering (2%) and encrustation (<1%). The former most affected cattle (31%), probably due to their large size: their larger bone surface is more likely to come into contact with roots than the smaller bone surfaces of caprines and pig (21% and 22% respectively). This is consistent with the percentages of root etching in medium (13%) and large sized indeterminate specimens (22%) dominated by caprines/pig and cattle, respectively. The action of vegetation may have removed or obscured other traces, such as bite and cut marks, creating potential biases in the interpretation of carnivore attrition and carcass processing.

Habitation phase		Caprines		Cattle		Pig		Medium-sized		Large-sized		Total	
		NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %
I	**Weathered**	12	0.9	4	1.1	2	0.7	2	0.3	1	0.9	21	0.7
	Root-etched	54	3.9	12	3.3	16	5.6	4	0.6	4	3.7	90	3.2
	Total[1]	1,374	-	365	-	284	-	719	-	107	-	2,849	-
II	**Weathering**	14	3.8	4	3.8	5	5.2	2	0.8	1	2.8	26	3.1
	Root-etched	73	19.8	23	22.1	19	19.6	57	23.7	10	27.8	182	21.5
	Encrusted	1	0.3	1	1.0	1	1.0	-	0.0	-	0.0	3	0.4
	Total[1]	368	-	104	-	97	-	241	-	36	-	846	-
III	**Weathering**	14	1.6	10	3.4	4	1.8	3	0.6	3	1.6	34	1.6
	Root-etched	157	18.4	127	43.6	54	24	48	9.3	21	11.1	407	19.6
	Encrusted	2	0.2	2	0.7	-	0.0	-	0.0	-	0.0	4	0.2
	Total[1]	851	-	291	-	225	-	516	-	189	-	2,072	-
IV	**Weathering**	93	6.4	24	4.5	19	5	-	0.0	6	1.8	142	3.8
	Root-etched	513	35.2	232	43.4	119	31.5	224	20.7	115	35	1,203	31.8
	Encrusted	40	2.7	4	0.7	5	1.3	18	1.7	9	2.7	76	2.0
	Total[1]	1,458	-	534	-	378	-	1,083	-	329	-	3,782	-
III-IV	**Weathering**	13	2.7	16	10.0	2	1.5	5	1.9	1	2.2	37	3.4
	Root-etched	145	30.0	60	37.5	35	25.7	40	15.4	7	15.2	287	26.5
	Encrusted	3	0.6	-	0.0	1	0.7	-	-	-	0.0	4	0.4
	Total[1]	483	-	160	-	136	-	259	-	46	-	1,084	-
All phases	**Weathering**	146	3.2	58	4.0	32	2.9	12	0.4	12	1.7	260	2.4
	Root-etched	942	20.8	454	31.2	243	21.7	373	13.2	157	22.2	2,169	20.4
	Encrusted	46	1.0	7	0.5	7	0.6	18	0.6	9	1.3	87	0.8
	Total[1]	4,534	-	1,454	-	1,120	-	2,818		707	-	10,633	-

Table 3.28. Incidence of environmental attrition in caprines, cattle, pig and animal size category (medium, large) in all phases at Argilos (loose teeth and neonatal excluded; NISP)

[1] Includes all specimens, with and without environmental traces

Fig. 3.39. Root etching on the caudal side of a right distal tibia of caprine (Argilos, Koutloudis sector, Room L3, Phase IV), (©A. Gkotsinas)

Root marks mainly affected the assemblages from phases II, III, IV and III-IV (21%, 20%, 32% and 26% respectively), whereas in Phase I, the impact of vegetation was limited (3%; **Table 3.28**). Dense vegetation covered the soil surface over the whole area of the ancient city, but the Phase I assemblage derived from deeper layers and so was less affected. The low percentages of weathering traces (**Fig. 3.40**) in all habitation phases (**Table 3.28**) imply that the majority of the remains were not exposed to weather conditions (sun and rain), suggesting immediate burial and/or deposition in roofed/covered space. It is remarkable, however, that most of the bones with weathering traces from phases II, IV and III-IV are from the interiors of the houses. Although the lack of contextual data from phases II and III-IV prevents detailed analysis of spatial distribution, the contextual breakdown of Phase IV provides some interesting points. More specifically, based on **Table 3.29**, most of the weathered bones, in the case of the Koutloudis sector, are not from open areas, as expected, but from the interiors of the buildings. More specifically 139 NISP derived from the interiors of rooms H12, L2–L4, L6–L112 and Q1 and two from the road R4. The fact that the rooms, which are assumed to have been roofed, housed weathered bones suggests that these bones may have been discarded elsewhere in open space, before re-deposition inside the rooms perhaps as part of the construction fill of the floor, or that they were dumped inside the rooms during phases of disuse. The same may be assumed for the SE sector, despite the lack of contextual data.

Fig. 3.40. Weathering on the right tibia diaphysis of caprine (Argilos, SE sector, Phase IV), (©A. Gkotsinas)

Koutloudis sector		Weathering			Total[1] (NISP)
		NISP	NISP %		
Building H	**H12**	9	2.2	4.7	412
Building L	**L1**	-	0.0		26
	L2	6	15.4		39
	L3	4	1.9		208
	L4	17	11.5		148
	L6	7	1.4		483
	L7	18	4.5		401
	L8	39	11.7		332
	L9	5	1.0		494
	L10	3	3.9		77
	L11	13	14.3		91
	L12	14	7.2		195
Building Q	**Q1**	4	5.6		72
Open spaces	**R4**	2	2.1	0.4	97
	SWH1	-	0.0		412
Total		141	4.0		3,487

Table 3.29. Incidence of weathering in all specimens by context in Koutloudis sector at Argilos in Phase IV (loose teeth and neonatal excluded; NISP)

[1] Number of recorded bones (weathered and non-weathered)

Finally, the contribution to assemblage formation of soil factors, including discolouration of bones and teeth, is negligible. Encrusted bones were mostly located in specific stratigraphic units, such as the interior spaces of Rooms L6 and Q1 of Phase IV. Discolouration affects 41 specimens from all four phases (**Table 3.30**) found in both exterior and interior spaces in all sectors. Of these specimens, twenty-six bear green stains caused by contact with corroding buried copper[271] (**Fig. 3.41**) and ten bear orange stains caused by iron objects (**Fig. 3.42**). Five further specimens bear reddish stains which probably related to bacteria and fungi or the presence of trace levels of minerals, such as manganese, in combination with the soil pH level (**Fig. 3.43**).

Habitation phase	Discolouration			
	Green	Orange	Red	Total
I	1	-	-	1
II	1	-	1	2
III	15	3	1	19
IV	9	7	3	19
Total	26	10	5	41

Table 3.30. Incidence of discolouration in all specimens by phase at Argilos (NISP)

Fig. 3.41. Right maxillary molar fragment of caprine with discolouration due to corroded copper (Argilos, Koutloudis sector, Room L1, Phase III), (©A. Gkotsinas)

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[271] Buikstra and Ubelaker 1994; Goffer 2007; Dupras and Schultz 2013.

Fig. 3.42. Right metacarpal of goat. The proximal part bears vegetation traces and the distal part bears iron traces (Argilos, Koutloudis sector, SWH1, Phase IV), (©A. Gkotsinas)

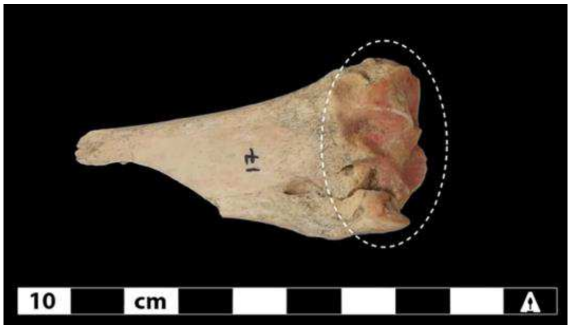

Fig. 3.43. Left radius fragment of caprine with reddish stains on distal epiphysis (Argilos, Koutloudis sector, Room L1, Phase III), (©A. Gkotsinas)

3.1.2.2.2.2. Carnivore attrition

The contribution of carnivore attrition was assessed based on the incidence of gnawing, the presence of digested bones, anatomical representation, and patterns of fragmentation. In regard to the incidence of gnawing, the analysis included (a) all gnawed specimens quantified in terms of NISP, excluding loose teeth, as bite marks are unlikely to be detected on tooth surfaces, and neonatal specimens, as gnawing would probably destroy them; and (b) the three main taxa namely caprines, cattle and pig. The other identified domestic and wild species were excluded as they were too few for any meaningful analysis. Indeterminate species, tortoise and birds were also excluded. Anatomical representation was explored through comparison with Brain's observations of anatomical representation of modern goats subjected to scavenger (and human) gnawing and trampling in a Hottentot village,[272] and the specimens were quantified in terms of MinAU. Although Brain's model, based on modern goats, is only directly comparable with sheep and goat, it was also used to explore anatomical representation in cattle and pig. It should be noted that, in Brain's model, long bone units with destroyed articulations but surviving shafts are treated as absent, whereas in Argilos they were recorded as present (in both NISP and MinAU).

The last piece of evidence regarding carnivore attrition is the fragmentation pattern of long bones, namely the humerus, radius, femur, tibia and metapodials. This analysis concerns only caprines, cattle and pig, quantified in terms of NISP, excluding neonatal specimens and loose epiphyses. The analysis is based on the following principles: diaphysis cylinder fragments are typical products of carnivore gnawing; diaphysis+epiphysis fragments are typically produced by humans during carcass processing; and diaphysis splinters may result from either carnivore attrition or human activity, including marrow extraction and trampling.[273] All the above aspects of the analysis are presented for all habitation phases, followed by an overview at the end of the section.

Phases I, II, III, IV and III-IV

As shown in **Table 3.31**, 10% of the assemblage has pitted **(Fig. 3.44)** and furrowed (**Fig. 3.45**) surfaces suggestive of gnawing by carnivores, which may plausibly be attributed to domestic dogs, as they are represented in the assemblage. The presence of three digested caprines elements, two from Phase II and one from Phase III, was probably also due to dog activity. Additionally, 2% of the bones bear thin parallel lines made by rodents, most probably mice. Gnawing by dogs is most frequent in pig (12%), followed by caprines and cattle (10% each), (**Table 3.31**). The percentage of gnawed bones suggests that dogs had moderate access to the discarded bone material in the built-up area, while mice too were active in the settlement although their contribution to assemblage formation is relatively insignificant.

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[272] Brain 1981.

[273] Binford 1981.

Habitation phase	Gnawing traces	Caprines		Cattle		Pig		Total	
		NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %
I	**Carnivore**	216	15.6	38	10.3	62	18.8	316	15.1
	Rodent	14	1.0	1	0.3	1	0.3	16	0.8
	No traces	1,158	83.4	328	89.4	266	80.9	1,752	84.1
	Total	1,388	100.0	367	100.0	329	100.0	2,084	100.0
II	**Carnivore**	32	8.6	6	5.6	19	19.2	57	9.9
	Rodent	3	0.8	3	2.8	2	2.0	8	1.4
	No traces	336	90.6	98	91.6	78	78.8	512	88.7
	Total	371	100.0	107	100.0	99	100.0	577	100.0
III	**Carnivore**	71	8.4	31	10.7	22	9.8	124	9.1
	Rodent	25	2.9	12	4.1	3	1.3	40	2.9
	No traces	755	88.7	248	85.2	200	88.9	1,203	88.0
	Total	851	100.0	291	100.0	225	100.0	1,367	100.0
IV	**Carnivore**	107	7.3	62	11.6	26	6.8	195	8.2
	Rodent	29	2.0	14	2.6	4	1.1	47	2.0
	No traces	1,322	90.7	458	85.8	348	92.1	2,128	89.8
	Total	1,458	100.0	534	100.0	378	100.0	2,370	100.0
III-IV	**Carnivore**	28	5.8	15	9.4	10	7.3	53	6.8
	Rodent	3	0.6	-	0.0	2	1.5	5	0.6
	No traces	452	93.6	145	90.6	124	91.2	721	92.6
	Total	483	100.0	160	100.0	136	100.0	779	100.0
All phases	**Carnivore**	454	10.0	152	10.4	139	11.9	745	10.4
	Rodent	74	1.6	30	2.1	12	1.0	116	1.6
	No traces	4,023	88.4	1,277	87.5	1,016	87.1	6,316	88.0
	Total	4,551	100.0	1,459	100.0	1,167	100.0	7,177	100.0

Table 3.31. Incidence of gnawing in caprines, cattle and pig per phase at Argilos (loose teeth and neonatal specimens excluded; NISP)

Fig. 3.44. Traces of dog gnawing (pitted surface) on the proximal articulation of a cattle right metacarpal (Argilos, Koutloudis sector, Room L1, Phase III), (©A. Gkotsinas)

Fig. 3.45. Traces of dog gnawing (furrowed surface-white arrows) on the medial side of a caprine right mandible (Argilos, Koutloudis sector, Room L6, Phase IV), (©A. Gkotsinas)

The evidence of carnivore gnawing is fairly consistent between phases at 7-10%, with the exception of Phase I where 15% of the assemblage bears such marks (**Table 3.31**). The frequency of bite marks may be underestimated due to root etching, especially in the phase II, III, IV and III-IV assemblages where root marks were more common, whereas the very low percentages of root etching in Phase I (3%), (above, **Table 3.28**) may have contributed to the higher percentages of carnivore gnawing marks in that phase. In relation to the distribution of gnawing marks between taxa, the percentages vary between the phases (**Table 3.31**). Thus, in phases I and II gnawing is most common in pig, followed by caprines and cattle, while in phases III and IV it is commonest in cattle followed by caprines or pig. Finally, in Phase III-IV gnawing is again most frequent in pig, followed by cattle and caprines.

The gnawed bones from all phases are derived from both open spaces and building interiors. For example, in Phase IV of the Koutloudis sector, 5% of the bones found indoors (rooms L1-L4, L6-L12 and room H12) and 12% of the bones found outdoors (R4 and SWH1) were gnawed (**Table 3.32**). The higher frequency of gnawed bones in open spaces was expected, but the generally low percentages imply that dogs may have had limited access inside the city grid or, in the case of the SWH1, that discards were rapidly covered over and thus protected. The latter scenario is supported by the complete lack of weathering marks on bones from SWH1 in Phase IV (above, **Table 3.28**). The gnawed bones from the interiors of Buildings H and L were probably part of the floor make-up, perhaps introduced from an open area elsewhere during construction, or the dogs had access to discarded bones inside the rooms when the rooms were abandoned between uses (e.g. rooms H12 and L1).

Koutloudis sector		**Gnawing**			**Total**[1] (NISP)
		NISP	NISP %		
Building H	**H12**	51	12.4	4.6	412
Building L	**L1**	4	15.4		26
	L2	6	15.4		39
	L3	6	2.9		208
	L4	6	4.1		148
	L6	26	5.4		483
	L7	11	2.7		401
	L8	11	3.3		332
	L9	6	1.2		494
	L10	2	2.6		77
	L11	2	2.2		91
	L12	5	2.6		195
Building Q	**Q1**	-	0.0		72
Open spaces	**R4**	9	9.3	12.4	97
	SWH1	54	13.1		412
Total		229	6.6		3,487

Table 3.32. Incidence of gnawing in Koutloudis sector at Argilos in Phase IV (loose teeth and neonatal specimens excluded; NISP)

[1] Number of recorded bones

Fig. 3.46 displays the anatomical representation of the main domesticated taxa from all habitation phases in descending order of survival frequency as observed by Brain (1981) with modern goat skeletons subjected to gnawing and trampling. To control for the possible influence of partial recovery, the smallest body parts (calcaneus, talus and phalanges) are distinguished by light fill in the Argilos histograms. The caprine and pig histograms present partial similarity to Brain's model, but that for cattle not so. Although sample size is modest for pig and cattle, the histograms are compatible with attrition by dogs, as well as recovery method, having influenced anatomical representation in the case of caprines and pig more than cattle. The anatomical representation of the main domesticated taxa is fairly consistent between phases, given the limitations of sample size, especially in phases II and III-IV (**Fig. 3.47**, **Fig. 3.48** and **Fig. 3.49**). Moreover, the high ratio of proximal to distal tibia in all species and habitation phases, unexpected because the former is late fusing and so, more vulnerable to attrition, might imply that the hind feet were sometimes separated from the rest of the carcass at mid-shaft of tibia.

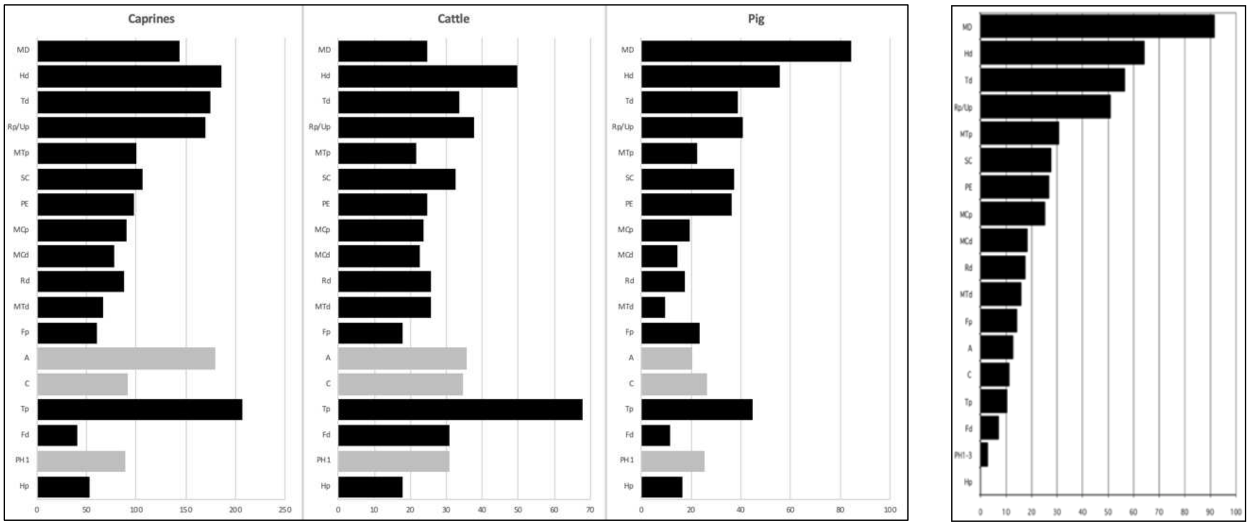

Fig. 3.46. Left: Anatomical representation of caprines (MinAU 1,912), cattle (MinAU 527) and pig (MinAU 500) of all habitation phases at Argilos; Right: Relative abundance of goat body parts (Brain 1981)

Key: MD: mandible, Hd: humerus distal, Td: tibia distal, Rp/Up: radius proximal/ulna proximal, MTp: metatarsal proximal, SC: scapula, PE: pelvis, MCp: metacarpal proximal, MCd: metacarpal distal, Rd: radius distal, MTd: metatarsal distal, Fp: femur proximal, A: astragalus, C: calcaneus, Tp: tibia proximal, Fd: femur distal, PH1: phalanx I, Hp: humerus proximal. Light shading: small body parts most subject to loss in recovery

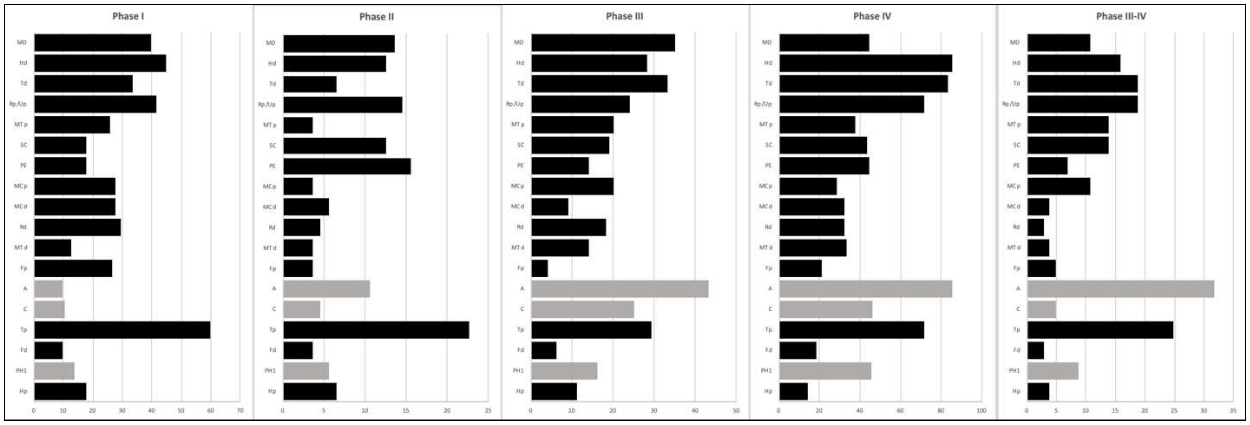

Fig. 3.47. Anatomical representation of caprines by habitation phase at Argilos (Phase I: MinAU 436, Phase II: MinAU 143, Phase III: MinAU 350, Phase IV: MinAU 796, Phase III-IV: MinAU 187)

Key: MD: mandible, Hd: humerus distal, Td: tibia distal, Rp/Up: radius proximal/ulna proximal, MTp: metatarsal proximal, SC: scapula, PE: pelvis, MCp: metacarpal proximal, MCd: metacarpal distal, Rd: radius distal, MTd: metatarsal distal, Fp: femur proximal, A: astragalus, C: calcaneus, Tp: tibia proximal, Fd: femur distal, PH1: phalanx I, Hp: humerus proximal. Light shading: small body parts most subject to loss in recovery

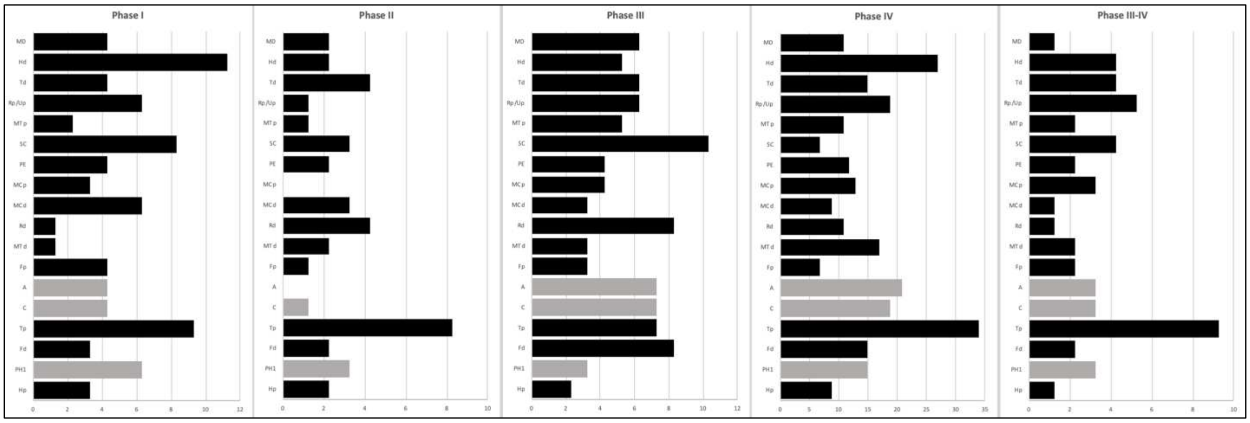

Fig. 3.48. Anatomical representation of cattle by habitation phase at Argilos (Phase I: MinAU 83, Phase II: MinAU 41, Phase III: MinAU 97, Phase IV: MinAU 254, Phase III-IV: MinAU 52)

Key: MD: mandible, Hd: humerus distal, Td: tibia distal, Rp/Up: radius proximal/ulna proximal, MTp: metatarsal proximal, SC: scapula, PE: pelvis, MCp: metacarpal proximal, MCd: metacarpal distal, Rd: radius distal, MTd: metatarsal distal, Fp: femur proximal, A: astragalus, C: calcaneus, Tp: tibia proximal, Fd: femur distal, PH1: phalanx I, Hp: humerus proximal. Light shading: small body parts most subject to loss in recovery

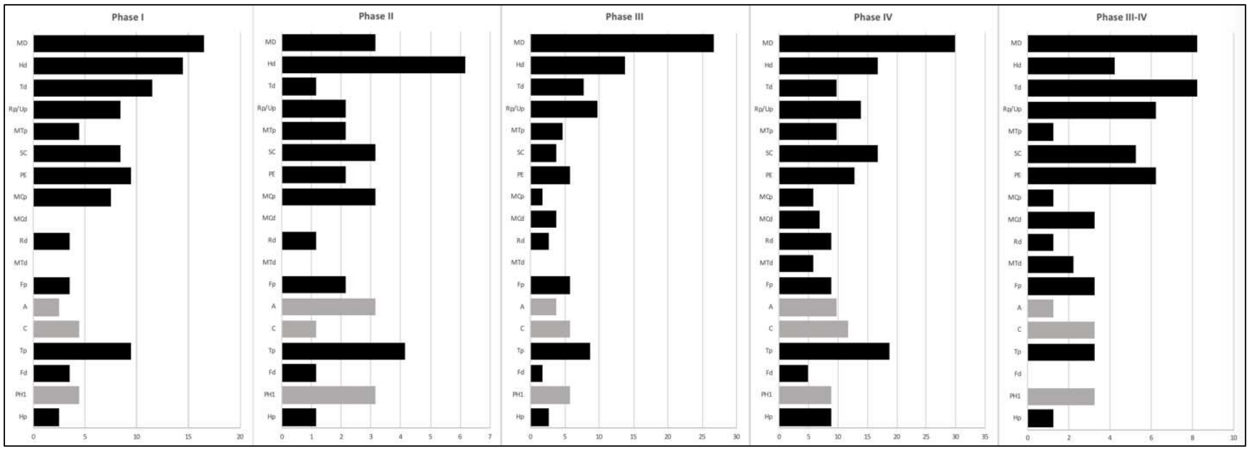

Fig. 3.49. Anatomical representation of pig by habitation phase at Argilos (Phase I: MinAU 107, Phase II: MinAU 38, Phase III: MinAU 102, Phase IV: MinAU 194, Phase III-IV: MinAU 59)

Key: MD: mandible, Hd: humerus distal, Td: tibia distal, Rp/Up: radius proximal/ulna proximal, MTp: metatarsal proximal, SC: scapula, PE: pelvis, MCp: metacarpal proximal, MCd: metacarpal distal, Rd: radius distal, MTd: metatarsal distal, Fp: femur proximal, A: astragalus, C: calcaneus, Tp: tibia proximal, Fd: femur distal, PH1: phalanx I, Hp: humerus proximal. Light shading: small body parts most subject to loss in recovery

In relation to the type of fragmentation, diaphysis cylinder fragments constitute 15% of the long bones in the assemblage of all habitation phases combined and are most common in pig (37%), followed by caprines (14%) and cattle (8%), (**Table 3.33**). The frequency of diaphysis cylinders may be influenced not only by the intensity of gnawing, but also by the number of bones discarded in a complete enough form to be potentially reduced to cylinders. Thus, complete long bones survived mainly in pig and caprines, suggesting that complete bones, suitable for reduction by dogs to diaphysis cylinders, may have been more frequent in these middle-sized animals than in cattle bones. In cattle, the low percentage of diaphysis cylinders (8%) and the higher percentages of diaphysis splinters (76%) and fragments including epiphysis (25%) may be related to human breakage (i.e. marrow extraction; below, 3.1.2.3) minimizing the number of complete long bones available to carnivores. The apparently moderate traces of carnivore attrition (10%; above, **Table 3.31**), in combination with the very low percentage of complete bones in all species (2%) and the high percentage of diaphysis splinters (58%), suggests that breakages were mostly caused by humans through butchery and marrow extraction. The incidence of the type of fragmentation of the long bones is fairly consistent between phases and between taxa by phase as well (**Table 3.33**).

Habitation phase	Fragmentation type	Caprines		Cattle		Pig		Total	
		NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %
I	**Complete/Almost complete**	3	0.4	2	1.7	12	14.7	17	1.9
	Diaphysis cylinder	72	10.1	3	2.5	17	20.7	92	10.0
	Diaphysis splinter	531	74.4	91	75.8	32	39.0	654	71.4
	Fragments including epiphysis	108	15.1	24	20.0	21	25.6	153	16.7
	Total	714	100.0	120	100.0	82	100.0	916	100.0
II	**Complete/Almost complete**	1	0.6	-	0.0	2	8.8	3	1.3
	Diaphysis cylinder	21	12.7	4	11.1	7	30.4	32	14.2
	Diaphysis splinter	120	72.2	29	80.6	7	30.4	156	69.3
	Fragments including epiphysis	24	14.5	3	8.3	7	30.4	34	15.2
	Total	166	100.0	36	100.0	23	100.0	225	100.0
III	**Complete/Almost complete**	3	0.8	2	2.0	7	11.7	12	2.3
	Diaphysis cylinder	41	11.3	13	12.7	23	38.3	77	14.7
	Diaphysis splinter	203	55.9	68	66.7	14	23.3	285	54.2
	Fragments including epiphysis	116	32.0	19	18.6	16	26.7	151	28.8
	Total	363	100.0	102	100.0	60	100.0	525	100.0
IV	**Complete/Almost complete**	9	1.8	-	0.0	18	17.8	27	3.5
	Diaphysis cylinder	104	21.1	16	9.4	45	44.6	165	21.6
	Diaphysis splinter	192	38.9	86	50.6	17	16.8	295	38.6
	Fragments including epiphysis	189	38.3	68	40.0	21	20.8	278	36.3
	Total	494	100.0	170	100.0	101	100.0	765	100.0
III-IV	**Complete/Almost complete**	4	1.7	1	1.1	-	0.0	5	1.4
	Diaphysis cylinder	33	14.1	8	8.6	19	61.3	60	16.8
	Diaphysis splinter	148	63.2	67	72.0	5	16.1	220	61.5
	Fragments including epiphysis	49	20.9	17	18.3	7	22.6	73	20.3
	Total	234	100.0	93	100.0	31	100.0	358	100.0
All phases	**Complete/Almost complete**	20	1.0	5	1.0	39	13.1	64	2.3
	Diaphysis cylinder	271	13.7	44	8.4	111	37.4	426	15.3
	Diaphysis splinter	1,194	60.6	341	65.5	75	25.3	1,610	57.7
	Fragments including epiphysis	486	24.7	131	25.1	72	24.2	689	24.7
	Total	1,971	100.0	521	100.0	297	100.0	2,789	100.0

Table 3.33. Incidence of fragmentation types in post-neonatal long bones in caprines, cattle and pig per phase at Argilos (excluded loose epiphyses and new breaks; NISP)

Moreover, the discovery of matching unfused specimens such as long bone unfused diaphysis with epiphysis of caprines, cattle and pig (e.g. proximal ulna, proximal and distal tibia, and distal metacarpal), as well as matching articulating elements of cattle, caprines, pig (above, **Table 3.26**), red deer and hare (**Fig. 3.50**), (e.g. radius–ulna; tibia–talus; phalanx I–II–III; metacarpals 2–5; metatarsal 4–5; metapodials-phalanges, carpal bones, tarsal bones) from phases II, III and IV, shows that the layers in question were not heavily disturbed by scavengers and humans (trampling). This suggests that discards were rapidly covered over and thus protected.

Fig. 3.50. Right metacarpals (MC 2-5) and first phalanges of hare from the same stratigraphic unit (Argilos, SE sector, Phase III), (©A. Gkotsinas)

Summary

Based on the incidence of gnawing, the anatomical representation of the main domestic animals and the type of fragmentation, the contribution of carnivore attrition to the formation of the faunal assemblage of all the habitation phases seems only modest. This suggests that dogs had limited access within the city grid, to both open spaces and building interiors. Access may also have been limited by rapid burial of discarded bones, a possibility consistent with the low percentages of weathering traces. However, the presence of gnawed bones in building interiors may be due to discard during phases of abandonment or to the introduction of cultural deposits from elsewhere to raise floor levels.

The differences in carnivore attrition between the common taxa are probably related to the availability of complete bones, as these are more attractive to dogs than bone fragments from which marrow has been extracted, while the modest levels of attrition by dogs imply that bone fragmentation was mostly caused by humans either pre-depositionally, during butchery/marrow extraction or post-depositionally, by trampling. The dominance of diaphysis splinters and the greater frequency of fragments including the epiphysis than diaphysis cylinders support this interpretation and suggests that human breakage for marrow extraction was the main agent of fragmentation (below, 3.1.2.3).

3.1.2.3. Carcass processing

The main pre-depositional anthropogenic impacts on faunal assemblages are butchery practices related to cooking and consumption and subsequent discard practices. To explore these factors, the incidence of cut marks, bone fragmentation patterns and the incidence of burning traces were analysed for all habitation phases. To this end, the assemblage was quantified in terms of NISP. Loose teeth and neonatal specimens, on which cut marks are unlikely to be observed, were excluded, while in the case of fragmentation types only long bones were analysed. The analysis was performed for mammalian species, although some notes were also made regarding tortoise and birds. Sheep and goat, due to the small sample and the fact that these two species of broadly the same size and conformation are likely to have been treated similarly, have been merged along with sheep/goat into one group, caprines.

Phases I, II, III, IV and III-IV

As **Table 3.34** shows, 14% of the total assemblage bears butchery traces. The percentages of cut marks per phase vary little between 14 and 16% (and 12% in the mixed Phase III-IV assemblage). Butchery marks were found on specimens of all the identified domestic and wild taxa with the exception of red fox (i.e. on caprines, cattle, pig, dog, horse, donkey, red deer, fallow deer, roe deer, boar and wolf; Appendix III: **Tables III.1-III.5**), and also on a tortoise and a bird specimen. Thus, these animals were certainly consumed. However, in some cases, the cut marks (e.g. skinning) could be related with the exploitation of skin and fur (e.g. wolf), which cannot be documented archaeologically. In regard to the type of cuts, skinning marks are preserved on 4%, dismemberment and filleting marks on 22% each, and chopping marks on 52% of the total assemblage, with the relative frequency of these categories varying only modestly between phases (**Table 3.35**).

Habitation phase	Cut		Uncut		Total (NISP)
	NISP	NISP %	NISP	NISP %	
I	420	13.7	2,651	86.3	3,071
II	145	15.6	787	84.4	932
III	341	15.2	1,897	84.8	2,238
IV	615	15.1	3,445	84.9	4,060
III-IV	139	11.9	1,033	88.1	1,172
Total	1,660	14.5	9,813	85.5	11,473

Table 3.34. Incidence of cut and uncut specimens by phase at Argilos (loose teeth and neonatal specimens excluded; Appendix III: Tables III.1-III.5, NISP)

	Phase I		Phase II		Phase III		Phase IV		Phase III-IV		Total	
	NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %
Skinning	17	4.0	8	5.5	7	2.1	29	4.7	10	6.5	71	4.3
Dismemberment	75	17.9	31	21.4	80	23.5	150	24.4	37	24.2	373	22.3
Filleting	106	25.2	41	28.3	77	22.6	112	18.2	29	19.0	365	21.8
Chopping	222	52.9	65	44.8	176	51.8	324	52.7	77	50.3	864	51.6
Total	420	100.0	145	100.0	340	100.0	615	100.0	153	100.0	1,673	100.0

Table 3.35. Incidence of types of butchery marks by phase at Argilos (loose teeth and neonatal specimens excluded; Appendix III: Tables III.1-III.5, NISP)

In relation to domestic species, caprines, pig and cattle bear all types of cut marks, namely skinning, dismemberment, filleting and chopping (**Table 3.36**). This indicates that the entire carcass processing sequence took place on site for at least some of the common domesticates, although the previous analysis of retrieval loss suggested that foot bones removed during initial carcass dressing may sometimes have been discarded off site (above, 3.1.2.2.1.1). The relative frequencies of marks from the successive stages of butchery differ between cattle, on the one hand, and caprines and pigs, on the other. In cattle, by comparison with the medium-sized domesticates: chop marks are more frequent, consistent with the more intensive fragmentation of their long bones (above, **Table 3.33**); dismembering and filleting marks are less frequent, probably because intensive fragmentation has 'inflated' the proportion of specimens without butchery traces; and skinning marks are more frequent, arguably because such marks are sometimes found on phalanges which were less susceptible to recovery loss in the larger domesticates. These overall differences between the common domesticates are repeated in the relatively large sub-assemblages from phases I, III and IV, but are less consistent when sample sizes are smaller (**Table 3.36**).

		Caprines		**Cattle**		**Pig**		**Total**	
		NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %
Phase I	**Skinning**	5	3.2	7	12.7	4	6.2	16	5.8
	Dismemberment	43	27.4	11	20.0	15	23.1	69	24.9
	Filleting	61	38.9	7	12.7	22	33.8	90	32.5
	Chopping	48	30.6	30	54.6	24	36.9	102	36.8
	Total	157	100.0	55	100.0	65	100.0	277	100.0
Phase II	**Skinning**	1	1.8	3	13.0	3	14.3	7	7.1
	Dismemberment	17	30.9	4	17.4	5	23.8	26	26.2
	Filleting	16	29.1	7	30.4	8	38.1	31	31.3
	Chopping	21	38.2	9	39.2	5	23.8	35	35.4
	Total	55	100.0	23	100.0	21	100.0	99	100.0
Phase III	**Skinning**	1	0.8	5	6.8	-	0.0	6	2.4
	Dismemberment	39	29.3	13	17.8	14	28.6	66	25.9
	Filleting	37	27.8	7	9.6	11	22.4	55	21.6
	Chopping	56	42.1	48	65.8	24	49.0	128	50.1
	Total	133	100.0	73	100.0	49	100.0	255	100.0
Phase IV	**Skinning**	9	3.5	9	7.2	1	1.2	19	4.1
	Dismemberment	75	29.1	25	19.8	23	28.8	123	26.5
	Filleting	56	21.7	18	14.3	14	17.5	88	19.0
	Chopping	118	45.7	74	58.7	42	52.5	234	50.4
	Total	258	100.0	126	100.0	80	100.0	464	100.0
Phase III-IV	**Skinning**	5	7.6	1	4.0	-	0.0	6	5.2
	Dismemberment	21	31.8	5	20.0	6	25.0	32	27.8
	Filleting	14	21.2	5	20.0	5	20.8	24	20.9
	Chopping	26	39.4	14	56.0	13	54.2	53	46.1
	Total	66	100.0	25	100.0	24	100.0	115	100.0
Total	**Skinning**	21	3.1	25	8.3	8	3.3	54	4.5
	Dismemberment	195	29.1	58	19.2	63	26.4	316	26.1
	Filleting	184	27.5	44	14.6	60	25.1	288	23.8
	Chopping	269	40.2	175	57.9	108	45.2	552	45.6
	Total	669	100.0	302	100.0	239	100.0	1,210	100.0

Table 3.36. Incidence of types of butchery marks in caprines, cattle and pig by phase at Argilos (loose teeth and neonatal specimens excluded; Tables III.1-III.5, NISP)

The locations of cut marks in all three dominant taxa are quite similar in all phases (**Fig. 3.51**, **Fig. 3.52** and **Fig. 3.53**), with any differences plausibly attributable to small sample sizes. Skinning marks occur on the distal metapodials, the first two phalanges (**Fig. 3.54**) and the frontal bones of the skull. Dismemberment marks were found on all articulations, excluding phalanges. More specifically, dismemberment cuts are concentrated at the shoulder (distal scapula), elbow (distal humerus-proximal ulna-proximal radius; **Fig. 3.55**), wrist (distal radius-carpals-proximal metacarpal), hip (pelvis-proximal femur), knee (distal femur-proximal tibia) and ankle (distal tibia-tarsals-proximal metatarsal) joints, on the neck (atlas) and on the articulation points of ribs. Filleting marks are located on long bone diaphysis and on the mandible, scapula, pelvis, ribs and thoracic vertebrae. Chopping, the most frequent cut, was found on both cranial and postcranial bones. On cranial bones, chopping marks are located on the ramus of the mandible, the frontal and nasal bones and the horncore of caprines. On postcranial bones chopping marks were identified on atlas, ribs, vertebrae, scapula, pelvis, long bones (**Fig. 3.56**) and tarsals, as well as on -cattle-phalanges (**Fig. 3.51**, **Fig. 3.52** and **Fig. 3.53**).

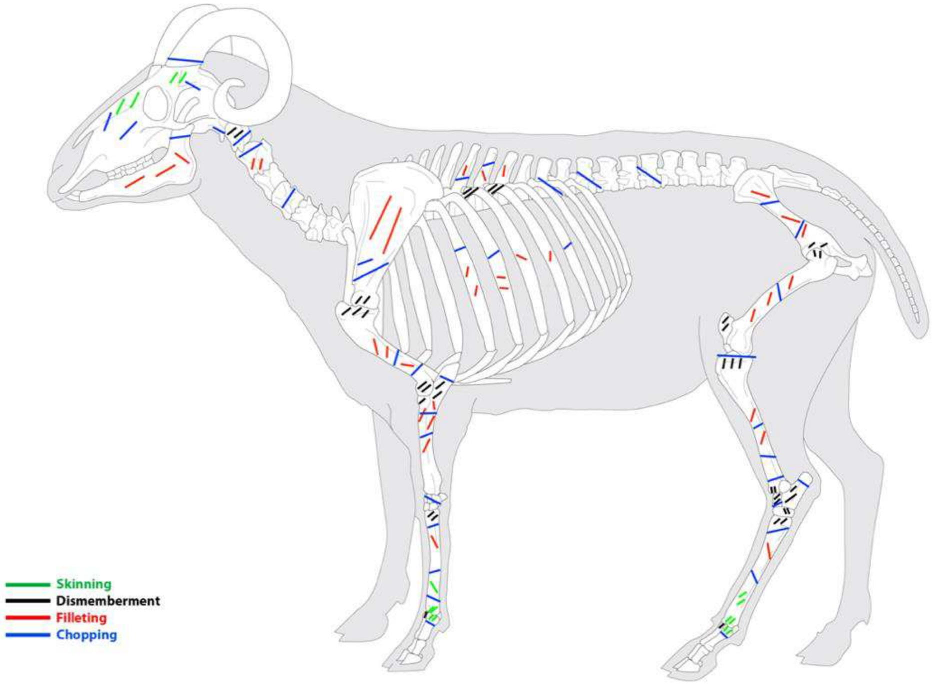

Fig. 3.51. Caprine bones displaying butchery marks, all phases, Argilos (Appendix III: Tables III.1-III.5), (©1996 ArcheoZoo.org)

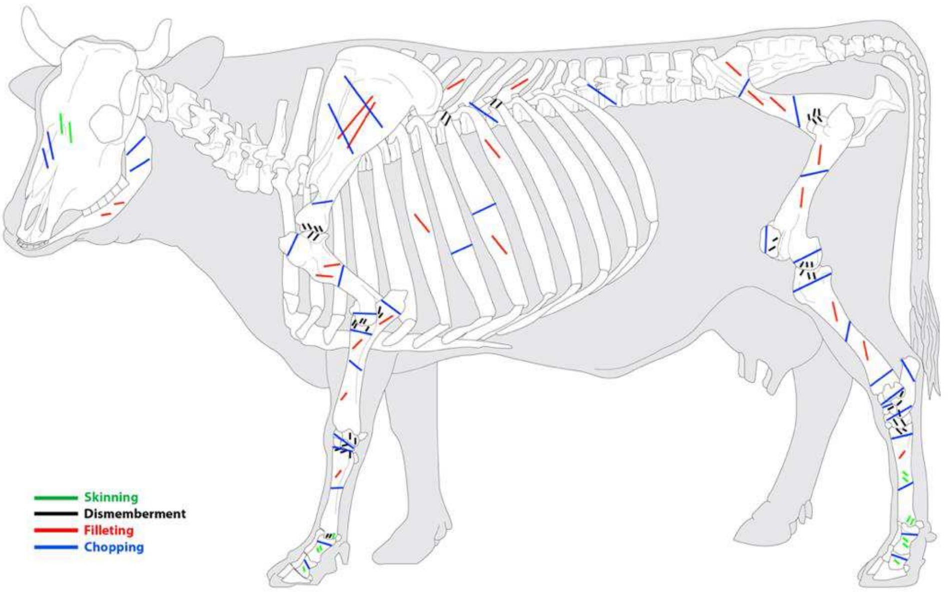

Fig. 3.52. Cattle bones displaying butchery marks, all phases, Argilos (Appendix III: Tables III.1-III.5), (©1996 ArcheoZoo.org)

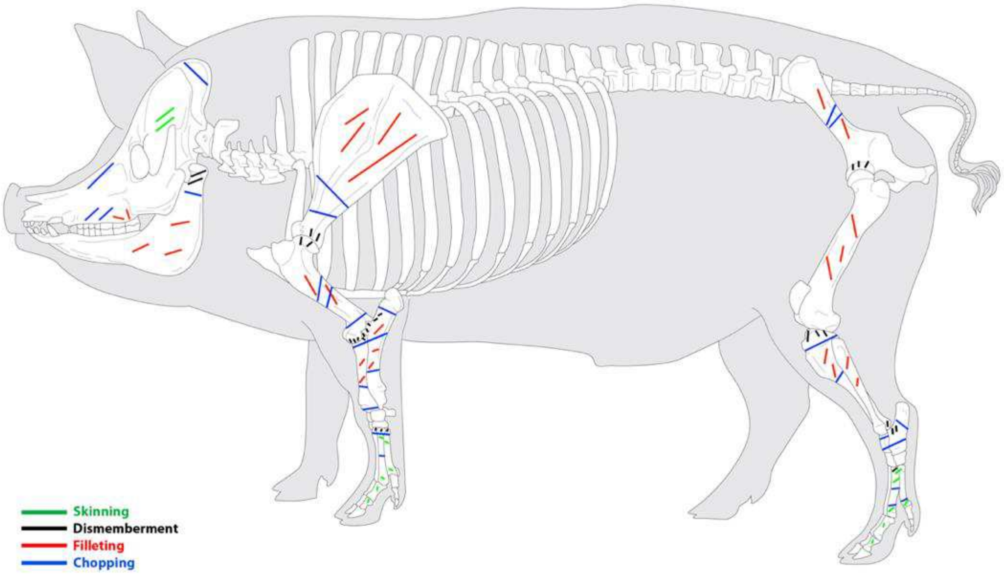

Fig. 3.53. Pig bones displaying butchery marks, all phases, Argilos (Appendix III: Tables III.1-III.5), (©1996 ArcheoZoo.org)

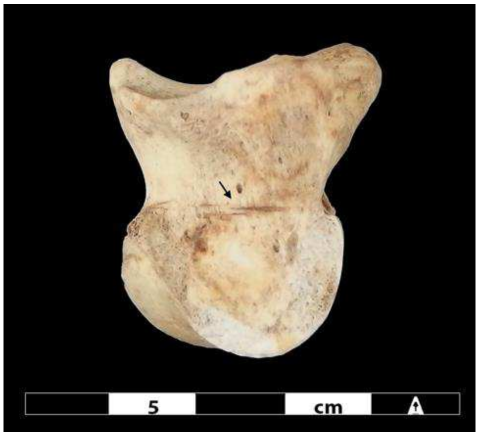

Fig. 3.54. Skinning marks (black arrow) on second phalanx of cattle (Argilos, Koutloudis sector, Room L7, Phase IV), (©A. Gkotsinas)

Fig. 3.55. Dismemberment marks (white arrows) on a caprine left distal humerus (Argilos, Koutloudis, Room L1, Phase III), (©A. Gkotsinas)

Fig. 3.56. Chop marks on a caprine metatarsal (Argilos, NR sector, Phase I), (©A. Gkotsinas)

The high incidence of dismemberment and filleting marks in caprines and pigs implies cooking and consumption of small portions of meat. The lower relative frequency of dismembering and filleting marks in cattle is probably an artefact of the three factors already discussed: their higher incidence of skinning marks (arguably due to better recovery of their phalanges 1-2); their higher incidence of chop marks (perhaps because their larger bones needed to be broken for pot-sizing); and, related to the latter, the higher fragmentation of their bones, resulting in larger numbers of specimens lacking butchery traces. The more intensive chopping and fragmentation of cattle bones is an expected corollary of their large carcass size and, on the one hand, the consequent need for greater investment in 'pot-sizing' for cooking purposes and, on the other hand, their larger marrow content making the investment of effort in extraction more worthwhile.[274] The apparently more intensive marrow extraction, in turn, has probably helped to minimise the impact of dog gnawing on cattle bones, at least in the first two habitation phases (above, **Table 3.31**).

Some butchery marks on caprine and cattle metapodials have been attributed on the basis of orientation to filleting rather than skinning. Given the minimal quantity of meat on these bones, these marks were perhaps inflicted in removal of the periosteum to facilitate breakage for marrow extraction. The frequent presence of burnt patches on metapodial diaphyses supports this hypothesis (below, **Table 3.38**).

As regards the other domestic species, dog, donkey and horse also bear butchery traces related to the entire carcass processing sequence. In the case of dog (**Fig. 3.57**), skinning marks are found on the metacarpals and first phalanx, dismemberment marks at the elbow, hip and ankle joints, and filleting marks on the maxilla, mandible, humerus, radius, femur, tibia and pelvis. Finally, chop marks are found on the mandible, long bone diaphysis (**Fig. 3.58**), pelvis and calcaneus. The type and location of the cuts suggest that dogs were consumed in all four habitation phases following a sequence of carcass processing similar to that for the three dominant domestic taxa.

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[274] Binford 1978: 25.

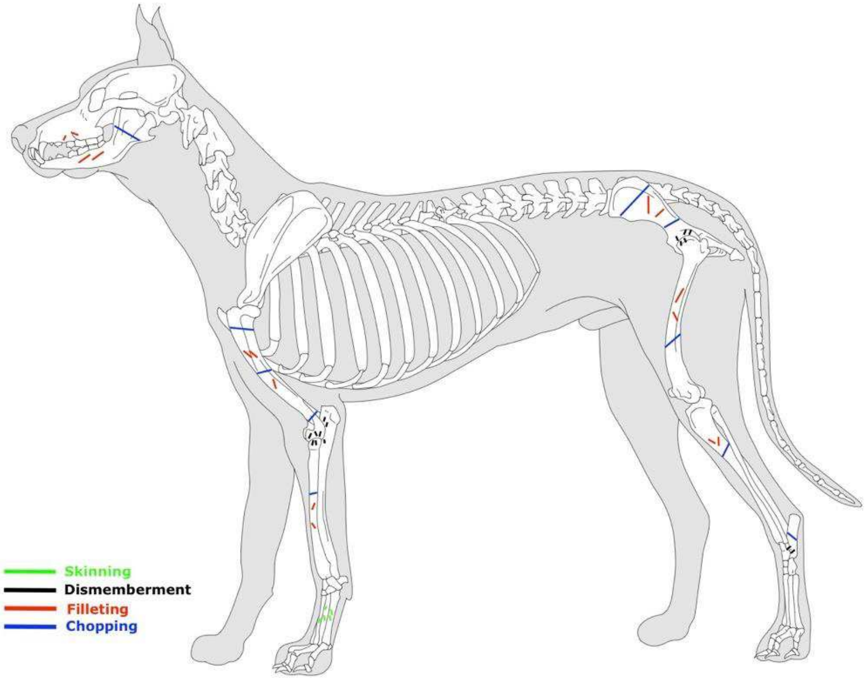

Fig. 3.57. Dog bones displaying butchery marks, all phases, Argilos (Appendix III: Tables III.1-III.5), (©1996 ArcheoZoo.org)

Fig. 3.58. Butchery marks (dismemberment and chopping; white arrows) on the distal diaphysis of dog right femur (Argilos, SE sector, Phase III), (©A. Gkotsinas)

The same can tentatively be inferred from the sparser data for donkey (**Fig. 3.59** and **Fig. 3.60**), while for the horse the evidence is too sparse for any reliable conclusion. The lack of cut marks in donkey specimens from Phase I and in horse specimens from Phases I, III and III-IV is most probably related to the small sample sizes (Appendix III: **Tables III.1-III.5**). Donkey and horse are very sparsely represented in the assemblage as a whole (44 and 18 NISP, respectively) and, in some cases, their remains are from a single context and belong to a single animal (e.g. Phase III: six matching donkey specimens from Room F5 of Building F)[275] and thus probably derived from rare individual consumption incidents or other depositional events.

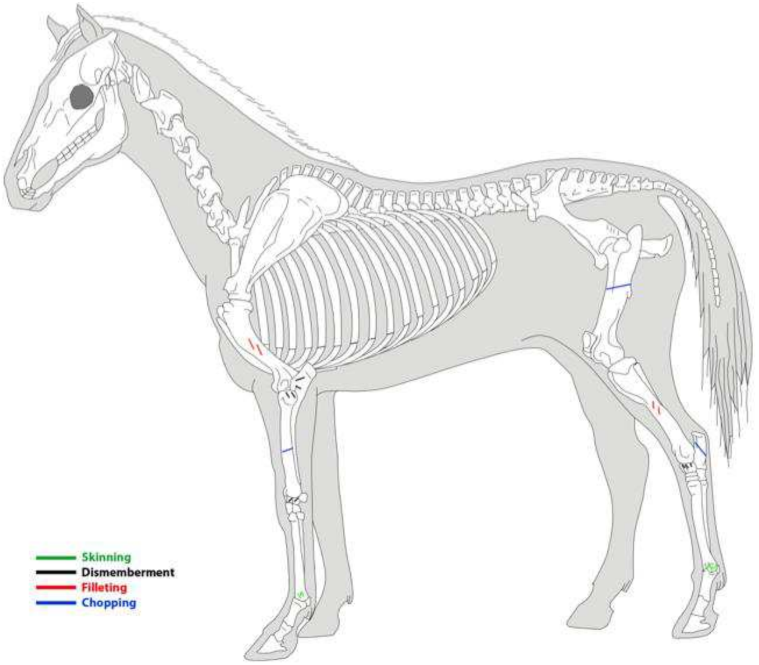

Fig. 3.59. Donkey bones displaying butchery marks, all phases, Argilos (Appendix III: Tables III.1-III.5), (©1996 ArcheoZoo.org)

Fig. 3.60. Distal radius with matching carpal bones (scaphoid, lunate, pyramidal) of donkey bearing cut marks (white arrows), (Argilos, SE sector, Phase III), (©A. Gkotsinas)

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[275] Stratigraphic unit: 10385314.

With respect to the wild fauna, butchery marks confirm that red deer, fallow deer, roe deer, hare, boar and wolf were consumed (Appendix III: **Tables III.1-III.5)**. The same can be suggested for red fox, as their bones were found with those of other consumed species, although the exploitation of fur could also be the case. Moreover, cut marks on a tortoise humerus (**Fig. 3.61**) and a bird tibia (taxon unknown) indicate exploitation also of these taxa. The presence of cranial and postcranial specimens of red deer and hare in the assemblage, as well as butchery marks on metapodials, tarsal bones and phalanges, imply that hunted animals, although perhaps gutted at the kill site, were brought more or less intact inside the settlement, where carcass processing took place. The same may tentatively be inferred for boar, while the small samples of the remaining wild species do not allow any further discussion, although the presence of butchery traces on a wolf distal tibia (Phase III) and mandible (Phase IV) is notable (above, 3.1.2.1). The scarcity of bones of the wild species suggests that game animals did not contribute significantly to the diet of Argilos.

Fig. 3.61. Butchery mark (white arrow) on tortoise humerus (Argilos, NR sector, Phase I), (©A. Gkotsinas)

Of bones bearing traces of burning, 137 NISP were uniformly burnt and 132 NISP were partly burnt (**Table 3.37**). The colour of the uniformly burnt bones varies from grey to blue and white (**Fig. 3.62**), suggesting exposure to high temperatures,[276] whether as a result of cooking accidents or of deliberate discard or use as fuel. Uniform traces were found on cranial and postcranial elements of caprines, cattle, pig and dog, and of small- and medium-sized indeterminate specimens

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[276] Buikstra-Swegle 1989; Shipman et al. 1984; Spennemann-Colley 1989.

in all habitation phases (in detail per phase: Appendix III: **Tables III.6-III.10**). The possibility of these bones being the remains of ritual practices, private or public, cannot be excluded, but cannot yet be explored due to the fact that contextual details are not yet available for most of the remains, while the initial context is unknown in the case of those found in the dump (specimens from phases I and II).

Habitation phase	**Burnt**	**Caprines**	**Cattle**	**Pig**	**Dog**	**Donkey**	**Red deer**	**Boar**	**Small sized**	**Medium sized**	**Large sized**	**Total** (NISP)
I	uniformly	34	1	10	3	-	-	-	1	10	-	59
	partly	12	3	3	2	-	1	-	1	1	-	23
II	uniformly	6	-	-	-	-	-	-	-	2	-	8
	partly	2	-	-	-	1	-	-	-	-	-	3
III	uniformly	28	1	1	-	-	-	-	-	8	-	38
	partly	24	8	2	-	-	2	-	-	3	1	40
IV	uniformly	8	1	1	1	-	-	-	-	4	-	15
	partly	40	13	2	-	-	1	1	-	2	2	61
III-IV	uniformly	6	7	2	-	-	-	-	1	2	-	18
	partly	3	-	1	-	-	-	-	-	-	-	4
Total	uniformly	82	10	14	4	-	-	-	1	26	-	137
	partly	81	24	8	2	1	4	1	2	6	3	132

Table 3.37. Incidence of burning by taxon in all phases at Argilos (Appendix III: Tables III.6-III.10, NISP)

Fig. 3.62. Uniformly burnt specimens (Argilos, NR sector, Phase I), (©A. Gkotsinas)

The partly burnt bones (NISP 132; **Table 3.37**) are probably a result of cooking over open fires (i.e. roasting). These are cranial and postcranial specimens mostly of caprines and cattle and to a lesser extent of pig, dog, donkey, red deer, boar and small-, medium- and large-sized indeterminate animals from all habitation phases (**Table 3.38**; in detail per phase: Appendix III: **Tables III.6-III.10**). Of the cranial bones, mandibles were most affected, with burning on the bases and on the tips of tooth crowns. Traces were also observed on nasal (**Fig. 3.63**) and maxillary bones, horncores and red deer antlers. On postcranial bones, burnt patches were observed on scapula, pelvis, phalanges, talus, calcaneus and on both the articular areas and diaphyses of long bones. Traces are most frequent on metapodials, followed by tibia, humerus, phalanges, pelvis, scapula, tarsal bones, radius, femur and patella. Moreover, ribs and vertebrae also bear burnt patches (**Table 3.38**). During cooking over an open fire, the flesh recedes in areas where it is thin, exposing the bone to localised burning. This potentially accounts for most of the above anatomical parts such as the skull bones, the mandible, the metapodial diaphyses, the phalanges, the tarsal bones and the articulation points. Burnt patches on tarsals/phalanges may be from roasting the whole animal; patches on the mandible and cranium may be from roasting the whole animal or the heads and those on meaty bones would be from whole animals or meat joints.

In sum, the small number of partly burnt bones suggest that cooking over open fires was probably occasional, while the uniformly burnt specimens suggest either accidental or deliberate discard in fire with high temperatures. In the latter case, even though the bones could have been used as fuel for heating-cooking, the case of them being remains of ritual acts cannot be excluded.

	Caprines		Cattle		Pig		Dog		Donkey	Red deer	Boar	Small sized		Medium sized		Large sized	Total (NISP)
	Uniformly burnt	Partly burnt	Uniformly burnt	Partly burnt	Uniformly burnt	Partly burnt	Uniformly burnt	Partly burnt	Partly burnt	Partly burnt	Partly burnt	Uniformly burnt	Partly burnt	Uniformly burnt	Partly burnt	Partly burnt	
HC/Antler	2	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	**4**
Frontal-Nasal	-	-	-	2	-	-	-	-	-	-	-	-	-	1	-	-	3
Maxilla	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	2
MD	-	13	-	-	-	-	-	1	-	-	-	-	-	-	-	-	14
Mandibular tooth	1	-	1	1	-	1	-	-	-	-	-	-	-	-	-	-	4
SC	5	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	8
H diaph.	4	3	-	-	2	2	-	-	-	-	-	-	-	-	-	-	11
Hd epiph.	1	3	-	-	-	1	-	-	-	-	-	-	-	-	-	-	5
Rp epiph.	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
R diaph.	6	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
Scaphoid	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
MC diaph.	3	15	-	3	1	-	2	-	-	-	1	-	-	-	-	-	25
MCd epiph.	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
PE	-	1	-	2	1	1	-	-	-	-	-	-	-	-	-	-	5
F. diaph.	1	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	3
Patella	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
T diaph.	4	12	-	-	1	-	-	-	-	-	-	-	-	-	-	-	17
Td epiph.	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	2
Calcaneus	1	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	3
Talus	-	-	-	1	1	-	-	-	1	-	-	-	-	-	-	-	3
Cuboid	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
MT diaph.	4	19	-	8	-	1	-	-	-	1	-	-	-	-	-	-	33
MTd epiph.	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	2
MP diaph.	2	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	4
PH I	4	2	-	-	2	2	-	1	-	-	-	-	-	-	-	-	11
PH II	1	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	4
PH III	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
Rib	-	-	-	-	-	-	-	-	-	-	-	2	1	16	3	3	25
Thoracic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
Lumbar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
Vert. indet.	1	1	-	-	-	-	-	-	-	-	-	-	-	7	1	-	10
Long bone indet. diaph.	38	2	9	2	-	-	-	-	-	-	-	-	-	2	-	-	53
Total	82	81	10	24	14	8	4	2	1	4	1	2	1	26	6	3	269
	163		34		22		6					3		32			

Table 3.38. Incidence of burning by taxon and anatomical part in all phases at Argilos (Appendix III: Tables III.6-III.10; NISP)

Key: HC: horncore, MD: mandible, SC: scapula, H: humerus, Hd: humerus distal, R: radius, Rp: radius proximal, MC: metacarpal, MCd: metacarpal distal, PE: pelvis, F: femur, T: tibia, Td: tibia distal, MT: metatarsal, MTd: metatarsal distal, MP: metapodial, PH: phalanx

Fig. 3.63. Chop and burn marks on a nasal bone of cattle (Argilos, Koutloudis sector, Room L1, Phase III), (©A. Gkotsinas)

3.1.2.4. Bones as raw material

Following carcass processing and consumption, some anatomical units were chosen as raw material for artifacts, further contributing to the formation of the deposited assemblage. Such activity is documented by traces of working and usage on bones, teeth, horncores and antlers. In Argilos, evidence for artefactual use of skeletal parts comes from all excavation sectors and habitation phases, from the Archaic to the Classical era. The skeletal parts bearing working traces are horncore of caprines, metacarpal of cattle and dog, talus of caprines and cattle, metatarsal of cattle, donkey and red deer, canine of pig, antler of red deer and a single caprine femur (**Table 3.39**). The selected anatomical units are, with one exception (the femur), non-meat-bearing bones and thus more likely to have been extracted during initial skinning and carcass dressing.[277] According to experimental data and ethnographic observations, the specimens selected for manufacturing must have been retrieved from carcasses as soon after butchery as possible, as fresh skeletal specimens are far easier to work.[278] In the case of red deer antlers, most are shed and were presumably collected from the surrounding landscape shortly after shedding to minimise decay from biotic and abiotic factors; antlers are a source of calcium and thus are frequently consumed by forest rodents or deer themselves. In contrast to the other skeletal parts, antlers must also be soaked in water to soften them, as experimentation and ethnohistorical studies suggest.[279]

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[277] Isaakidou 2003: 234.

[278] Watts 1995: 12; Wescott and Holladay 1995: 16.

[279] Guthrie 1983; MacGregor 1985; Osipowicz 2007; Semenov 1976; Schibler 2001.

Habitation phase	Anatomical unit	Caprines	Cattle	Pig	Donkey	Dog	Red deer	Total (NISP)
I	**Antler**	-	-	-	-	-	1	1
	Total	-	-	-	-	-	1	1
II	**Horncore/Antler**	1	-	-	-	-	1	2
	Talus	4	-	-	-	-	-	4
	Total	5	-	-	-	-	1	6
III	**Horncore/Antler**	2	-	-	-	-	8	10
	Talus	12	2	-	-	-	-	14
	Metatarsal	-	-	-	-	-	2	2
	Total	14	2	-	-	-	10	26
IV	**Horncore/Antler**	2	-	-	-	-	27	29
	Metacarpal	-	-	-	-	1	-	1
	Femur	1	-	-	-	-	-	1
	Talus	12	-	-	-	-	-	12
	Metatarsal	-	2	-	1		1	4
	Total	15	2	-	1	1	28	47
III-IV	**Horncore/Antler**	5	-	-	-	-	4	9
	Lower canine	-	-	1	-	-	-	1
	Metacarpal	-	1	-	-	-	-	1
	Talus	9	2	-	-	-	-	11
	Metatarsal	-	1	-	-	-	2	3
	Total	14	4	1	-	-	6	25
All phases	**Horncore/Antler**	10	-	-	-	-	41	51
	Lower canine	-	-	1	-	-	-	1
	Metacarpal	-	1	-	-	1	-	2
	Femur	1	-	-	-	-	-	1
	Talus	37	4	-	-	-	-	41
	Metatarsal	-	3	-	1	-	5	9
	Total	48	8	1	1	1	46	105

Table 3.39. Incidence of worked bones by taxon and anatomical unit per habitation phases at Argilos (NISP)

Horncores with evidence of working are all from caprines; by-products were found scattered in the SE and Koutloudis sectors, in all habitation phases except the first (above, **Table 3.39**). The horns were removed from the skull by transverse sawing, but too high up the horn core, and arguably too carefully, to have been inflicted in skinning.

Working of metapodials is also indicated by by-products, found in the SE and Koutloudis sectors in deposits of phases III, IV and III-IV (above, **Table 3.39**). These too were sawn transversely

(**Fig. 3.64**); the shape and usage of the finished (and missing) objects are unknown. Metapodials are the only long bones routinely used for manufacturing artifacts and are almost exclusively from large-sized animals, namely cattle, donkey and red deer, although one, displaying a transverse hole at its proximal end, was identified as dog. Metapodials of large animals were probably favoured because they are robust, long and straight and, in the case of large ruminants, because the central groove at the junction of the third and fourth metapodial facilitates longitudinal sawing.

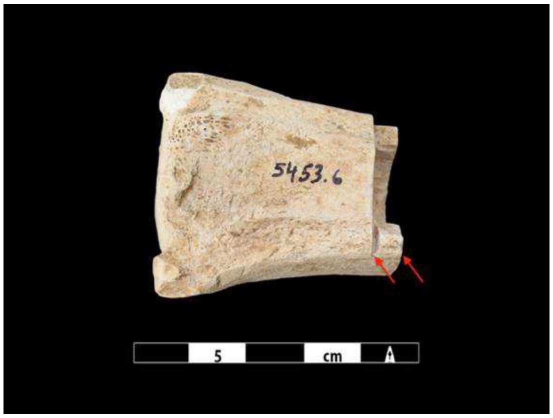

Fig. 3.64. Transverse sawing traces (red arrows) on a proximal right metatarsal of donkey (Argilos, Koutloudis sector, Room L9, Phase IV), (©A. Gkotsinas)

Of the post-cranial specimens bearing working traces, the majority are talus. Tali were frequently chosen as raw materials to serve a variety of functions in the past due to their dense, compact structure and aesthetically-pleasing symmetrical shape.[280] Worked tali were found in all habitation phases apart from Phase I (above, **Table 3.39**) and most are derived from the interior of buildings of the SE sector and, to a lesser extent, from the buildings of the Koutloudis sector. Most of these tali were identified to caprines (NISP 37) and a small number to cattle (NISP 4). Traces of modification are limited to wear, most probably from usage, and the degree of wear ranges from slight to heavy. In the latter case, the outer bone surface has been worn away, exposing the interior sponge (**Fig. 3.65**). Wear traces are localized on the dorsal and plantar side, and in one case, on the lateral and media.

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[280] Brien 1982; Dandoy 2006.

Based on historical sources[281] and vase iconography, worn, worked or unworked tali are usually interpreted as being used in a game akin to the throwing of dice or as religious artifacts, such as divination pieces.[282] However, in the case of Argilos, the high degree of wear on the plantar and dorsal side on most of the tali, would have prevented such usages. According to the most recent interpretations, the worked tali, mostly medio-laterally polished, could have functioned as ceramic burnishers[283] or hide softeners.[284] This could also be the case for the tali from Argilos with dorsal-plantar polish. Furthermore, the existence of a transverse hole in two tali, one of caprines and one of cattle (**Fig. 3.66**), suggests that they may have been suspended. Drilled and flattened tali could have been used as amulets,[285] however in Argilos the two drilled tali are not flattened and they don't bear any further modifications. Finally, traces of iron attached to the dorsal side of a caprine talus, where a natural dent exists, are also notable.

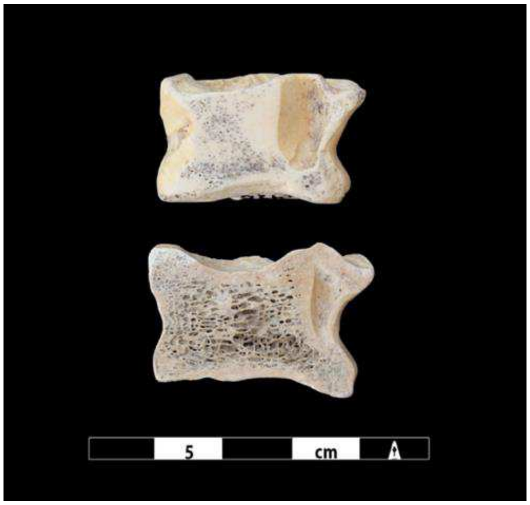

Fig. 3.65. Light (top) and heavy (bottom) wear on the plantar side of caprine tali (Argilos, SE sector, Building F, Phase III), (©A. Gkotsinas)

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[281] E.g., Herodotus, The Histories, Book I: 94.
[282] Reese 2000.
[283] Choyke and Bartosiewicz 2009; Meier 2013.
[284] Bejenaru et al. 2010.
[285] Dandoy 2006.

Fig. 3.66. Transverse hole (dorsal-plantar) on a right talus of cattle (Argilos, SE sector, Building F, Phase III), (©A. Gkotsinas)

In regard to pig canines, only a single worked specimen from a male animal was found, which could also belong to a young wild boar. The specimen derived from Room L5 of Building L in the Koutloudis sector, dated to Phase III-IV (above, **Table 3.39**). Its tips were perforated, with the location of the transverse holes at the proximal and distal end and the size of the tusk suggesting that it may have been part of a bracelet, in which case the surviving tusk would be the mirror image of a second one belonging to the same animal. The two tusks may have been connected at their ends, where the transverse holes were drilled (**Fig. 3.67**).

Fig. 3.67. Male pig tusk with perforated tips (red arrows), and the design representation of a bracelet (Argilos, Koutloudis sector, Room L5, Phase III-IV), (©A. Gkotsinas)

Red deer antlers are present in all phases (above, **Table 3.39**), as debitage from antler-working. Most are derived from the Koutloudis sector, where their largest concentration (NISP 16) was in Room L8 of Building L. Microscopic analysis detected four types of cuts: chopping, peeling, transverse sawing and longitudinal sawing. Chopping was used in the case of hunted deer, to remove the antlers from the skull. The function of peeling (**Fig. 3.68**) was to smooth the outer, naturally rough, surface of the antler and to determine the shape of the future product. Both transverse and longitudinal sawing was used to remove the peeled sections and to extract bars (cf. *baguettes*) and plates (**Fig. 3.69)**. On one tine fragment, the presence of a transverse hole suggests that this was an unfinished object (**Fig. 3.70**). It is not clear whether the antler fragments from the SE and Koutloudis sectors were discarded from a single main workshop or from multiple small-scale workshops. The latter could be the case for the specimens found in Room L8. [286]

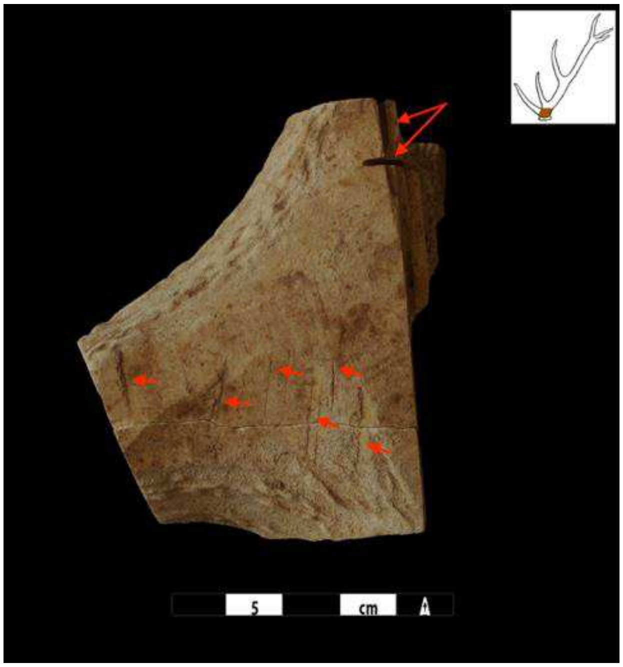

Fig. 3.68. Peeled surface and sawing marks (red arrows) on the lower beam of a red deer antler (Argilos, Koutloudis sector, Room L8, Phase IV), (Gkotsinas and Gardeisen 2021: 250, Fig. 6)

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[286] Gkotsinas and Gardeisen 2021.

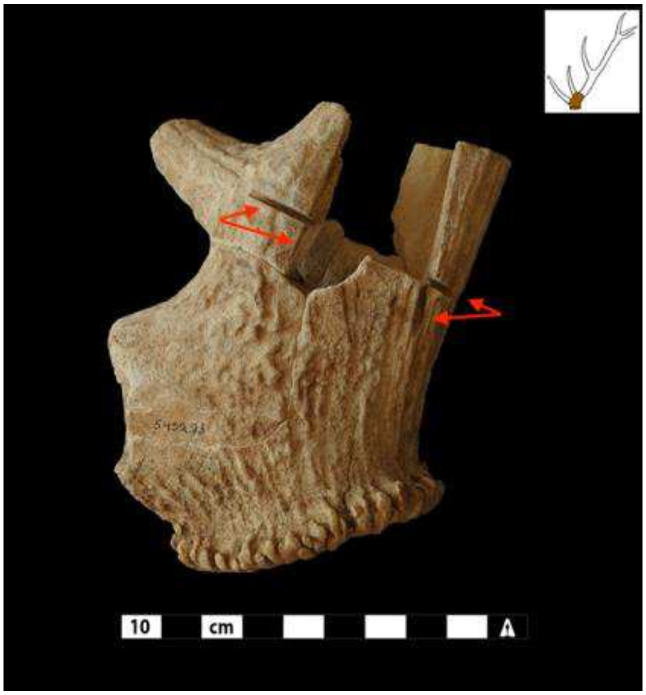

Fig. 3.69. Traces of transverse and longitudinal sawing on the lateral side of a left basal fragment (red arrows) of a red deer antler (Argilos, Koutloudis sector, RoomL8, Phase IV), (Gkotsinas and Gardeisen 2021: 251, Fig. 13)

Fig. 3.70. Tine fragment of a red deer antler with transverse hole (red arrow), (Argilos, Koutloudis sector, Room L8, Phase IV), (Gkotsinas and Gardeisen 2021: 251, Fig. 14)

In regard to finished objects made of bones and antlers, only a small number were discovered in all three sectors, dated mostly to the third and fourth habitation phases (15 objects). This small sample is represented mainly by rings, styluses, spindle whorls (**Fig. 3.71**) and decorated plate fragments (**Fig. 3.72**). In relation to the origins of these artifacts, the presence of working by-products in Argilos suggests that manufacturing activity implying that these objects could have been produced by local workshops.

Fig. 3.71. Spindle whorls made of bone (Argilos, SE sector, Building F, Phase II), (©A. Gkotsinas)

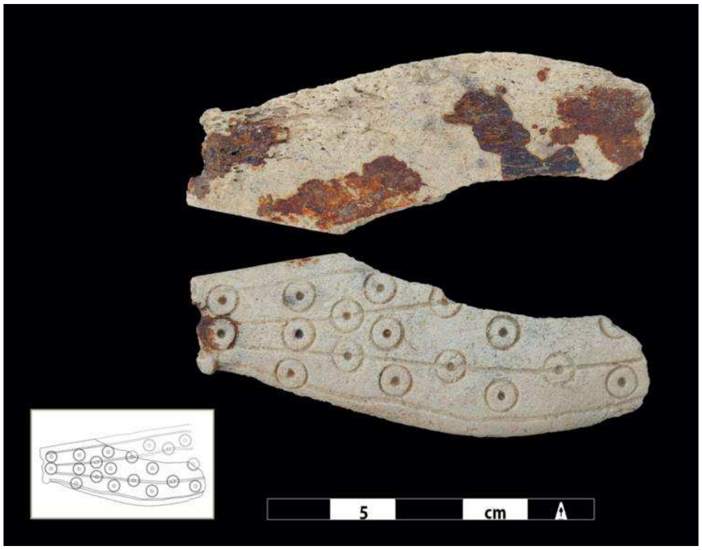

Fig. 3.72. Front and back side of a decorated plate fragment made of red deer antler. The plate was attached to an iron object (Argilos, SE sector, Building F, Phase III-IV), (©A. Gkotsinas)

Conclusions

In Argilos, a few by-products of working skeletal material were found, with shed antlers of red deer and tali of caprines preferred as raw material. Most of the discarded by-products of working are from the SE and Koutloudis sectors and phases II, III, IV and III-IV, while those from Phase I are sparse. Given that the Phase I faunal assemblage is one of the largest, this perhaps indicates the absence of systematic manufacturing during the first habitation phase, at least in the excavated parts of the site. In relation to the SE and Koutloudis sectors, the small number of discarded by-products could be related to the assemblage being derived – with the possible exception of Room L8 – from a habitation area that was unlikely to receive workshop waste. Although by-products are few and scattered, most refuse from any workshop may have been discarded elsewhere, away from the working and habitation area, so the possibility remains of some form of specialised manufacturing activity in Argilos.

Finished bone or antler artifacts are few, but most were probably small, personal items and were perhaps rarely lost or discarded within the settlement. Overall, bone working seems not to have significantly affected the formation of the deposited assemblage, apart from modification of the talus. In the case of deer antlers, the dominance of shed specimens is an indicator of the systematic exploitation of the surrounding landscape beyond hunting.

3.1.2.5. Mortality patterns and management strategies

The age at death of deadstock (the death assemblage) sheds light on Argilos inhabitants' management strategies for their livestock. These management strategies were geared both to meeting the nutritional needs of Argilos' population and to supporting the broader livestock economy of the city. 'Livestock' in this context refers to the principal productive domesticate species, namely sheep, goat, cattle and pig. To explore their mortality patterns, four complementary sources were considered for each species: (a) the degree of mandibular tooth eruption and wear; (b) the ratio of fused to unfused specimens among postcranial elements at successive fusion stages; (c) the relative proportions of neonatal and post-neonatal postcranial remains; and (d) the ratio of males to females among sexable adult specimens. Due to the high rate of fragmentation of the sample, the use of metrical data for determination of sex was not feasible for cattle and pig. Thus, the metrical data were used for this purpose only in the case of caprines. For these analyses, aged and sexed specimens of sheep, goat, cattle and pig were quantified in terms of MinAU. Because the available data from each habitation phase are meagre, mortality patterns are not tabulated for different spatial contexts and analysis of possible changes between phases can only be attempted with great caution.

3.1.2.5.1. Caprines

The sample sizes for sheep and goat are small. Accordingly, although species-level data are tabulated for aged mandibular teeth, sexed pelves and biometrics, cumulative age curve made only for combined caprines (sheep+goat+sheep/goat). The data for neonatal mortality and the epiphyseal fusion evidence for post-neonatal mortality are tabulated only for combined caprines because neonatal and unfused specimens are difficult to identify to species level.

Based on the dental data summarised in **Table 3.40**, caprines were slaughtered at all age stages between 2-6 months and 6-8 years old, with mortality highest in adults (2+ years) and especially among mature (fourth-sixth year) adults (**Fig. 3.73**). This basic pattern appears to be replicated in all phases and is apparently shared by both species. No dental specimens from the youngest age stage (0-2 months) were recovered, but the modest representation of newborn postcranial specimens (**Table 3.41**) implies that at least some breeding stock were kept in or very close to the settlement. The evidence of epiphyseal fusion (**Table 3.42**) is fairly consistent between phases, given the limitations of sample size, and broadly matches that of dental development (**Fig. 3.74**) in indicating only modest juvenile mortality (ca. 25% in the first two years in all phases). The fusion data contradict the dental evidence, however, in suggesting relatively few deaths among mature adults (only ca. 35% dying in their fourth year or later). This latter discrepancy cannot be attributed to taphonomic biases, given that unfused specimens are more vulnerable than fused to both attrition and partial recovery, which should favour overrepresentation of adults. One possible interpretation of the discrepancy is that heads (including mandibles) of juvenile caprines were selectively discarded outside the settlement (and thus that the epiphyseal fusion data provide more reliable evidence for caprine mortality at Argilos), but it is more likely that large animals (including adult rather than juvenile caprines) would have been slaughtered, and their carcasses then 'dressed', outside the built-up area. Alternatively, if most caprines did indeed die as adults, these adult deaths may well have included a significant proportion of males, while adult males, if kept in large numbers, are likely to have been castrated. Castration, in turn, may delay fusion,[287] exaggerating the proportion of young deaths in epiphyseal fusion data. Consistent with this latter interpretation, the adult sex ratio of Argilos caprines (**Table 3.43**) is close to 3 females: 2 males, implying a high proportion of males, which are identified as sheep. In this case, a marked contrast in adult sex ratio cannot be ruled out between phases I and II (17:2), in which females are overwhelmingly predominant, and phases III and IV (15:16), in which the ratio is even, but small samples demand caution. It may be significant that the speciated male pelves are all of sheep, while female pelves were identified of both species, but the small size of the sample, and especially that of goats, demands caution. Additionally, biometrical data from caprine elements exhibit sexual dimorphism, namely distal scapula, distal humerus, proximal radius and distal metacarpal. This indicates the presence of several larger sheep, which were identified as probable males (**Fig. 3.75, Fig. 3.76, Fig. 3.77** and **Fig. 3.78**), reinforcing the suggestion of a high proportion of males. As with the sexed pelves, however, the goat sample especially is too small to be informative.

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[287] Popkin et al. 2012.

Habitation phase	Stage	Suggested Age (months)[1]	No. of Stages				Total	
			1	2	3	4	MinAU	MinAU %
I	A	0-2	-	-	-	-	-	0.0
	B	2-6	1g	-	-	-	1	2.6
	C	6-12	3g + 1	-	-	-	4	10.5
	D	12-24	1s + 1	-	-	-	2	5.3
	E	24-36	2s + 2g + 1	-	-	-	5	13.2
	F	36-48	6s + 4g + 2	-	-	-	12	31.6
	G	48-72	3s + 1g + 2	1s + 2	-	-	7.6	20.0
	H	72-96	4s + 1g		-	-	6.4	16.8
	I	96-120	-		-	-	-	0.0
	Total		35 (16s + 12g + 7)	3 (1s + 2)	-	-	38	100.0
II	A	0-2	-	-	-	-	-	0.0
	B	2-6	2s	-	-	-	2	16.7
	C	6-12	-	1s	-	-	-	0.0
	D	12-24	1s		-	-	2	16.7
	E	24-36	2g	-	-	-	2	16.7
	F	36-48	2s	-	-	-	2	16.7
	G	48-72	1s + 1	1g	-	-	2.7	22.5
	H	72-96	1		-	-	1.3	10.7
	I	96-120	-	-	-	-	-	0.0
	Total		10 (6s + 2g + 2)	2 (1s + 1g)	-	-	12	100.0
III	A	0-2	-	-	-	-	-	0.0
	B	2-6	1	-	-	-	1	3.3
	C	6-12	-	-	-	-	-	0.0
	D	12-24	3s + 1g + 1	-	-	-	5	16.7
	E	24-36	1s + 2	1	-	-	3.3	11.0
	F	36-48	4s + 2g + 1		-	-	7.7	25.7
	G	48-72	6s + 1g	1g + 2	-	-	9.1	30.3
	H	72-96	1s + 2		-	-	3.9	13.0
	I	96-120	-	-	-	-	-	0.0
	Total		26 (15 + 4 + 7)	4 (1g + 3)	-	-	30	100.0
IV	A	0-2	-	-	-	-	-	0.0
	B	2-6	-	-	-	-	-	0.0
	C	6-12	2s	-	-	-	2	5.4
	D	12-24	1s +1	-	1	-	2.4	6.5
	E	24-36	2s +1	1s		-	3.9	10.5
	F	36-48	2s + 1g + 3		1s	-	7	18.9
	G	48-72	4s + 2g + 5	1s +7		-	18.5	50.0
	H	72-96	1s + 1		-	-	3.2	8.7
	I	96-120	-	-	-	-	-	0.0
	Total		26 (12s + 3g + 11)	9 (2s + 7)	2 (1s + 1)	-	37	100.0
III-IV	A	0-2	-	-	-	-	-	0.0
	B	2-6	-	-	-	-	-	0.0
	C	6-12	-	-	-	-	-	0.0
	D	12-24	-	-	-	-	-	0.0
	E	24-36	2s	-	-	-	2	22.2
	F	36-48	1s + 2g + 2	-	-	-	5	55.6
	G	48-72	1s	1g	-	-	2	22.2
	H	72-96	-		-	-	-	0.0
	I	96-120	-	-	-	-	-	0.0
	Total		8 (4s + 2g + 2)	1 (1g)	-	-	9	100.0

All phases	A	0-2	-	-	-	-	-	0.0
	B	2-6	2s + 1g + 1	-	-	-	4	3.1
	C	6-12	2s + 3g + 1	1s	-	-	6.4	5.1
	D	12-24	6s + 1g + 3		1	-	11	8.7
	E	24-36	7s + 4g + 4	1s + 1		-	16.2	12.9
	F	36-48	15s + 9g + 8		1s	-	33.9	26.9
	G	48-72	15s + 4g + 8	1s + 3g +9		1s + 2	38.8	30.8
	H	72-96	6s + 1g + 4		-		15.7	12.5
	I	96-120	-	-	-		-	0.0
	Total		105 (53s + 23g + 29)	16 (3s + 3g + 10)	2 (1s + 1)	3 (1s + 2)	126	100.0

Table 3.40. Mandibular evidence for mortality of caprines per habitation phase at Argilos (MinAU)

Key: 3s + 1g + 1 = 3 sheep + 1 goat + 1 sheep/goat

[1] After Payne (1987), (see 2.1.2.2; Table 2.6)

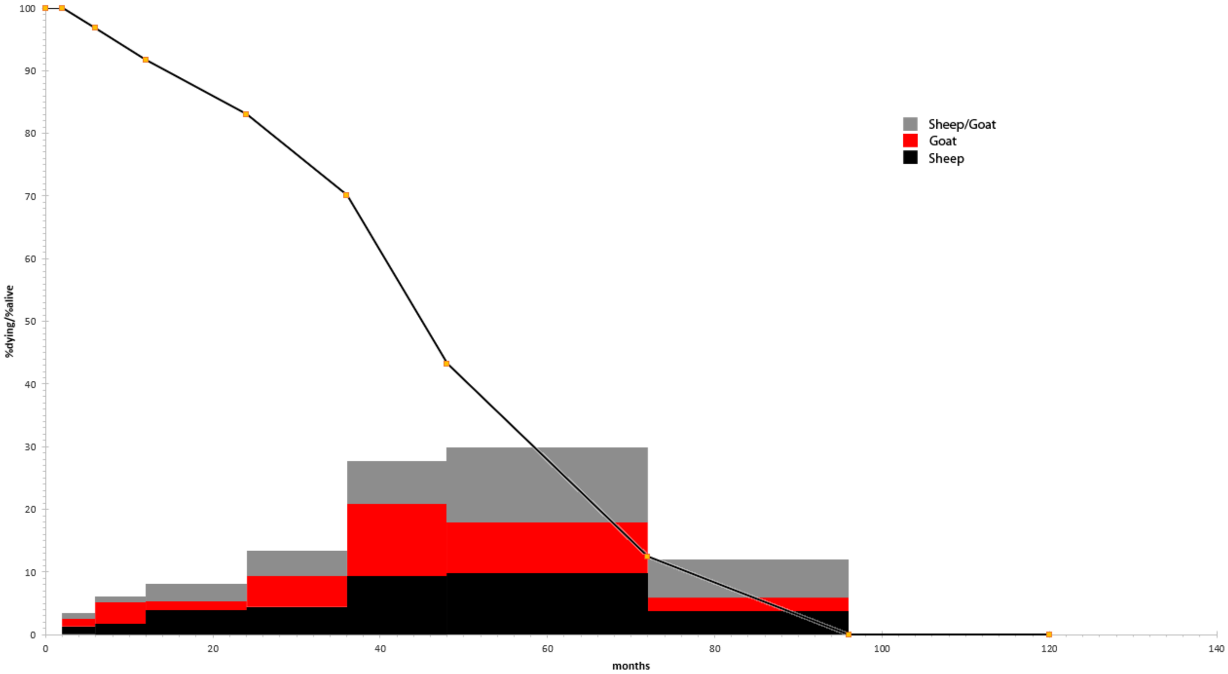

Fig. 3.73. Eruption and wear of mandibular cheek teeth data of caprines (cumulative age curve), sheep, goat, and sheep/goat (histogram) in all habitation phases at Argilos (Table 3.40; MinAU)

Habitation phase	Neonatal		Post-neonatal		Total (MinAU)
	MinAU	MinAU %	MinAU	MinAU %	
I	2	0.4	444	99.6	446
II	1	0.6	173	99.4	174
III	1	0.2	439	99.8	440
IV	4	0.4	952	99.6	956
III-IV	1	0.4	239	99.6	240
All phases	9	0.4	2,247	99.6	2,256

Table 3.41. Representation of neonatal and post-neonatal specimens of caprines per habitation phase at Argilos (MinAU)

Habitation phase	**Fusion Stage** (months)[1]	**Unfused**[2] (MinAU)	**Fused**		**Indeterminate** (MinAU)
			MinAU	MinAU %	
I	6-10	8	50	86.2	57
	13-16	3	20	87.0	10
	18-28	12	27	69.2	38
	30-36	15	12	44.4	51
	36-42	6	2	25.0	73
II	6-10	3	14	82.4	36
	13-16	3	8	72.7	2
	18-28	6	8	57.1	3
	30-36	3	5	62.5	4
	36-42	6	1	14.3	25
III	6-10	8	38	82.6	35
	13-16	4	35	89.7	4
	18-28	13	38	74.5	12
	30-36	14	22	61.1	16
	36-42	12	8	40.0	22
IV	6-10	20	118	85.5	98
	13-16	6	90	93.8	18
	18-28	26	89	77.4	37
	30-36	26	41	61.2	36
	36-42	19	12	38.7	66
III-IV	6-10	7	21	75.0	25
	13-16	-	22	100.0	1
	18-28	7	18	72.0	3
	30-36	8	3	27.3	3
	36-42	7	4	36.4	18
All phases	6-10	46	241	84.0	251
	13-16	16	175	91.6	35
	18-28	64	180	73.8	93
	30-36	66	83	55.7	110
	36-42	50	27	35.1	204

Table 3.42. Epiphyseal fusion evidence for mortality in caprines per habitation phase in Argilos (MinAU)

[1] Following Barone (1986) and Gardeisen (1997), (see 2.1.2.2; Fig. 2.10); [2] Including unfused diaphysis, unfused epiphysis, fusing specimens and specimens of immature size or texture

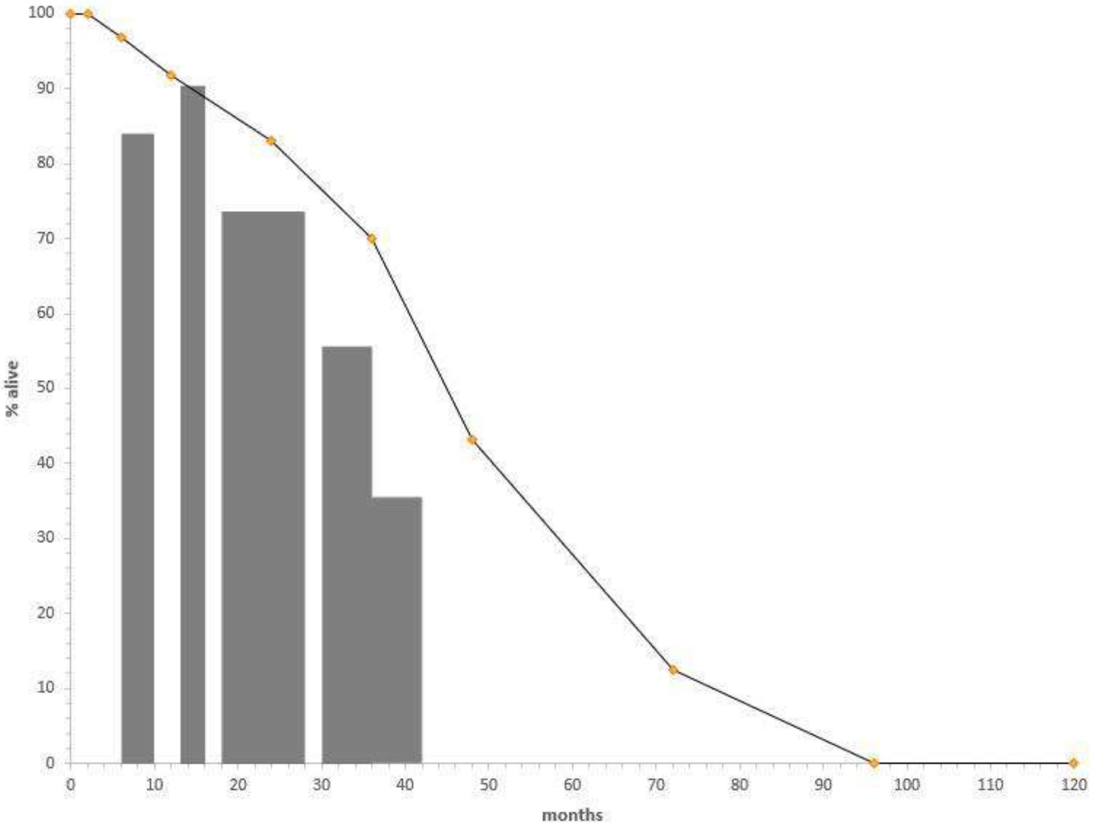

Fig. 3.74. Comparison of wear of mandibular cheek teeth (cumulative age curve) and epiphyseal fusion data (histogram) of caprines in all habitation phases at Argilos (Table 3.40 and Table 3.42; MinAU)

Habitation phase	Female	Male	Indeterminate	Total (MinAU)
I	4s + 2g+ 4	1	5	16
II	2s + 5	1s	2s + 5	15
III	1s + 1	2s + 1	8	13
IV	2s + 1g + 10	5s + 6	2s + 1g + 15	42
III-IV	-	1s + 1	4	6
All phases	32 (9s + 3g + 20)	18 (9s + 9)	42 (4s + 1g + 37)	92

Table 3.43. Evidence of sexed pelves of caprines per habitation phase at Argilos (MinAU)

Key: 4s + 2g + 4 = 4 sheep + 2 goat + 4 sheep/goat

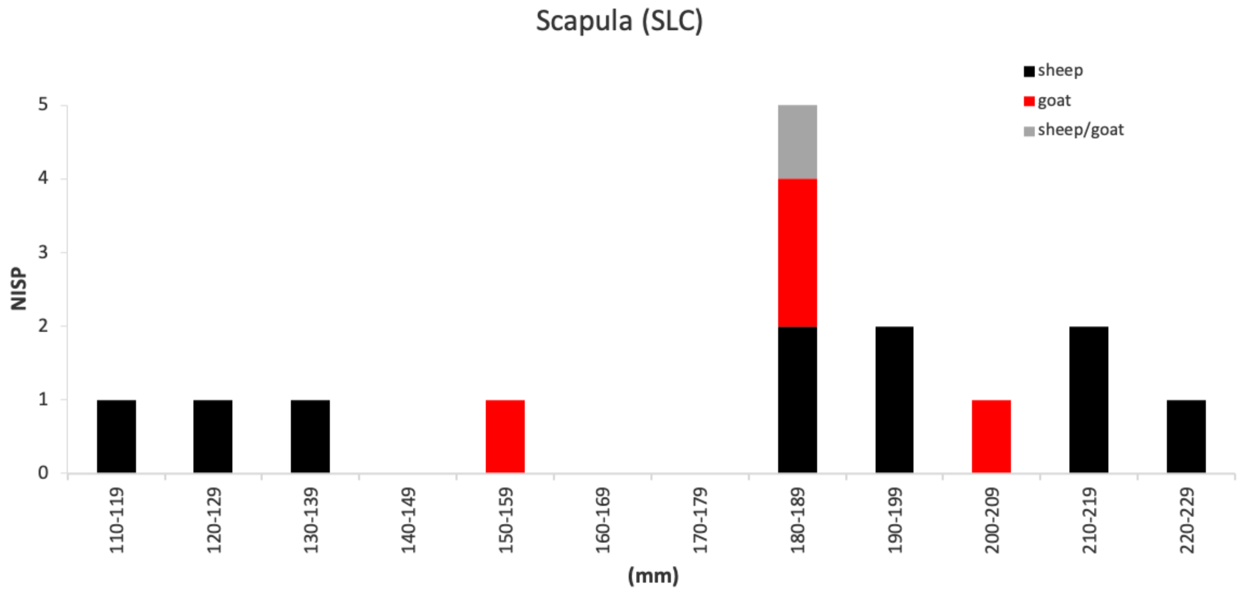

Fig. 3.75. Distribution of scapula SLC measurements in sheep, goat and sheep/goat at Argilos (Appendix II: Tables II.2, II.5 and II.8; NISP 15)

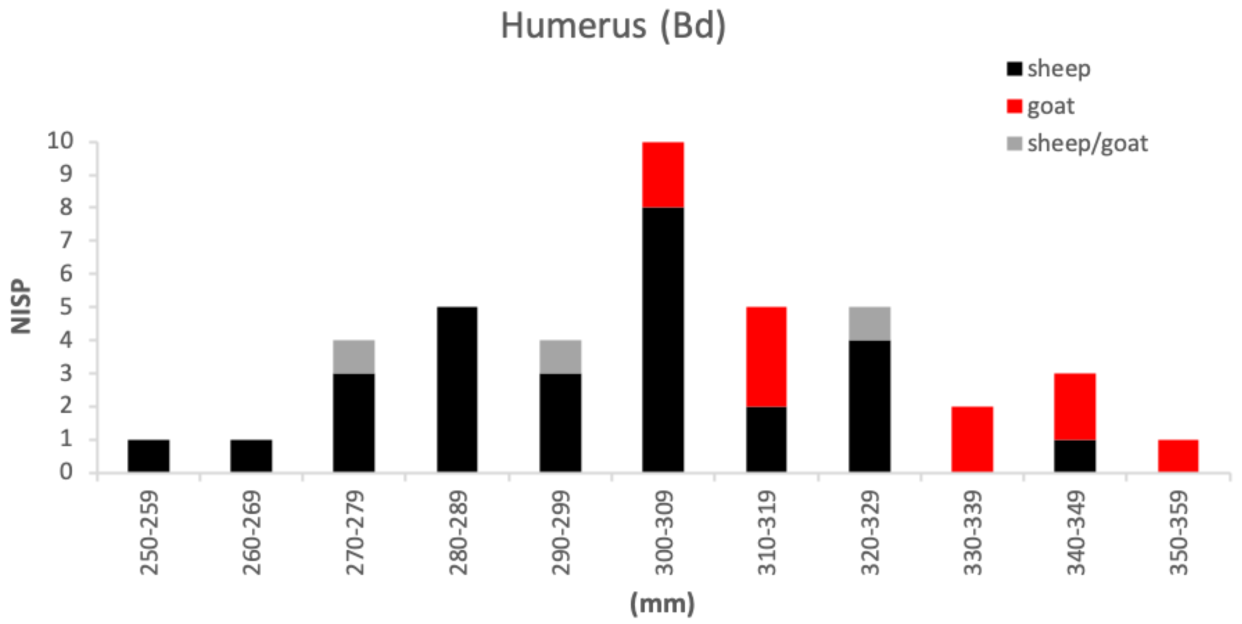

Fig. 3.76. Distribution of humerus Bd measurements in sheep, goat and sheep/goat at Argilos (Appendix II: Tables II.2, II.5 and II.8; NISP 41)

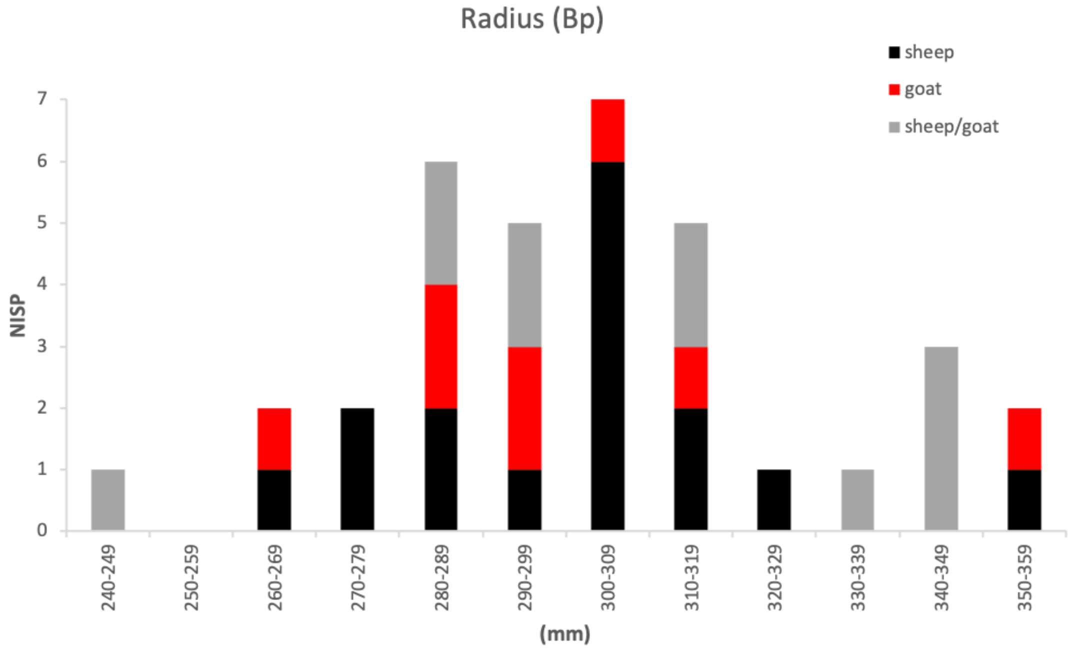

Fig. 3.77. Distribution of radius Bp measurements in sheep, goat and sheep/goat at Argilos (Appendix II: Tables II.2, II.5 and II.8; NISP 35)

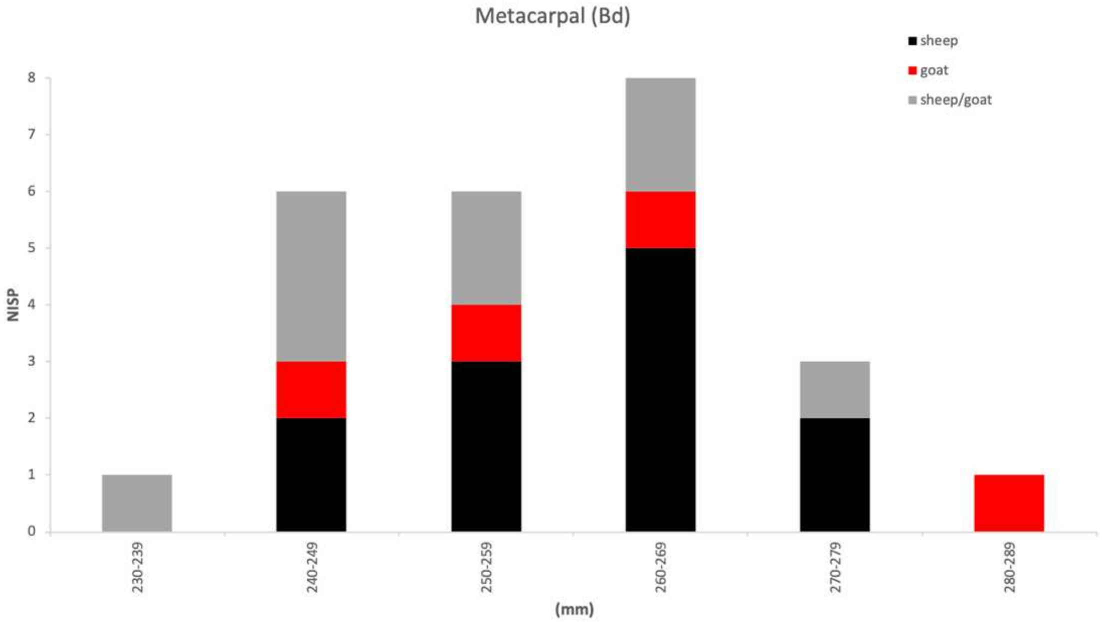

Fig. 3.78. Distribution of metacarpal Bd measurements in sheep, goat and sheep/goat at Argilos (Appendix II: Tables II.2, II.5 and II.8; NISP 25)

Turning to the management priorities of Argilos caprines, the scarcity of neonatal specimens and of mandibles of either species from age stages A or B (0-6 months), when male lambs and kids might be slaughtered to spare milk for human use, suggests that milk production was not a major husbandry goal (**Fig. 3.79**).[288] The predominance of adult deaths, mostly of goat, coupled with the high proportion of adult male sheep (above, **Fig. 3.73**), mostly during the Classical period (phases III, IV, III-IV; above **Table 3.40**), suggests that production of wool and secondarily meat from sheep and of meat from goats were the major goals of caprine husbandry at Argilos. This interpretation is of course dependent on the dental mortality data from Argilos being representative of regional deadstock, rather than of animals sent to Argilos for slaughter from herds reared at other nearby settlements. The recovery of a few neonatal specimens, implying local presence of breeding stock, offers some support for this latter scenario.

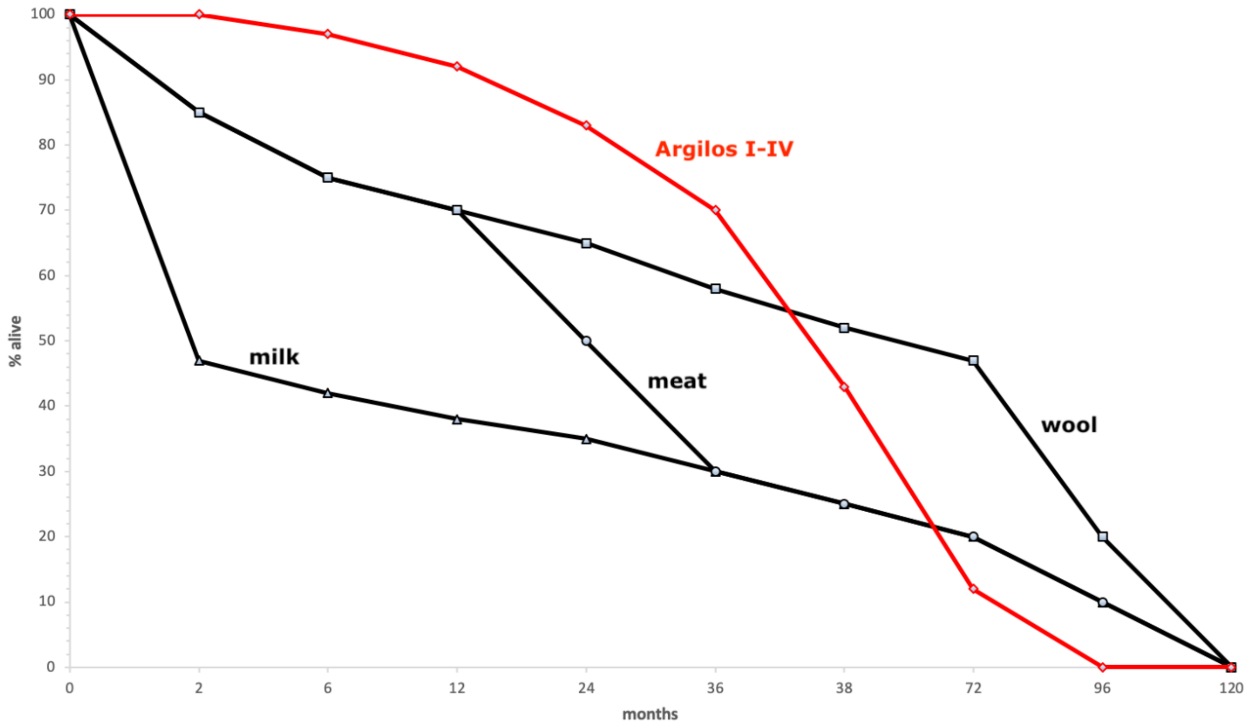

Fig. 3.79. Cumulative age curves based on eruption and wear of mandibular cheek teeth of caprines in all habitation phases at Argilos (Table 3.40; MinAU) compared with Payne's production models (after Payne 1973: 282-284, Figs 1-3)

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[288] Payne 1973: 281-282.

3.1.2.5.2. Cattle

Both the dental and epiphyseal evidence for age at death in cattle is sparse for all habitation phases and thus potentially unreliable. Nonetheless, some tentative observations can be made. Based on mandibular data for all phases combined (the samples for individual phases are too small for comment), cattle were slaughtered from 6-18 months after birth until old age, with mortality highest in adult and senile individuals (**Table 3.44**; **Fig. 3.80**). No dental specimens from the youngest age groups (0-6 months) were recovered, while the presence of one newborn postcranial specimen (**Table 3.45**) implies that at least some breeding stock were kept in or very close to the settlement.

The evidence of epiphyseal fusion (**Table 3.46**) is fairly consistent between phases, given the limitations of sample size, but diverges from the evidence of dental development in suggesting more young deaths (fusion – 44% before 2-3 years of age; teeth – 19% before 30 months) and fewer older deaths (fusion – 40% after 3-4 years of age; teeth – 67% adult-senile; **Fig. 3 81**). This discrepancy cannot easily be attributed to taphonomic biases, given that unfused specimens are more vulnerable than fused to both attrition and partial recovery, which should favour overrepresentation of adults. As with caprines, a possible interpretation is that heads (including mandibles) of younger cattle were selectively discarded outside the settlement or that younger cattle were slaughtered, and their carcasses then ‘dressed’, outside the built-up area, so that the epiphyseal fusion data provide more reliable evidence for cattle mortality in the case of Argilos. It is more usual, however, for larger (and thus older) animals to be slaughtered off-site or for their carcasses to be subject to anatomically selective discard. A further possible interpretation is that the adult and senile cattle represented by mandibles included castrated males, for which castration had delayed epiphyseal fusion and thus caused age at death to be underestimated. The sex ratio (**Table 3.47**) for Argilos cattle is 2 females: 1 male, but based on a sample of only three sexed specimens that is far too small for any reliable conclusions to be drawn.

Habitation phase	Stage	Suggested age (months)[1]	No. of stages		Total (MinAU)
			1	2	
I	A	0-1	-	-	-
	B	1-6	-	-	
	C	6-18	-	-	-
	D	18-30	-	-	-
	E	30-60	-	-	-
	F	young adult	1	-	1
	G	adult	1	-	1
	H	old adult	1	-	1
	I	senile	1	-	1
	Total		4	-	4
II	A	0-1	-	-	-
	B	1-6	-	-	
	C	6-18	1	-	1
	D	18-30	-	-	-
	E	30-60	2	-	2
	F	young adult	-	-	-
	G	adult	1	-	1
	H	old adult	-	-	-
	I	senile	3	-	3
	Total		7	-	7
III	A	0-1	-	-	-
	B	1-6	-	-	-
	C	6-18	-	-	-
	D	18-30	-	-	-
	E	30-60	-	-	-
	F	young adult	-	-	-
	G	adult	3	1	4
	H	old adult	-		-
	I	senile	2	-	2
	Total		5	1	6
IV	A	0-1	-	-	-
	B	1-6	-	-	-
	C	6-18	1	-	1
	D	18-30	3	-	3
	E	30-60	-	1	0.5
	F	young adult	-		0.5
	G	adult	-	-	-
	H	old adult	1	-	1
	I	senile	3	-	3
	Total		8	1	9

III-IV	A	0-1	-	-	-
	B	1-6	-	-	-
	C	6-18	-	-	-
	D	18-30	-	-	-
	E	30-60	-	-	-
	F	young adult	-	-	-
	G	adult	1	-	1
	H	old adult	-	-	-
	I	senile	-	-	-
	Total		1	-	1
All phases	A	0-1	-	-	-
	B	1-6	-	-	-
	C	6-18	2	-	2
	D	18-30	3	-	3
	E	30-60	2	1	2.7
	F	young adult	1		1.3
	G	adult	6	1	6.7
	H	old adult	2		2.3
	I	senile	9	-	9
	Total		25	2	27

Table 3.44. Mandibular evidence for mortality of cattle per habitation phase at Argilos (MinAU)

[1] After Halstead (1985), (see 2.1.2.2; Table 2.6)

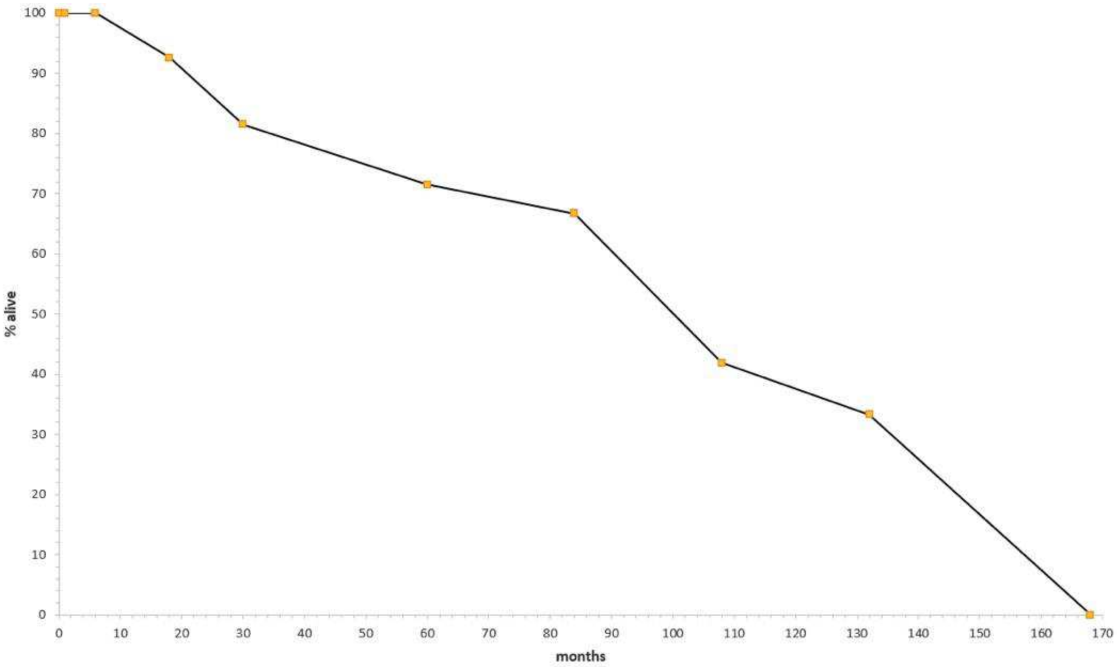

Fig. 3.80. Cumulative age curve based on eruption and wear of mandibular cheek teeth of cattle in all habitation phases at Argilos (Table 3.44; MinAU)

Habitation phase	Neonatal		Post-neonatal		Total (MinAU)
	MinAU	MinAU %	MinAU	MinAU %	
I	-	0.0	106	100.0	106
II	-	0.0	51	100.0	51
III	1	0.8	128	99.2	129
IV	-	0.0	330	100.0	330
III-IV	-	0.0	66	100.0	66
All phases	1	0.1	681	99.9	682

Table 3.45. Representation of neonatal and post-neonatal specimens of cattle per habitation phase at Argilos (MinAU)

Phase	Fusion Stage (months)[1]	Unfused[2] (MinAU)	Fused		Indeterminate (MinAU)
			MinAU	MinAU %	
I	7-10	-	3	100.0	9
	18	2	23	92.0	1
	24-36	1	7	87.5	8
	36-48	3	3	50.0	20
II	7-10	-	1	100.0	4
	18	-	10	100.0	2
	24-36	2	5	71.4	2
	36-48	8	-	0.0	11
III	7-10	-	6	100.0	8
	18	3	15	83.3	4
	24-36	10	3	23.1	4
	36-48	12	3	20.0	17
IV	7-10	1	9	90.0	7
	18	9	65	87.8	24
	24-36	12	18	60.0	8
	36-48	20	23	53.5	51
III-IV	7-10	-	2	100.0	4
	18	-	14	100.0	4
	24-36	4	4	50.0	2
	36-48	3	2	40.0	14
All phases	7-10	1	21	95.5	32
	18	14	127	90.1	35
	24-36	29	37	56.1	24
	36-48	46	31	40.3	113

Table 3.46. Epiphyseal fusion evidence for mortality in cattle per habitation phase at Argilos (MinAU)

[1] Following Barone (1986) and Gardeisen (1997), (see 2.1.2.2; Fig. 2.10); [2] Including unfused diaphysis, unfused epiphysis, fusing specimens and specimens of immature size or texture

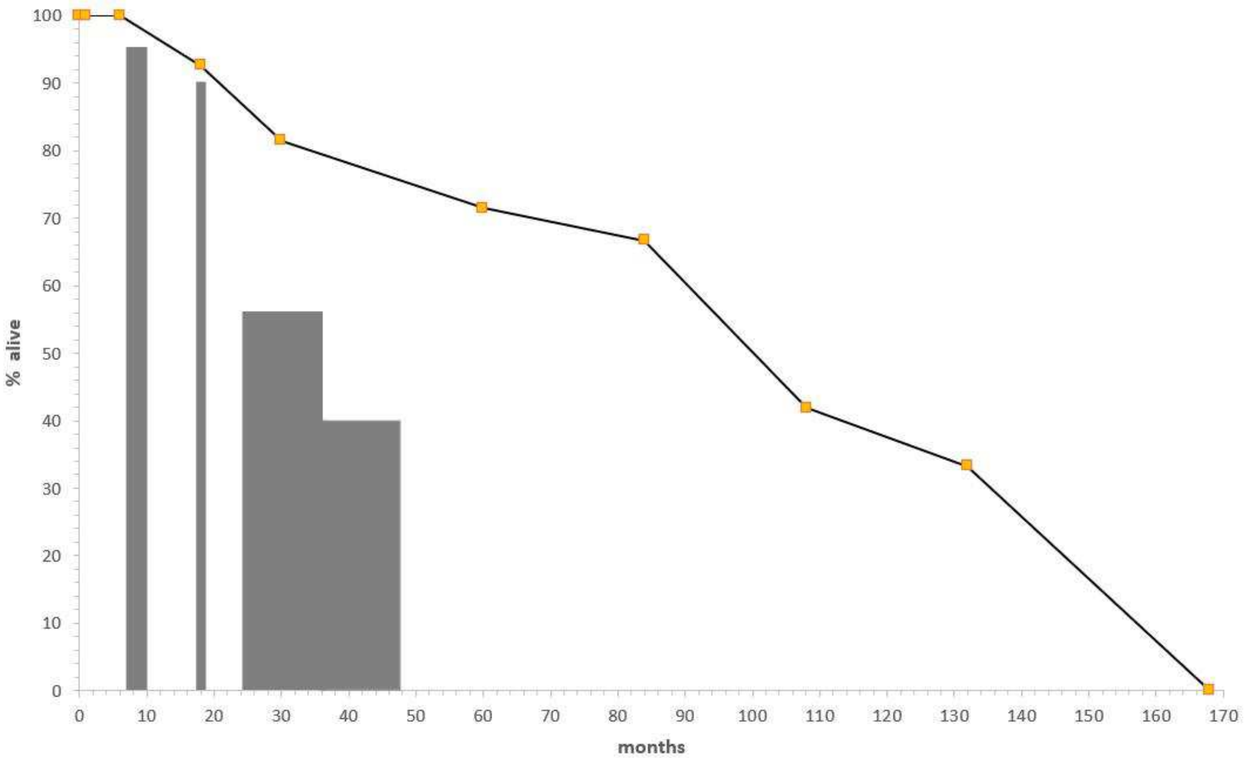

Fig. 3 81. Comparison of wear of mandible cheek teeth (cumulative age curve) and epiphyseal fusion data (histogram) of cattle in all habitation phases at Argilos (Table 3.44 and Table 3.46; MinAU)

Habitation phase	Female	Male	Indeterminate	Total (MinAU)
I	-	-	4	4
II	-	-	-	-
III	-	1	3	4
IV	2	-	9	11
III-IV	-	-	2	2
All phases	2	1	18	21

Table 3.47. Evidence of sexed pelves of cattle per habitation phase at Argilos (MinAU)

In relation to the management priorities of Argilos cattle, the rarity of very young deaths argues against intensive dairying. Thereafter, interpretation depends greatly on whether epiphyseal fusion or dental data are considered more reliable. The frequent juvenile-subadult deaths, implied by epiphyseal fusion, would suggest management for meat production, but not of course if castration of males has delayed epiphyseal fusion and exaggerated the frequency of young deaths. In the latter (arguably more probable) case, the high proportion of adult-senile deaths suggests the use of cattle mainly for breeding (in which case their offspring are missing) or traction. Consistent with the last suggestion is a cattle first phalanx with exostoses from the fourth habitation phase in the Koutloudis sector (below, 3.1.2.6).

3.1.2.5.3. Pig

Based on the dental data summarised in **Table 3.48**, pigs were slaughtered at all age stages, with mortality highest in juveniles (2-12 months) and subadults (1-2 years) – a pattern replicated in all phases (except Phase II with a sample of only two; **Fig. 3.82**). The presence of newborn postcranial specimens (**Table 3.49**) corresponds with the modest dental evidence from the youngest age stage (0-2 months) in implying that breeding stock were kept in or very close to the settlement. The evidence of epiphyseal fusion (**Table 3.50**) is fairly consistent between the phases, with about 60% mortality in the first year and only 6% surviving beyond the fourth year. The fusion data again contradict the dental evidence (**Fig. 3.83**), but in this case in suggesting higher survivorship of third-year pigs (i.e. a partly older cull). This discrepancy obviously cannot be attributed to the effects of castration (and thus delayed fusion) but may be an artefact of the unusually high proportion of immature deaths in pig, with unfused specimens more vulnerable to carnivore attrition (which was particularly high in pigs). In regard to sex, female and male pigs are equally represented (**Table 3.51**), although partial recovery may have inflated the proportion of males.

Turning to the management priorities of Argilos pigs, the mortality evidence indicates that most were killed in the first and second years, a common pattern in this species and related to the very high rate of reproduction. Some of the earliest deaths, within the first two months after birth, could also have been due to natural infant mortality, although cut marks, which might indicate slaughter rather than natural death, are difficult to detect on neonatal specimens. The few oldest animals were presumably breeding adults, although those in their second year could also have bred. Alternatively, slaughter of these subadults, especially if they were not being used for breeding, may have been delayed so that they provided fat as well as meat.

Habitation phase	Stage	Suggested age[1] (months)	No. of stages			Total	
			1	2	3	MinAU	MinAU %
I	A	0-2	2	-	-	2	12.5
	B	2-6	5	1	-	5.8	36.2
	C	6-12	1		-	1.2	7.5
	D	12-24	5	-	-	5	31.2
	E	24-30	1	-	-	1	6.2
	F	>30	1	-	-	1	6.2
	Total		15	1	-	16	100.0
II	A	0-2	-	-	-	-	0.0
	B	2-6	1	-	-	1	50.0
	C	6-12	-	-	-	-	0.0
	D	12-24	-	-	-	-	0.0
	E	24-30	-	-	-	-	0.0
	F	>30	1	-	-	1	50.0
	Total		2	-	-	2	100.0
III	A	0-2	-	-	-	-	0.0
	B	2-6	8	-	-	8	33.3
	C	6-12	6	-	-	6	25.0
	D	12-24	4	-	-	4	16.7
	E	24-30	2	-	-	2	8.3
	F	>30	4	-	-	4	16.7
	Total		24	-	-	24	100.0
IV	A	0-2	2	-	-	2	8.3
	B	2-6	1	-	-	1	4.2
	C	6-12	4	1	-	4.4	18.3
	D	12-24	7		-	7.6	31.7
	E	24-30	4	2	-	5.1	21.2
	F	>30	3		-	3.9	16.2
	Total		21	3	-	24	100.0
III-IV	A	0-2	1	-	-	1	14.3
	B	2-6	2	-	-	2	28.6
	C	6-12	1	-	-	1	14.3
	D	12-24	2	-	-	2	28.6
	E	24-30	1	-	-	1	14.3
	F	>30	-	-	-	-	0.0
	Total		7	-	-	7	100.0
All phases	A	0-2	5	-	-	5	6.8
	B	2-6	17	1	-	17.6	24.1
	C	6-12	12		1	12.8	17.5
	D	12-24	18	-		18.6	25.5
	E	24-30	8	2	-	8.9	12.2
	F	>30	9			10.1	13.8
	Total		69	3	1	73	100.0

Table 3.48. Mandibular evidence for mortality of pig per habitation phase at Argilos (MinAU)

[1] After Halstead (2020), (see 2.1.2.2; Table 2.6)

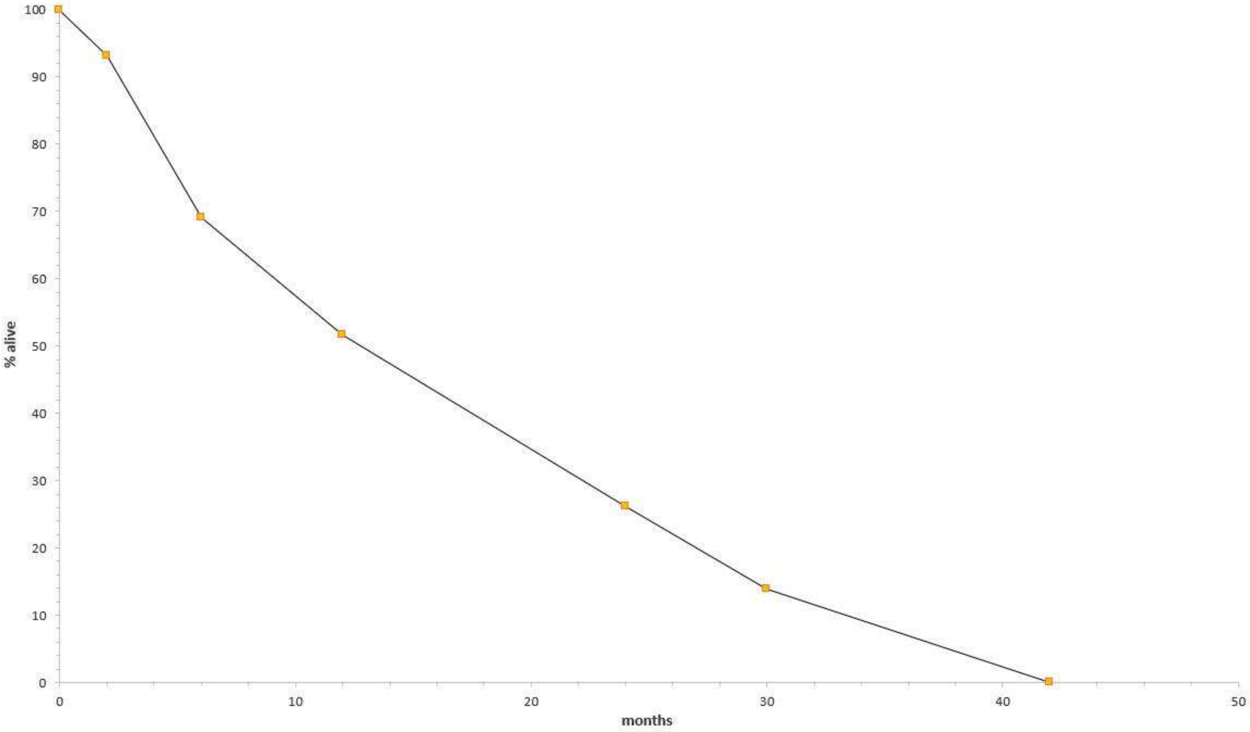

Fig. 3.82. Cumulative age curve based on eruption and wear of mandibular cheek teeth of pig in all habitation phases at Argilos (Table 3.48; MinAU)

Habitation phase	**Neonatal**		**Post-neonatal**		**Total** (MinAU)
	MinAU	MinAU %	MinAU	MinAU %	
I	11	9.8	101	90.2	112
II	6	9.7	56	90.3	62
III	9	6.5	129	93.5	138
IV	30	1.1	235	88.7	265
III-IV	1	1.2	82	98.8	83
All phases	57	8.6	603	91.4	660

Table 3.49. Representation of neonatal and post-neonatal specimens of pig per habitation phase at Argilos (MinAU)

Habitation phase	Fusion Stage[1] (months)	Unfused[2] (MinAU)	Fused		Indeterminate (MinAU)
			MinAU	MinAU %	
I	12	16	11	40.7	22
	24-30	20	19	48.7	5
	36-42	13	1	7.1	16
II	12	6	6	50.0	5
	24-30	9	7	43.8	2
	36-42	6	-	0.0	6
III	12	15	11	42.3	4
	24-30	19	14	42.4	3
	36-42	14	2	12.5	12
IV	12	30	22	42.3	16
	24-30	46	20	30.3	7
	36-42	36	2	5.3	21
III-IV	12	9	5	35.7	5
	24-30	24	7	22.6	4
	36-42	4	-	0.0	10
All phases	12	76	55	42.0	52
	24-30	118	67	36.2	21
	36-42	73	5	6.4	65

Table 3.50. Epiphyseal fusion evidence for mortality in pig per habitation phase at Argilos (MinAU)

[1] Following Barone (1986) and Gardeisen (1997), (see 2.1.2.2; Fig. 2.10); [2] Including unfused diaphysis, unfused epiphysis, fusing specimens and specimens of immature size or texture

Habitation phase	Female	Male	Indeterminate	Total (MinAU)
I	8	4	7	19
II	-	2	1	3
III	2	4	-	6
IV	4	5	4	13
III-IV	1	1	1	3
All phases	15	16	13	44

Table 3.51. Evidence of sexed mandibular canines of pig per habitation phase at Argilos (MinAU)

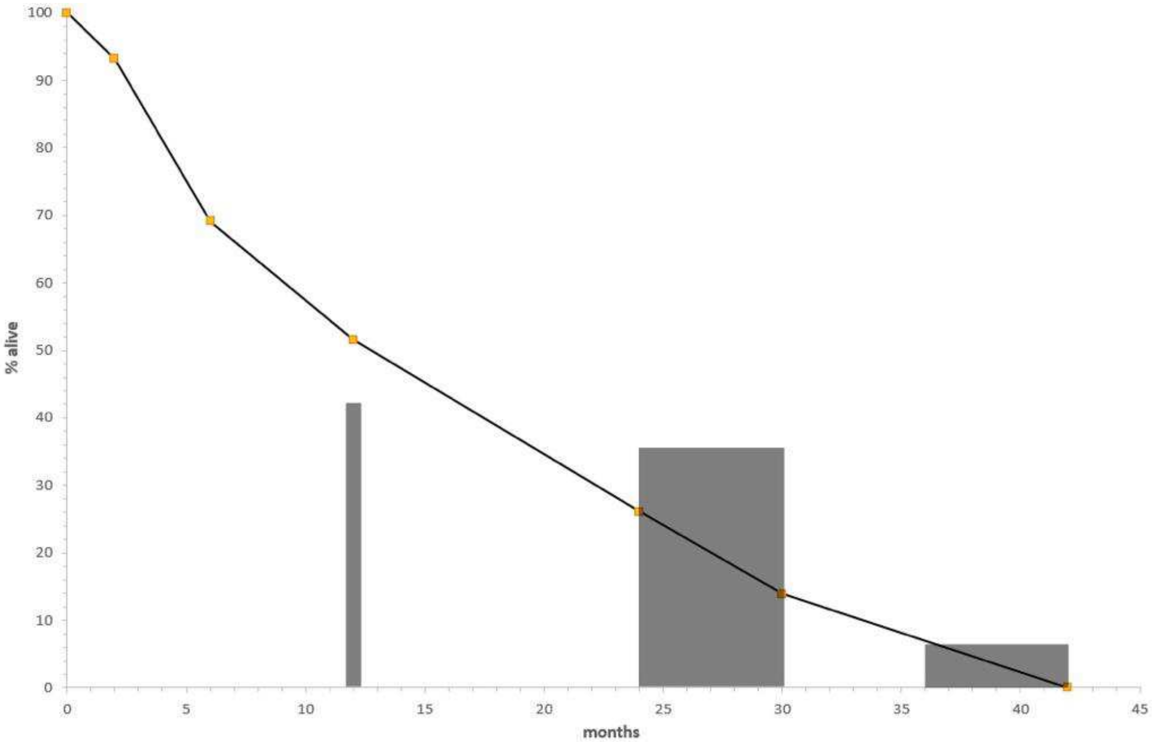

Fig. 3.83. Comparison of wear of mandible cheek teeth and epiphyseal fusion data (fused bones) of pig in all habitation phases in Argilos (Table 3.48 and Table 3.50; MinAU)

Conclusion

In summary, according to the available data, caprines apparently represent locally reared stock which were exploited mostly for wool (sheep) and meat (goats), with no evidence for milking although this resource is unlikely to have been ignored altogether. This pattern seems to be common in all habitation phases, with wool exploitation perhaps being more intensive during the Classical period. Cattle seemed to have been kept mostly for breeding and also probably traction. The scarcity of the available evidence does not allow any firm conclusions regarding differences between habitation phases. Finally, pigs were consumed mostly in the first and second years in all four phases, and were perhaps exploited for their fat as well as meat. Given the scarce data for the age and sex profile of the deadstock of the four productive domestic species, these conclusions regarding husbandry priorities must be regarded as tentative.

3.1.2.6. Living conditions

In regard to the animals' living conditions, 26 pathological cases were recorded from across the habitation phases in the domestic animals, caprines, cattle, pig, dog and donkey (**Table 3.52**).[289] These cases related to diseases in long bones, digits, tarsals and teeth, as well as skeletal wounds in scapula, metatarsal and ribs. The development of dental pathology (**Fig. 3.84**) is caused by the food consumed, the ingestion of minerals or particles from the substrate grazed and the oral environment of the animal.[290] The bone diseases are mostly related to osteophytes (**Fig. 3.85**), while the bones with skeletal wounds bear calluses, which are masses of bone tissue, usually of woven bone, formed in response to a need to support the bone or joint, for example, after a fracture (**Fig. 3.86**). Moreover, there is one case of exostoses in a cattle first phalanx due to mechanical pressure imposed by humans.[291] This specimen exhibits extension of the proximal articular surface, a modification typical of joints subjected to heavy stress, such as pulling an ard or plough.[292]

	Caprines	**Cattle**	**Pig**	**Dog**	**Donkey**	**Medium**	**Large sized**	**Total** (NISP)
Mandible	-	-	-	1	-	-	-	1
Mandibular teeth	-	4	-	-	-	-	-	4
Scapula	-	-	1	-	-	-	-	1
Radius	1	-	-	-	-	-	-	1
Metacarpal	-	-	1	3	-	-	-	4
Tibia	1	-	-	-	-	-	-	1
Calcaneus	1	-	-	-	-	-	-	1
Metatarsal	-	-	1	-	-	-	-	1
Phalanx I	3	1	-	-	-	-	-	4
Phalanx II	2	-	-	-	1	-	-	3
Rib	1	1	-	-	-	1	2	5
Total	9	6	3	4	1	1	2	26

Table 3.52. Pathological evidence by taxon and anatomical part in all habitation phases at Argilos (NISP)

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[289] Baker and Brothwell 1980.
[290] Davies 2005.
[291] Baker and Brothwell 1980: 115.
[292] Bartosiewicz et al 1997: 50-55.

The small number of alterations in bone and teeth suggest that in terms of diet and herd management strategies, the life assemblage was generally healthy and any effects on the animals' physiology due to human treatment was limited.

Fig. 3.84. Alterations on a cattle incisor (Argilos, Koutloudis sector, Room L1, Phase III), (©A. Gkotsinas)

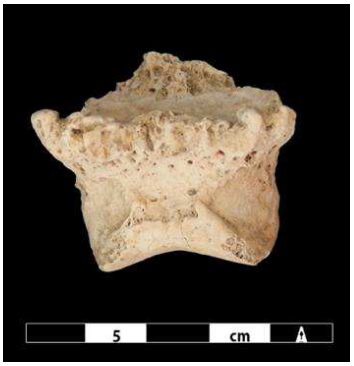

Fig. 3.85. Pathological traces on a donkey second phalanx (Argilos, SE sector, Phase II), (©A. Gkotsinas)

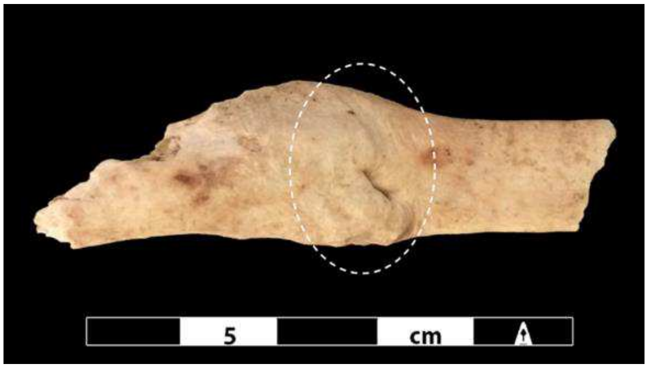

Fig. 3.86. Callus on a caprine rib (Argilos, NR sector, Phase I), (©A. Gkotsinas)

3.1.3. Synthesis

The city of Argilos on the Strymonic Gulf was occupied from the middle of the 7th to the end of the 3rd c. BC. The zooarchaeological investigation focused on the faunal assemblage from the SE, Koutloudis and National Road sectors in the first four habitation phases, covering the period from the Archaic to the Classical era. The assemblage is derived from 1,045 stratigraphic units and includes 18,549 specimens, of which 12,748 NISP (4,088 MinAU) were identified to the level of species, genus, subfamily, class and mammal size category. The sample assemblage has been affected significantly by pre- and post-depositional taphonomic factors, namely retrieval and excavation method, environmental factors and carcass processing.

Zooarchaeological analysis showed that the death assemblage was composed of both domestic and wild fauna. The former includes seven species, namely sheep, goat, cattle, pig, dog, donkey and horse, while some unspeciated bird specimens probably belong to chicken. Sheep and goat predominate in all phases, with sheep in higher proportions than goat. Sheep seem to have been exploited mainly for wool and goats for meat, with no evidence of intensive dairying. These patterns of exploitation seem fairly constant between phases although wool production may have been more intensive during the Classical period (later phases). Cattle, except during Phase IV, is the third most abundant species and was mainly exploited for meat production and traction. The last of the productive animals, pig, is the second most abundant species in most periods apart from Phase III, when it is third, behind cattle. Pig was bred mainly for meat, although fat might also have been a priority.

The post-slaughter carcass processing practices reveal common consumption patterns in all four productive species and in all habitation phases. The similarities suggest that the butchery and cooking techniques were probably alike for both medium (e.g. sheep) and large (e.g. cattle) carcasses. In regard to cooking techniques, roasting over an open fire was practiced occasionally. The carcass was sometimes roasted piecemeal (e.g. cattle) and sometimes whole (e.g. pig), perhaps on a spit. Apart from meat, marrow was systematically extracted in all four phases, and most heavily so in the case of cattle.

In relation to the other domestic animals, dog is consistently present in all phases, whether for herding and guarding, as a hunting companion or as a pet. The presence of dog is documented by bone remains of this species, but also by gnawing marks on bone surfaces and by some digested specimens. Dog bones were found alongside those of the other consumed animals, and some of them bear traces of cut marks and burning, suggesting cooking and consumption. The dog remains are few, so its consumption was on a small scale, but whether it occurred in the context of special events, or perhaps as a response to scarcity of food, is unknown. The representation of equids in the assemblage is fairly scarce. Donkey is present in all phases, while horse appears only in phases III and IV. Donkeys may primarily have been used for menial tasks (e.g. transportation, agricultural work) and horses perhaps in hunting, but there is no zooarchaeological evidence from Argilos to support these speculations. Like dog, equid bones were found among those of the common consumed species. Some bear cut marks, and donkey also bears cooking traces, both suggesting consumption. The flesh of equids was thus apparently considered edible, but their low representation in the assemblage suggests only occasional consumption.

In regard to the wild fauna, seven species of terrestrial mammals, namely red, roe and fallow deer, hare, boar, wolf and red fox and one species of reptile (tortoise) were identified. The list was completed by the presence of aquatic fauna, which includes both shellfish and salt- and freshwater fish. The variety of species in the assemblage indicates that the habitants of Argilos had access to surrounding natural resources. The terrestrial wild mammals are represented mostly by deer, hare and boar. Red deer was the main game species present in all phases and seems to have been hunted more extensively during Classical times, when the presence of horse may be associated with an increase in hunting. After hunting, the carcass seems to have been brought inside the settlement intact, where butchery and cooking took place. The small proportion of game species suggests that meat from the four main domestic species was relatively plentiful. Red fox and wolf, although the latter at least was apparently consumed, may have been killed for their fur or in defence of livestock, while the pursuit especially of large animals, such as red deer and boar, may have been undertaken as a display of status rather than for the procurement of practical resources.

The collecting of shed deer antlers was a further aspect of natural resource exploitation. Shed antlers were used as raw material for craftwork in Argilos. One possible workshop was revealed in Room L8 of the Koutloudis sector and was in use during the Late Classical period (Phase IV). Apart from antlers, bones and teeth from both domestic and wild species were used for making objects, although on a small scale. Additionally, although not detectable archaeologically, some of the identified taxa, including birds and tortoise, could have also been exploited for their skin, feathers, gelatine and perhaps keratin.

The animal bone remains found in all three sectors constituted part of the city's food waste. They were found inside the city grid, in both interior and exterior areas of the buildings, in all the habitation phases. The bones found inside the buildings were probably included in the fills of the floors made and repaired during different periods of the rooms' usage. These are mostly small and fragmented specimens although some also bear gnawing and weathering marks, indications of their initial depositional environment. However, some rooms might have been abandoned temporarily and turned into a refuse repository. That was probably the case for rooms L1 and H12 in the Koutloudis sector during the Classical period.

Apart from the abandoned rooms, roads and open-air channels also received waste. Specimens from roads were mostly fragmented, having been exposed to dog gnawing, human trampling and weather conditions. Open-air channels, one in the SE (E-F) and one in the Koutloudis sector (SWH1), received larger amount of wastes and probably functioned as permanent refuse areas. However, large amounts of food waste from the Archaic period were also discarded in a dump revealed in the NR sector. As this dump relates only to the first two phases, it is not clear whether the dumps or the abandoned and unused areas were the main refuse points for Argilos' food waste. It is also possible that some dumping areas received rubbish from household activities and others refuse from public meals discarded in the context of large-scale public events.

Overall, the management of domestic animals, the exploitation of natural resources, cooking practices, and discard behaviour were largely consistent over time.

3.2. Karabournaki

3.2.1. The settlement of Karabournaki

The ancient settlement of Karabournaki is located on the promontory of the same name (*Mikro Karabournou* or *Mikro Emvolo*), on the Thermaic Gulf. It is east of Mount Chortiatis, between the edge of the plain of Thessaloniki to the north (nowadays the modern city of Thessaloniki) and the Anthemous Valley at the southernmost end of the Gulf of Thessaloniki[293] (**Fig. 3.87**).

Fig. 3.87. The location of Karabournaki (©Apple Maps)

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[293] Rey 1927: 48.

3.2.1.1. The historical framework

Many researchers identify the settlement of Karabournaki with ancient Therme[294] in the region of Mygdonia, which gave its name to the gulf, as reported by several ancient writers.[295] Hecataeus of Miletus provided the first record of the city and Herodotus described it as a coastal settlement with its own port. In 480 BC, during the second Persian invasion of Greece, King Xerxes' Persian fleet anchored in Therme's harbour. In 431 BC, during the Peloponnesian War, it was captured by the Athenians, and then, in 429 BC, by the Macedonians under King Perdikkas II.[296] Aischines characterized Therme as a "village" or "town", while Strabo documented that in 316-5 BC, King Cassander of Macedonia founded the city of Thessaloniki by uniting 26 towns located in the Thermaic Gulf and the coastal zone to the west of the Chalkidici peninsula (Krousis region), Therme among them.[297] According to Pliny,[298] after the establishment of the new city, Therme continued to be inhabited, coexisting with Thessaloniki.

During the 20th c. AD, Karabournaki was systematically used as a military base up until 1989. At that time, large scale interventions took place on site, including the demolition, levelling up and erections of buildings and other structures. Furthermore, the core of the ancient settlement was used as an animal cemetery for horses, at first by the Greek Cavalry and then by the Kalamaria Equestrian Club, a practice which continued until 1986.

3.2.1.2. The archaeological research

Archaeological interest in the site commenced in the 19th century, while the first investigations were made during World War I by the allied armies that had camped there.[299] British, French and

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[294] Bakalakis 1953-54: 221-229; 1963: 30-34; 1983: 31-34; Chatziioannou 1985: 73-79; Christianopoulos 1991; Daffa-Nikonanou 1972: 19-23; Dimitsas 1879: 258-268; Romaios 1940: 1-7; Soueref 1997: 407-420; Tiverios 1990: 71-81; 2001: 319-320; Vickers 1972: 156-170; 1981: 327-333; Vokotopoulou 1986: 15-18.

[295] Herodotus VII, 121, 123, 124, 127, 130, 179, 183; Aeschylus II, 27; Thucydides I. 61.2; II. 29.6; Strabo VII. 21; Aeschines 27.

[296] Edson 1947: 88-105.

[297] Cooksey et al. 1918-19: 51-63.

[298] Pliny NH IV 10.

[299] Casson 1916: 293-297; Gardner and Casson 1919: 38-39; Tiverios 2001: 298.

Russian soldiers excavated the periphery of the ancient settlement, revealing 29 burials from the 6th and 5th c. BC. In 1930, I. Papadopoulos executed the first surface survey, and the Aristotle University of Thessaloniki began excavations under Prof. K. Romaios.[300] During the 1950s and 1960s, Konstantinos and Stamatis Tsakos gathered antiquities from the site,[301] and sections were investigated in 1954 due to road (Plastira Street) construction in the area[302] (**Fig. 3.88**). In 1994, the 16th Ephorate of Prehistoric and Classical Antiquities (hereafter 'Ephorate') in collaboration with the Aristotle University began excavations in Karabournaki. The Ephorate was excavating until 1996 on the flat area (trapeza) north of the hill (toumba) and the cemetery found to the east, near the toumba,[303] while the Aristotle University started excavation at the top of the toumba, which is still ongoing.[304] Finally, 39 burials were excavated in 1999 by the Ephorate due to technical works by the Naval Command of Northern Greece and Government House (Palataki; **Fig. 3.88**).[305]

Evidence from small finds, as well as the historical sources, shows the site was continuously used from the 15th c. BC to the 20th c. AD. However, the organized settlement itself appeared in the Late Bronze Age and continued to the Roman era, with its heyday during the Archaic era (7th–6th c. BC).[306] The military use of the site was harmful as the latest habitational layers, at least in some parts of the settlement, were destroyed, while in many places even the earlier, deeper strata were also heavily disturbed.[307]

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[300] Romaios 1941: 358-359.
[301] Skiadas 2009.
[302] Petsas 1967: 303; Tiverios 2001: 299-300.
[303] The excavations were conducted by E. Trakosopoulou and E. Poulaki-Panremarli; Pantermali and Trakosopoulou 1998a: 203; 1998b: 283
[304] The excavations are conducted by Prof. M. Tiverios, Prof. E. Manakidou and Dr. D. Tsiafaki.
[305] Tsimpidou-Avloniti 1999: 532.
[306] Tiverios 2009: 394.
[307] Tiverios 2001: 300.

Fig. 3.88. Karabournaki – general view of the site (©Apple Maps). The locations outlined in yellow are related to the ancient settlement, port and cemetery.

3.2.1.3. Settlement organization

Karabournaki extended over the toumba, approximately 24 m high, found at the southern part of the promontory and initially reached the coast, but is now separated by Plastira Street which runs between the mound and the coast (above, **Fig. 3.88**). The trapeza, north of the toumba, was separated from the toumba by a natural stream, and was also probably part of the ancient settlement[308] (**Fig. 3.89**).

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[308] Pantermali and Trakosopoulou 1998b: 286-287.

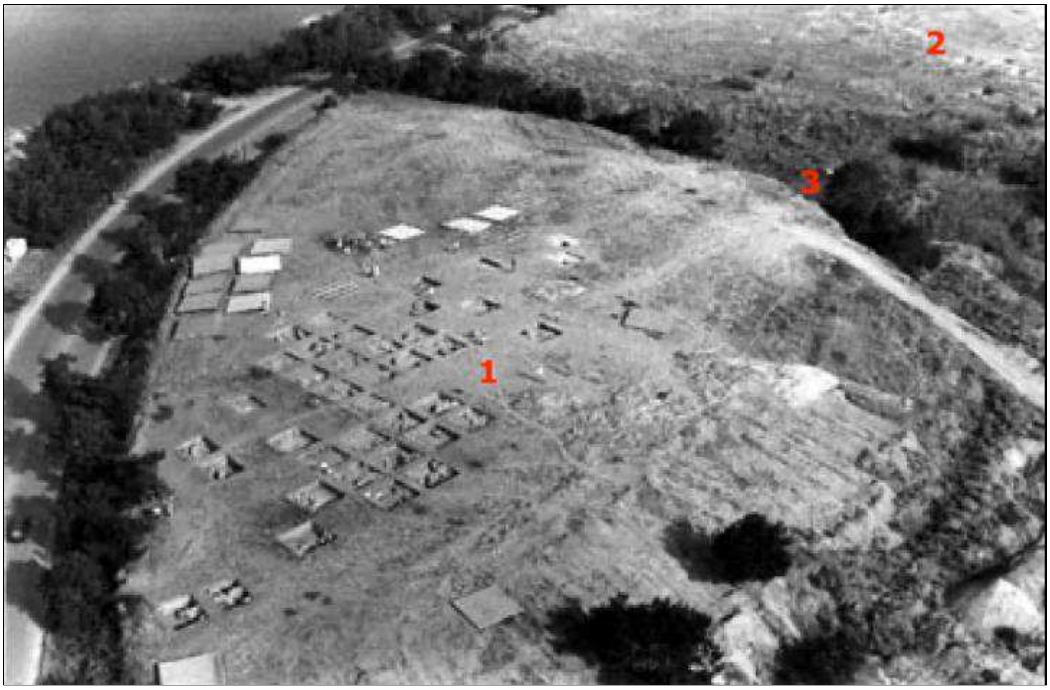

Fig. 3.89. Karabournaki overview – Toumba (No. 1) and Trapeza (No. 2) separated by a natural stream (No. 3) (©http://karabournaki.ipet.gr)

The excavation of the toumba was conducted in four sectors namely 22, 23, 26 and 27 (**Fig. 3.90**). Based on findings to date, the settlement was not fortified, and part of it has been revealed on the top of the toumba (**Fig. 3.91**). The earliest constructions are semi-subterranean, beehive-shaped "argelae", dated from the late 8th and early 7th c. BC[309] and perhaps associated with the tribe of the Vryges (Phrygians).[310] Of maximum diameter 1–2.5 m, their subterranean parts were dug into the natural ground, and the above-ground parts were built with mudbricks.[311] Their initial use has not yet been determined with certainty and they may have been related with domestic and working activities. At a later stage they were used as refuse areas for cultural material (e.g. pottery, loom weights, etc.) and faunal remains.[312] Within the residential area of the settlement are preserved parts of houses (**Fig. 3.90** and **Fig. 3.91**), which for the moment maybe grouped into two phases: the first from around the middle of the 6th c. BC and the second from the early 5th c. BC.[313] Rubble

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[309] Chatzis 2008; 2010: 155-192; 2012; Descamps-Lequime 2002: 108-115; Skiadas 2009; Tsiafaki 2012: 153-161; Tsiafakis 2010: 379-388.

[310] Tiverios et al. 2003: 257.

[311] Tsiafakis 2010; 2013.

[312] Tiverios 2001: 302.

[313] Tsiafakis 2010.

masonry was used for the walls, and the roofs were tiled, often with Laconian-type roof tiles. The structures were built next to each other on a NW–SE orientation. Clay hearths were discovered inside some of them, possibly associated with food production activities, while other internal spaces were used as storage rooms, having been found to contain large storage vessels, pithoi and amphoras.

In addition to residential structures, craft workshops for pottery and metalworking have also been detected.[314] Pebbled alleys have been revealed in various parts of the settlement, made of small pebbles, shells and rubble. A large number of circular pits have also been excavated at the site. They are considered to have been refuse pits as they contained large quantities of broken pottery, and their dating corresponds to that of the rectangular houses (mid-6th–early 5th c. BC), faunal remains, and other cultural material remains.

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[314] Manakidou and Tsiafakis 2017; Tsiafakis and Manakidou 2013.

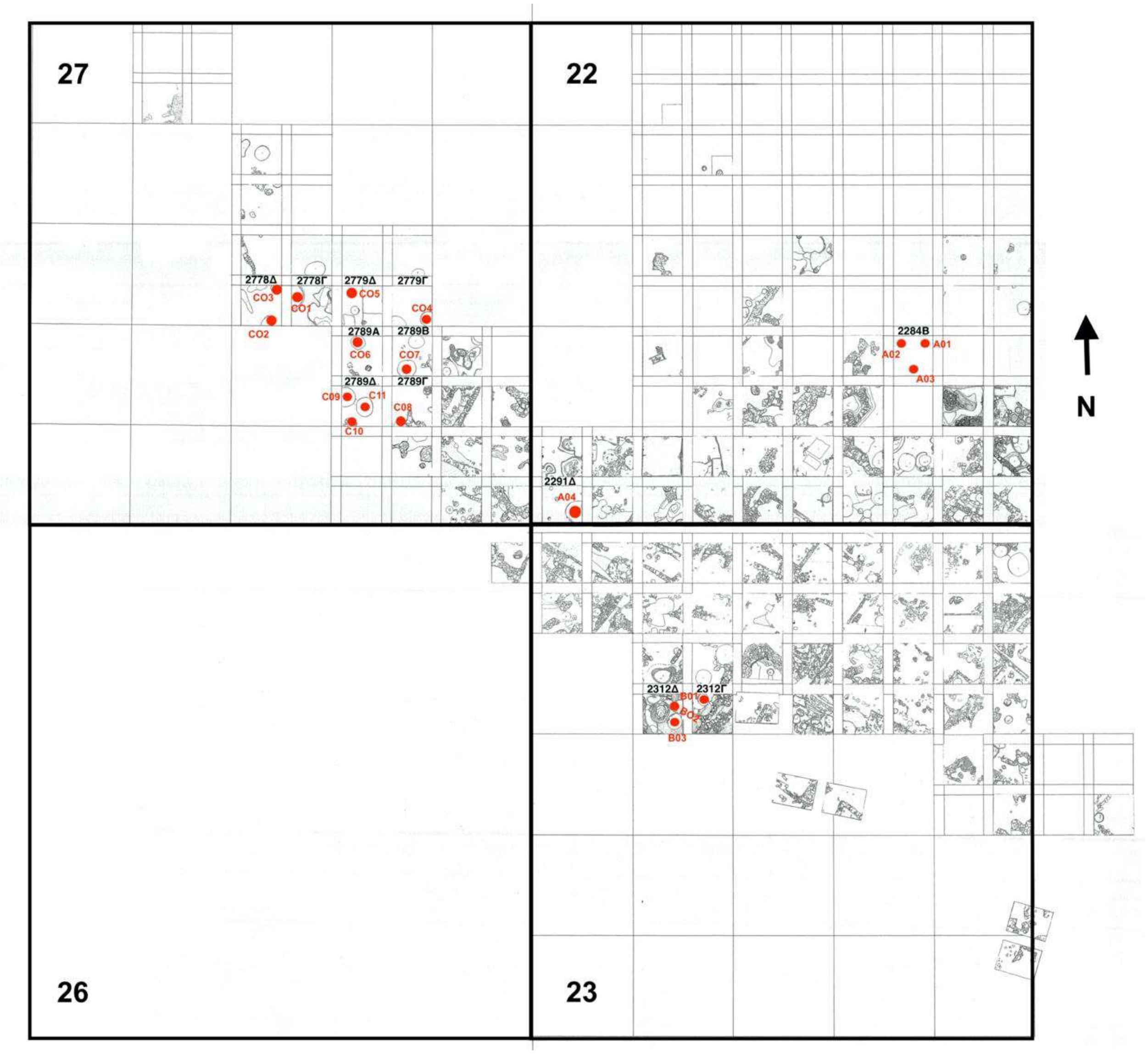

Fig. 3.90. Plan of Karabournaki settlement (toumba); the locations in red are the studied contexts (semi-subterranean structures and pits), (Karabournaki excavation archives)

Fig. 3.91. Karabournaki, part of the excavated settlement (©http://karabournaki.ipet.gr)

The settlement continued south towards the sea, where its harbour was located (above, **Fig. 3.88**). The southern area of the settlement has been destroyed by the modern road, while the harbour and the coastal area of the city have been submerged due to sea-level changes. Traces of the harbour have been revealed directly to the south of Plastira Street,[315] while traces of underwater structures have been observed to the north of the ancient site, under Government House, and were possibly associated with port facilities (above, **Fig. 3.88**).

The harbour would have played a vital role in the city's life and prosperity as it was one of the most important in the Thermaic Gulf. Based on the imported pottery from the cities of Euboea, Attica and Corinth,[316] the Cyclades and eastern Aegean (Thassos, Lesbos, Chios, Samos, Miletus and Clazomenae)[317] found on site, the port had close trade contacts with all major centres of the Aegean world, actively participating in the exchange of agricultural products, such as olive oil and wine[318] since the Geometric era. Moreover, the discovery of Cypriot-Phoenician pottery[319] and

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[315] Tiverios 2001: 299.

[316] Manakidou 2013: 175-187, Tsiafakis et al. 2010.

[317] Tsiafakis 2000: 417-423; Tsiafakis and Manakidou 2013: 73-88.

[318] Filis 2012: 309-320; Liami 2009; Liami et al. 2008; Manakidou 2003: 193-196; 2005: 71-83; 2010: 463-470; Tsiafaki 2012: 160.

[319] Manakidou and Tsiafaki 2012: 147-150; Tiverios et al. 2003: 259.

Carian inscriptions[320] shows that the reach of Karabournaki's port apparently exceeded the borders of the Aegean Sea, and that the city had a cosmopolitan character[321] (**Fig. 3.92**).

Fig. 3.92. Example of ceramic finds from the ancient settlement in Karabournaki (Karabournaki excavation archives)

Finally, the cemetery was located east of the city and in close proximity to it (above, **Fig. 3.88**). Thirty-one burials have been excavated so far, 28 by the Ephorate in 1994 and three by British troops during World War I, dating from the 6th and 5th c. BC.[322] The cemetery is estimated to have covered an area of approximately 10 hectares.[323] It does not display any strict organization or unified pattern. The orientation of the graves varies, and they are placed in groups around smaller nuclei of burials.[324] Burials were also found in various other spots to the NW of the site: 65 graves in total, dating from the Iron Age to the 5th c. BC, 39 excavated during technical works by M. Tsimpidou and 26 by French troops during World War I. Finally, six burials, along with 97 refuse

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[320] Adiego et al. 2012: 195-202; Tiverios et al. 2010: 388; Tzanavari and Christidis 1995: 13-17.

[321] Dupont 1982: 193-208.

[322] Descamps-Lequime and Charatzopoulou 2011a: 105-132.

[323] Panti 2008.

[324] Pantermali and Trakosopoulou 1998a: 205.

pits, were found to the SE of the settlement. These burials date to the 6th and 5th c. BC, while the pits span the Early Iron Age to the 5th c. BC.[325]

3.2.2. The zooarchaeological study

The zooarchaeological remains from Karabournaki include both terrestrial and aquatic faunal remains. The latter, numerically dominant in the faunal assemblage and including salt- and freshwater fish and shellfish,[326] are not included in this study. Thus, the present study concerns only the terrestrial faunal remains derived from 18 refuse areas, which were in use from the 8th c. BC to the 3rd quarter of the 5th c. BC (above, **Fig. 3.90**; the studied areas are highlighted in red). These refuse areas correspond to only 89 stratigraphic units of the 1,464 excavated during 1994-2016 excavation seasons. These were chosen because at the time of my study: the dating documentation of the rest of the stratigraphic units was not complete, the study of the site was in progress (and is still ongoing) and secure chronological data could only be provided for these 18 refuse areas. Thus, for the purposes of this study, it was decided to only include these 18 particular contexts. The study investigates the composition of the assemblage of each depositional context regarding species representation and pre- and post-depositional traces to discover the origins of the discarded material and to explore animal management and the exploitation of natural resources. However, due to the sample size, the lack of closed contexts and the wide chronological range both within and between most of the contexts, the analysis considers the contents of each pit and structure to be from the Early Iron Age to Classical era. Thus, any assumptions drawn from the assemblage are oriented to enlightening the reconstruction of bone deposition processes and animal management practices overall, for all contexts and time periods.

The sections below describe the assemblage, from the study sample assemblage to the death assemblage, in the same order as that used to describe the formation processes of the Argilos material: the size of the assemblage and species composition; taphonomy in relation to the factors that form the sample and faunal assemblage; carcass processing and discard management; and

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[325] Pantermali and Trakosopoulou 1998b: 287-288.

[326] Tiverios et al 2013.

mortality patterns and animal management strategies. The final section summarizes the information and discusses the management of domestic and wild animals, consumption practices and discard strategies in Karabournaki from the 8th c. BC to the 3rd quarter of the 5th c. BC.

3.2.2.1. The assemblage and species representation

The overall assemblage comprised 1,973 specimens of which 1,614 NISP (592 MinAU) were identified to the level of species, genus, subfamily, class, and animal size categories. The bone remains were derived from 89 stratigraphic units, collected during the excavation seasons from 1997–2017. Eighty-six of the stratigraphic units are from 16 beehive-shaped, semi-subterranean structures (hereafter 'structures') and three are from two pits (**Table 3.53**), all located within the city's grid (above, **Fig. 3.90**). The pits functioned as refuse dumps, while the structures, after their abandonment, apparently served the same purpose for faunal remains, pottery and other artefacts. The period of use of the pits and structures for refuse disposal varies, with some of the contents covering a wide chronological range (**Table 3.53**).

Context		Historical Phase	No. Stratigraphic Units		NISP	NISP %	NISP	NISP %
Structure	A01	Early Archaic	1	86	37	2.3	1,605	99.4
	A02	Archaic	4		319	19.8		
	A03	Early Archaic	9		102	6.3		
	A04	Late Archaic–Early/Middle Classical	12		308	19.1		
	B01	Early Geometric–Late Archaic	7		43	2.7		
	B02	Early Geometric–Late Archaic	10		66	4.1		
	B03	Late Archaic–Early/Middle Classical	7		60	3.7		
	C01	Early Archaic–Middle Classical	6		171	10.5		
	C02	Early Archaic–Middle Classical	2		11	0.7		
	C03	Archaic	1		16	1.0		
	C04	Archaic	2		18	1.1		
	C05	Archaic	4		12	0.7		
	C07	Late Archaic–Early/Middle Classical	5		67	4.2		
	C08	Archaic	8		41	2.5		
	C09	Archaic	7		331	20.5		
	C11	Archaic	1		3	0.2		
Pit	C06	Archaic	1	3	1	0.1	9	0.6
	C10	Archaic	2		8	0.5		
Total			89		1,614	100.0	1,614	100.0

Table 3.53. Stratigraphic units, historical phases, and numbers of recorded specimens by context at Karabournaki (NISP)

The bone distribution within the 18 studied contexts defers significantly. From the total of 1,614 specimens (NISP), the structures A02, A04 and C09 contain the highest amount of faunal remains (between 19-20%), followed by the structures A03 and C01 (6-11%). The structures A01, B01-B03, C03, C04, C07 and C08 make up between 1-4%, while the structures C02, C05 and C11 and the pits C06 and C10 contain <1% of the total bone assemblage (Fig. 3.93).

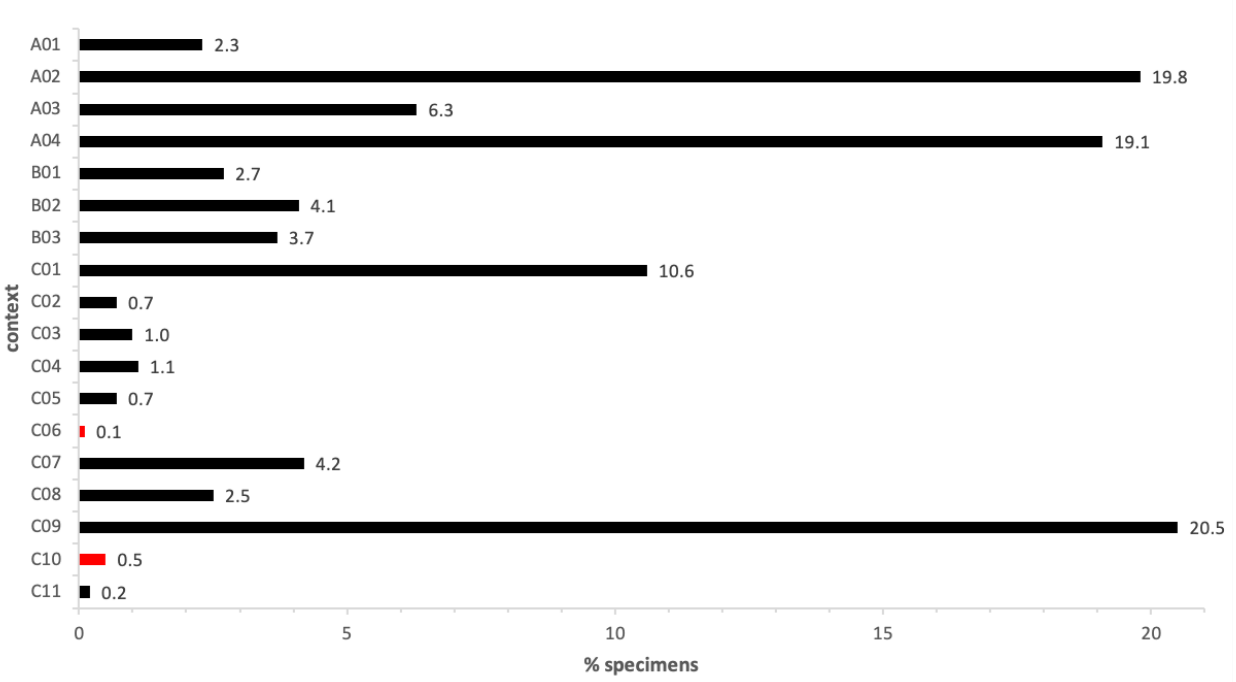

Fig. 3.93. Distribution of the recorded specimens by context at Karabournaki (structures in black, pits in red; Table 3.53; NISP 1,614)

The assemblage includes 1,614 specimens of which 66% were of identified mammals; 2% were of tortoise, <1% were of birds; and 32% were indeterminate specimens of small-, medium-, and large-sized animals (**Table 3.54**). In regard to the identified mammals from all contexts, domesticate and wild taxa were identified, namely sheep (*Ovis aries*), goat (*Capra hircus*), cattle (*Bos taurus*), pig (*Sus domesticus*), dog (*Canis familiaris*), donkey (*Equus asinus*), red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*) and hare (*Lepus europaeus*), (**Table 3.55**). A significant number of indeterminate mammalian specimens were identified only to the level of the three animal size categories (small, medium, large; **Table 3.55**) and comprised mainly indeterminate rib, vertebrae, skull and long bone shaft fragments. Finally, of the birds, one specimen has been attributed to mallard (*Anas platyrhynchos*).

	NISP	**NISP %**
Identified mammals	1,056	65.4
Tortoise	30	1.9
Birds	4	0.2
Size classes (mammals)	524	32.5
Total	1,614	100.0

Table 3.54. Taxonomic composition of all contexts at Karabournaki (Appendix I: Tables I.6-I.23, NISP)

Context	**Sheep**[1]	**Goat**[1]	**Sheep/ Goat**	**Cattle**	**Pig**	**Dog**	**Donkey**	**Red deer**	**Roe deer**	**Hare**	**Tortoise**	**Bird**	**Small sized**	**Medium sized**	**Large sized**	**Total** (NISP)
A01	3	2	9	9	10	1	1	-	1	-	-	-	-	1	-	37
A02	10	10	76	43	22	1	-	1	-	1	2	-	-	105	48	319
A03	5	-	22	2	13	1	-	1	1	-	-	-	-	55	2	102
A04	11	4	106	52	53	3	1	7	-	1	-	3	3	46	18	308
B01	-	-	18	3	4	1	-	-	-	-	-	-	-	9	8	43
B02	1	-	20	11	10	1	-	-	-	-	1	-	-	17	5	66
B03	6	-	21	1	4	1	-	-	-	-	-	-	-	26	1	60
C01	28	2	31	43	8	3	1	14	-	1	2	-	-	19	19	171
C02	1	-	3	4	2	-	-	-	-	-	-	-	-	1	-	11
C03	2	1	1	9	1	-	1	1	-	-	-	-	-	-	-	16
C04	-	1	8	1	5	-	-	-	-	-	-	-	-	1	2	18
C05	-	-	-	1	1	-	-	-	-	-	-	-	-	7	3	12
C06	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
C07	5	3	9	10	6	-	-	-	-	-	24	-	-	7	3	67
C08	1	1	12	6	8	-	-	-	-	-	-	-	-	7	6	41
C09	13	9	54	82	66	-	2	4	-	-	-	1	1	24	75	331
C10	-	-	2	2	-	-	-	-	-	-	1	-	-	3	-	8
C11	-	-	-	1	-	-	-	-	-	-	-	-	-	-	2	3
All contexts	86	33	392	280	214	12	6	28	2	3	30	4	4	328	192	1,614
All contexts %[1]	23.0	8.8	-	17.3	13.3	0.7	0.4	1.7	0.1	0.2	1.9	0.2	0.2	20.3	11.9	100.0

Table 3.55. Taxonomic breakdown by context at Karabournaki (Appendix I: Tables I.6-I.23, NISP)

[1] Percentages of sheep and goat include sheep/goat assigned proportionately (NISP)

In relation to the representation of domestic animals in terms of MinAU, in both structures and pits, sheep, goat and sheep/goat (caprines) are dominant (51%) – with sheep being more abundant than goat – followed by cattle (29%), pig (16%), dog (2%) and donkey (<1%), From the wild species, red deer is the main game species (1%) followed by hare and roe deer (both <1%), (**Table 3.56**, **Fig. 3.94**).

Context	**Sheep**[1]	**Goat**[1]	**Sheep/Goat**	**Cattle**	**Pig**	**Dog**	**Donkey**	**Red deer**	**Roe deer**	**Hare**	**Total** (MinAU)
A01	3	2	7	9	4	1	1	-	1	-	28
A02	10	9	45	29	16	1	-	1	-	1	112
A03	4	-	10	1	6	1	-	-	1	-	23
A04	11	4	29	24	22	3	1	2	-	1	97
B01	-	-	12	2	1	1	-	-	-	-	16
B02	1	-	10	11	5	1	-	-	-	-	28
B03	6	-	13	-	4	1	-	-	-	-	24
C01	25	2	10	18	7	2	-	3	-	1	68
C02	1	-	2	1	2	-	-	-	-	-	6
C03	2	1	1	4	1	-	1	1	-	-	11
C04	-	1	5	-	2	-	-	-	-	-	8
C05	-	-	-	1	1	-	-	-	-	-	2
C07	4	3	5	4	3	-	-	-	-	-	19
C08	1	1	8	5	5	-	-	-	-	-	20
C09	11	9	30	59	16	-	2	1	-	-	128
C10	-	-	1	1	-	-	-	-	-	-	2
All contexts	79	32	188	169	95	11	5	8	2	3	592
All contexts %[1]	36.0	14.5	-	28.6	16.0	1.9	0.8	1.4	0.3	0.5	100.0

Table 3.56. Taxonomic breakdown by context at Karabournaki (Appendix I: Tables I.6-I.23, MinAU)

[1] Percentages of sheep and goat include sheep/goat assigned proportionately (MinAU)

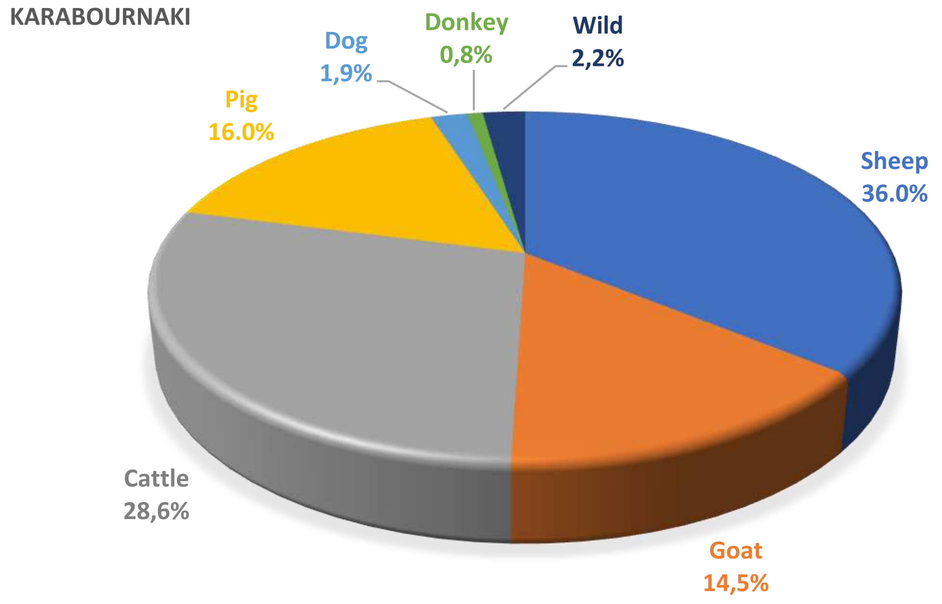

Fig. 3.94. Species representation from all contexts at Karabournaki (Table 3.56, MinAU 592)

Regarding the indeterminate material from all contexts, the dominance of medium-sized animals (63%) matches the dominance of the identified medium-sized taxa, namely caprines, pig and roe deer (69% NISP, 67% MinAU). Second in abundance are the large-sized indeterminate (37%) and identified animals, namely cattle, donkey and red deer (30% NISP, 31% MinAU), and third are the small-sized indeterminate (<1%) and identified species represented by dog and hare (1% NISP, 2% MinAU), (**Table 3.57** and **Table 3.58**).

Indeterminate taxa	**NISP**	**NISP %**
Small sized	4	0.8
Medium sized	328	62.6
Large sized	192	36.6
Total	524	100.0

Table 3.57. Composition of animal size categories of the indeterminate taxa in all contexts at Karabournaki (Appendix I: Tables I.6-I.23, NISP)

Identified taxa	NISP	NISP %	MinAU	MinAU %
Small sized[1]	15	1.4	14	2.4
Medium sized[2]	727	68.9	396	66.9
Large sized[3]	314	29.7	182	30.7
Total	1,056	100.0	592	10.00

Table 3.58. Composition of animal size categories of the identified taxa in all contexts at Karabournaki (Appendix I: Tables I.6-I.23, NISP-MinAU)

[1] Dog, hare; [2] Caprines, pig, roe deer; [3] Cattle, donkey, red deer

The distribution of the main domesticate taxa (caprines, cattle and pig) within the different contexts, in terms of MinAU, is as follows: caprines dominated in all contexts apart from Structure C09, where cattle predominate, and structures B02, C03 and pit C10, where caprines are found in equal proportions with cattle. Moreover, in context C05 no caprine specimens were identified. Cattle in most of the contexts occupied the second place, apart from Structure C09 where they predominate and structures A03 and B03 where they occupy third place behind pig. Moreover, in Structure C05 cattle are in equal proportions with pig, while cattle remains are absent from structures B03 and C04. The third most abundant domestic species is pig, which is present in all contexts, apart from Pit C10, while, as mentioned above, in structures A03 and B03 it occupied second place behind caprines (**Fig. 3.95**).

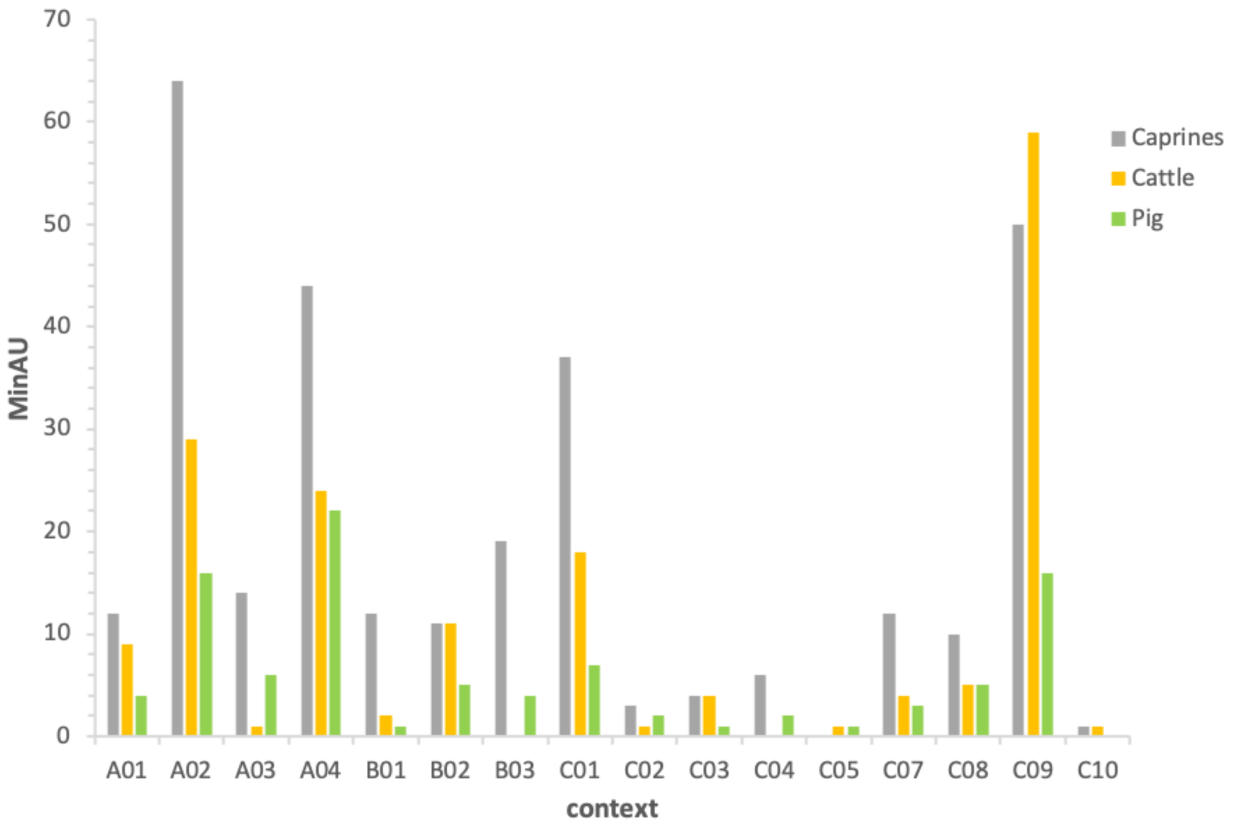

Fig. 3.95. Distribution of caprines, cattle and pig by context at Karabournaki (Table 3.56, MinAU 563)

In regard to the remaining taxa, the representation of dog and donkey is sparse and occurs only in 8 and 5, out of 16 contexts, respectively. Red deer, the main game species, is found mostly in structures A04 and C01, while roe deer and hare are represented by two and three specimens, respectively (above, **Table 3.56**). In terms of NISP, bird bones are found only in structures A04 and C08. The remains of tortoise consist almost exclusively of carapace specimens, which, since most of the specimens match (e.g. C07), probably belong to the same animal. The above observed differences in the distribution of the domesticate and wild taxa are affected significantly by the bone distribution within the 18 studied contexts (above, **Fig. 3.93**).

In relation to body part distribution within the structures and the pits, the most abundant anatomical parts, in terms of NISP, are ribs, skull bones, mandibles, horncores, and vertebrae, followed by long bones, dominated by metapodials (Appendix I: **Tables I.6-I.23**). The predominance of ribs, vertebrae and skull bones is consistent with their abundance in the skeleton. Moreover, in some structures, a concentration of specific body parts was observed, such as 13 horncores in Structure A02 (**Fig. 3.96**). Although these concentrations could have been intentional, the rest of the structures' contents do not support any such conclusion. The case of the pig neonatal skeletal remains in Structure C09 (**Fig. 3.97**) could be an exception, related to ritualistic practices or structured deposition, but they could equally belong to animals that died through natural infant mortality, and this would be consistent with their deposition in a waste deposit together with other discarded faunal remains.

Fig. 3.96. Right and left horncores of sheep and goat (Karabournaki, Structure A02), (©A. Gkotsinas)

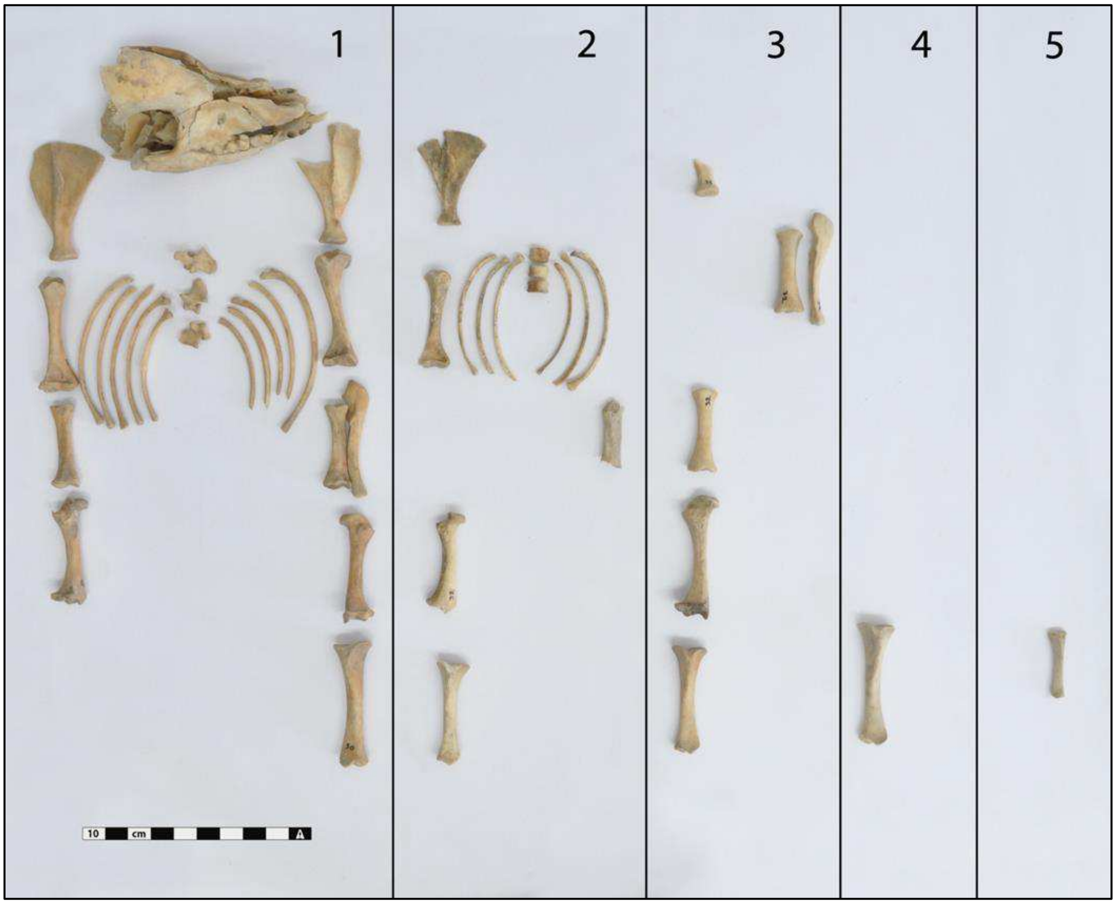

Fig. 3.97. Skeletal remains of five neonatal pigs (Karabournaki, Structure C09), (©A. Gkotsinas)

3.2.2.2. Taphonomy: Post-depositional factors

The following sections present the post-depositional factors, namely human actions, environmental conditions, and animal activities, that could have affected the preservation of the sample assemblage and thus the interpretation of the deposited assemblage. The effects of human activity relate to excavation and retrieval methods, environmental agents include weathering and vegetation, and animal activity is mainly related to scavenging. Due to the small size of the assemblage, the information for each context is presented as a unit, regardless of the chronological range within and between each context, while, when possible, some general remarks are made for each context. The specimens are presented in terms of NISP, while tortoise, birds and the three animal size categories of indeterminate mammalian specimens were excluded from the analysis of post-depositional factors. Sheep, goat and sheep/goat were merged into a single group, caprines, as, due to their similarity in size and structure, they are expected to be affected similarly by post-depositional processes. Moreover, the main domesticate taxa, namely caprines, cattle and pig are presented analytically for all the contexts together, whereas the remaining identified mammals (dog, donkey, red deer, roe deer and hare) are excluded from analysis due to the scarcity of data.

3.2.2.2.1. Human agents

The assemblage was mostly collected by application of coarse dry-sieving, while fine wet-sieving was used selectively in the context of archaeobotanical recovery, and no remains of any terrestrial fauna have yet been studied. Nevertheless, the lack of systematic application of both coarse dry-sieving and wet-sieving could cause biases against the representation of small sized anatomical elements, age groups and species.[327]

To explore the possibility that retrieval was anatomically biased, for the total assemblage (all contexts) the frequency of the smaller (ulna, calcaneum, talus, phalanges) and larger (scapula, humerus, radius, pelvis, femur, tibia, metapodials) limb bones in a complete skeleton was compared with the respective percentages for the main domesticates only, namely caprines, cattle and pig. As **Table 3.59** shows, the post-neonatal small limb bones are underrepresented for caprines and pig, whereas in cattle they are closer to what is expected for a complete skeleton. This may be due to the greater ease of detection, during collection by hand (and also to some extent during dry-sieving), of small body parts from cattle than of their much smaller counterparts from caprines and pig. Alternatively, small body parts, such as phalanges, may be underrepresented for reasons other than retrieval if they were separated from the rest of the carcass during butchery and discarded elsewhere. **Table 3.60** explores this possibility for caprines and pig with reference to two anatomically adjacent sets of body parts: talus and calcaneus with distal tibia and proximal metatarsal; and phalanges 1–3 (fore- and hind-limbs) with distal metapodials (metacarpal, metatarsal and indeterminate metapodial).[328]

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[327] Payne 1972b.

[328] Cf. Payne 1985: 222, Table 2.

	Caprines			**Cattle**			**Pig**		
	Large[1]	Small[2]	Small %	Large[1]	Small[2]	Small %	Large[1]	Small[2]	Small %
Expected (whole skeleton)	28	18	39.1	28	18	39.1	28	18	39.1
Karabournaki (all contexts)	180	53	22.7	103	48	31.8	50	11	18.0

Table 3.59. Abundance of small and large limb bones of caprines, cattle and pig in all contexts at Karabournaki (neonatal excluded; MinAU 445)

[1] Scapula, humerus, radius, pelvis, femur, tibia, metapodials (metacarpal, metatarsal, metacarpal/ metatarsal); [2] Ulna, talus, calcaneus, phalanx I, phalanx II, phalanx III

		Caprines	**Pig**
1st set	**Tibia distal**	13	-
	Talus	16	3
	Calcaneus	12	1
	Metatarsal proximal	3	9
2nd set	**Metapodial distal**	10	8
	Phalanx I	9	2
	Phalanx II	7	1
	Phalanx III	4	-

Table 3.60. Abundance of small and large limb bones in the two anatomically adjacent sets for caprines and pig in all contexts at Karabournaki (neonatal excluded; MinAU 98)

As regards the first set, in caprines the ratio of distal tibia to talus and calcaneus is close to parity, but the proximal metatarsal is underrepresented, consistent with the frequent discard of the rear foot, distally of the tarsal bones, during carcass dressing. By contrast, pig talus and calcaneus are underrepresented, compared with proximal metatarsal, while distal tibia is absent, implying loss of the latter, as well as the tarsal bones, during retrieval. In regard to the second set of articulated specimens, in caprines the fairly similar numbers of distal metapodial and phalanx I contrast with the underrepresentation of the smaller phalanx II and phalanx III, implying loss of the latter during retrieval. On the same grounds, the underrepresentation of phalanx I and II and the absence of phalanx III in pig imply retrieval loss.

In sum, the smaller limb bones are underrepresented compared to larger ones in caprines and pig, probably as a result both of archaeological recovery losses (especially phalanx II-III) and of frequent discard elsewhere of much of the (at least rear) foot. The discovery of matching specimens belonging to five incomplete neonatal pig skeletons in Structure C09 reinforces the assumption of recovery losses as only one of the skeletons found quite complete (above, **Fig. 3.97**). In cattle, the ratio between small and large limb bones and the presence of matching bones in structures C01 and C09 (e.g., distal tibia with calcaneus and malleolus in C01; proximal metatarsal with talus, navicular-cuboid and cuneiform lateral in C01, **Fig. 3.98**; proximal metatarsal with navicular-cuboid in C09; and scaphoid with capitato-trapezoid in C09), reinforce the interpretation that cattle specimens have not been affected significantly by recovery losses and the remains of carcass dressing seemed to be discarded within the structures.

Fig. 3.98. Matching (left) proximal metatarsal with lateral cuneiform, navicular-cuboid and distal talus of cattle (Karabournaki, Structure C01), (©A. Gkotsinas)

The potential bias due to damage of the sample assemblage during and after excavation (digging, processing and storage conditions) was estimated based on the frequency of fresh breakages. This estimate concerns only post-neonatal long bones, as inclusion of the more fragile bones, such as skull, ribs, vertebrae, scapula, and pelvis, as well as neonatal specimens, could cause overestimation. Overall, 10% of the recorded post-neonatal long bones from all contexts bear fresh breaks, apart from Pit C06 and Structure C11, which did not contain any long bones (**Table 3.61**). The damage caused during and/or after the excavation is quite low and seems not to have significantly affected the formation of the sample assemblage.

Context		Total	
		NISP	NISP %
A01	**New break**	1	8.3
	Total[1]	12	-
A02	**New break**	8	11.4
	Total[1]	70	-
A03	**New break**	4	17.4
	Total[1]	23	-
A04	**New break**	4	6.7
	Total[1]	60	-
B01	**New break**	5	50.0
	Total[1]	10	-
B02	**New break**	1	5.0
	Total[1]	20	-
B03	**New break**	3	21.4
	Total[1]	14	-
C01	**New break**	-	0.0
	Total[1]	49	-
C02	**New break**	-	0.0
	Total[1]	5	-
C03	**New break**	-	0.0
	Total[1]	6	-
C04	**New break**	-	0.0
	Total[1]	7	-
C05	**New break**	-	0.0
	Total[1]	1	-
C07	**New break**	2	12.5
	Total[1]	16	
C08	**New break**	3	25.0
	Total[1]	12	-
C09	**New break**	6	7.9
	Total[1]	76	-
C10	**New break**	-	0.0
	Total[1]	2	-
All contexts	**New break**	37	9.7
	Total[1]	383	-

Table 3.61. Incidence of new breaks in post-neonatal long bones by context at Karabournaki (NISP)

[1] Includes all long bones, complete and fragmented (old and fresh breakages)

In relation to the incidence of fresh breakage in the main domesticate taxa, according to **Table 3.62**, cattle is least affected (3%), followed by pig (16%) and caprines (12%), probably because cattle bones are most robust and easily detected by naked eye. Such damage during and/or after excavation is likely to have deflated the number of complete or almost complete bones, at least for caprines and pig, thus potentially distorting fragmentation patterns as evidence for carcass processing, and also to have reduced the availability of biometric data. Additionally, it is likely to have contributed to retrieval losses, since the resulting smaller fragments are more likely to be missed.

	Caprines		**Cattle**		**Pig**	
	NISP	NISP %	NISP	NISP %	NISP	NISP %
New break	25	11.8	3	2.8	8	16.0
Total[1]	211	-	108	-	50	-

Table 3.62. Incidence of new breaks in post-neonatal long bones of caprines, cattle and pig in all contexts at Karabournaki (NISP)

[1] Includes all long bones, complete and fragmented (old and fresh breakages)

3.2.2.2.2. Environmental agents

Environmental attrition is caused by weather conditions (sun, rain) and soil factors (root etching, encrustation). **Table 3.63** shows that, in total, 33% of the assemblage bears vegetation traces, while c.1% is affected by weathering, and only one specimen is encrusted. Vegetation traces caused by root etching (**Fig. 3.99**) are represented at high levels (>50%) in most of the contexts, apart from A02, B01, B03 and C09, while no root etching was recorded on specimens from A03, C06 and C11. The presence of vegetation traces is significant in that it might have obscured traces of carnivore activity or carcass processing and thus introduce bias into the interpretation of other formation processes. The high proportion of root etching is most likely due to the shallow depth of most of the deposits studied here, while contexts with sparse or no vegetation traces may have been found at a greater depth, as in the case of Structure C09 (root etching 6.5%) with bones derived from a depth of 4.23 - 5.15 m. Weathering traces are rare, suggesting limited exposure on the ground surface and thus rapid burial in the pits and structures. Finally, only one specimen, from

Structure A04, was encrusted, implying that soil diagenesis did not affect the formation of the faunal assemblage of any of the contexts.

Context		Total	
		NISP	NISP %
A01	**Root etching**	23	60.5
	Total[1]	38	-
A02	**Root etching**	16	5.3
	Total[1]	302	-
A03	**Weathering**	1	1.1
	Total[1]	95	-
A04	**Root etching**	167	59.0
	Encrustation	1	0.4
	Total[1]	283	-
B01	**Root etching**	15	36.6
	Total[1]	41	-
B02	**Root etching**	42	71.2
	Weathering	1	1.7
	Total[1]	59	-
B03	**Root etching**	14	24.1
	Total[1]	58	-
C01	**Root etching**	85	51.5
	Total[1]	165	-
C02	**Root etching**	7	70.0
	Total[1]	10	-
C03	**Root etching**	12	75.0
	Total[1]	16	-
C04	**Root etching**	11	68.8
	Total[1]	16	-
C05	**Root etching**	6	50.0
	Total[1]	12	-
C07	**Root etching**	31	75.6
	Weathering	1	2.4
	Total[1]	41	-
C08	**Root etching**	29	74.4
	Weathering	1	2.6
	Total[1]	39	-
C09	**Root etching**	18	6.5
	Weathering	1	0.4
	Total[1]	277	-
C10	**Root etching**	2	33.3
	Total[1]	6	-
All contexts	**Root etching**	478	32.8
	Weathering	5	0.3
	Encrustation	1	0.1
	Total[1]	1,458	-

Table 3.63. Incidence of environmental attrition by context at Karabournaki (loose teeth and neonatal specimens excluded; NISP)

[1] Includes all the specimens, with and without environmental traces

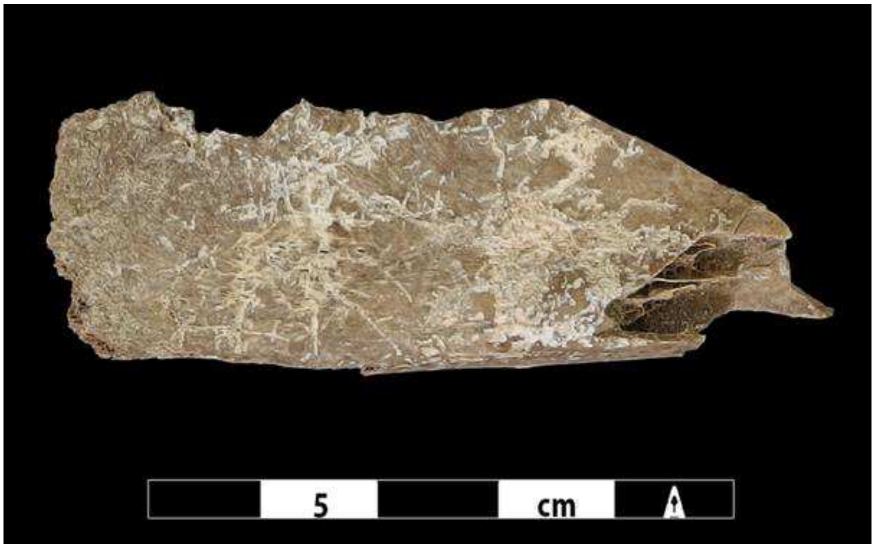

Fig. 3.99. Root etching on the caudal side of a left scapula fragment of caprines (Karabournaki, Structure B01), (©A. Gkotsinas)

In regard to the incidence of environmental attrition in the main domesticated taxa, pig was affected most by root etching (42%), followed by caprines (40%) and cattle (31%), (**Table 3.64**). The difference in the frequency of these traces, between medium- (caprines, pig) and large-sized (cattle) animals, if not fortuitous, is probably related to variation in species composition between shallow and deep deposits.

	Caprines		**Cattle**		**Pig**	
	NISP	NISP %	NISP	NISP %	NISP	NISP %
Root etching	188	39.2	82	31.3	61	41.5
Weathering	2	0.4	1	0.4	2	1.4
Total[1]	479	-	262	-	147	-

Table 3.64. Incidence of environmental attrition in caprines, cattle, pig in all contexts at Karabournaki (loose teeth and neonatal excluded; NISP)

[1] Includes all specimens, with and without environmental traces

Finally, 10 specimens from Structure A04 and one from Structure C01 bear reddish stains (**Fig. 3.100**) that are probably related to bacteria and fungi or the presence of trace levels of minerals, such as manganese, in combination with the pH level.

Fig. 3.100. Right radius proximal diaphysis fragment (medial side) of cattle with reddish stains (Karabournaki, Structure A04), (©A. Gkotsinas)

3.2.2.2.3. Animal agents

The contribution of animals to the formation of the faunal assemblage was assessed based on the incidence of gnawing marks and of types of old breaks. Gnawing traces recorded in Karabournaki, based on their morphology, were made by both carnivores and rodents. The former may plausibly be attributed to domestic dog as it is the only carnivore represented in the assemblage (**Fig. 3.101**). Overall, dog gnawing marks were observed on 14% of the bone assemblage and were identified in almost all the contexts apart from structures C02 and C05 and pits C06 and C10. The percentages of gnawing marks fluctuate between 22% and 33% in contexts A01, A03, B02, C01, C03 and C11; between 10% and 19% in contexts A02, B01, B03, C04, C07 and C09; and between 6% and 8% in contexts in A04 and C08 (**Table 3.65**). The frequency of gnawing by dogs is almost identical between caprines (17%), pig (16%) and cattle (15%), (**Table 3.66**). Rodent gnawing marks were observed on only 2% of the bone assemblage, spread across almost half of the contexts (8) and affecting cattle (3%), caprines (2%) and pig (2%), (**Table 3.65** and **Table 3.66**). The percentages of gnawing traces by both dogs and rodents may be underestimated due to high number of specimens with root-etched surfaces (33%; above, **Table 3.63**).

Fig. 3.101. Dog gnawing traces on a radius left proximal diaphysis of sheep (Karabournaki, Structure B01), (©A. Gkotsinas)

Context	Gnawing traces	Total	
		NISP	NISP %
A01	**Carnivore**	9	23.7
	Rodent	2	5.3
	Total[1]	38	-
A02	**Carnivore**	32	10.6
	Rodent	3	1.0
	Total[1]	302	-
A03	**Carnivore**	23	24.2
	Rodent	1	1.1
	Total[1]	95	-
A04	**Carnivore**	16	5.7
	Rodent	4	1.4
	Total[1]	283	-
B01	**Carnivore**	4	9.8
	Rodent	1	2.4
	Total[1]	41	-
B02	**Carnivore**	13	22.0
	Total[1]	59	-
B03	**Carnivore**	10	17.2
	Rodent	2	3.4
	Total[1]	58	-
C01	**Carnivore**	38	23.0
	Rodent	3	1.8
	Total[1]	165	-
C03	**Carnivore**	5	31.3
	Total[1]	16	-
C04	**Carnivore**	3	18.8
	Total[1]	16	-
C07	**Carnivore**	5	12.2
	Total[1]	41	-
C08	**Carnivore**	3	7.7
	Total[1]	39	-
C09	**Carnivore**	40	14.4
	Rodent	6	2.2
	Total[1]	277	-
C11	**Carnivore**	1	33.3
	Total[1]	3	-
All contexts	**Carnivore**	202	13.8
	Rodent	22	1.5
	Total[1]	1,462	-

Table 3.65. Incidence of gnawing by context at Karabournaki (loose teeth and neonatal specimens excluded; NISP)

[1] Includes all the specimens, with and without gnawing traces

Gnawing traces	**Caprines**		**Cattle**		**Pig**	
	NISP	NISP %	NISP	NISP %	NISP	NISP %
Carnivore	81	16.9	40	15.2	24	16.2
Rodent	10	2.1	7	2.7	3	2.0
Total[1]	479	-	263	-	148	-

Table 3.66. Incidence of animal attrition in caprines, cattle, pig in all contexts at Karabournaki (loose teeth and neonatal excluded; NISP)

[1] Includes all the specimens, with and without gnawing traces

In relation to the pattern of fragmentation of long bones, following Binford (1981) bone fragments with surviving diaphysis and epiphysis (complete or part) are likely to be products of human carcass processing, whereas those with only diaphysis (complete or part) preserved could be products of scavenger (gnawing; **Fig. 3.102**) or human activity (marrow extraction, trampling). **Table 3.67** shows the percentage of diaphysis cylinder fragments (the most characteristic of scavenging) in the total assemblage is 16%, suggesting that dogs had at most a modest impact on the pattern of fragmentation of discarded long bones, whereas fragments including part at least of the epiphysis were found much more frequently (36%), suggesting a greater impact for human activity related to carcass processing. Diaphysis splinters are also well represented (35%), but the widespread occurrence of chopping marks in all species (below, 3.2.2.3) implies a major role for human agents.

In sum, the combination of modest traces of carnivore attrition (14%; above, **Table 3.65**), a very low percentage of complete bones in all species (4%) and a high percentage of both diaphysis splinters (35%) and fragments including epiphysis (36%) suggests that fragmentation of long bones was mostly caused by humans during butchery and marrow extraction.

Fig. 3.102. Dog gnawing traces on the epiphysis (diaphysis cylinder) of a caprine left humerus (Karabournaki, Structure A01), (©A. Gkotsinas)

Context	Complete/Almost complete	Diaphysis cylinder	Diaphysis splinter	Fragments including epiphysis	Total[1] (NISP)
A01	-	3	3	5	12
A02	2	8	27	25	70
A03	-	2	13	4	23
A04	2	10	26	18	60
B01	-	2	1	2	10
B02	1	1	10	7	20
B03	1	2	4	4	14
C01	6	6	15	22	49
C02	-	-	3	2	5
C03	1	1	-	4	6
C04	-	1	3	3	7
C05	-	1	-	-	1
C07	-	6	2	6	16
C08	-	1	4	4	12
C09	1	16	21	32	76
C10	-	-	1	1	2
All contexts	14	60	133	139	383
All contexts %	3.7	15.7	34.7	36.3	100.0

Table 3.67. Incidence of fragmentation types in post-neonatal long bones from all contexts at Karabournaki (NISP)

[1] Includes all the specimens (complete and fragmented bones)

This interpretation receives further support from examination of fragmentation patterns by taxon. **Table 3.68** shows that complete bones are most common in pig (19%) followed by caprines (2%), while there are no complete bones from cattle. The fact that complete long bones survived mainly in pig and, to a lesser extent in caprines, suggests that complete bones, suitable for reduction by dogs to diaphysis cylinders, may have been more frequent in these middle-sized animals than in cattle bones. This is consistent with the much higher percentages of diaphysis cylinders in pig (33%) and caprines (20%) than in cattle (6%) and, conversely, the higher percentages of both diaphysis splinters (48%) and fragments including epiphysis (47%) in cattle than in caprines (39% and 38%, respectively) and especially pig (17% and 31%, respectively). Bone fragmentation was primarily due to deliberate human agency, therefore, and – as might be expected – was much more intensive in large-bodied cattle than in the medium-sized. Fragmentation of long bones was least intensive in the case of pigs, despite their generally younger age at death (below, 3.2.2.5.3) and thus the greater fragility of their bones, providing yet further evidence that bones were broken in large measure by human agents in order to extract marrow, which is less rich in young animals.

Fragmentation types	**Caprines**		**Cattle**		**Pig**	
	NISP	NISP %	NISP	NISP %	NISP	NISP %
Complete/Almost complete	4	2.2	-	0.0	8	19.0
Diaphysis cylinder	38	20.4	6	5.7	14	33.3
Diaphysis splinter	73	39.2	50	47.6	7	16.7
Fragments including epiphysis	71	38.2	49	46.7	13	31.0
Total	186	100.0	105	100.0	42	100.0

Table 3.68. Incidence of fragmentation types in post-neonatal long bones of caprines, cattle and pig from all contexts at Karabournaki (excluded loose epiphyses and new breaks; NISP)

Apart from patterns of bone fragmentation, there are many cases of matching or articulating specimens: nine cases of matching unfused diaphysis and epiphysis from structures A02, A04, C01, C07, C08 and C09; one case of a matching radius and ulna from Structure A03; and seven cases of matching carpal, tarsal, and skull bones from structures A04, C01 and C09 (above, **Fig. 3.98**). Additionally, matching specimens from pig neonatal skeletons were derived from Structure C09 (above, **Fig. 3.97**). These data suggest that the faunal remains of some of the structures were disposed of rapidly after butchery and remained undisturbed thereafter by scavenging and trampling.

Taphonomy: Summary

It appears that the recovery and excavation processing affected the representation of small sized anatomical elements of caprines and pig. In relation to the formation of the faunal assemblage, the high percentage of root etching may create biases in assessment of the incidence of other pre- and post-discard traces, such as cut marks and gnawing traces, respectively. Root marks are, as would be expected, less frequent on specimens found in deeper layers. In regard to animal agents, traces of scavenging by dogs are documented in almost all contexts but the effect on the formation of the faunal assemblage is modest, suggesting that dogs had limited access to refuse areas or that bone waste was buried rapidly. The presence of matching and articulated specimens also suggests limited post-discard disturbance of at least some refuse deposits, the sparse representation of weathering traces suggests that most bone refuse was not exposed for a long period on the surface prior to burial. Such rapid burial also implies that the bones were derived from multiple discard episodes over the extended period of use of the various refuse dumps. Differences between contexts in frequency of weathering and gnawing traces, however, imply some contextual variation in the balance between rapidly buried refuse and that deposited after a period of surface exposure.

3.2.2.3. Carcass processing

Carcass processing encompasses the butchery practices related to cooking and consumption patterns as well as discard practices. These pre-depositional impacts on the formation of the deposited assemblage are the result of human activity and thus of more direct interest than the taphonomic effects discussed above. To explore these factors, the incidence of butchery marks, the fragmentation they caused, and traces of burning were analysed. Due to the limitations of the assemblage – in terms of small size and wide chronological range – the analysis initially treats the entire assemblage as a single unit, but some observations are also made regarding differentiation between contexts in evidence for carcass processing. The assemblage was quantified in terms of NISP excluded tortoise carapace, loose teeth, which are unlikely to bear any cuts, and neonatal specimens, for which the identification of cut marks is difficult. Sheep, goat, and sheep/goat were merged into a single group, caprines, and, in the case of fragmentation types, only post-neonatal long bones were analysed.

Overall, 18% of the recorded specimens bear butchery traces (**Table 3.69**), divided into skinning (6%), dismemberment (18%), filleting (29%) and chopping marks (47%), (**Table 3.70**). The presence of all type of cut marks and the coexistence, within the refuse deposits, of both bones with high meat yield (e.g. humerus, tibia) and bones with low meat yields (e.g. metapodials, phalanges; Appendix I: **Tables I6-I23**), which are usually removed from the carcass during/after consumption and during initial butchery, respectively, suggests that waste from all stages of the butchery and consumption sequence was discarded together. This in turn suggests that initial butchery and consumptions were not strongly segregated, spatially or temporally, and thus is perhaps more consistent with carcass processing at a domestic level rather than by specialist butchers.

Butchery marks were identified on specimens of caprines (21%), cattle (28%), pig (25%), dog (16%), donkey (20%), red deer (30%), roe deer (50%) and birds (33%), (**Table 3.71**). Thus, these animals were certainly consumed, while the same may be suggested for hare as their bones were found with the other consumed species. Butchery marks were also found on medium- (8%) and large-sized (7%) indeterminate mammalian specimens. The frequency of cut specimens varies between the contexts and it is related with the abundance of bones in each context. From the contexts containing more than 100 specimens, C09 dominate (23%) followed by C01 (19%), A02 (18%) and A04 (14%), (**Table 3.69**).

In regard to domestic species, caprines, pig and cattle bear all types of cut marks, namely skinning, dismemberment, filleting and chopping (**Table 3.70**). This indicates that the entire carcass processing sequence for these taxa frequently took place on site, although the previous analysis of retrieval loss suggested that foot bones from caprines and pig removed during initial carcass dressing may sometimes have been discarded off-site (above, 3.2.2.2.1).

Context	Cut		Uncut		Total (NISP)
	NISP	NISP %	NISP	NISP %	
A01	11	29.7	26	70.3	37
A02	55	18.2	247	81.8	302
A03	15	15.8	80	84.2	95
A04	40	14.0	246	86.0	286
B01	3	7.3	38	92.7	41
B02	10	16.7	50	83.3	60
B03	7	12.1	51	87.9	58
C01	31	18.8	134	81.2	165
C02	2	20.0	8	80.0	10
C03	5	31.3	11	68.8	16
C04	2	12.5	14	87.5	16
C05	-	0.0	12	100.0	12
C06	-	0.0	1	100.0	1
C07	8	19.0	34	81.0	42
C08	6	15.4	33	84.6	39
C09	63	22.7	215	77.3	278
C10	1	16.7	5	83.3	6
C11	2	66.7	1	33.3	3
All contexts	261	17.8	1,206	82.2	1,467

Table 3.69. Incidence of cut and uncut specimens by context at Karabournaki (loose teeth, neonatal specimens and carapace excluded; NISP)

Species	Skinning		Dismemberment		Filleting		Chopping		Total (NISP)
	NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %	
Caprines	6	5.5	27	24.8	35	32.1	41	37.6	109
Cattle	10	13.0	10	13.0	15	19.5	42	54.5	77
Pig	1	2.6	5	12.8	17	43.6	16	41.0	39
Dog	-	0.0	1	50.0	-	0.0	1	50.0	2
Donkey	-	0.0	-	0.0	1	100.0	-	0.0	1
Red deer	-	0.0	5	83.3	-	0.0	1	16.7	6
Roe deer	-	0.0	1	100.0	-	0.0	-	0.0	1
Bird indet.	-	0.0	-	0.0	2	66.7	1	33.3	3
Medium sized	-	0.0	-	0.0	7	28.0	18	72.0	25
Large sized	-	0.0	-	0.0	4	30.8	9	69.2	13
Total	17	6.2	49	17.8	81	29.3	129	46.7	276

Table 3.70. Incidence of types of butchery marks by taxon at Karabournaki (loose teeth, neonatal specimens and carapace excluded, NISP)

Species	Cut		Uncut		Total (NISP)
	NISP	NISP %	NISP	NISP %	
Caprines	100	21.2	372	78.8	472
Cattle	73	28.1	187	71.9	260
Pig	37	24.7	113	75.3	150
Dog	1	12.5	7	87.5	8
Donkey	1	20.0	4	80.0	5
Red deer	6	30.0	14	70.0	20
Roe deer	1	50.0	1	50.0	2
Bird indet.	1	33.3	2	66.7	3
Medium sized	25	7.7	301	92.3	326
Large sized	13	6.8	179	93.2	192
Total	258	17.9	1,180	82.1	1,438

Table 3.71. Incidence cut and uncut specimens by taxon at Karabournaki (loose teeth, neonatal specimens and carapace excluded, NISP)

In relation to domesticate taxa, skinning marks were found mostly on cattle specimens. Dismemberment marks are more prevalent on caprines, followed by cattle and pig, while filleting incidences are highest in pig, followed by caprines and cattle. Finally, chop marks are most prevalent in cattle, consistent with the more intensive fragmentation of their long bones (above, **Table 3.68**), followed by pig and caprines (above, **Table 3.70**). The fact that filleting, and to a lesser extent dismembered, marks are less frequent in cattle, is probably because intensive fragmentation has ‘inflated’ the proportion of specimens without butchery traces; and skinning marks are more frequent in cattle, arguably because such marks are sometimes found on phalanges which were less susceptible to recovery loss in the larger domesticates.

In relation to the location of the various traces, skinning marks were identified mainly on the phalanges of cattle and, less frequently, of caprines, as well as the distal metatarsal of caprines and the skull of caprines and pig. Dismemberment marks were found on most of the joints, namely long bone epiphyses, tarsal bones, mandible, scapula, and pelvis articulation points of all three main domestic species. Filleting incidences, which are highest in medium-sized domesticates, were located on the diaphyses of long bones and on the mandible, scapula, pelvis, and ribs of all the domestic taxa, while in pig, filleting marks were also found on the skull bones. Finally, chopping traces were found in both the cranial and postcranial bones, namely mandible, vertebrae, ribs, scapula, pelvis, and long bones (**Fig. 3.103**) of all three taxa (**Fig. 3.104**, **Fig. 3.105** and **Fig. 3.106**).

Fig. 3.103. Chop marks (white arrows) on a caprine right proximal radius and ulna (Karabournaki, Structure C09), (©A. Gkotsinas)

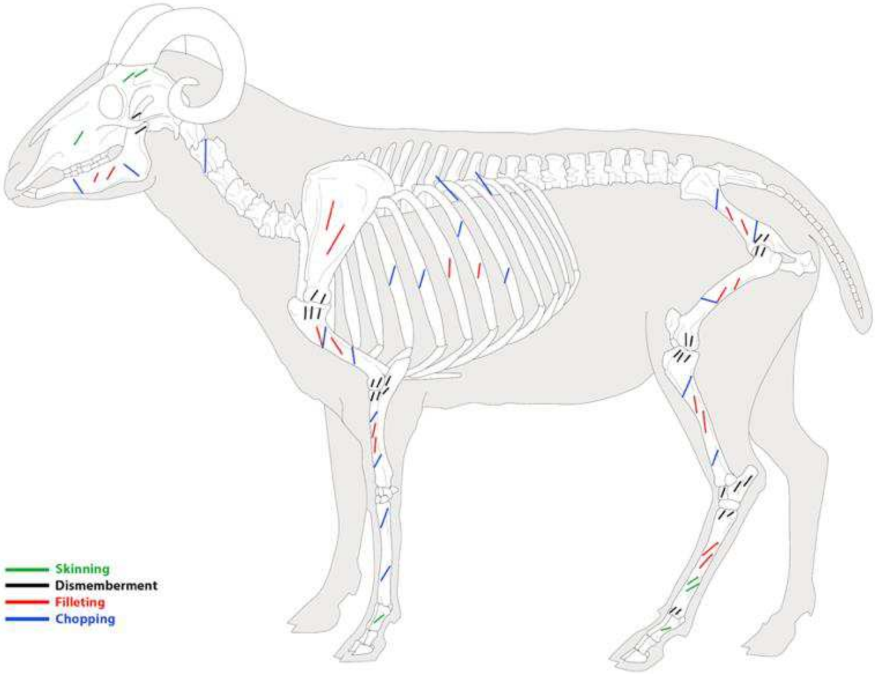

Fig. 3.104. Caprine bones from all contexts displaying butchery marks at Karabournaki (©1996 ArcheoZoo.org)

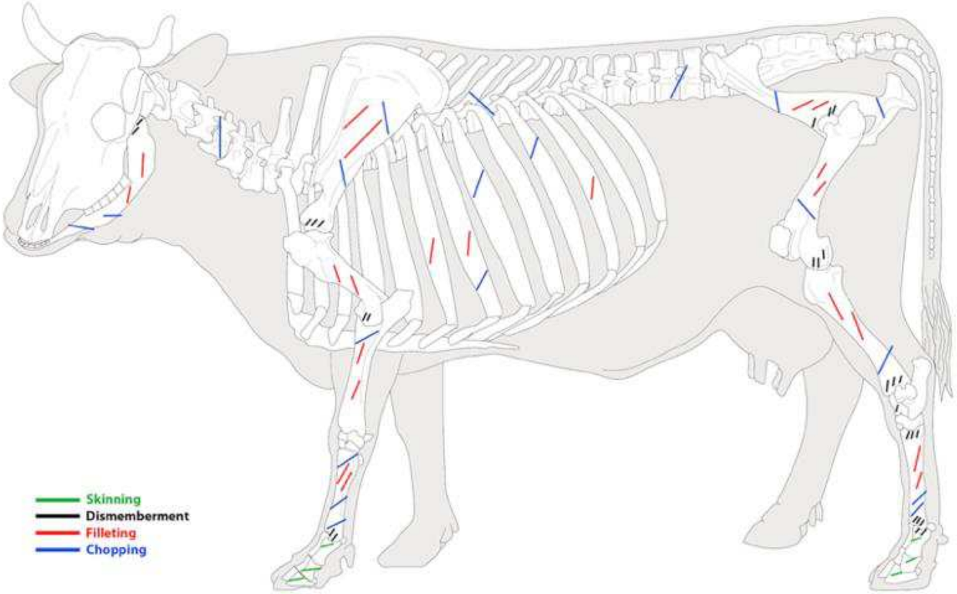

Fig. 3.105. Cattle bones from all contexts displaying butchery marks at Karabournaki (©1996 ArcheoZoo.org)

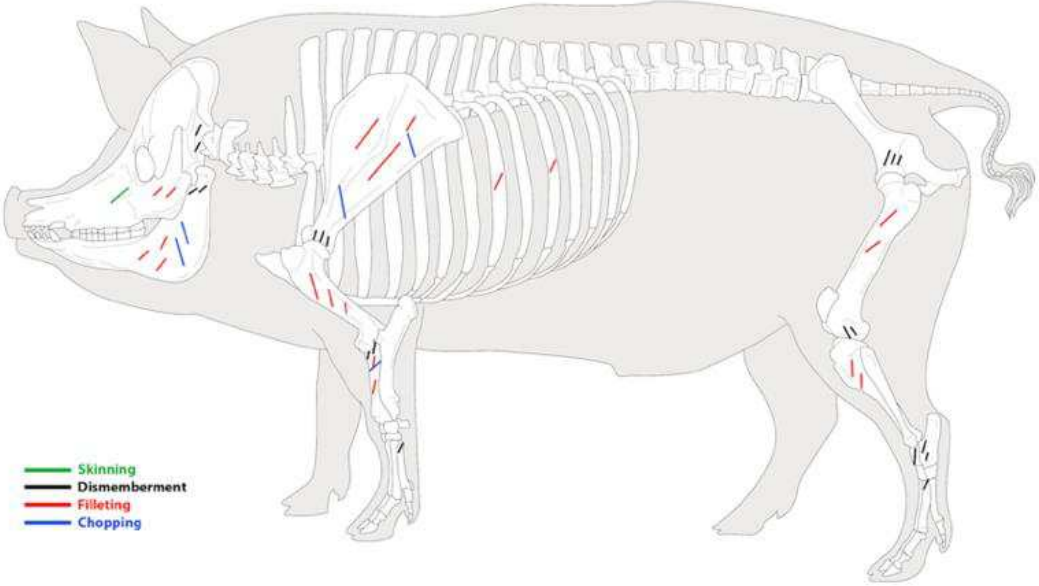

Fig. 3.106. Pig bones from all contexts displaying butchery marks at Karabournaki (©1996 ArcheoZoo.org)

Some apparent differences in the prevalence of each type of butchery mark may be related to differences in sample size and/or the post-depositional factors. For example, the lack of dismemberment marks on distal tibia of pig is because of the absence of this anatomical part in the assemblage, while gnawing by dogs may have obscured dismemberment traces by destruction of the epiphyses where these are usually found (above, **Fig. 3.102**). Other differences, however, are probably related to differential treatment of large and small carcasses. For example, the dominance of chopping marks in cattle reflects intensive butchery to minimize the size of the carcass for cooking as well as for marrow extraction; cattle bones contain more marrow than those of the other species.

In relation to the other identified domestic (dog and donkey) and wild taxa (red deer, roe deer), and the birds bearing cut marks, the data are too scarce for any further analysis. However, it is notable that both dog and donkey were consumed, albeit apparently only occasionally.

Burning traces were recorded on 9% of specimens. Of these, 3% are uniformly and 7% partly burnt (**Table 3.72**). The uniformly burnt specimens were derived from seven contexts, A02, A03, A04, B01, B03, C09 and C10, with B03 and C09 containing the most burnt specimens. The specimens are mostly ribs, vertebrae and metapodials of medium-sized indeterminate species and caprines and, to a lesser extent, of large-sized indeterminate animals and pig. The colour of the uniformly burnt surface varies from grey to blue and white (**Fig. 3.107**), suggesting exposure to high temperatures,[329] whether accidentally or intentionally. The latter could be related to the use of bones as fuel. The composition of the burnt material (in terms of anatomical parts and species) offers no indication of ritualistic practices. Moreover, due to exposure to fire, some bones may have been totally destroyed and thus lost to the preserved death assemblage.

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[329] Buikstra-Swegle 1989; Shipman et al. 1984; Spennemann-Colley 1989.

Context	Incidence of burning traces				Total (NISP)
	Uniformly burnt	Uniformly burnt %	Partly burnt	Partly burnt %	
A01	-	0.0	4	10.8	37
A02	4	1.3	52	16.3	319
A03	3	2.9	6	5.9	102
A04	1	0.3	3	1.0	308
B01	7	16.3	3	7.0	43
B02	-	0.0	3	4.5	66
B03	13	21.7	7	11.7	60
C01	-	0.0	11	6.4	171
C02	-	0.0	-	0.0	11
C03	-	0.0	-	0.0	16
C04	-	0.0	3	16.7	18
C05	-	0.0	-	0.0	12
C06	-	0.0	-	0.0	1
C07	-	0.0	1	1.5	66
C08	-	0.0	4	9.8	41
C09	11	3.9	7	2.5	283
C10	1	14.3	1	14.3	7
C11	-	0.0	-	0.0	3
All contexts	40	2.6	105	6.7	1,564

Table 3.72. Incidence of burning in post-neonatal long bones from all contexts in Karabournaki (NISP)

Fig. 3.107. Uniformly burnt caprine first phalanx (Karabournaki, Structure B03), (©A. Gkotsinas)

The partly burnt bones exhibit black stains and were found in most of the structures, apart from C02, C03, C05, C06 and C11. They are mostly metapodials, mandibles and, to a lesser extent, ribs and long bone diaphyses and epiphyses of caprines and cattle. Apart from a dog skull fragment, the other partly burnt specimens also belong mainly to caprines and cattle, but some are also from pig and medium- and large-sized indeterminate species. The partly burnt traces probably resulted from heating or cooking over open fire (i.e. roasting). This possibility is supported by the fact that burning is mostly localized on mandible bases, as well as tips of teeth and metapodials. These anatomical units are only thinly protected by flesh which tends to shrink during roasting, leaving the bone surface exposed locally to heat. The presence of such traces of burning on metapodials and phalanges (phalanx I, II and III) (**Fig. 3.108** and **Fig. 3.109**) is an indication that, at least in some cases, entire carcasses of caprines and cattle were roasted.

Fig. 3.108. Proximal right metacarpal of sheep exhibiting burning on the medial side of diaphysis (Karabournaki, Structure C01), (©A. Gkotsinas)

Fig. 3.109. Caprine second phalanx exhibiting burning on the abaxial side (Karabournaki, Structure A02), (©A. Gkotsinas)

3.2.2.4. Bones as raw material

Apart from bone remains which suggest butchery and consumption activities, there is evidence for the use of some skeletal parts as raw materials for making objects. The worked specimens were derived from structures A02, A04, B02, C01 and C09 (**Table 3.73**). The skeletal parts concerned are mainly caprine tali and red deer antlers. Additionally, one cattle metapodial and one calcaneus and an indeterminate long bone of caprine also bear working traces.

The traces on tali are limited to signs of wear on the dorsal and plantar side, probably created through use, and most of them were derived from Structure C09 (**Fig. 3.110**). According to the most recent interpretations, the worked tali, mostly medio-laterally polished, could have functioned as ceramic burnishers[330] or hide softeners.[331] This could also be the case for the tali from Karabournaki with dorsal-plantar polish. Deer antlers, shed and thus probably collected from the surroundings of the site, bear traces of peeling and transverse and longitudinal sawing (**Fig. 3.111**). A few worked specimens complete the evidence for use of bone and antler as raw material for craft items.

Context	**Antler**	**Talus**		**Calcaneus**	**Metapodial**	**Long bone indet.**	**Total** (NISP)
	red deer	caprines	cattle	caprines	cattle	caprines	
A02	1	-	-	-	-	-	1
A04	2	1	-	1	-	-	4
B02	-	-	-	-	-	1	1
C01	2	-	1	-	-	-	3
C09	-	4	-	-	1	-	5
Total	5	5	1	1	1	1	14

Table 3.73. Incidence of worked bones by taxon and anatomical unit by context at Karabournaki (NISP)

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[330] Choyke and Bartosiewicz 2009; Meier 2013.
[331] Bejenaru et al. 2010.

Fig. 3.110. Wear traces on a caprine talus (Karabournaki, Structure C09), (©A. Gkotsinas)

Fig. 3.111. Shed red deer antlers. The two at the top bear working traces (Karabournaki, Structures A02 and C01), (©A. Gkotsinas)

3.2.2.5. Mortality patterns and management strategies

The age at death of the productive species, namely sheep, goat, cattle, and pig, offers information regarding the animal management strategies of the Karabournaki inhabitants. The species' mortality patterns were explored on the basis of the mandibular tooth wear stages, the fusion stage of the postcranial elements, the relative proportions of neonatal and post-neonatal postcranial remains, and the ratio of males to females among the sexable adult specimens, namely pelvis for caprines and cattle and mandibular canines and canine cavities for pig. Moreover, the few available metrical data were used as supplementary evidence for the determination of sex ratios in caprines, while in cattle and pig the use of metrical data was not feasible. All specimens were quantified in terms of MinAU, while the small sample size and the wide chronological range of the assemblage preclude analysis by context. Thus, the following analysis presents an overall assessment of the contents of the structures and pits over time.

3.2.2.5.1. Caprines

The sample sizes for sheep and goat are small and thus sheep, goat and sheep/goat were merged into the single group caprines. Accordingly, although species-level data are tabulated for aged mandibular teeth, sexed pelves and biometrics, mortality patterns are largely analysed for combined caprines, despite the possibility that humans exploited the two species differently. The data for neonatal mortality and the epiphyseal fusion evidence for post-neonatal mortality are tabulated only for combined caprines because neonatal and unfused specimens are difficult to identify to species level. In practice, however, given the apparent predominance of sheep over goats at Karabournaki, the combined caprine mortality data probably relate mainly to sheep.

Based on the mandible wear stages, the caprines seem to have been slaughtered steadily from the latter part of their first year (stage C juveniles) to their fourth-sixth years (stage G mature adults; **Table 3.74**, **Fig. 3.112**). Thereafter mortality declined among older animals of six to ten years (stages H and I), probably reflecting the relatively small numbers of elderly animals in the herds. There is no evidence of animals killed very young, within the first six months after birth, an outcome consistent with the poor representation of neonatal specimens (**Table 3.75**). The presence of the latter, however, even at a very low level, implies that at least some breeding stock were kept in or very close to the settlement. The epiphyseal data (**Table 3.76**), although limited by the last fusion stage being at 3–3.5 years, appear very consistent with the dental development evidence (**Fig. 3.113**). The sex adult sex ratio of caprines (**Table 3.77**) suggests that only females survived past the first few months of life, although the majority of pelves were of indeterminate sex. The caprine biometrical data possibly contradict this picture, with distal humerus Bd of goat and proximal radius Bp of sheep both including smaller and larger specimens that might tentatively be attributed to females and males, respectively (**Table 3.78**). The samples are in each case very small, however, and the assemblage also spans a few centuries during which the size of either or both species might have changed.

Stage	**Suggested Age**[1] (months)	**No. of Stages**		**Total**	
		1	2	MinAU	MinAU %
A	0-2	-	-	-	0.0
B	2-6	-	-	-	0.0
C	6-12	1s + 3	-	4	12.1
D	12-24	3s + 2	-	5	15.2
E	24-36	1g + 4	-	5	15.2
F	36-48	2s + 1g +1	-	4	12.1
G	48-72	3s + 4	1s +3	10.1	30.6
H	72-96	2s		2.9	8.7
I	96-120	2	-	2	6.1
Total		29 (11s + 2g + 16)	4 (1s + 3)	33	100.0

Table 3.74. Mandibular evidence for mortality of caprines from all contexts in Karabournaki (MinAU)

Key: 1s + 1g + 2 = 1 sheep + 1 goat + 2 sheep/goat

[1] After Payne (1987), (see 2.1.2.2; Table 2.6)

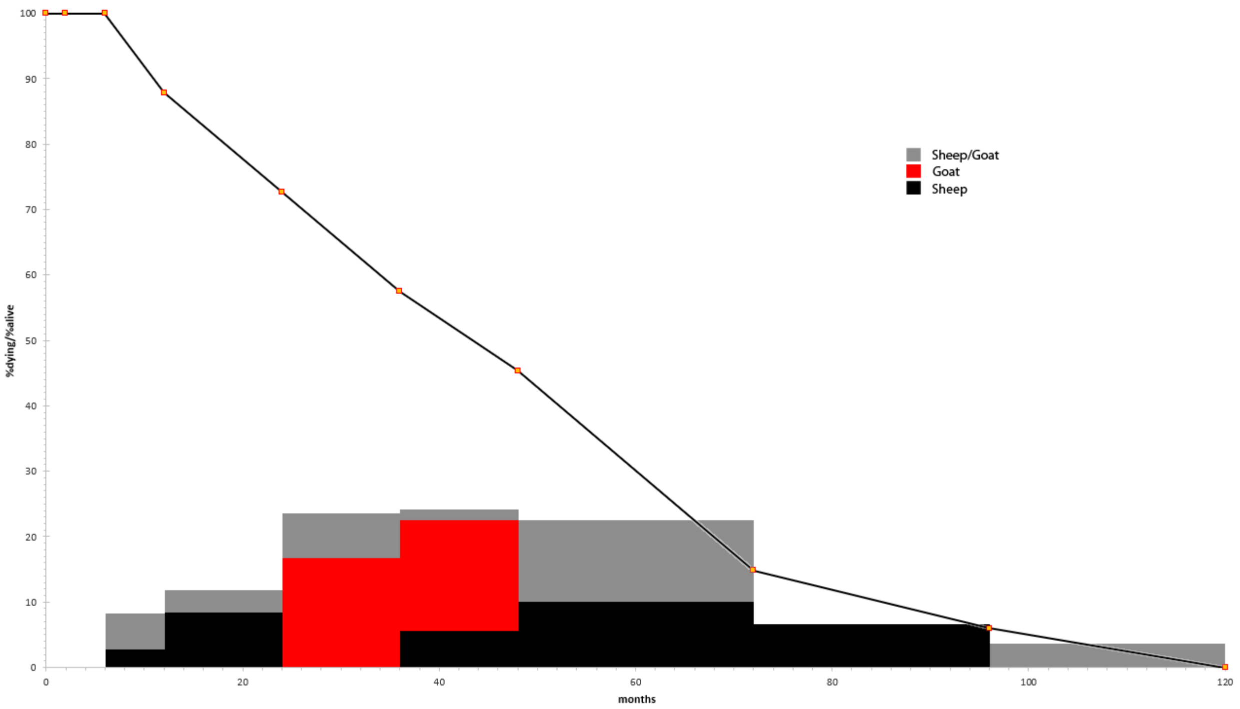

Fig. 3.112. Eruption and wear of mandibular cheek teeth data of caprines (cumulative age curve), sheep, goat, and sheep/goat (histogram) at Karabournaki (Table 3.74; MinAU)

Neonatal		**Post-neonatal**		**Total** (MinAU)
MinAU	MinAU %	MinAU	MinAU %	
1	0.3	298	99.7	299

Table 3.75. Representation of neonatal and post-neonatal specimens of caprines from all contexts at Karabournaki (MinAU)

Fusion Stage (months)[1]	**Unfused**[2] (MinAU)	**Fused**		**Indeterminate** (MinAU)
		MinAU	MinAU %	
6-10	4	26	86.7	31
13-16	1	13	92.9	2
18-28	7	23	76.7	28
30-36	10	9	47.4	11
36-42	9	10	52.6	29

Table 3.76. Epiphyseal fusion evidence for mortality in caprines from all contexts at Karabournaki (MinAU)

[1] Following Barone (1986) and Gardeisen (1997), (see 2.1.2.2; Fig. 2.10); [2] Including unfused diaphysis, unfused epiphysis, fusing specimens and specimens of immature size or texture

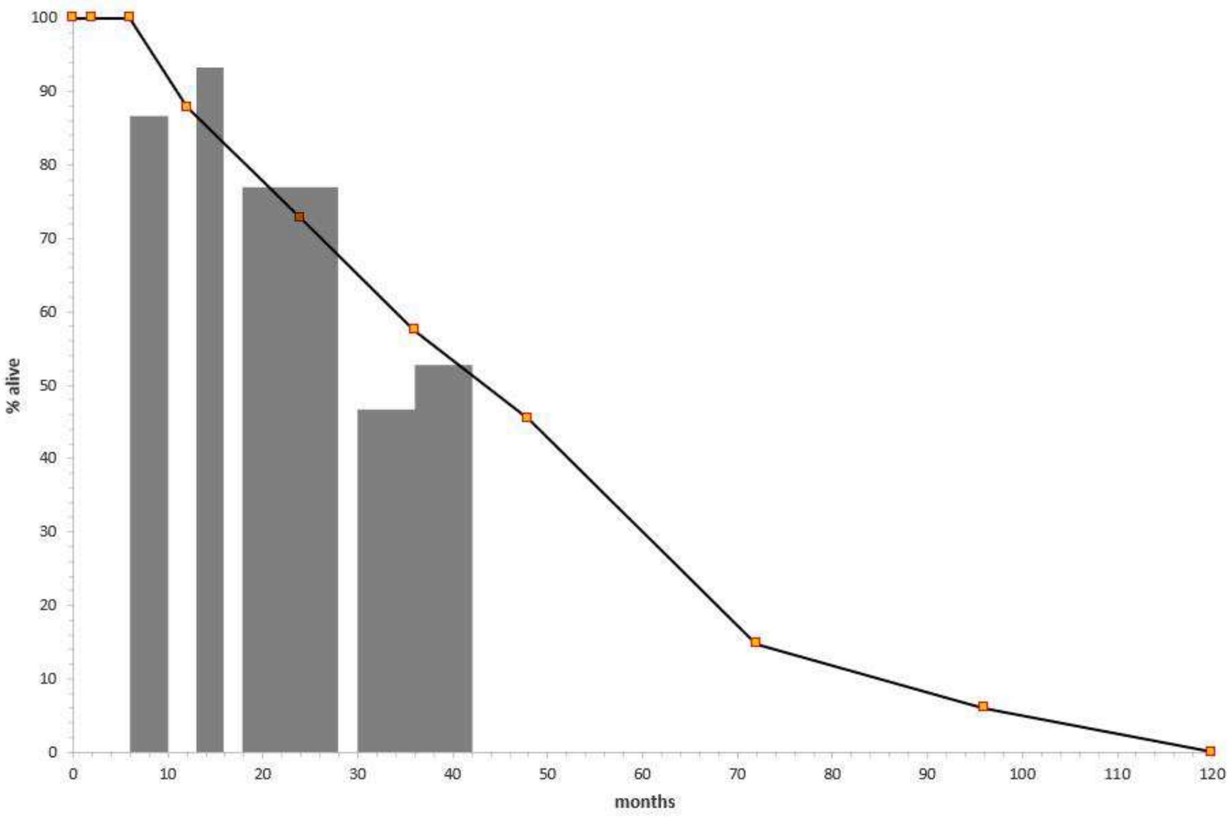

Fig. 3.113. Comparison of wear of mandibular cheek teeth (cumulative age curve) and epiphyseal fusion data (histogram) of caprines in all contexts at Karabournaki (based on Table 3.74 and Table 3.76; MinAU)

Female	Male	Indeterminate	Total (MinAU)
4 (1s + 1g + 2)	-	11 (2s + 9)	15

Table 3.77. Evidence of sexed pelves of caprines from all contexts at Karabournaki (MinAU)

Key: 1s + 1g + 2 = 1 sheep + 1 goat + 2 sheep/goat

(mm)	Scapula (SLC)	Humerus (Bd)	Radius (Bp)	Metacarpal (Bd)	Pelvis (LA)
110-119	1s				
170-179	1s				
190-199	1s				
230-239				1s	
240-249			1s	2s	
250-259				2s	
260-269				1s	1s
270-279		1s + 1g			
280-289		1g	1g		
290-299			1		
300-309			2s		
310-319			1s		
330-339			1g		
340-349		1g			
360-369		1g			
Total	3	5	7	6	1

Table 3.78. Caprine biometric data from Karabournaki: scapula SLC, humerus Bd, radius Bp, metacarpal Bd and pelvis LA, (Tables II.3 and II.6; NISP)

Key: 1s + 1g = 1 sheep + 1 goat; blue shading: possible males

In relation to management priorities of caprines at Karabournaki, the scarcity of neonatal specimens and of mandibles from the first 6 months (stages A and B) suggests that milk production was not a major husbandry goal.[332] The high proportion of adults and elderly animals suggests that caprines, mainly sheep, were reared for wool(/hair) as well as meat, mainly from goat (**Fig. 3.114**, above, **Fig. 3.112**).

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[332] Payne 1973: 281-282.

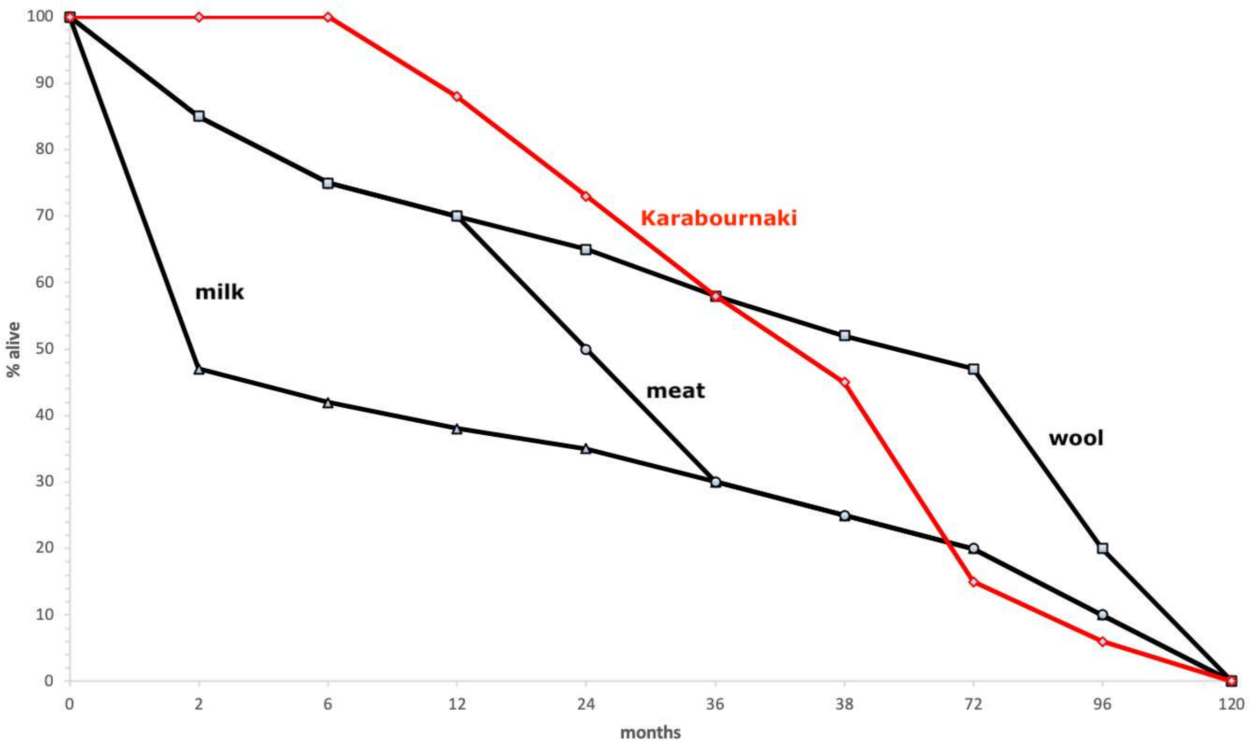

Fig. 3.114. Cumulative age curves based on eruption and wear of mandibular cheek teeth of caprines at Karabournaki (based on Table 3.74; MinAU) compared with Payne's production models (after Payne 1973: 282-284, Figs 1-3)

3.2.2.5.2. Cattle

The mortality profile of cattle, based on the admittedly meagre data from mandibular cheek teeth, again suggests a steady slaughter of young, young adult and adult animals (stages D-G) with mortality highest in stage E and G (**Table 3.79**, **Fig. 3.115**). Despite the lack of dental evidence for slaughter in the first 18 months after birth, a single neonatal specimen implies that at least some breeding stock were kept in or very close to the settlement (**Table 3.80**). The epiphyseal evidence matches poorly with that of mandibular dental development but is also internally inconsistent in implying more deaths in the first year than in the first two years and first three years inclusively (**Table 3.81**, **Fig. 3.116**). This inconsistency may be due to differential discard of some body parts (e.g. heads and feet discarded during primary butchery) of younger or older animals, but it could also be a fortuitous outcome of small sample size. Castration of males, resulting in delayed epiphyseal fusion, may also have caused age at death to be underestimated and thus contributed to the apparently lower adult survivorship implied by epiphyseal than dental data. In regard to sex distribution, only female pelves were recorded (**Table 3.82**), but the sample is far too small for any reliable conclusions to be drawn.

The dental and epiphyseal evidence for age at death are too scarce and contradictory for secure conclusions as to the management priorities of Karabournaki cattle, but the apparent combination of both young and adult deaths is compatible with exploitation for a mixture of primary (meat, etc.) and secondary products (e.g. traction).

Stage	**Suggested age**[1] (months)	**Total**	
		MinAU	MinAU %
A	0-1	-	0.0
B	1-6	-	0.0
C	6-18	-	0.0
D	18-30	1	12.5
E	30-60	2	25.0
F	young adult	1	12.5
G	adult	2	25.0
H	old adult	-	0.0
I	senile	2	25.0
Total		8	100.0

Table 3.79. Mandibular evidence for mortality of cattle from all contexts at Karabournaki (MinAU)

[1] After Halstead (1985), (see 2.1.2.2; Table 2.6)

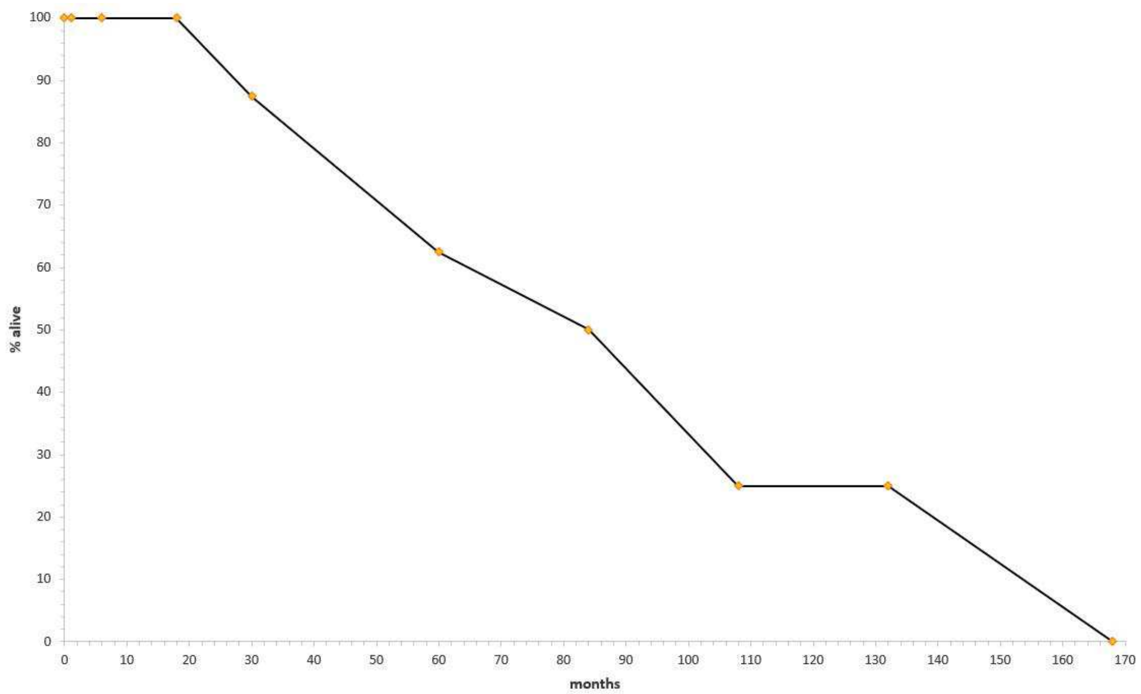

Fig. 3.115. Cumulative age curve based on eruption and wear of mandibular cheek teeth of cattle in all contexts at Karabournaki (based on Table 3.79; MinAU)

Neonatal		Post-neonatal		Total (MinAU)
MinAU	MinAU %	MinAU	MinAU %	
1	0.6	168	99.4	169

Table 3.80. Representation of neonatal and post-neonatal specimens of cattle from all contexts at Karabournaki (MinAU)

Fusion Stage[1] (months)	**Unfused**[2] (MinAU)	**Fused**		**Indeterminate** (MinAU)
		MinAU	MinAU %	
7-10	3	5	62.5	12
18	1	10	90.9	10
24-36	1	33	97.1	20
36-48	7	5	41.7	25

Table 3.81. Epiphyseal fusion evidence for mortality in cattle from all contexts at Karabournaki (MinAU)

[1] Following Barone (1986) and Gardeisen (1997), (see 2.1.2.2; Fig. 2.10); [2] Including unfused diaphysis, unfused epiphysis, fusing specimens and specimens of immature size or texture

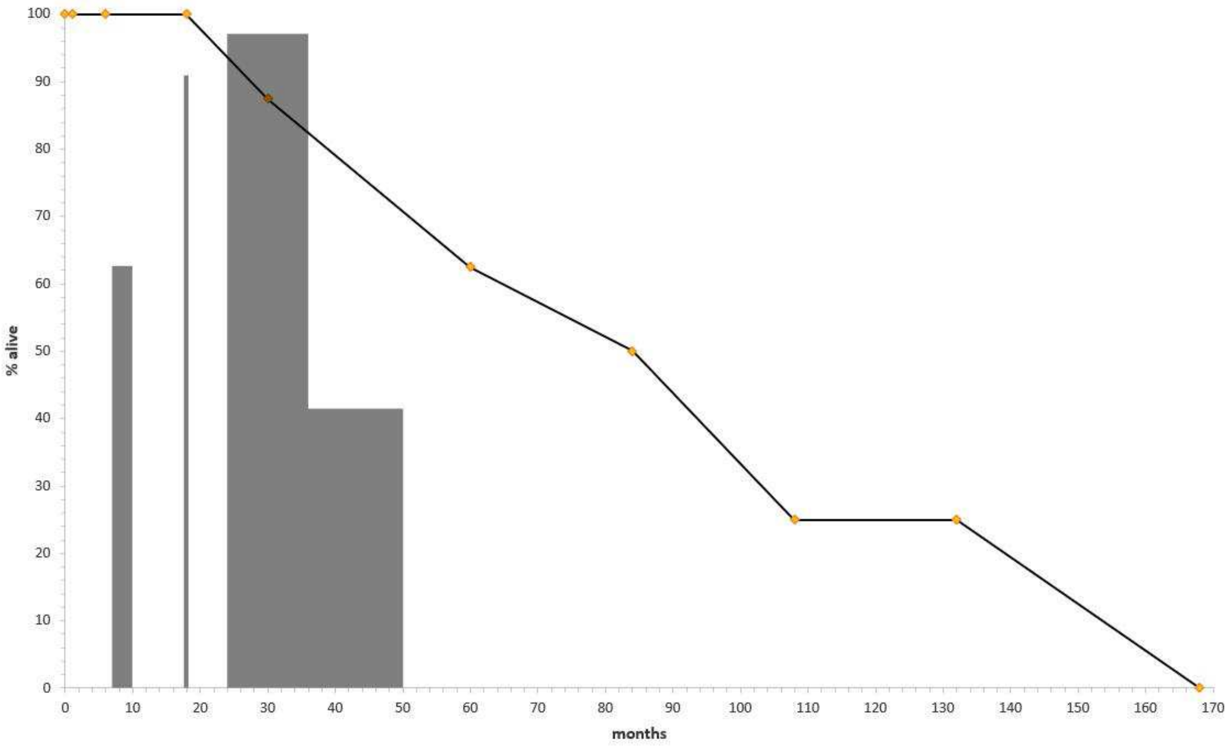

Fig. 3.116. Comparison of wear of mandibular cheek teeth (cumulative age curve) and epiphyseal fusion data (histogram) of cattle in all contexts at Karabournaki (Table 3.79 and Table 3.81; MinAU)

Female	Male	Indeterminate	Total (MinAU)
2	-	4	6

Table 3.82. Evidence of sexed pelves of cattle from all contexts at Karabournaki (MinAU)

3.2.2.5.3. Pig

Based on the mandibular data (**Table 3.83**), most pigs were as usual slaughtered young: about half as juveniles in their first year of life and another fifth as sub-adults or young adults (12-30 months), while the remaining third survived into adulthood (>2,5 years) and may have been kept for breeding (**Fig. 3.117**). One infant (stage A) mandible, together with more numerous neonatal postcranial specimens (**Table 3.84**), implies that breeding stock were kept in or very close to the settlement. The epiphyseal fusion evidence is broadly consistent with that of dental development (**Table 3.85**; **Fig. 3.118**), with the higher first-year mortality implied by the former data again perhaps attributable to small sample size and/or to castration and delayed epiphyseal fusion. As regards adult sex ratio, males are overwhelmingly predominant (**Table 3.86**) but may have been overestimated due to the known recovery bias against female canines.

In regard to the management priorities of Karabournaki pigs, slaughter was particularly intensive among piglets of 2-6 months (29%), possibly killed for their tender meat or because their carcasses were suitable for consumption by a small social group and at any rate suggesting commensality on a domestic rather than public scale. In addition to the single mandible from a piglet of 0-2 months in structure C09, four further neonatal piglets are represented by postcranial remains only from the same context. These youngest remains may represent natural infant mortality, a suggestion consistent with anatomical hints that some at least had been buried more or less intact (although cut marks, which might indicate slaughter rather than natural death, are difficult to detect on neonatal specimens). While the adult deaths (>30 months), and possibly also the subadults and young adults (12-30 months), may have been kept for breeding, some of the older individuals may also have been reared to achieve larger carcasses for bigger commensal events or to provide fat as well as meat.

Stage	**Suggested age**[1] (months)	**Total**	
		MinAU	MinAU %
A	0-2	1	4.8
B	2-6	6	28.6
C	6-12	3	14.3
D	12-24	3	14.3
E	24-30	1	4.7
F	>30	7	33.3
Total		21	100.0

Table 3.83. Mandibular evidence for mortality of pig from all contexts at Karabournaki (MinAU)

[1] After Halstead (2020), (see 2.1.2.2, Table 2.6)

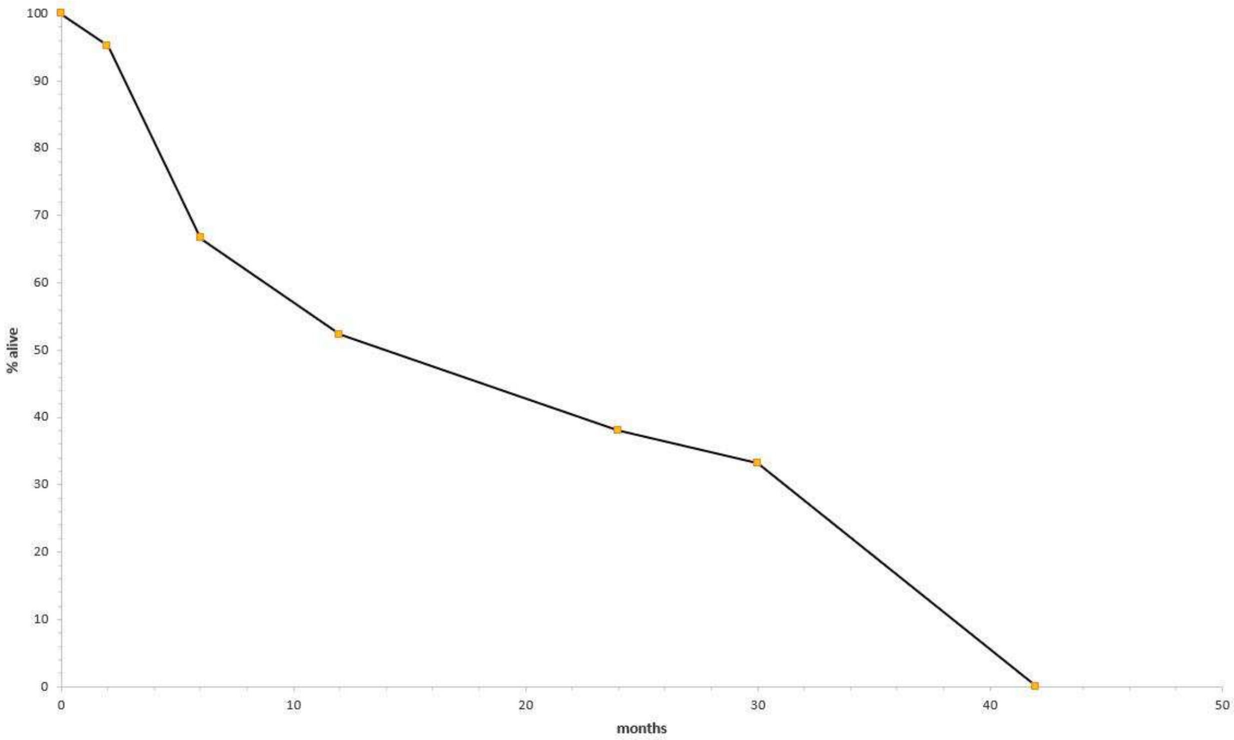

Fig. 3.117. Cumulative age curve based on eruption and wear of mandibular cheek teeth of pig in all contexts at Karabournaki (Table 3.83; MinAU)

Neonatal		**Post-neonatal**		**Total** (MinAU)
MinAU	MinAU %	MinAU	MinAU %	
7	7.4	88	92.6	95

Table 3.84. Representation of neonatal and post-neonatal specimens of pig from all contexts at Karabournaki (MinAU)

Fusion Stage[1] (months)	**Unfused**[2] (MinAU)	**Fused**		**Indeterminate** (MinAU)
		MinAU	MinAU %	
12	10	6	37.5	6
24-30	8	4	33.3	5
36-42	10	1	9.1	8

Table 3.85. Epiphyseal fusion evidence for mortality in pig from all contexts at Karabournaki (MinAU)

[1] Following Barone (1986) and Gardeisen (1997), (see 2.1.2.2; Fig. 2.10); [2] Including unfused diaphysis, unfused epiphysis, fusing specimens and specimens of immature size or texture

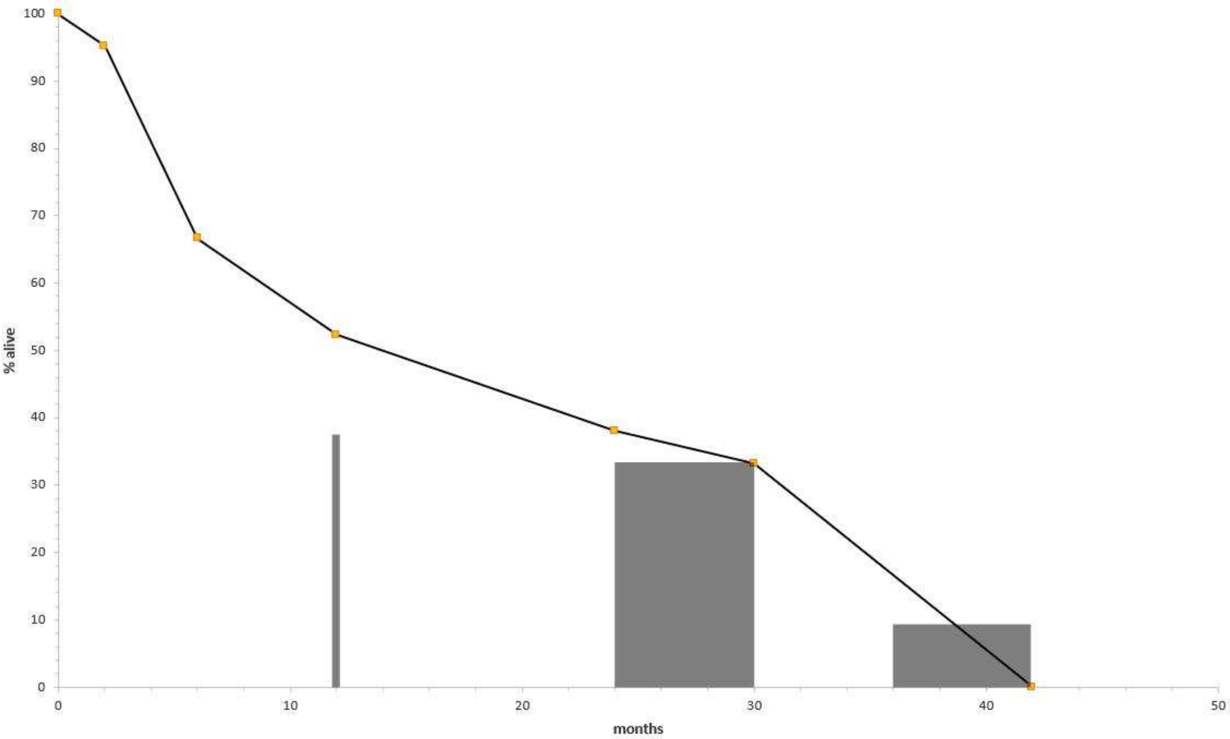

Fig. 3.118. Comparison of wear of mandible cheek teeth (cumulative age curve) and epiphyseal fusion data (histogram) of pig in all contexts at Karabournaki (Table 3.83 and Table 3.85; MinAU)

Female	**Male**	**Indeterminate**	**Total** (MinAU)
2	6	5	13

Table 3.86. Evidence of sexed mandibular canines of pig from all contexts at Karabournaki (MinAU)

3.2.2.6. Living conditions

The management of the main productive species could have affected their living conditions, which can be evidenced in bone and tooth disease and skeletal wounds. However, macroscopic study did not record any pathological cases in any of the species, suggesting that animal health was good. This could be an indirect sign of good quality living conditions and diet.

3.2.3. Synthesis

The settlement of Karabournaki is located between the nowadays city of Thessaloniki to the north and the Anthemous Valley to the south and was occupied from the 15th c. BC to the 20th c. AD. The studied animal bone deposits were derived from two pits and 16 beehive-shaped, semi-subterranean structures (89 stratigraphic units) revealed within the settlement, covering the period from the Early Iron Age to the Classical era. The sample assemblage includes 1,973 specimens, of which 1,614 (592 MinAU) were identified to the level of species, genus, subfamily, class, and animal size. The broad date range of the contents and the small number of identified specimens, both in NISP and MinAU, in most cases are an obstacle to detailed analysis by context or period. Thus, the analysis only relates to the assemblage as a whole, and any proposed interpretations regarding animal management, cooking practices, exploitation of natural resources and discard policy must be considered with caution given their coarse chronological resolution.

The death assemblage was composed of both domestic and a small range of wild fauna. The former includes the four main productive species, namely sheep, goat, cattle, and pig. The remains of caprines dominate in almost all contexts, with sheep in higher proportions than goat. They were exploited mostly for their meat and wool(/hair), with no evidence of intensive dairying. Cattle was the second most abundant species in most contexts. The age at death profile suggests meat-oriented management, possibly combined with traction. Pig was bred mainly for meat, with a preference in this case for young piglets.

Butchery included on-site skinning, dismembering, and filleting for the main domestic species. Roasting is the only documented cooking practice and was used with all four productive domesticates. In the cases of caprines and cattle, all anatomical units were roasted, indicating that these animals were roasted whole. The domesticates were consumed for their flesh and their bones were further exploited through chopping for marrow extraction. This practice seems to have been more extensive in cattle than in caprines and pig. Moreover, some bones, namely talus, metapodial and calcaneus, mostly of caprines but also of cattle, were used as raw material for making objects.

The data from the other domestic animals, namely dog and donkey, are sparse, and thus no secure inferences can be made regarding their use. However, it seems that even though both species were consumed, their sparse representation implies that this was probably only occasional. The presence of dogs is also documented by gnawing marks on the bones of other species, but, as was the case in Argilos, their impact on faunal preservation was shaped partly by the rapid burial of most bone refuse and partly by human removal of marrow prior to discard. With regard to game species, red deer predominate, followed by hare and roe deer. Red deer was not only consumed for meat but their shed antlers were also collected and used as raw material for artefact production. Mallard was also hunted, while the remains of tortoise carapace probably relate to later intrusions through burrows. Exploitation of the wild fauna also extended to salt- and freshwater fish and shellfish. Evidence of the consumption of both terrestrial and marine fauna indicates that the inhabitants of Karabournaki exploited the surrounding environment broadly for both food and raw materials. Regarding the raw materials, even though they were not detectable archaeologically, skin, feathers, gelatine and perhaps keratin could also have been exploited from both domestic and wild animals.

The origins of the animal bone deposits inside the pits and the structures varies. The majority of the bone remains represented refuse from primary butchery, food preparation and consumption, while some heavily burnt material had perhaps been used as fuel and some specimens bear traces of working. The bone remains within each context also varies in terms of quantity, species, anatomical parts, and traces of pre- and post-depositional alteration, but the broad chronological range of each fill proposes that the contents were derived from multiple, and probably diverse, depositional events over time.

After their abandonment, the beehive-shaped semi-subterranean structures, were the main receptacles for bone remains, and few specimens were found in the pits. Some of the bones were discarded directly inside the structures (e.g., most obviously the more or less intact skeletons of neonatal piglets in the Structure C09), while a very few, after being discarded, were exposed on the surface long enough to exhibit clear signs of weathering. Additionally, some of the remains were exposed, at least temporarily, to gnawing by dogs (and possibly trampling by humans). But overall, the state of preservation of the assemblage suggests that most discarded bones were buried fairly rapidly. Moreover, several groups of articulating bone specimens (in addition to the neonatal pigs) indicate limited disturbance after incorporation in at least some of these refuse dumps. The location of the waste dumps within the city grid and the composition of the discarded contents imply that the bone remains most probably came from nearby households, while the few worked specimens may also have been derived from craft workshops, such as the pottery and metalworking workshops detected.

3.3. Kastri Thassos

3.3.1. The settlement of Kastri

The settlement of Kastri is located on the flat summit of its namesake hill, near the modern-day village of Theologos, in the south of the interior of the island of Thassos (**Fig. 3.119**).

Fig. 3.119. The location of Kastri on Thassos island (©Apple Maps)

3.3.1.1. The historical framework

There is no historical information regarding the area of Theologos during the Early Iron Age, while mentions in the surviving ancient literary sources of the island's inhabitants prior to the arrival of the first Greek settlers from the island of Paros in the 7th c. BC are minimal.[333] According to the sources, the island was inhabited by the Phoenicians,[334] who succeeded the previous inhabitants, as well as the Thracian tribes of Odonians,[335] Edonians and Sapaioi. On this basis, the Phoenicians would have arrived on the island in the 10th–9th c. BC, led there by Kadmos and Thassos to establish a trading post. They were also the first to exploit the mines at Koinura and Ainura on the eastern part of the island.[336] No relevant information is available for the Odonians or the Edonians, apart from one detail that Thassos had previously been called Odonis,[337] referring to the first of these two tribes. Archilochos mentions the Sapaioi among the inhabitants of the island. They were driven out by the Greek settlers to the opposite coast of Thrace, according to the *Momentum Archilochi*. They remained there until the Parians and the Naxians fought for control of the island in the 7th c. BC:[338] the Parians asked the Sapaioi for help and in return allowed them to resettle on the island.[339]

Hence, it appears that the arrival of Greek settlers led to the expulsion of the local Thracian tribes for some time until they returned and shared the island peacefully with the Greeks, as the archaeological evidence from Limenas Thassos indicates.[340]

3.3.1.2. Archaeological research

The prehistoric site of Kastri was first excavated in 1971–1980 by the Greek Archaeological Service under Dr. Ch. Koukouli-Chrysanthaki. The excavations brought to light architectural

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[333] Lazaridis 1971: 14.
[334] Pseudo-Scymnus, lines 659-662.
[335] Stephanus Byzantius, s.v. Ὤδονες.
[336] Herodotus VI, 47.
[337] Hesychius, s.v. Οδωνίς.
[338] Pouilloux 1954: 30-31.
[339] Tsantsanoglou 2003: 235-255.
[340] Papadopoulos and Zannis 2009: 104.

remnants of two habitation phases. The first dates from the Late Neolithic I and II, while the second dates from the Late Bronze Age to the Early Iron Age. Additionally, cemeteries belonging to the settlement were excavated at the nearby sites of Tsiganadika, Kentria and Larnaki, dating from the Late Bronze Age and the Early Iron Age.[341]

3.3.1.3. Settlement organization

The settlement located on a hill (**Fig. 3.120**) and the earliest habitation phases from Late Neolithic I and II are represented by limited architectural remnants, mostly timber-framed circular or apsidal buildings.[342] Hearths, ovens, successive floors and large storage pithoi were found inside. Extensive layers of pebbles were also revealed, probably belonging to open-air yards.[343]

Fig. 3.120. The hill of Kastri (Papadopoulos and Nerantzis 2014:71, Fig. 3)

After Late Neolithic II, the settlement seems to have been abandoned and reoccupied during the Late Bronze Age until the Early Iron Age, when it was permanently abandoned. The rectangular stone structures discovered belong to the later habitation phase. From these structures only one building, House I, has been identified (**Fig. 3.121**). A stone enclosure was also found along the northern and western edge of the hill. The use of this enclosure is unknown, but, given the

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[341] Koukouli-Chrysanthaki 1992.
[342] Koukouli-Chrysanthaki 1970: 16.
[343] Koukouli-Chrysanthaki 1973: 445.

exceptional natural defences of the site, it probably functioned as a buttress wall, although it is possible that it marked the boundary of the settlement.[344] Rock paintings with spirals and curved snake-like lines, found outside the settlement,[345] were probably also associated with the latter habitation phase of the settlement.

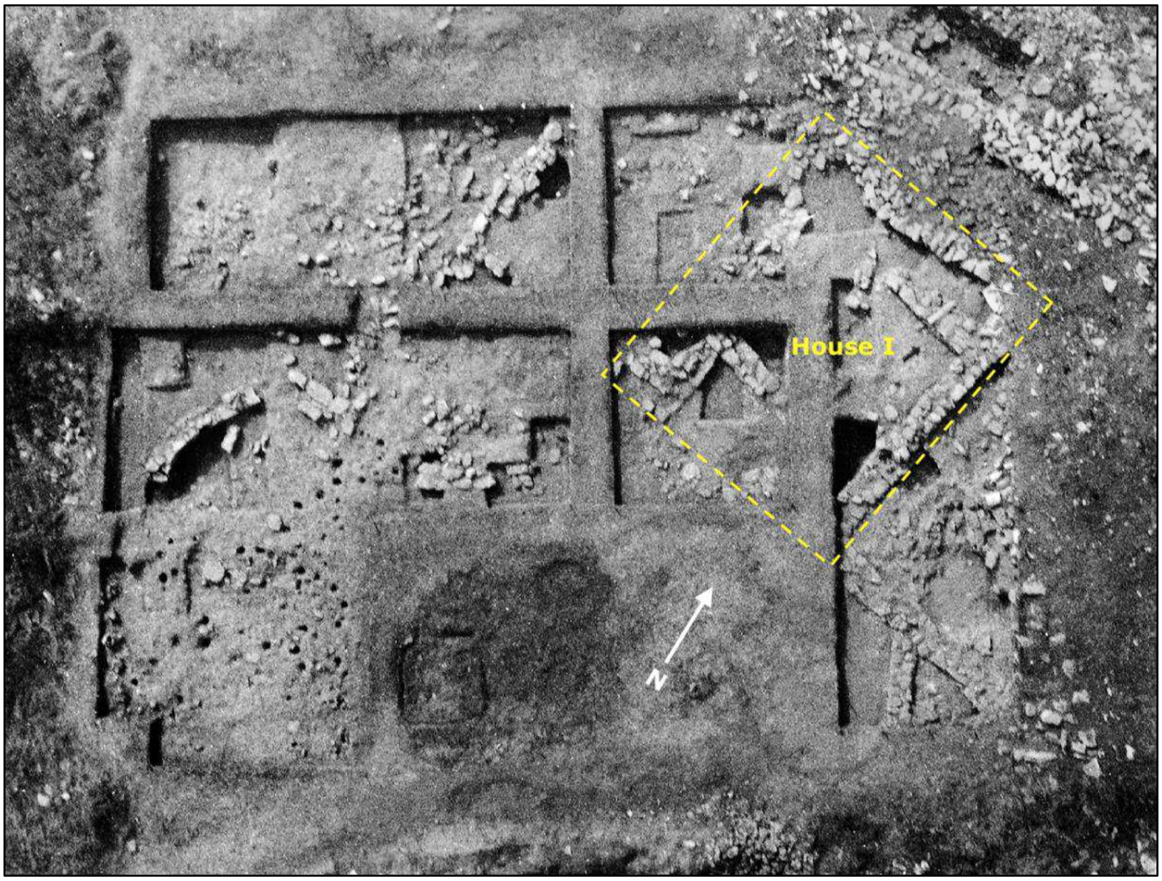

Fig. 3.121. The structural remains and House I at Kastri (Papadopoulos and Nerantzis 2014: 73, Fig. 8)

The cemeteries of Kastri at Kentria, Larnaki and Tsiganadika date back to the Late Bronze Age and Early Iron Age (1300–700 BC) and comprise two types of burials. The first is an above-ground burial chamber, single- or double-spaced, with a rectangular, circular or horseshoe-shaped plan, while the second is a rectangular platform with a niche at its centre which contained the burial.[346]

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[344] Papadopoulos and Nerantzis 2014: 74.
[345] Koukouli-Chrysanthaki 2012: 16.
[346] Koukouli-Chrysanthaki 1992: 371-372.

According to the excavator, the spatial organization of the cemeteries indicates that the society at Kastri during the Late Bronze Age and Early Iron Age was separated into clans.[347]

3.3.2. The zooarchaeological study

The zooarchaeological remains from Kastri include both terrestrial and aquatic faunal remains. The latter, which include only marine shellfish,[348] are not included in this study. Thus, the present study concerns all the terrestrial faunal remains from the second habitation phase dated to the Early Iron Age. The recorded bone remains were derived from the interior of House I, while the rest were found scattered among the ruins of other structures south and south-east of House I (**Fig. 3.122**). The use and function of these structures is still unknown, as their study has not yet been completed. Thus, the assemblage was analysed as a whole and no contextual analysis has been undertaken.

The faunal analysis aims to explore animal management and consumption and discard practices in Early Iron Age Kastri (hereafter EIA Kastri). The following sections present and analyse taxonomic composition, taphonomy, carcass processing, mortality patterns and management strategies, concluding with a synthesis of animal exploitation at EIA Kastri.

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[347] Koukouli-Chrysanthaki 1992; Owen disagrees, arguing that elements of social differentiation, such as gold and silver, are now lost, and the surviving funerary data do not suffice to support the aforementioned hypothesis (Owen 2006, 360).

[348] Karali 1999: 389-399.

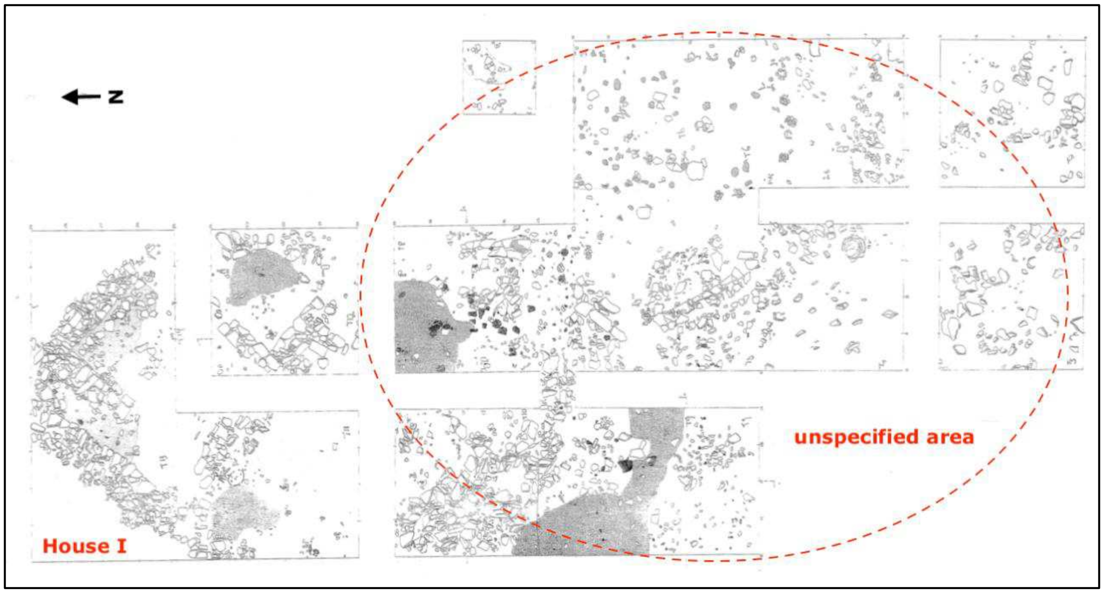

Fig. 3.122. The excavated section at Kastri; for practical reason the plan has been inverted (Kastri excavation archives)

3.3.2.1. The assemblage and species representation

The faunal material from EIA Kastri derived from 116 stratigraphic units and was collected during the systematic excavation seasons of 1973, 1976, 1978 and 1980.[349] Five of these units came from the interior of House I and the remaining 111 from the areas south and south-east of House I, where unknown construction remains were revealed (above, **Fig. 3.122)**. From House I, 57 specimens were recorded, and the remaining 3,084 specimens came from the unknown structural remains (**Table 3.87**). For initial taxonomic presentation, the specimens were quantified in terms of NISP, while the composition of the identified species was quantified in MinAU. In the case of sheep and goat, specimens identified only to the level of sheep/goat have been assigned to these two species proportionately.

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[349] Koukouli-Chrysanthaki 1992.

Context	No. Stratigraphic Units	NISP
House I	5	57
Area south and south-east of House I	111	3,084
All contexts	116	3,141

Table 3.87. Stratigraphic units and number of recorded specimens at EIA Kastri (NISP)

Specimens from seven domesticated and three wild taxa were identified. The domesticated animals are sheep (*Ovis aries*), goat (*Capra hircus*), cattle (*Bos taurus*), pig (*Sus domesticus*), dog (*Canis familiaris*), donkey (*Equus asinus*) and horse (*Equus caballus*); and the wild taxa are red deer (*Cervus elaphus*), hare (*Lepus europaeus*) and tortoise (*Testudo* sp.) (Appendix I: **Table I.24**). Comparison of goat measurements between Kastri and Kastanas, the only Early Iron Age publication for North Greece, shows some limb bones from Kastri with measurements higher than at Kastanas. The specimens with higher measurements (shaded blue in **Table 3.88**) may belong to adult males, given the marked sexual dimorphism in goats, or to castrated males. Alternatively, it is possible that some of the bigger specimens correspond to feral goats.

Measurements (mm)	Kastri			Kastanas		
	No.[1]	min	max	No.[1]	min	max
Scapula						
GLP	2	36.1	38.5	2	28.7	32.6
LG	5	25.5	29.4	5	22.4	27.6
BG	9	19.4	29.2	5	18.7	23.4
SLC (KLC)	12	15.1	27.3	8	17.2	19.9
Humerus						
Bd	6	29.6	38.8	28	28.0	35.3
Radius						
Bp	6	29.5	38.4	31	27.9	35.3
BFp	6	27.9	36.9	30	25.7	35.7
Bd	2	29.7	30.0	10	28.1	33.0
Metacarpal						
Bp	3	26.0	31.0	22	20.6	26.7
Bd	6	24.5	27.8	12	24.8	30.9
Pelvis						
LA (female)	3	26.6	29.8	15	24.0	30.3
Femur						
Bp	1	45.5		5	41.6	49.9
Bd	2	34.8	36.0	3	38.1	39.4
Tibia						
Bd	13	22.6	47.5	44	21.4	29.5
Talus						
GLl	7	26.7	30.7	12	26.1	31.4
GLm	6	24.7	28.1	12	24.3	29.7
Dl	6	14.0	16.5	12	16.4	20.5
Calcaneus						
GL	4	57.1	68.1	8	47.5	61.4
GB	3	21.5	24.2	7	20.3	22.3
Metatarsal						
Bp	4	20.1	24.5	17	18.1	24.2
Bd	2	24.5	24.7	12	22.0	24.8
Phalanx I						
Bp	8	14.6	18.2	18	10.9	13.8
Bd	7	14.1	18.0	19	10.4	14.0

Table 3.88. Metrical data (mm) for goat from EIA Kastri (Appendix II: Table II.7), with comparative data for goat from MBA-EIA Kastanas (Becker 1986: 353-354, Table XXIV); blue shading: possible males or feral goats

[1] Number of specimens

Mammals identified to taxon make up 70%, tortoise <1% and indeterminate specimens identified only to mammalian size class 30% of the assemblage (**Table 3.89**). Among the indeterminate specimens, the dominance of medium-sized mammals (87%; **Table 3.90**) matches the dominance of the identified medium-sized species, namely sheep, goat, and pig (93% NISP, 92% MinAU; **Table 3.91**). Second in abundance are the large-sized indeterminate (12%; **Table 3.90**) and large identified animals, namely cattle, horse, donkey, and red deer (7% NISP, 7% MinAU; **Table 3.91**), and third are the small-sized indeterminate (<1%; **Table 3.90**) and identified species, in EIA Kastri represented by dog and hare (each <1% NISP, <1% MinAU; **Table 3.91**). The percentages of indeterminate mammals are quite similar to those for identified species of the corresponding size, with the exception of the large-sized animals, where the percentages of the identified specimens are less than the indeterminate ones. This discrepancy might be due to a difference in treatment of carcasses of different size, with the trunk (indeterminate ribs, vertebrae) of big species more frequently introduced to the site and the identified limb bones more frequently discarded off-site. However, the breakage (old and new) of both trunk and limb bones, which tends to be more intensive in large-sized animals, could also be the cause, inflating the indeterminate specimens.

	NISP	NISP %
Identified mammals	2,195	69.9
Tortoise	14	0.4
Size classes (mammals)	932	29.7
Total	3,141	100.0

Table 3.89. Taxonomic composition at EIA Kastri (Appendix I: Table I.24, NISP)

	NISP	NISP %
Small sized	7	0.8
Medium sized	810	86.9
Large sized	115	12.3
Total	932	100.0

Table 3.90. Composition of mammal size categories at EIA Kastri (Appendix I: Table I.24, NISP)

	NISP	NISP %[1]	MinAU	MinAU %[1]
Sheep[1]	155	41.9	154	42.2
Sheep/Goat	1,603	-	773	-
Goat[1]	170	45.9	160	43.9
Cattle	133	6.1	84	6.7
Pig	111	5.1	68	5.4
Dog	5	0.2	5	0.4
Donkey	2	0.1	2	0.2
Horse	4	0.2	4	0.3
Red deer	3	0.1	3	0.2
Hare	9	0.4	9	0.7
Total	2,195	100.0	1,262	100.0

Table 3.91. Species composition at EIA Kastri (Appendix I: Table I.24, NISP-MinAU)

[1] Percentages of sheep and goat include sheep/goat assigned proportionately (NISP-MinAU)

In terms of MinAU, the domesticates are dominated equally by goat (44%) and sheep (42%), followed by cattle (7%), pig (5%) and dog, horse, and donkey (all <1%). Among the wild animals, hare predominates followed by red deer (both <1%), (**Fig. 3.123**).

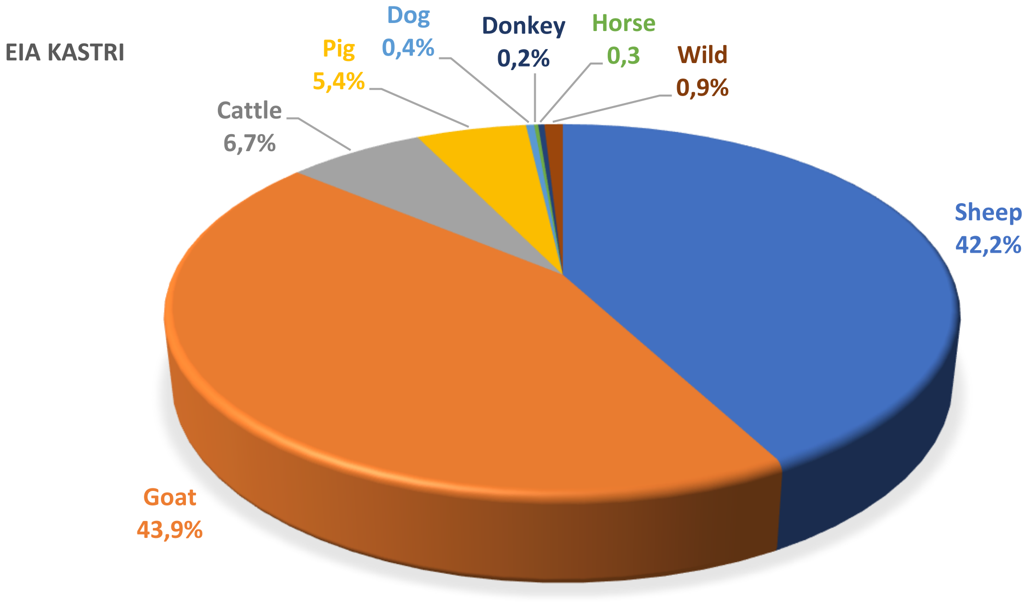

Fig. 3.123. Species representation at EIA Kastri (Table 3.91; MinAU 1,262)

3.3.2.2. Taphonomy: Post-depositional factors

As described for Argilos, taphonomic analysis was conducted in reverse chronological order, beginning with any factors that shaped the sample assemblage during after excavation (human agents) and then those that shaped the faunal assemblage after discard (environmental and carnivore attrition). Human agent effects relate to excavation and retrieval methods, environmental agents include weathering and vegetation roots, and carnivore agents are mainly related to the activity of scavengers. These agents could have affected the preservation of the sample assemblage and thus, the interpretation of the deposited assemblage. The assemblage was quantified in terms of NISP or MinAU, as in the case of Argilos and Karabournaki, while tortoise and indeterminate specimens assigned to the three animal size categories were excluded from the analysis of post-depositional factors. Sheep, goat, and sheep/goat were merged into a single group, caprines, as, due to their similarity in size and structure, they are expected to be affected similarly by post-depositional processes. Moreover, particular body parts from the identified taxa were excluded, namely frontal, occipital, temporal, and indeterminate long bones[350] and, in some analyses, loose teeth and loose epiphyses. Neonatal specimens were also excluded as they are very vulnerable to breakage and their undeveloped bone surface causes difficulties in distinguishing any taphonomic traces (**Fig. 3.124**).

Fig. 3.124. Example of an undeveloped surface of a right radius diaphysis of a neonatal caprine (EIA Kastri, SU 759), (©A. Gkotsinas)

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[350] Due to procedural issues the taphonomic variables were not recorded for frontal, occipital, temporal, and indeterminate long bone specimens.

3.3.2.2.1. Human agents

In this section, retrieval methods and excavation techniques are explored to investigate the formation of the sample assemblage. In regard to retrieval methods, faunal remains were recovered only by hand, without either wet- or dry-sieving, posing a risk of both severe and selective losses. Hand-picking increases the amount of material lost and leads to under- or non-representation of smaller and younger animals, and small anatomical parts and bone fragments, as these are often not easily discernible in the ground.[351] **Table 3.92** explores the possibility that the retrieval method was anatomically biased by comparing the frequency of the small and large limb bones of a complete skeleton with the respective frequencies of specimens recovered for the main domesticates, caprines, cattle and pig. As **Table 3.92** shows, the post-neonatal small limb bones of all three taxa are underrepresented, with cattle the closest to what is expected for a complete skeleton. This may be explained by the fact that small cattle bones are more easily detectable when collected by hand, in contrast with those of caprines and pig, which are much smaller. Alternatively, some small body parts, such as phalanges, may be underrepresented for reasons other than retrieval if they were separated from the rest of the carcass during butchery and discarded at an off-site location. **Table 3.93** explores this possibility for caprines with reference to three anatomically adjacent sets of body parts (the sample size for pig is too small to be informative).

	Caprines			Cattle			Pig		
	Large[1]	Small[2]	Small %	Large[1]	Small[2]	Small %	Large[1]	Small[2]	Small %
Expected (whole skeleton)	28	18	39.1	28	18	39.1	28	18	39.1
EIA Kastri	743	222	23.0	54	26	32.5	46	12	20.7

Table 3.92. Abundance of small and large limb bones of caprines, cattle and pig at EIA Kastri (neonatal specimens excluded; MinAU 1,103)

[1] Scapula, humerus, radius, pelvis, femur, tibia, metapodial (metacarpal, metatarsal, metacarpal/metatarsal); [2] Ulna, talus, calcaneus, phalanx I, phalanx II, phalanx III

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[351] Payne 1972b.

		Caprines	Pig
1st set	Radius proximal	110	3
	Ulna proximal	35	2
2nd set	Tibia distal	58	2
	Talus	34	1
	Calcaneus	28	2
	Metatarsal proximal	42	-
3rd set	Metapodial distal	67	3
	Phalanx I	82	7
	Phalanx II	32	-
	Phalanx III	11	-

Table 3.93. Abundance of small and large limb bones in the three articulated sets for caprines and pig at EIA Kastri (neonatal specimens excluded; MinAU 519)

In the case of the first anatomical set, the radius and ulna are not usually separated during butchery, so the marked under-representation of the smaller ulna is compatible with incomplete retrieval (although differential survival is another possible factor, given that the proximal ulna fuses after the proximal radius). In the case of the second set, the smaller talus and calcaneus are fewer than both the distal tibia and the proximal metatarsal and so must be under-represented for reasons of incomplete recovery rather than off-site discard. In regard to the third set of articulated specimens, the strong underrepresentation of the smallest phalanx II and phalanx III could in principle be due to off-site butchery (if carcasses were dressed to below phalanx I) but is more parsimoniously attributed to during retrieval.

The extent of damage during excavation and storage was estimated from the frequency of fresh breaks of long bones. As shown in **Table 3.94** and in **Table 3.95**, 19% of long bones bear fresh breaks, with medium sized animals, namely caprines (20%) and pig (18%), affected slightly more than cattle (14%), possibly because cattle bones are bigger, and so easier to detect, and also more robust and thus less prone to accidental breakage during digging. The high frequency of fresh breaks at EIA Kastri has probably caused some loss of potentially identifiable material and will certainly have deflated the number of complete or almost complete bones, thus potentially distorting fragmentation patterns as evidence for carcass processing, and also have reduced the availability of biometric data. Additionally, it is likely to have contributed to retrieval losses, since the resulting smaller fragments are more likely to have been missed.

	All taxa	
	NISP	NISP %
New break	190	19.2
Total[1]	988	-

Table 3.94. Incidence of freshly broken long bones of taxonomically identified material at EIA Kastri (neonatal specimens excluded; NISP)

[1] Includes all long bones, complete and fragmented (old and fresh breakages)

	Caprines		Cattle		Pig		Total	
	NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %
New break	175	19.7	7	13.7	7	17.5	189	19.3
Total[1]	887	-	51	-	40	-	978	-

Table 3.95. Incidence of freshly broken long bones of caprines, cattle and pig at EIA Kastri (neonatal specimens excluded; NISP)

[1] Includes all long bones, complete and fragmented (old and fresh breakages)

In sum, the above analysis suggest that human agents have affected the composition of the sample assemblage during and after excavation. The smaller limb bones are underrepresented compared to larger ones in caprines and pig, probably as a result of archaeological recovery losses, while breakage during and/or after excavation is particularly likely to have distorted fragmentation patterns as evidence for carcass processing.

3.3.2.2.2. Environmental agents

Environmental factors, namely vegetation (root etching), soil (encrustation) and weather (sun, rain), may have affected the preservation of the faunal assemblage. **Table 3.96** shows the incidence of environmental attrition in EIA Kastri. Vegetation (root etching; **Fig. 3.125**) has affected the highest proportion of the sample (27%), followed by encrustation (7%) and weathering (1%). The high proportion of root etching is most likely due to the existence of vegetation on the surface of the soil and the relatively shallow depth of the EIA deposits at Kastri. Root etching is likely to have obscured surface traces scavenging and butchery and so have biased interpretation of these two assemblage formation processes. Encrustation, related to the soil mineral content and pH of the burial environment, may similarly have obscured scavenging and butchery traces due to the hard and sometimes thick layer that may build up on the surface of specimens (**Fig. 3.126**). In addition, two specimens bear stains of reddish pigmentation, which are probably related to bacteria and fungi, while the presence of trace levels of minerals, such as manganese, in combination with the pH level cannot be excluded as a source of the stains (**Fig. 3.127**). Finally, weathering, caused by the exposure of specimens to sun and rain, has not significantly affected the formation of the assemblage, suggesting that the bone remains were buried directly or soon after discard.

	All taxa	
	NISP	NISP %
Weathered	16	0.9
Root etching	466	27.1
Encrustation	118	6.9
Total[1]	1,720	-

Table 3.96. Incidence of environmental attrition on taxonomically identified material at EIA Kastri (loose teeth and neonatal specimens excluded; NISP)

[1] Includes all specimens, with and without environmental traces

Fig. 3.125. Vegetation traces on a caprine right radius (EIA Kastri, SU 333), (©A. Gkotsinas)

Fig. 3.126. Encrustation on a pig left scapula (EIA Kastri, SU 667), (©A. Gkotsinas)

Fig. 3.127. Reddish stains on a caprine left ulna (EIA Kastri, SU 140), (©A. Gkotsinas)

In relation to the taxonomic distribution of these environmental factors, root etching and encrustation most affected pig (31% and 14% respectively; **Table 3.97**), although this might be a result of the relatively small sample size (NISP 85).

	Caprines		**Cattle**		**Pig**		**Total**	
	NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %
Weathered	12	0.8	2	1.6	1	1.2	15	0.9
Root etching	405	27.3	26	20.6	26	30.6	457	27.0
Encrustation	92	6.2	11	8.7	12	14.1	115	6.8
Total[1]	1,484	-	126	-	85	-	1,695	-

Table 3.97. Incidence of environmental attrition in caprines, cattle and pig at EIA Kastri (loose teeth and neonatal specimens excluded; NISP)

[1] Includes all specimens, with and without environmental traces

3.3.2.2.3. Animal agents

The animal contribution to the formation of the faunal assemblage was documented through gnawing marks, digested specimens, and patterns of fragmentation. Traces of gnawing occur on 15% of the identified postcranial bones of post-neonatal specimens (**Table 3.98**). Most of these bones (14 %) have a pitted surface (**Fig. 3.128**) suggestive of gnawing by carnivores and may plausibly be attributed to domestic dogs, as they are represented in the assemblage. A very small percentage of bones (1%) displays bites by rodents, while the majority (85%) of the bones are unaffected by gnawing. Moreover, one specimen, a caprine talus, was recorded as digested – probably by a dog. The overall frequency of gnawing marks suggests that dog activity was moderate within the excavated area of the settlement.

Gnawing traces	**All taxa**	
	NISP	NISP %
Carnivore	239	13.9
Rodent	17	1.0
Total[1]	1,720	-

Table 3.98. Incidence of gnawing on taxonomically identified material at EIA Kastri (loose teeth and neonatal specimens excluded; NISP)

[1] Includes all specimens, with and without gnawing traces

Fig. 3.128. Gnawing traces on a caprine left scapula (EIA Kastri, SU 557), (©A. Gkotsinas)

Among the main domestic taxa, the frequency of dog gnawing does not differ between caprines (14%) and cattle (14%), but is lower in pig (9%), (**Table 3.99**), perhaps due to the relatively small sample size or to the high levels of root etching, and encrustation (above, **Table 3.97**). To further explore the impact of the carnivore activity in the main domesticates, anatomical representation at Kastri is compared with the descending order of survival frequency observed by Brain (1981) for modern goat skeletons subjected to gnawing and trampling; to control for the possible influence of partial recovery, the smallest body parts (calcaneus, talus, and phalanges) are distinguished by light fill in the histograms. Anatomical representation is erratic in the case of the modest samples of cattle (MinAU 66) and pig (MinAU 61) bones and bears little resemblance to Brain's model in the case of the much larger sample of caprines (MinAU 898). On this basis, it appears that attrition by dogs has influenced anatomical representation of the principal domesticates only modestly (**Fig. 3.129**).

Gnawing traces	**Caprines**		**Cattle**		**Pig**		**Total**	
	NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %
Carnivore	212	14.3	17	13.5	8	9.4	237	14.0
Rodent	14	0.9	2	1.6	1	1.2	17	1.0
Total[1]	1,484	-	126	-	85	-	1,695	-

Table 3.99. Incidence of gnawing in caprines, cattle and pig at EIA Kastri (loose teeth and neonatal specimens excluded; NISP)

[1] Includes all specimens, with and without gnawing traces

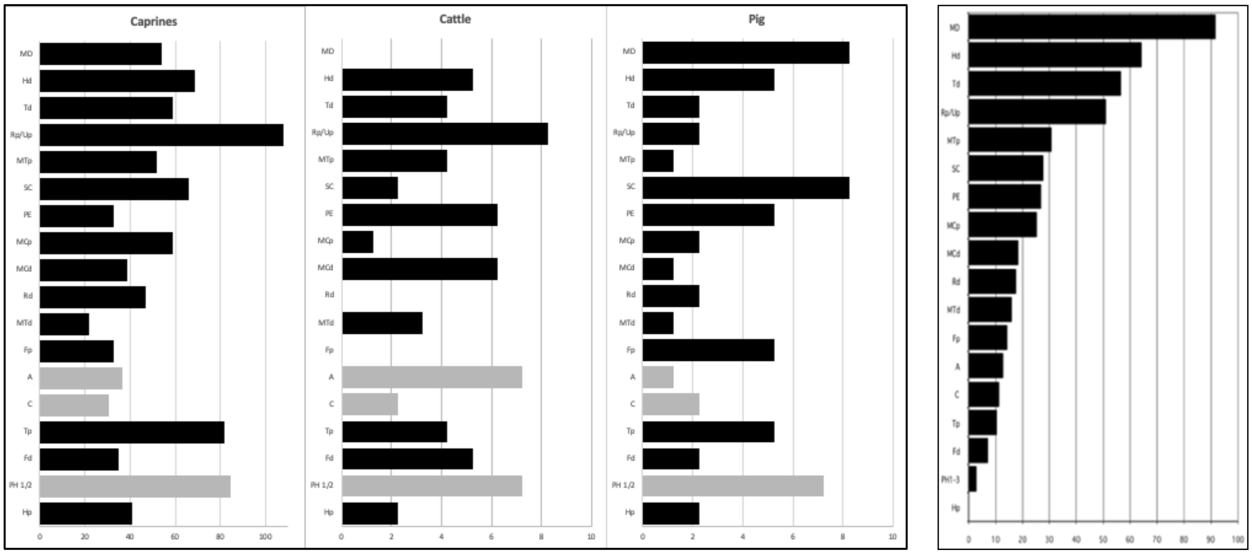

Fig. 3.129. Left: Anatomical representation of caprines (MinAU 898), cattle (MinAU 66) and pig (MinAU 61) at EIA Kastri; Right: Relative abundance of goat body parts (Brain 1981)

Key: MD: mandible, Hd: humerus distal, Td: tibia distal, Rp/Up: radius proximal/ulna proximal, MTp: metatarsal proximal, SC: scapula, PE: pelvis, MCp: metacarpal proximal, MCd: metacarpal distal, Rd: radius distal, MTd: metatarsal distal, Fp: femur proximal, A: astragalus, C: calcaneus, Tp: tibia proximal, Fd: femur distal, PH1: phalanx I, Hp: humerus proximal. Light shading: small body parts most subject to loss in recovery

In regard to patterns of long bone fragmentation, the percentage of diaphysis cylinders in the assemblage, which are typical products of scavenger activity, is only (12%; **Table 3.100**) and is again highest in pig (28%), followed by caprines (11%) and cattle (4%), (**Table 3.101**). The frequency of diaphysis cylinders, if not a product of small sample size in the case of cattle (NISP 45) and pig (NISP 32), may be influenced not only by the intensity of gnawing, but also by the number of bones discarded in a complete enough form to be potentially reduced to cylinders. Thus, complete long bones survived mainly in pig and caprines, suggesting that complete bones, suitable for reduction by dogs to diaphysis cylinders, may have been more frequent in these middle-sized animals than in cattle bones. Moreover, the low percentage of diaphysis cylinders (4%) and the higher percentages of diaphysis splinters (42%) and fragments including epiphysis (53%) in cattle suggest more intensive human breakage (for marrow extraction), minimizing the number of complete long bones available to carnivores. The apparently moderate traces of carnivore attrition (14%; above, **Table 3.99**), in combination with the very low percentage of complete bones (<1%;) and the high percentage of diaphysis splinters (59%), (**Table 3.100**), suggests that breakages were mostly caused by humans through butchery and marrow extraction, although the presence of gnawing marks on some diaphysis splinters (**Fig. 3.130**) suggests that dogs could also be responsible for this fragment type, while trampling too cannot be excluded. The latter requires bones to have been discarded in open areas with relatively heavy human and animal 'traffic', but the low frequency of weathered bones (1%; above, **Table 3.97**) suggests that bones were not subject to prolonged exposure. Consistent with this, two cases of matching unfused diaphysis and epiphysis of goat (distal metacarpal and proximal tibia) and one case of matching carpal bones of cattle (**Fig. 3.131**) from open contexts shows that the layers in question were not heavily disturbed by scavengers and human trampling.

	All taxa	
	NISP	NISP %
Complete/Almost complete	5	0.6
Diaphysis cylinder	91	11.5
Diaphysis splinter	466	58.9
Fragments including epiphysis	229	29.0
Total	791	100.0

Table 3.100. Incidence of fragmentation types in post-neonatal long bones of the taxonomically identified material at EIA Kastri (excluded loose epiphyses and new breaks; NISP)

	Caprines		Cattle		Pig		Total	
	NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %
Complete/Almost complete	2	0.3	-	0.0	1	3.1	3	0.3
Diaphysis cylinder	80	11.4	2	4.4	9	28.1	91	11.7
Diaphysis splinter	429	60.9	19	42.3	16	50.0	464	59.4
Fragments including epiphysis	193	27.4	24	53.3	6	18.8	223	28.6
Total	704	100.0	45	100.0	32	100.0	781	100.0

Table 3.101. Incidence of fragmentation types in post-neonatal long bones in caprines, cattle and pig at EIA Kastri (excluded loose epiphyses and new breaks; NISP)

Fig. 3.130. Dog gnawing traces on a caprine left radius diaphysis splinter (EIA Kastri, SU 756), (©A. Gkotsinas)

Fig. 3.131. Matching right capito-trapezoid, scaphoid, and lunate of cattle. The scaphoid bears cut marks (white arrow), (EIA Kastri, SUs 550 and 565), (©A. Gkotsinas)

3.3.2.3. Carcass processing

To explore carcass processing, the incidence of cut marks, bone fragmentation patterns and the incidence of burning traces were analysed. The assemblage was quantified in terms of NISP. In the case of butchery traces, loose teeth, and neonatal specimens, on which cut marks are unlikely to be observed, were excluded, while in the case of fragmentation types only long bones, namely humerus, radius, femur, tibia and metapodials were analysed. The above-mentioned analyses were performed only for identified mammalian species, and thus tortoise and indeterminate mammals were excluded. Sheep and goat, due to the small sample and the fact that these two species of broadly the same size and conformation are likely to have been treated similarly, have been merged along with sheep/goat into one group, caprines.

As **Table 3.102** shows, cut marks inflicted during butchery were noted on 4% of the identified specimens. Cut marks were observed on specimens of caprines (4%), cattle (10%) and pig (6%), while only one (11%) was found on a hare bone (**Table 3.103**). Thus, these species were certainly consumed in some way. In regard to the type of cuts, skinning marks are preserved on 1%, dismemberment marks on 45%, filleting marks on 15% and chopping marks on 38% of the total assemblage (**Table 3.104**).

	All taxa	
	NISP	NISP %
Cut	73	4.3
Uncut	1,644	95.7
Total	1,717	100.0

Table 3.102. Incidence of cut and uncut specimens on the taxonomically identified material at EIA Kastri (loose teeth and neonatal specimens excluded; Appendix III: Table III.11, NISP)

	Caprines		**Cattle**		**Pig**		**Hare**	
	NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %
Cut	55	3.7	12	9.5	5	5.9	1	11.1
Uncut	1,428	96.3	114	90.5	80	94.1	8	88.9
Total	1,483	100.0	126	100.0	85	100.0	9	100.0

Table 3.103. Incidence of cut and uncut specimens by taxon at EIA Kastri (loose teeth and neonatal specimens excluded; Appendix III: Table III.11, NISP)

	All taxa	
	NISP	NISP %
Skinning	1	1.4
Dismemberment	33	45.2
Filleting	11	15.1
Chopping	28	38.4
Total	73	100.0

Table 3.104. Incidence of types of butchery marks on the taxonomically identified material at EIA Kastri (loose teeth and neonatal specimens excluded; Appendix III: Table III.11, NISP)

Domestic species bear all types of cut marks, indicating that the entire carcass processing sequence took place on site for at least some of the common domesticates. The results in the previous analysis of retrieval loss reinforces the above suggestion. The relative frequencies of marks from the successive stages of butchery between the three main taxa cannot be compared meaningfully due to the sample size, while environmental attrition, mostly by root etching, as well as animal attrition and breakage (old and new) may also have affected the preservation and frequency of butchery traces. For instance, the presence of diaphysis cylinders and bone shafts fragments without epiphyses (above, **Table 3.101**) will affect the occurrence of dismemberment marks, which are usually found on the joints. Similarly, encrustation, such as that on the goat distal epiphysis in **Fig. 3.132**, could cover any dismemberment marks.

Fig. 3.132. Encrustation on the distal epiphysis of a goat left humerus (EIA Kastri, SU 753), (©A. Gkotsinas)

However, some general remarks can be made. In cattle, chop marks (58%) seemed to be more frequent than dismembering (33%) and filleting marks (8%), while in caprines dismembering marks are dominant (47%), followed by chopping (33%), filleting (18%) and skinning (2%), (**Table 3.105**). The intensive chopping of cattle bones is an expected corollary of their large carcass size and, on the one hand, the consequent need for greater investment in 'pot-sizing' for cooking purposes and, on the other hand, their larger marrow content making the investment of effort in extraction more worthwhile.[352]

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[352] Binford 1978: 25.

	Caprines		Cattle		Pig	
	NISP	NISP %	NISP	NISP %	NISP	NISP %
Skinning	1	1.8	-	0.0	-	0.0
Dismemberment	26	47.3	4	33.3	2	40.0
Filleting	10	18.2	1	8.3	-	0.0
Chopping	18	32.7	7	58.3	3	60.0
Total	55	100.0	12	100.0	5	100.0

Table 3.105. Incidence of types of butchery marks in caprines, cattle and pig at EIA Kastri (loose teeth and neonatal specimens excluded; Appendix III: Table III.11, NISP)

Skinning was observed only on a caprine first phalanx, while dismemberment marks on articular areas were identified in all taxa that bear cut marks. In caprines they indicate partitioning at the neck, elbow, wrist, hip, and ankle; in cattle at the elbow, wrist (above, **Fig. 3.131**) and knee (**Fig. 3.133**); in pig only at the elbow; and in hare at the shoulder. Cut marks indicating the filleting of meat from the bone were recorded on forelimbs and hind limbs of caprines and hind limbs of cattle. Finally, chopping marks were identified in all three common domesticates on the mandible and ankle; in caprines on the horncore, shoulder, hip and forearm; and in cattle at the knee and second phalanx (**Fig. 3. 134**, **Fig. 3.135**, **Fig. 3.136**; Appendix III: **Table III.11**). These traces suggest chopping of carcasses into small portions (pot-sizing) for cooking (e.g. at the knee), while chops at the base of horncore could be to assist skinning.

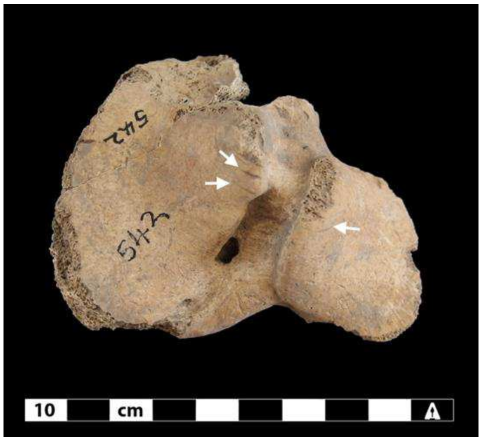

Fig. 3.133. Dismemberment cuts (white arrows) at the proximal epiphysis of a cattle right tibia (EIA Kastri, US 542), (©A. Gkotsinas)

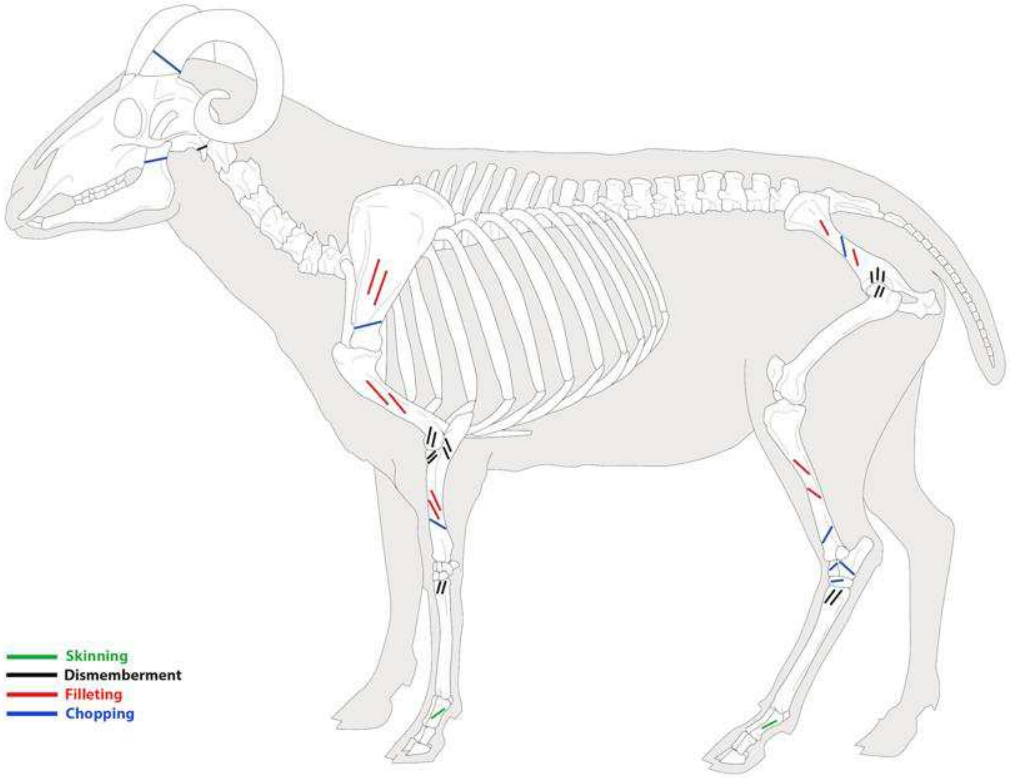

Fig. 3. 134. Caprine bones displaying butchery marks in EIA Kastri (Appendix III: Table III.11), (©1996 ArcheoZoo.org).

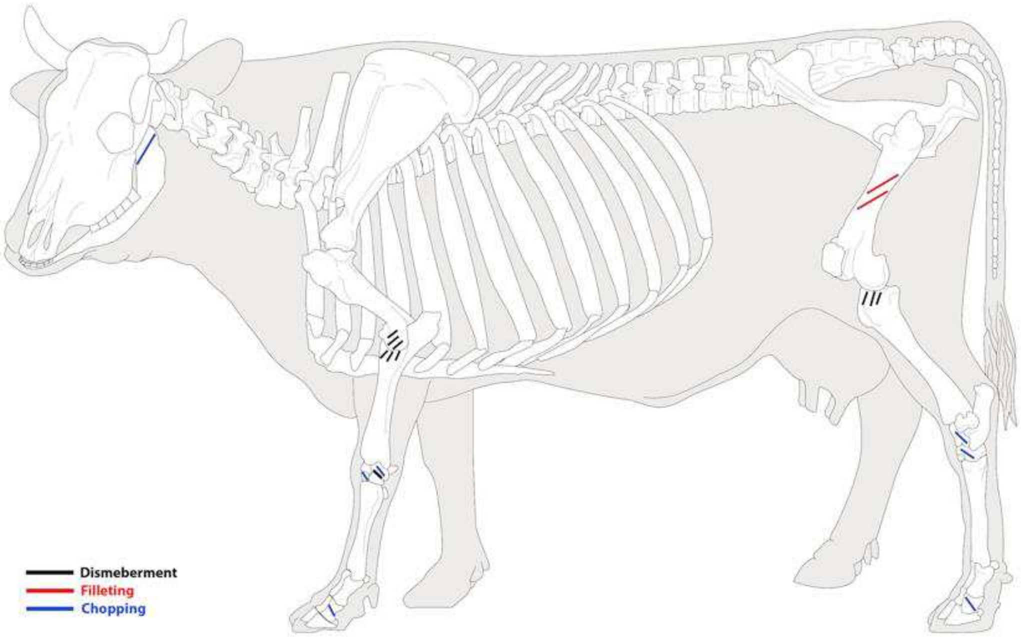

Fig. 3.135. Cattle bones displaying butchery marks in EIA Kastri (Appendix III: Table III.11), (©1996 ArcheoZoo.org)

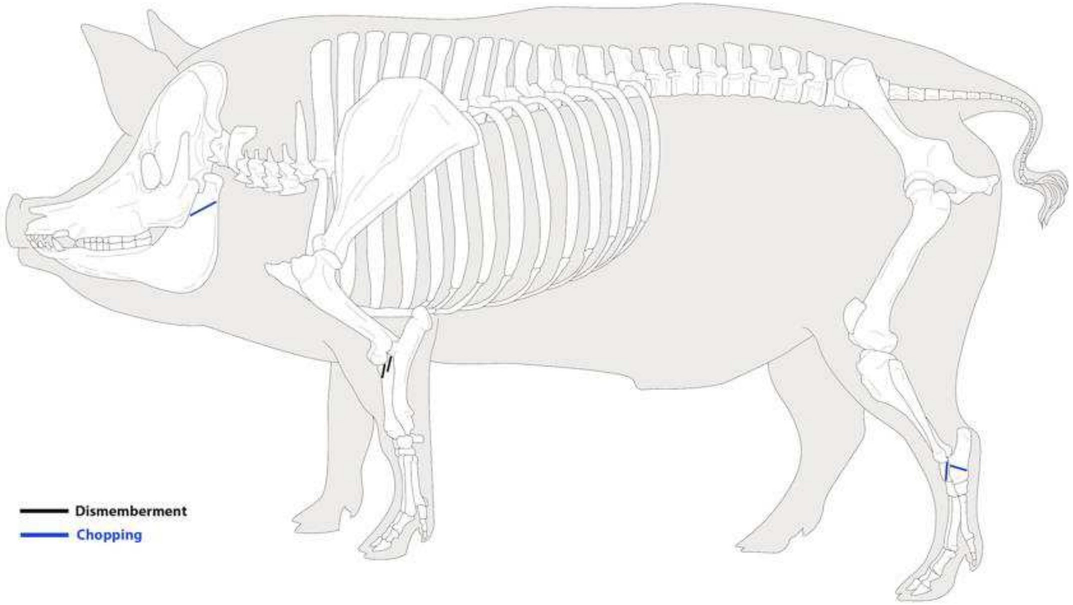

Fig. 3.136. Pig bones displaying butchery marks in EIA Kastri (Appendix III: Table III.11), (©1996 ArcheoZoo.org)

The absence of cut marks in dog, donkey, horse and red deer, whose remains were found together with those of the species bearing butchery traces, is not necessarily an indication of a lack of consumption as it is very likely to be the result of the small sample size. Moreover, tortoise is only represented by fragments of carapace on which no butchery marks or any modification were identified.

Traces of burning were found on 2% of the recorded specimens, of which <1% are uniformly burnt and 2% are partly burnt, bearing black stains on the bones' surfaces (**Table 3.106**). In the uniformly burnt bones, the colour varies from black (**Fig. 3.137**) to grey and light blue, suggesting fire exposure at high temperatures.[353] This exposure could be a result of the use of bones as fuel for cooking or heating purposes or of their burning in refuse disposal. Uniform traces were found on postcranial elements of caprines, cattle and pig, and more specifically on three radius and one metacarpal of caprines, one talus of cattle and one pelvis of pig (**Table 3.107**).

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[353] Buikstra-Swegle 1989; Shipman et al. 1984; Spennemann-Colley 1989.

	All taxa	
	NISP	NISP %
Burnt (uniformly)	6	0.3
Burnt (partly)	29	1.7
Unburnt	1,691	98
Total	1,726	100.0

Table 3.106. Incidence of burning on the taxonomically identified material at EIA Kastri (loose teeth excluded; NISP)

Fig. 3.137. Uniformly burnt caprine left radius diaphysis shaft (EIA Kastri, SU 464), (©A. Gkotsinas)

The partly burnt bones are exclusively of caprines, with traces found on the base of mandibles (**Fig. 3.138**) and the tips of tooth crowns, at the distal articulation of scapula, at the distal articulation and diaphysis of humerus, at the proximal articulation and diaphysis of radius, at the diaphysis of tibia, at the proximal trochlea of astragalus and at the distal articulation and diaphysis of metapodials (**Table 3.107**, **Fig. 3.139**). The fact that the bones exhibit burns only on certain parts suggests heating or cooking over an open fire (i.e. roasting), where the flesh recedes in areas where it is thin, exposing the bone to localised burning. This potentially accounts for most of the above anatomical parts. Burnt patches on tarsals/distal metapodials may be from roasting the whole animal; patches on the mandible may be from roasting the whole animal or the heads; and those on meaty bones (e.g. humerus) could be from roasting whole animals or meat joints. The presence of burning on metapodial diaphyses may also be related with processing for marrow extraction. The low numbers of partly burnt bones suggest that cooking over open fires was only practised occasionally and concerned caprines.

	Caprines		Cattle	Pig	Total (NISP)
	Uniformly burnt	Partly burnt	Uniformly burnt	Uniformly burnt	
Mandible	-	12	-	-	12
Scapula	-	4	-	-	4
Humerus	-	4	-	-	4
Radius	3	2	-	-	5
Metacarpal	1	2	-	-	3
Pelvis	-	-	-	1	1
Tibia	-	1	-	-	1
Talus	-	2	1	-	3
Metatarsal	-	2	-	-	2
Total	4	29	1	1	35

Table 3.107. Incidence of burning by taxon and anatomical part in EIA Kastri (loose teeth excluded; NISP)

Fig. 3.138. Black stain at the base of a goat left mandible (EIA Kastri, SU 549), (©A. Gkotsinas)

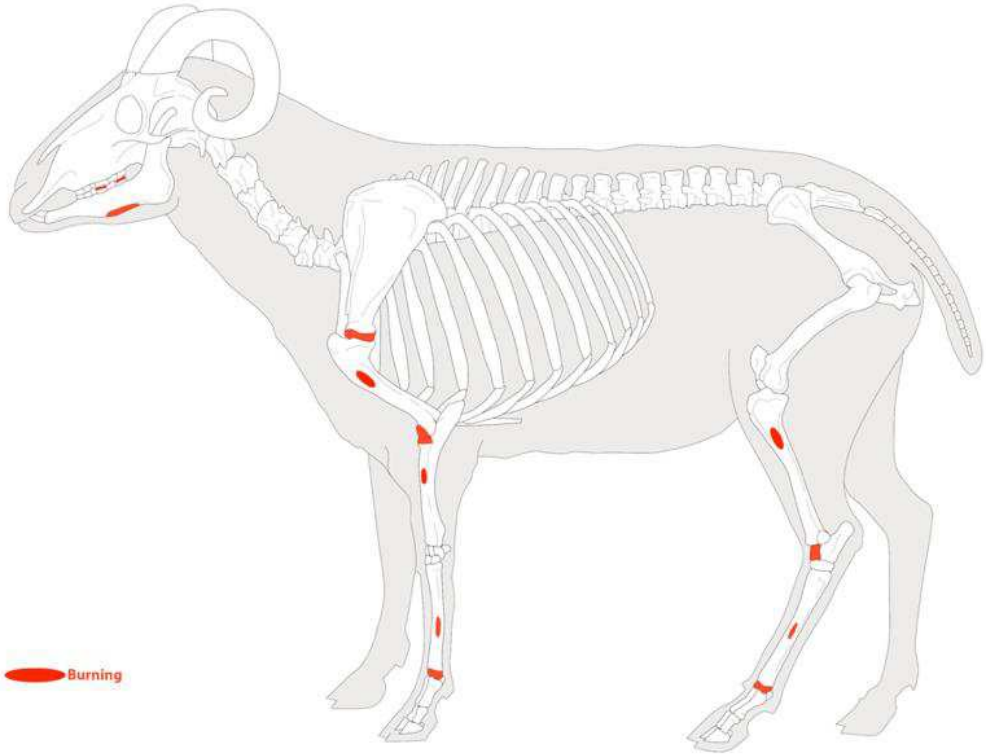

Fig. 3.139. Caprine bones displaying burnt traces at EIA Kastri (Table 3.107), (©1996 ArcheoZoo.org)

Finally, the presence of six worked bones indicates an additional stage of carcass utilization in Kastri. However, due to their intense modification, the original features of the worked bones were obscured, offering no evidence of the selective use of particular body parts or taxa.

3.3.2.4. Mortality patterns and management strategies

Evidence for patterns of mortality is available from mandibular tooth eruption and wear stages, the fusion stages of postcranial elements, the relative proportions of neonatal and post-neonatal postcranial remains, and the ratio of males to females among sexable adult specimens as well as supplementary metrical evidence for sex ratios. The above analyses concern the three main taxa, with the exception of the mandibular tooth stages, which were not available for cattle, and the metrical data, which were not feasible for cattle and pig. For these analyses, aged and sexed specimens of caprines, cattle and pig were quantified in terms of MinAU.

3.3.2.4.1. Caprines

The sample sizes for sheep and goat are small. Accordingly, although species-level data are tabulated for aged mandibular teeth, sexed pelves and biometrics, mortality patterns are largely analysed for combined caprines (sheep+goat+sheep/goat), despite the possibility that humans exploited the two species differently. The data for neonatal mortality and the epiphyseal fusion evidence for post-neonatal mortality are tabulated only for combined caprines because neonatal and unfused specimens are difficult to identify to species level.

Based on the dental data summarised in **Table 3.108**, caprines were slaughtered at all age stages with the exception of the last, age stage I, between 8-10 years old. The highest mortality is in young (6-24 months) animals, and especially in juveniles (age stage C), and in subadults and young adults (second-fourth year) (**Fig. 3.140**). Thereafter mortality declined among mature adults of four to eight years (stages G and H), reflecting the relatively small numbers of elderly animals remaining in the herds. The mandibular evidence for stage A (0-2 months; **Table 3.108**), although sparse, implies that at least some breeding stock was kept in or very close to the settlement, an outcome consistent with the presence of neonatal specimens (**Table 3.109**). The evidence of epiphyseal fusion (**Table 3.110**) contradict the dental evidence in suggesting more deaths within the first year and relatively fewer deaths among young adults (**Fig. 3.141**). This latter discrepancy cannot be attributed to taphonomic biases, given that unfused specimens are more vulnerable than fused to both attrition and partial recovery, which should favour overrepresentation of adults. One possible interpretation of the discrepancy is that heads (including mandibles) of juvenile caprines were selectively discarded outside the settlement (and thus that the epiphyseal fusion data provide more reliable evidence for caprine mortality), but it is more likely that large animals (including adult rather than juvenile caprines) would have been slaughtered, and their carcasses then ‘dressed’, outside the built-up area. Alternatively, if the local caprine population included a significant proportion of adult males, these are likely to have been castrated. Castration, in turn, may delay fusion,[354] exaggerating the proportion of young deaths in epiphyseal fusion data. This scenario is ostensibly contradicted by the adult sex ratio of caprines in which females are overwhelmingly predominant (14 females: 3 males; **Table 3.111**), implying that males were killed

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[354] Popkin et al. 2012.

during their first months, while females survived past the first months of life, but this result might conceivably have been rendered misleading by late fusion of pelves of castrated males. Conversely, biometrical data for the sexually dimorphic forelimb elements of caprines, namely distal scapula, distal humerus, proximal radius and distal metacarpal, include several quite large (as well as some smaller) goats (**Fig. 3.142**, **Fig. 3.143**, **Fig. 3.144** and **Fig. 3.145**). If these animals represent domestic males (or male castrates), rather than feral individuals, then the adult sex ratio of goats at least may have been relatively even. In this case, castrated adult male goats may indeed account for the observed discrepancy between dental and epiphyseal fusion age data.

Stage	**Suggested age**[1] (months)	**No. of Stages**					**Total**	
		1	2	3	4	5	MinAU	MinAU %
A	0-2	1g	-	-	-	-	1	2.7
B	2-6	1	1s	-	-	-	1	2.7
C	6-12	3s + 2g + 3		-	-	-	9	24.3
D	12-24	3s + 1g + 4	1g	-	-	-	8.2	22.2
E	24-36	1s + 2g + 1		1	-	-	5.3	14.3
F	36-48	2s + 3g			1g	1	6.5	17.6
G	48-72	1	1s	2s			2	5.4
H	72-96	1s			-		4	10.8
I	96-120	-	-		-	-	-	0.0
Total		29 (10s + 9g + 10)	3 (2s + 1g)	3 (2s + 1)	1 (1g)	1 (1)	37	100.0

Table 3.108. Mandibular evidence for mortality of caprines at EIA Kastri (MinAU)

Key: 3s + 1g + 1 = 3 sheep + 1 goat + 1 sheep/goat

[1] After Payne (1987), (see 2.1.2.2; Table 2.6)

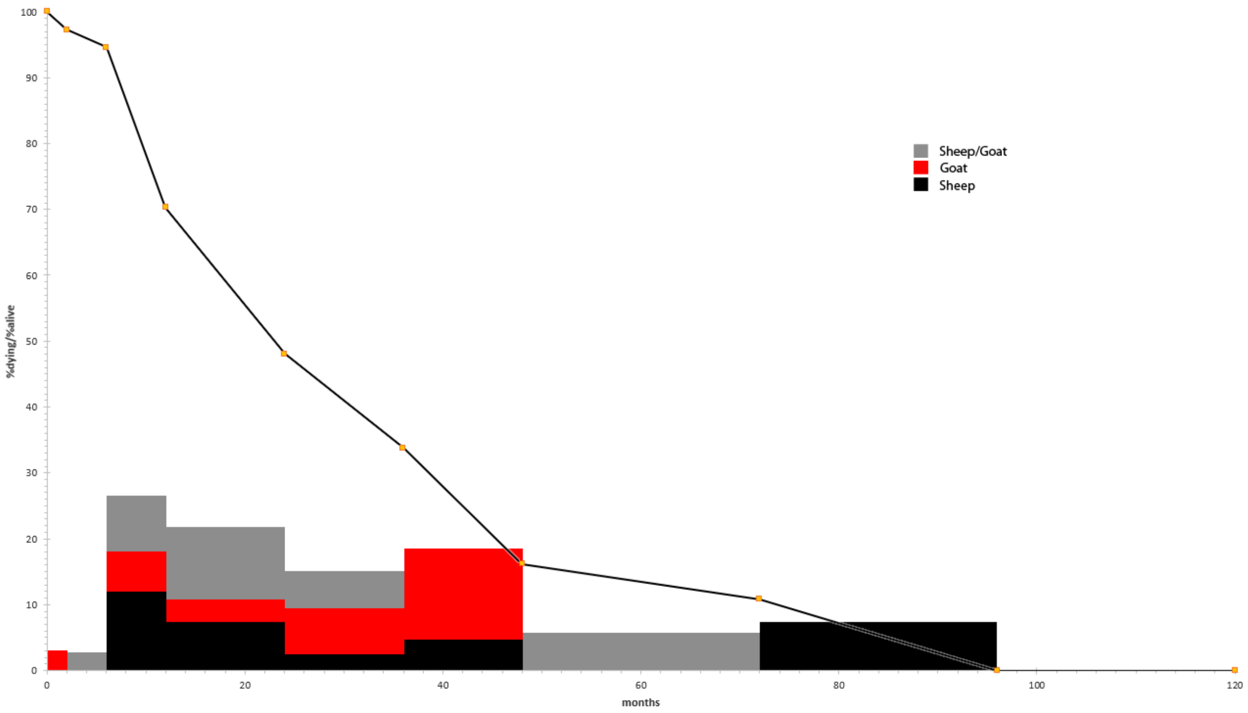

Fig. 3.140. Eruption and wear of mandibular cheek teeth data of caprines (cumulative age curve), sheep, goat and sheep/goat (histogram) at EIA Kastri (Table 3.108; MinAU)

Neonatal		**Post-neonatal**		**Total** (MinAU)
MinAU	MinAU %	MinAU	MinAU %	
7	0.7	965	99.3	972

Table 3.109. Representation of neonatal and post-neonatal specimens of caprines at EIA Kastri (MinAU)

Fusion Stage[1] (months)	**Unfused**[2] (MinAU)	**Fused**		**Indeterminate** (MinAU)
		MinAU	MinAU %	
6-10	39	97	71.3	130
13-16	19	85	81.7	10
18-28	27	46	63.0	156
30-36	41	22	34.9	90
36-42	19	9	32.1	130

Table 3.110. Epiphyseal fusion evidence for mortality in caprines at EIA Kastri (MinAU)

[1] Following Barone (1986) and Gardeisen (1997), (see 2.1.2.2; Fig. 2.10); [2] Including unfused diaphysis, unfused epiphysis, fusing specimens and specimens of immature size or texture

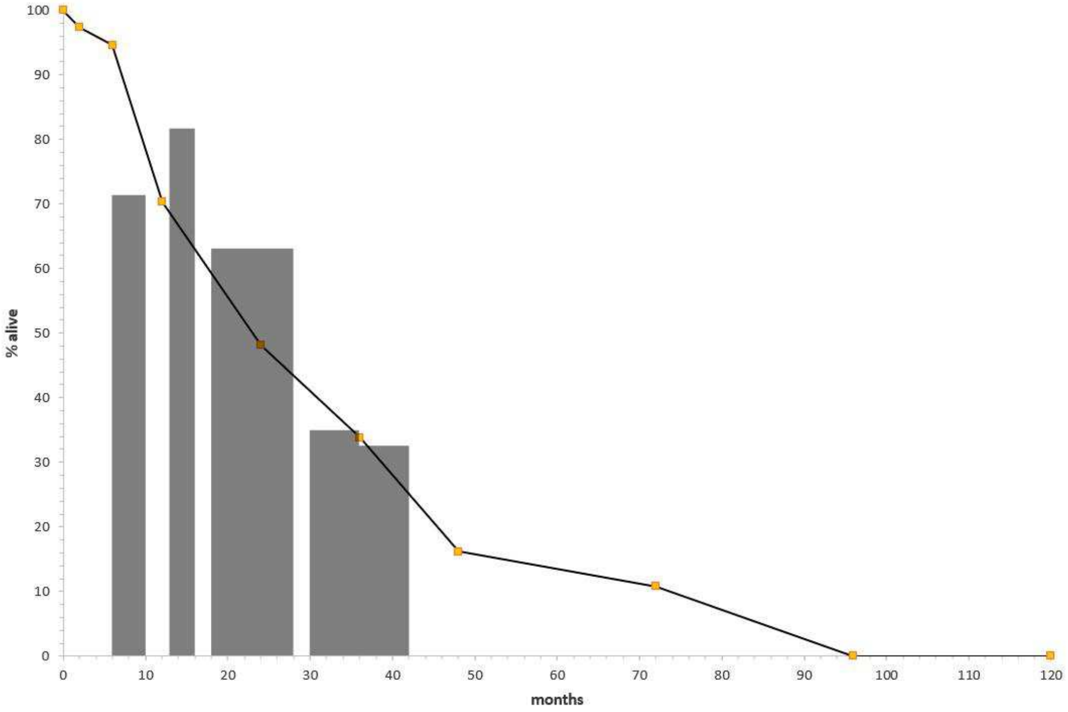

Fig. 3.141. Comparison of wear of mandibular cheek teeth (cumulative age curve) and epiphyseal fusion data (histogram) of caprines at EIA Kastri (Table 3.108 and Table 3.110; MinAU)

	Female	Male	Indeterminate	Total (MinAU)
Caprines	2s + 4g + 8	1s + 2	1s + 2g + 10	30
Total	14	3	13	

Table 3.111. Evidence of sexed pelves of caprines at EIA Kastri (MinAU)

Key: 4s + 2g + 4 = 4 sheep + 2 goat + 4 sheep/goat

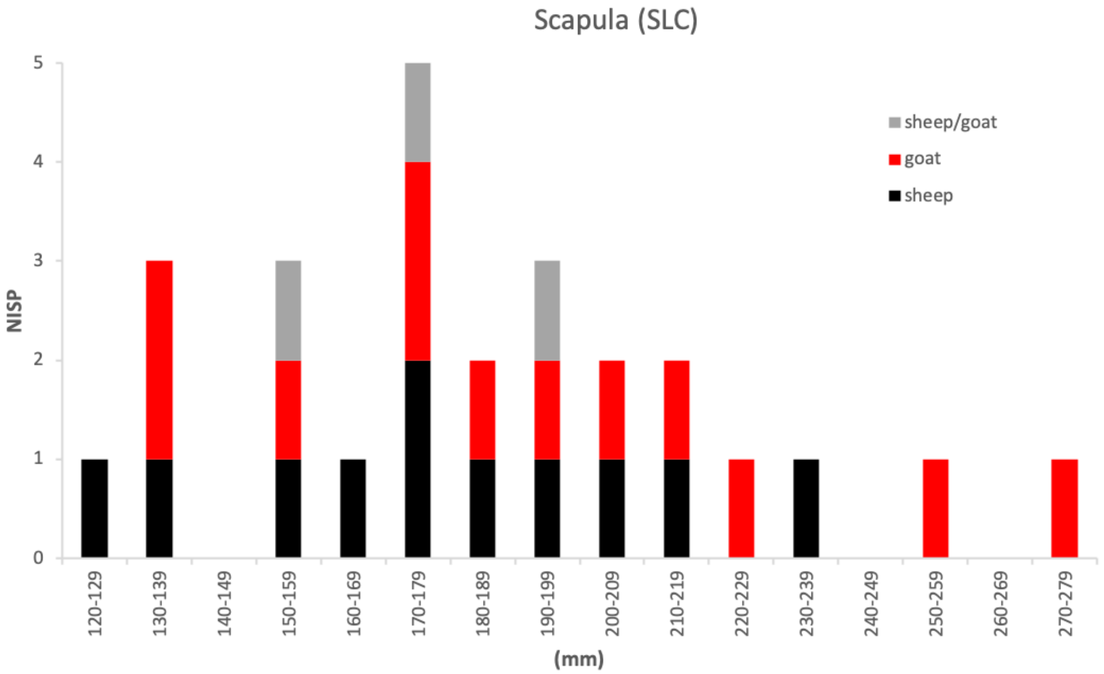

Fig. 3.142. Distribution of scapula SLC measurements in caprines at EIA Kastri (Appendix II: Tables II.4, II.7 and II.10; NISP 26)

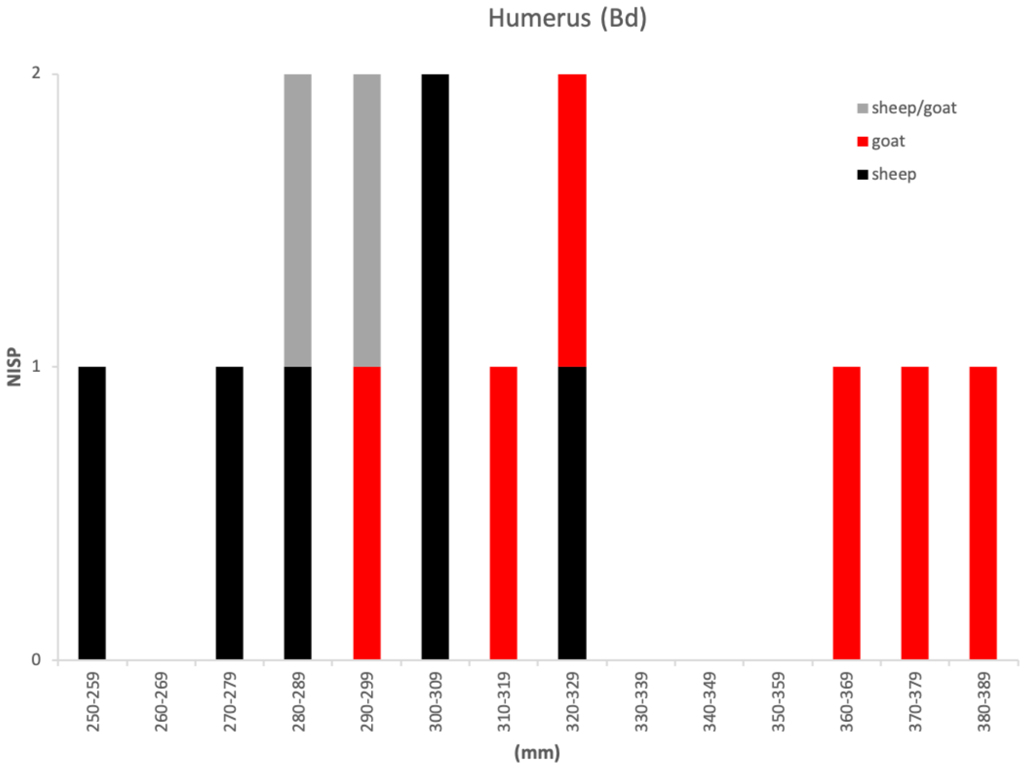

Fig. 3.143. Distribution of humerus Bd measurements in caprines at EIA Kastri (Appendix II: Tables II.4, II.7 and II.10; NISP 14)

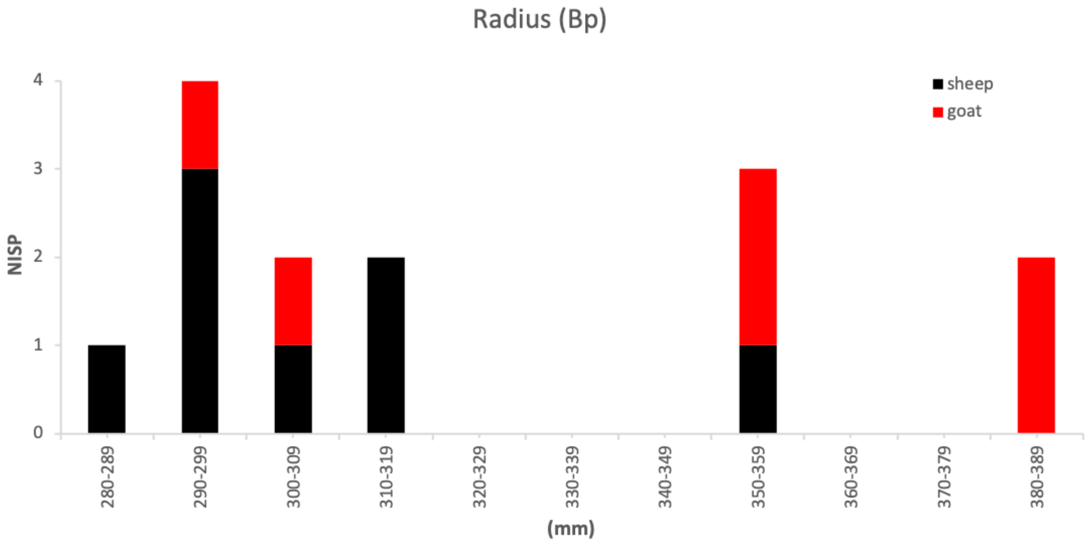

Fig. 3.144. Distribution of radius Bp measurements in caprines at EIA Kastri (Appendix II: Tables II.4 and II.7; NISP 14)

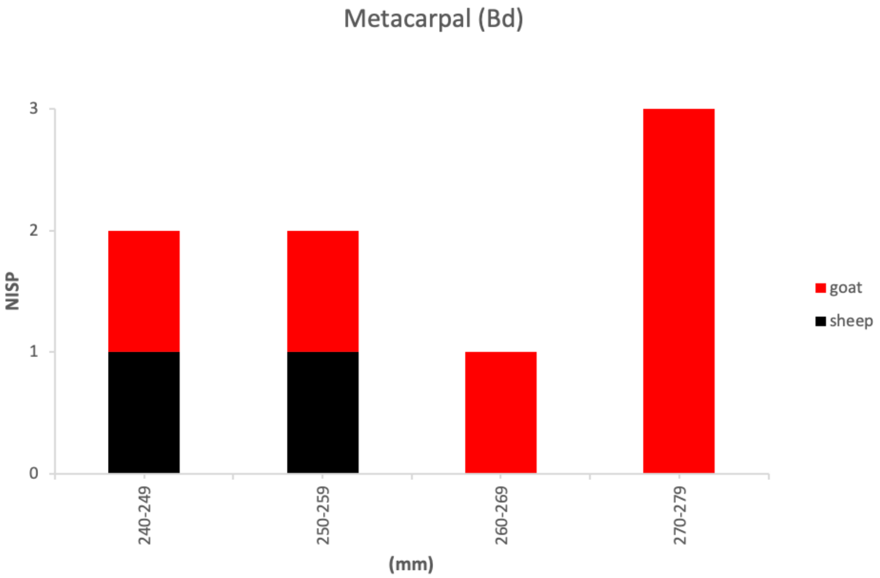

Fig. 3.145. Distribution of metacarpal Bd measurements in caprines at EIA Kastri (Appendix II: Tables II.4 and II.7; NISP 8)

Turning to the management priorities of EIA Kastri caprines, the presence of neonatal specimens and a stage A mandible suggest local breeding, but the scarcity of stage A-B goat lambs and kids, which might have been slaughtered to spare milk for human use, suggests milk production was at most a low priority.[355] The concentration of deaths among juveniles (stage C, 6-12 months) and subadults (stage D, 12-24 months) suggests that production of meat was the major goals of caprine husbandry at EIA Kastri, but relatively heavy mortality also among young adults (stages E-F, third-fourth years) of both species, apart from meat, mostly of goat, suggests that production of fibre, mainly from sheep, may also have been important considerations (**Fig. 3.146**; above **Fig. 3.140**). The recovery of neonatal specimens implies the presence nearby of breeding stock and thus suggests that the above interpretation of husbandry goals may be representative of local livestock rather than of deadstock imported from non-local herds.

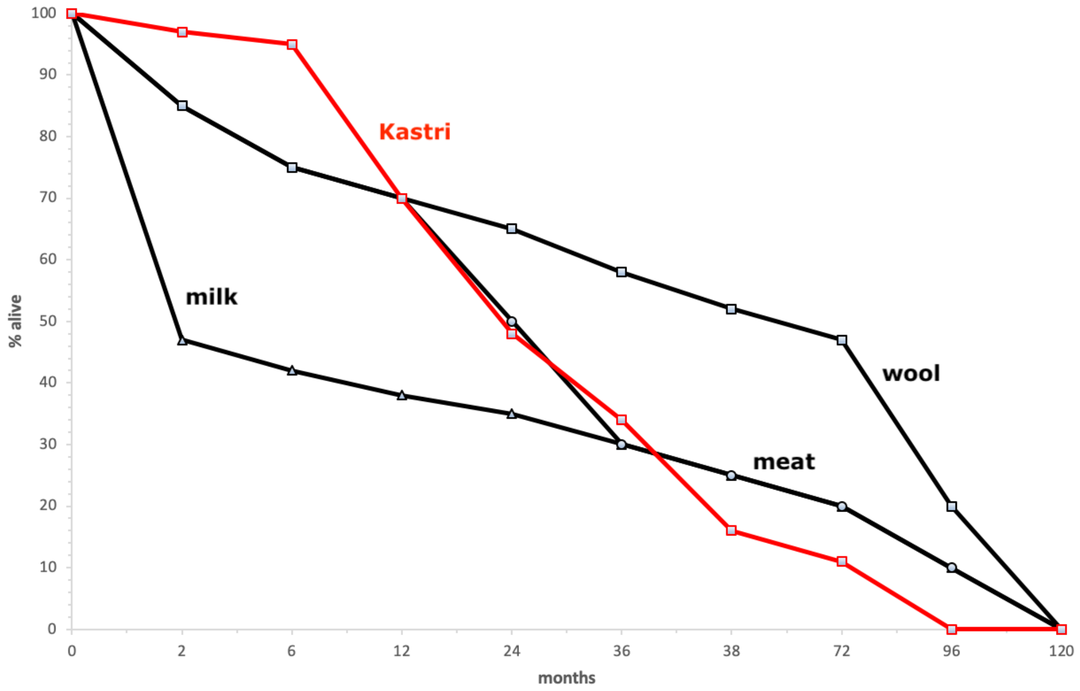

Fig. 3.146. Cumulative age curves based on eruption and wear of mandibular cheek teeth of caprines at EIA Kastri (Table 3.108; MinAU) compared with Payne's production models (after Payne 1973: 282-284, Figs 1-3)

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[355] Payne 1973: 281-282.

3.3.2.4.2. Cattle

In cattle, there is insufficient data for the mandibular dental eruption and wear stages, while the evidence of epiphyseal fusion is meagre. Nonetheless, some tentative observations can be made. Based on the evidence of epiphyseal fusion summarized in **Table 3.112** only adult cattle (3+ years old) were slaughtered (**Fig. 3.147**). The data for neonatal mortality is consistent with the evidence of epiphyseal fusion, as no neonatal specimens were recorded (**Table 3.113**), but this may be attributable to small sample size and/or the expected lower infant mortality in cattle than smaller caprines and especially pig, rather than indicating that cattle were not bred in the vicinity of Kastri. Regarding sex, only one female pelvis was identified (**Table 3.114**).

In relation to the management priorities of EIA Kastri cattle, the absence of young deaths argues against dairying, while the dominance of young adult (4th year) and especially full adult deaths suggests use of cattle mainly for breeding and perhaps traction.

Fusion Stage[1] (months)	**Unfused**[2] (MinAU)	**Fused**		**Indeterminate** (MinAU)
		MinAU	MinAU %	
7-10	-	1	100.0	7
18	-	19	100.0	7
24-36	-	7	100.0	13
36-48	3	7	70.0	6

Table 3.112. Epiphyseal fusion evidence for mortality in cattle at EIA Kastri (MinAU)

[1] Following Barone (1986) and Gardeisen (1997), (see 2.1.2.2; Fig. 2.10); [2] Including unfused diaphysis, unfused epiphysis, fusing specimens and specimens of immature size or texture

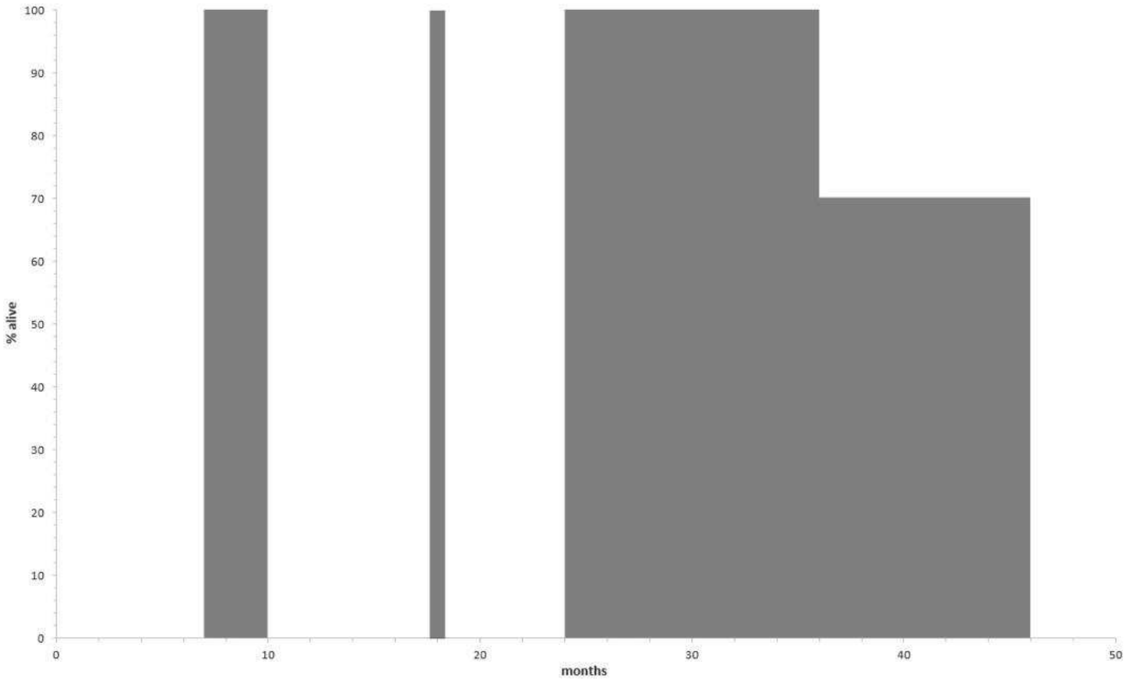

Fig. 3.147. Epiphyseal fusion evidence (fused bones) for survivorship of cattle at EIA Kastri (Table 3.112; MinAU)

Neonatal		**Post-neonatal**		**Total** (MinAU)
MinAU	MinAU %	MinAU	MinAU %	
-	0.0	80	100.0	80

Table 3.113. Representation of neonatal and post-neonatal specimens of cattle at EIA Kastri (MinAU)

Female	**Male**	**Indeterminate**	**Total** (MinAU)
1	-	5	6

Table 3.114. Evidence of sexed pelves of cattle at EIA Kastri (MinAU)

3.3.2.4.3. Pig

The evidence of the epiphyseal fusion stage and dental eruption and wear stages in pig is also sparse, as is the postcranial evidence for neonatal mortality and sex. Despite the meagre data, some observations can be made, although, due to the very small sample, the proposed interpretations should be considered tentative.

Based on the evidence of the mandibular wear stages summarized in **Table 3.115**, most pigs were killed in their first year, age stages B and C, while there is no evidence for animals surviving after their second year (stages E+), (**Fig. 3.148)**. Despite the absence of stage A mandibles (0–2 months), one neonatal postcranial specimen (**Table 3.116**) implies that at least some breeding stock were kept in or very close to the settlement. The evidence of epiphyseal fusion (**Table 3.117**) contradicts the dental evidence in suggesting higher survivorship within the first year and the survival of the odd pig after the second year (**Fig. 3.149**). This discrepancy is most parsimoniously attributed to the very small samples of both dental and epiphyseal fusion age data. In regard to sex, male pigs are dominate over females (males 2: female 1; **Table 3.118**), although partial recovery may once more have inflated the proportion of males.

Turning to the management priorities of EIA Kastri pigs, the mortality evidence indicates that most were killed in the first year, a common pattern in this species and related to the very high rate of reproduction and also, depending on its diet, on the capacity of pig to reach a substantial weight at a very early age.[356] The few adults were presumably breeding animals, while slaughter of subadults may have been delayed so that they provided fat as well as meat.

Stage	**Suggested age**[1] (months)	**Total**	
		MinAU	MinAU %
A	0-2	-	0.0
B	2-6	4	50.0
C	6-12	3	37.5
D	12-24	1	12.5
E	24-30	-	0.0
F	>30	-	0.0
Total		8	100.0

Table 3.115. Mandibular evidence for mortality of pig at EIA Kastri (MinAU)
[1] After Halstead (2020), (see 2.1.2.2; Table 2.6)

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[356] Halstead and Isaakidou 2011.

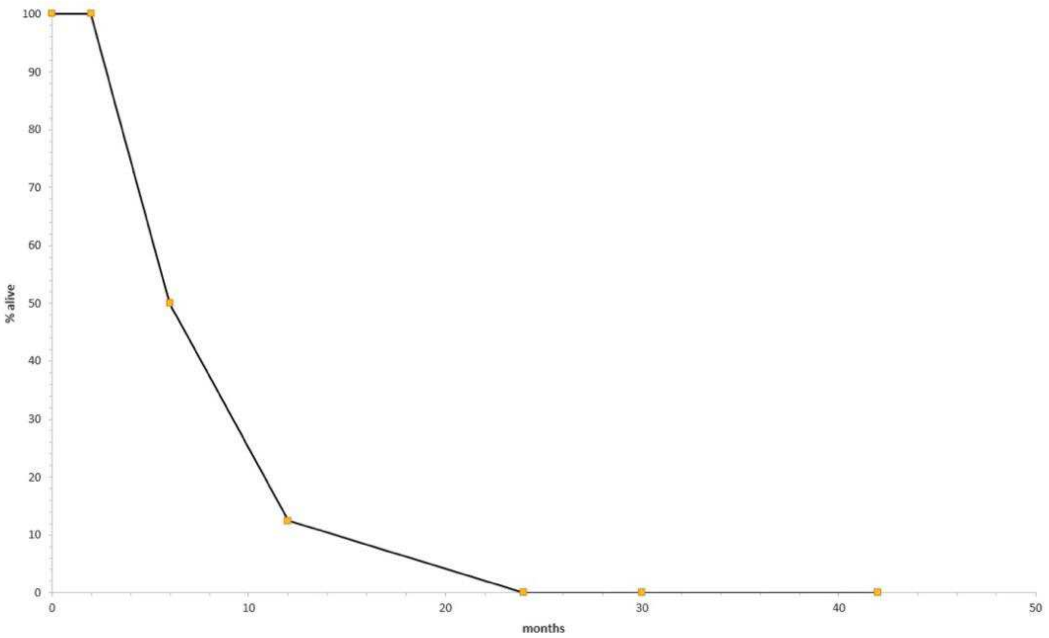

Fig. 3.148. Cumulative age curve based on eruption and wear of mandibular cheek teeth of pig at EIA Kastri (Table 3.115; MinAU)

Neonatal		Post-neonatal		Total (MinAU)
MinAU	MinAU %	MinAU	MinAU %	
1	1.7	58	98.3	59

Table 3.116. Representation of neonatal and post-neonatal specimens of pig at EIA Kastri (MinAU)

Fusion Stage (months)[1]	Unfused[2] (MinAU)	Fused		Indeterminate (MinAU)
		MinAU	MinAU %	
12	3	4	57.1	12
24-30	9	3	25.0	5
36-42	7	1	12.5	13

Table 3.117. Epiphyseal fusion evidence for mortality in pig at EIA Kastri (MinAU)

[1] Following Barone (1986) and Gardeisen (1997), (see 2.1.2.2; Table 2.6); [2] Including unfused diaphysis, unfused epiphysis, fusing specimens and specimens of immature size or texture

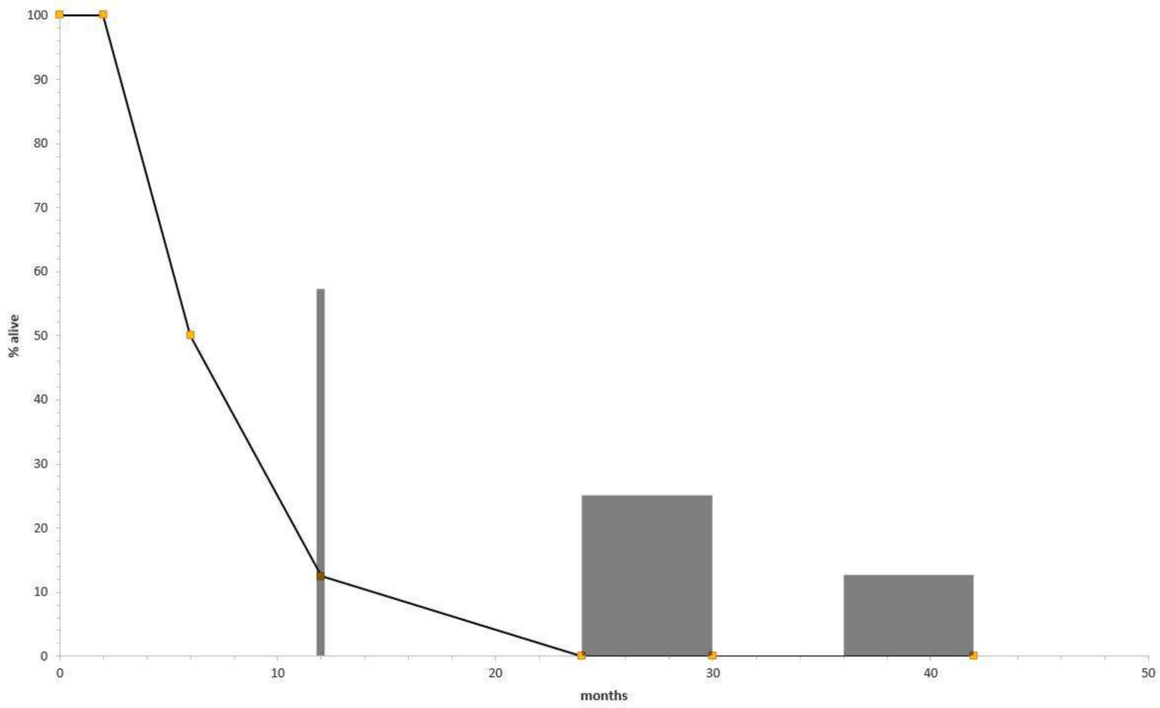

Fig. 3.149. Comparison of wear of mandibular cheek teeth (cumulative age curve) and epiphyseal fusion data (histogram) of pig at EIA Kastri (Table 3.115 and Table 3.117; MinAU)

Female	Male	Indeterminate	Total (MinAU)
1	2	6	9

Table 3.118. Evidence of sexed mandibular canines of pig at EIA Kastri (MinAU)

3.3.2.5. Living conditions

In regard to the living conditions of the animals, the lack of pathological records could imply that the life assemblage did not have any genetic abnormalities or diseases which altered their bones or teeth. Moreover, the absence of skeletal wounds and signs of mechanical stress by humans (e.g. due to ploughing) suggests that the animals' quality of life, including their treatment by humans, could be considered good, although it is dangerous to argue from absence of evidence and especially in the case of small samples as with cattle and pigs at Kastri.

3.3.3. Synthesis

The site of Kastri was located on a plateau in the south of Thassos island. The animal bone deposits dated from the Early Iron Age and were derived from the interior of House I and the areas south and south-east of it. Because the archaeological study is in progress, the zooarchaeological analysis did not include any contextual analysis and the assemblage was treated as a whole. The sample assemblage was derived from 116 stratigraphic units and includes 4,403 specimens, of which 3,141 (1,262 MinAU) were identified to the level of species, genus, subfamily, class, and animal size categories. Post-depositional taphonomic factors, namely the retrieval and excavation methods, carnivore attrition, and vegetation and soil factors, have to varying degree affected the preservation of the assemblage.

Kastri's livestock consisted of sheep, goat, cattle, and pig, with goat and sheep equally predominant. Mortality patterns of sheep and goat indicate a mixed economy with greater emphasis on meat and less on secondary products, namely hair and perhaps wool. Although the data for cattle were limited, it appears to have been exploited mainly for breeding and labour, while pig was as usual bred mainly for meat, although fat might also have been a priority. The post-slaughter carcass processing practices indicate that the entire carcass processing sequence took place on site for the main taxa. Cattle seem to have been chopped more intensively than caprines and pig, most probably for cooking purposes (pot-sizing). In regard to the latter, cooking over an open fire was practised only occasionally, at least for caprines. Apart from meat, marrow probably was extracted, and most heavily so in the case of cattle. Some of the bones were used as raw material for making objects, while some might also have been used as fuel for cooking or heating. Additionally, though they cannot be detected archaeologically, skin, gelatine and perhaps keratin, could have also been exploited.

Apart from the common domesticates, dog, donkey and horse were also present but their representation in the assemblage is fairly scarce. Consumption of dog, and equids is uncertain, although their bones were found among those of the consumed species. Dog could have served for herding and guarding, as a hunting companion or as a pet. Equids may primarily have been used for menial tasks (e.g. transportation, agricultural work) and, in the case of horse, perhaps in hunting, but there is no relevant zooarchaeological evidence to support these speculations.

In regard to wild terrestrial fauna, red deer, hare and tortoise were identified. Butchery marks on hare suggest that this animal was consumed. The same should be assumed for red deer, while the remains of tortoise could be the result of a later intrusion. The list of wild fauna was completed by the aquatic fauna, which comprises only marine shellfish. The presence of all the above taxa indicates hunting and access of the habitants of EIA Kastri to surrounding terrestrial and marine natural resources.

Finally, in regard to discard management, butchery and consumption remains seem to have been discarded indiscriminately within the settlement's limits, some of them in open areas, exposed to scavenger and human trampling, but this suggestion must remain tentative until more detailed, contextualised analysis is possible.

Chapter 4. Animal exploitation in North Greece from the Early Iron Age to Classical era

This chapter synthesises the available zooarchaeological data from the region of Macedonia in North Greece, dated from the Early Iron Age to the Classical era. The information relates to animal exploitation, consumption patterns and discard management. For each aspect, the results of the three studied settlements presented in Chapter 3 (Argilos, Karabournaki and Kastri) are briefly summarized along with data from relevant published studies and reports from other sites in the same region, namely: Akanthos, Assiros, Drama Industrial Area, Herakleion, Ivani Prionia, Kastanas, Kentria, Larnaki, Mikro Livadi Mavropigi, Nea Irakleitsa, Oisyme and Tsiganadika (**Fig. 4.1**).[357] These zooarchaeological studies are complemented by palynological and archaeobotanical data, isotopic analyses of faunal and human skeletal remains, and literary sources.

Fig. 4.1. Map of the Macedonian region showing Early Iron Age to Classical sites with faunal remains mentioned in the text (©Apple Maps)

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[357] Chapter 1, Table 1.2.

4.1. Animal exploitation

Animal exploitation relates to the management of domestic and use of wild taxa, as well as the nutrition and living environments of both domestic and wild fauna. Because the present synthesis is based on zooarchaeological data from different types of sites in the region of Macedonia, namely settlements, sanctuaries and cemeteries, evidence for animal exploitation is presented below by type of site, while, for settlements, domestic and wild taxa are considered separately. For each type of site, the use of animals is explored separately for two periods: the Early Iron Age (1050–700 BC); and the combined Archaic and Classical eras (700–357 BC). Finally, for each type of site, a broader discussion is undertaken of the exploitation of domestic animals during the first seven centuries of the first millennium BC in the wider Aegean basin.

4.1.1. Settlements

Assemblages from settlements of Early Iron Age date are derived from Assiros, Karabournaki, Kastanas (layers 9 and 10) and Kastri, and of Archaic and Classical date from Argilos, Karabournaki and Kastanas (layers 1 - 8). Assiros and Kastanas are lowland settlements located on a toumba, Assiros being 25 km north of the city of Thessaloniki in the Langadas basin and Kastanas 30 km northwest of Thessaloniki on the left shore of the River Axios nowadays, and on an islet in antiquity. Argilos and Karabournaki are coastal settlements, located on the Strymon and Thermaic gulfs, respectively, while Kastri is a rural settlement on an upland plateau in the south of the island of Thassos (above, **Fig. 4.1**). At Karabournaki, the Early Iron Age (Early Geometric) is represented only by two contexts, whose contents are mixed and also include specimens from the Archaic period.[358] Thus, Karabournaki is not included in the discussion of animal exploitation in the Early Iron Age. Moreover, for Assiros, only preliminary results are available.

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[358] Chapter 3, Table 3.53.

4.1.1.1. Domestic fauna

The common domestic species, namely sheep, goat, cattle, and pig, were identified in all the Early Iron Age to Classical settlements. Specimens identified only to the level of sheep/goat have been assigned to these two species proportionately (in terms of MinAU for Argilos, Karabournaki and Kastri and MNI for Kastanas). In regard to Early Iron Age settlements, at Assiros combined caprines (sheep, goat, and sheep/goat) predominate followed by pig and cattle.[359] At Kastanas sheep are almost equal with pig, followed by cattle and goat, while at Kastri, goat and sheep are almost equally represented, followed by cattle and pig (**Fig. 4.2**). The difference in species composition between the two sites is most probably due to the contrasting locations of the settlements. Kastri is located in a hilly environment in the interior of an island, with limited space for agriculture and for animal husbandry tied to the arable landscape, while Kastanas is located in the lowlands. Thus, the high percentage of goat at Kastri is arguably because goat is better suited than the remaining livestock species to the rugged terrain of Thassos with its greater wealth of browse than graze.

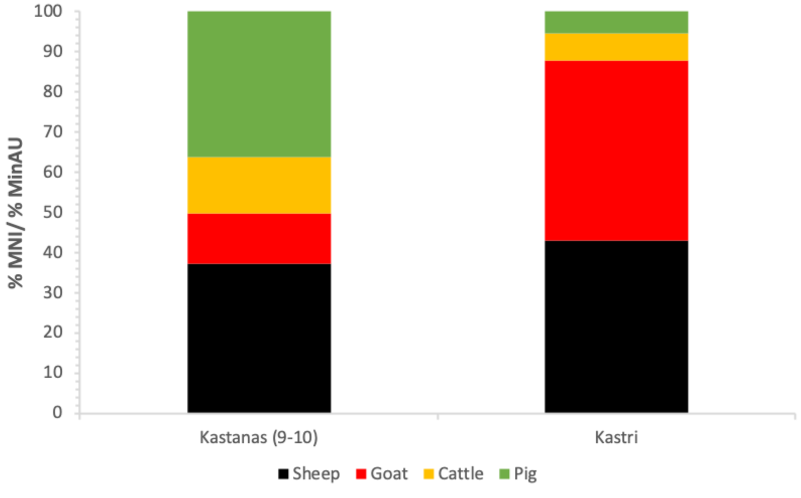

Fig. 4.2. Representation of sheep, goat, cattle, and pig at EIA sites in the region of Macedonia (MNI/MinAU; Appendix IV: Table IV.1): Kastanas 9-10 (MNI 191; Becker 1986: 48, Table 14; 335, Table IV) and Kastri (MinAU 1,239; Table 3.91)

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[359] Halstead and Jones 1980.

In regard to management priorities for the main taxa, comparison between Kastanas and Kastri was based on mandibular cheek tooth data as the epiphyseal fusion data from Kastanas is presented only for selected body parts. Moreover, a cumulative age curve for cattle was constructed only for Kastanas as there is insufficient mandibular evidence for this species at Kastri. Sheep and goat are presented together as combined caprines for Kastanas, where age at death data are not presented separately for the two species, and are too sparse for construction of separate cumulative curves at Kastri. To enable comparison between sites, the age stages reported for Kastanas dental data have been converted to those used for Kastri and other sites analysed for the present study.[360] Where the Kastanas age stages are broader than those used in this thesis, the relevant parts of the cumulative age curves are represented by dashed lines, indicating that the timing of caprine deaths between 36 and 120 months (**Fig. 4.3**), and likewise of cattle deaths before 18 and after 30 months of age (**Fig. 4.4**), is unknown.

Overall, at both EIA Kastanas and Kastri, caprines seem to have been kept mainly for meat, although this does not preclude exploitation on a small scale of milk and/or fibre, with use of the latter perhaps slightly more intensive at Kastanas than Kastri (**Fig. 4.3**). For Kastri, the available data do not indicate any clear difference between sheep and goats in mortality and thus in husbandry priorities. In relation to cattle management priorities, at Kastanas cattle were used at least in part for meat production (**Fig. 4.4**), whereas at Kastri, based on the epiphyseal fusion data, predominantly adult cattle were probably kept mainly for breeding and perhaps traction.[361] At Assiros, caprines were also kept for meat, while there is no available data in relation to age at death of cattle.[362] Pig, at all the EIA sites was killed mostly within its first year, with Kastri having more young deaths (as well as a lower proportion of pigs) than Kastanas (**Fig. 4.5**). Young mortality is very common in pig and related to its very high rate of reproduction, while the difference between the two sites may be related to their location rather than to a preference at Kastri for consumption of piglets (below, Synthesis). Finally, the few adult deaths at Kastanas were presumably breeding animals, but would also have offered more fat than the predominant young piglets.

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[360] Chapter 2, Table 2.7.
[361] Chapter 3, Fig. 3.147.
[362] Halstead and Jones 1980.

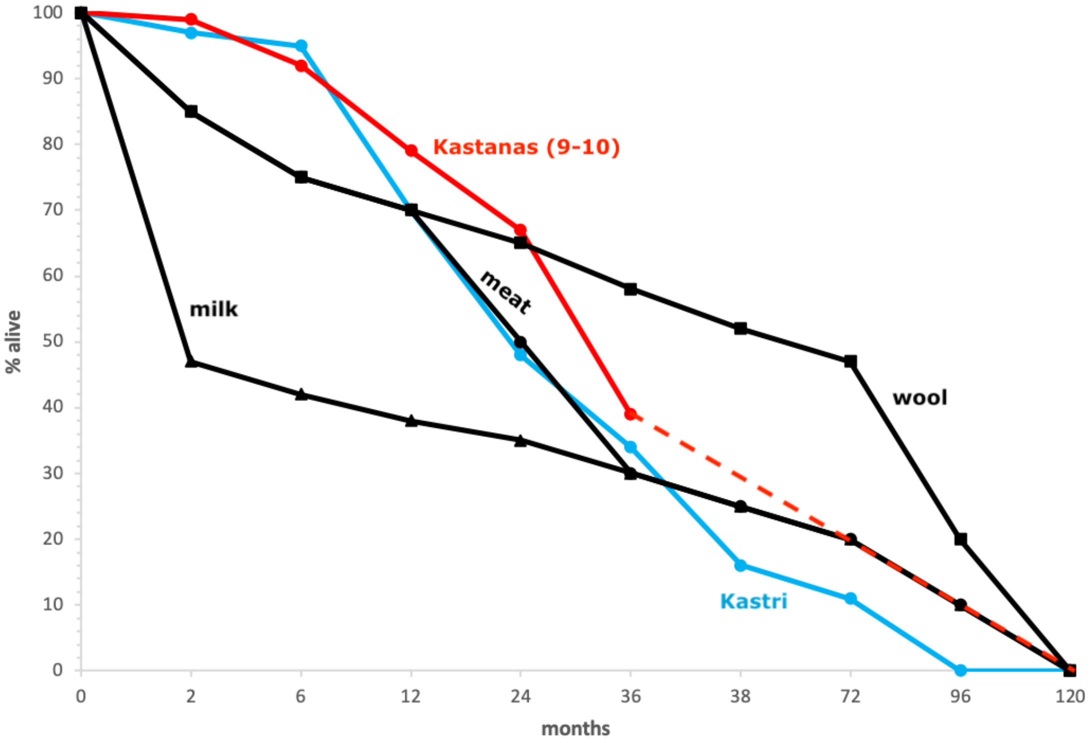

Fig. 4.3. Cumulative age curves based on eruption and wear of mandibular cheek teeth of caprines at EIA Kastri (MinAU 37; Table 3.108) and Kastanas 9-10 (NISP 107; Becker 1986: 49, Table 15; dotted lines indicate use of broader age categories), compared with Payne's production models (after Payne 1973: 282-284; Figs 1-3)

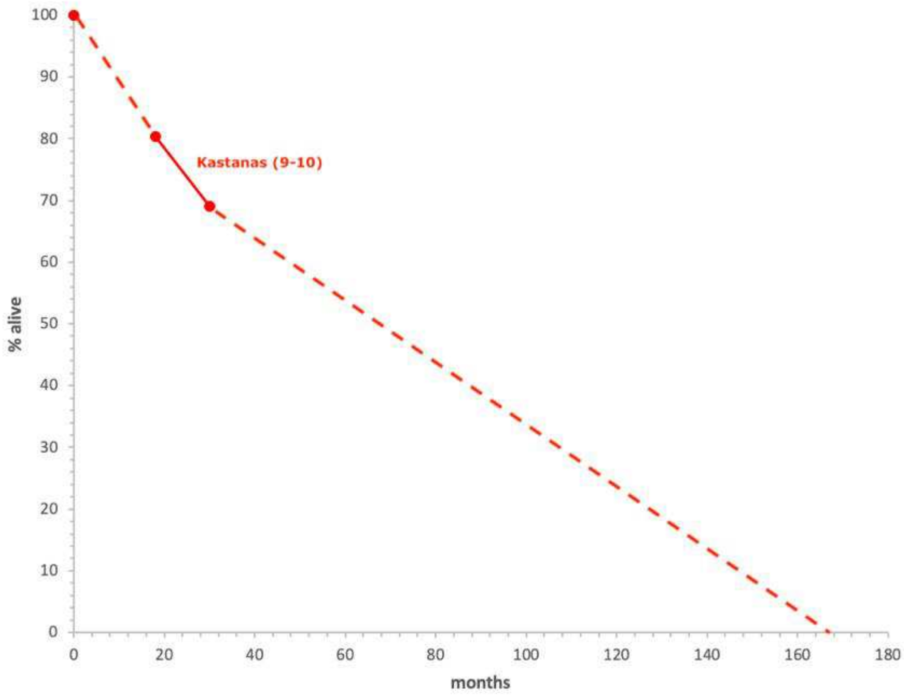

Fig. 4.4. Cumulative age curves based on eruption and wear of mandibular cheek teeth of cattle at EIA Kastanas 9-10 (NISP 51; Becker 1986: 31, Table 5; dotted lines indicate use of broader age categories)

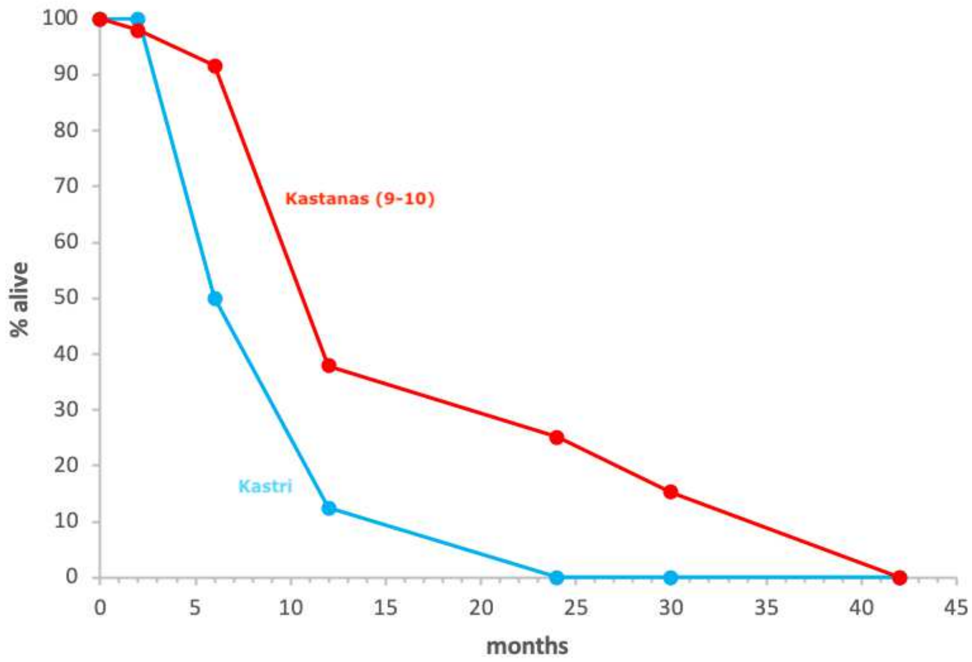

Fig. 4.5. Cumulative age curves based on eruption and wear of mandibular cheek teeth of pig at EIA Kastri (MinAU 8; Table 3.115) and Kastanas 9-10 (NISP 203; Becker 1986: 64, Table 24)

In the Archaic and Classical eras, sheep predominated at Argilos and Karabournaki, followed, in fairly even proportions, by pig, cattle and goat at Argilos and by cattle, pig and goat at Karabournaki. At Kastanas the species representation is totally different. Pig dominated, followed by sheep, cattle, and goat (**Fig. 4.6**). The differences in the species composition between the sites could be related with both the location and the economic priorities of the settlements. Karabournaki was situated between the plain of Thessaloniki and the Anthemous valley, with lagoons in its vicinity, while Argilos was surrounded by grasslands of small extent and the wooded mountain range of Kerdylia. Thus, cattle herding was suited better to Karabournaki than Argilos (below, Synthesis). As regards management priorities, the cumulative age curves of caprines and pig for all three sites were again constructed by converting the Kastanas age groups to those used for Argilos and Karabournaki.[363] For caprines, production at Argilos was geared primarily to fibre (perhaps especially in sheep) rather than meat (perhaps more important in goat), while milk was not a major husbandry goal. At Karabournaki, available data suggest a clear contrast between sheep, managed for fibre, and goat, managed for meat, while at Kastanas the mortality curve for combined caprines (mainly sheep) suggests management for meat perhaps combined with fibre (**Fig. 4.7**). In relation to the use of cattle, both Argilos and Karabournaki exhibit a high proportion of adult deaths, implying emphasis on secondary products and, given the rarity of very young deaths, probably use for traction rather than milk, while at Kastanas meat production appear to have been more important (**Fig. 4.8**). Finally, in regard to the management of pig, at all three sites half of the pigs were killed within the first 12 months, with Kastanas having rather younger and Argilos rather older mortality. As mentioned above, killing pigs in their first year is most probably related to their very high rate of reproduction, while delayed slaughter of some subadults may have been intended to provide fat as well as meat (**Fig. 4.9**).

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[363] Chapter 2, Table 2.7.

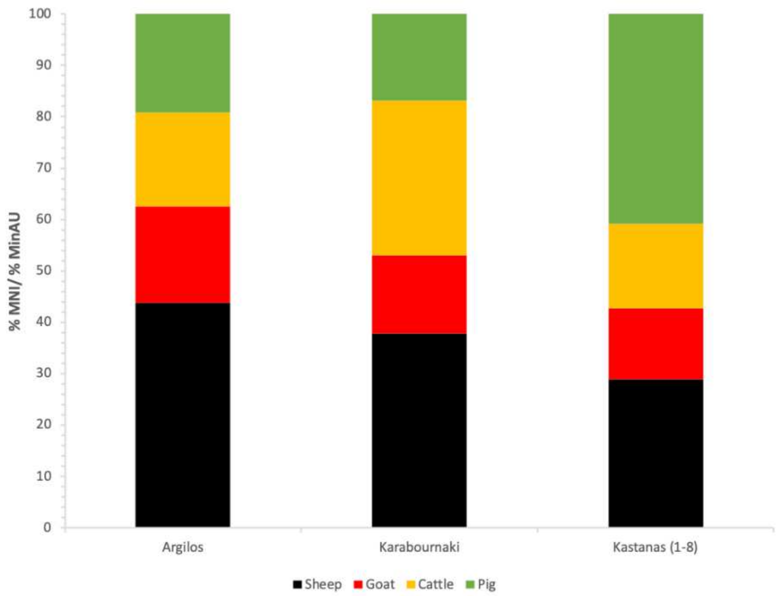

Fig. 4.6. Representation of sheep, goat, cattle, and pig at Archaic and Classical sites in the region of Macedonia (MNI/MinAU; Appendix IV: Table IV.1): Argilos (MinAU 3,742; Table 3.21), Karabournaki (MinAU 563; Table 3.56) and Kastanas 1-8 (MNI 267; Becker 1986: 48, Table 14; 335, Table IV)

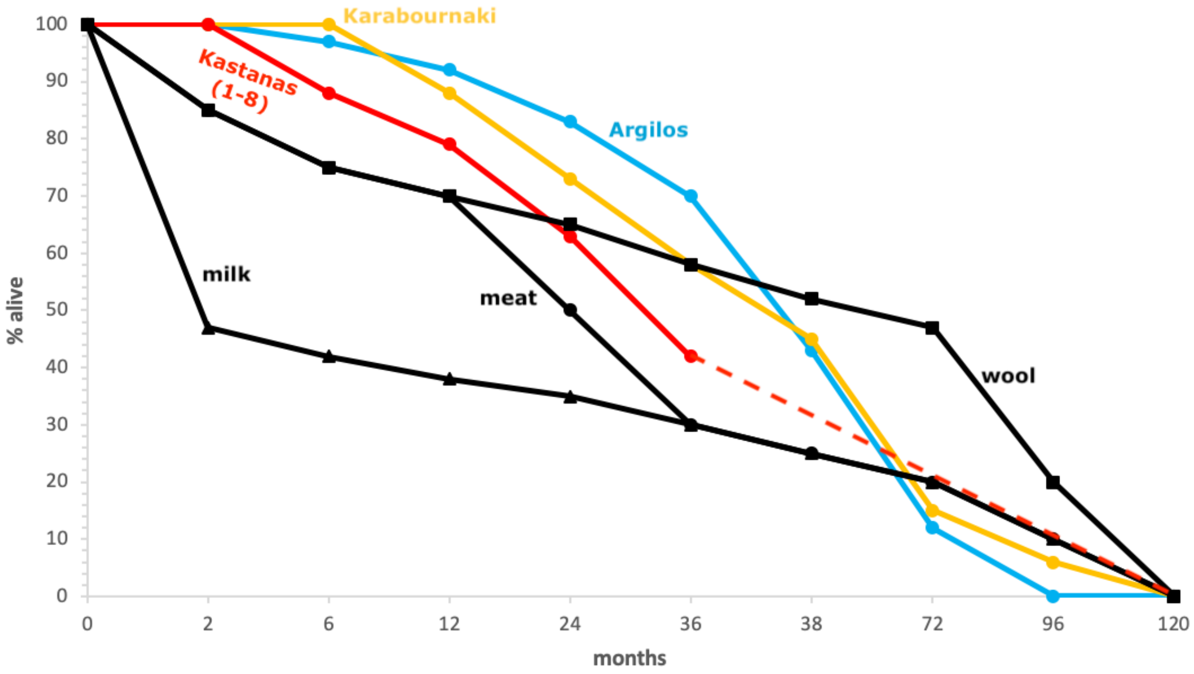

Fig. 4.7. Cumulative age curves based on eruption and wear of mandibular cheek teeth of caprines at Archaic and Classical Argilos (MinAU 126; Table 3.40), Karabournaki (MinAU 33; Table 3.74) and Kastanas 1-8 (NISP 91; Becker 1986: 49, Table 15; dotted lines indicate use of broader age categories), compared with Payne's production models (after Payne 1973: 282-284, Figs 1-3)

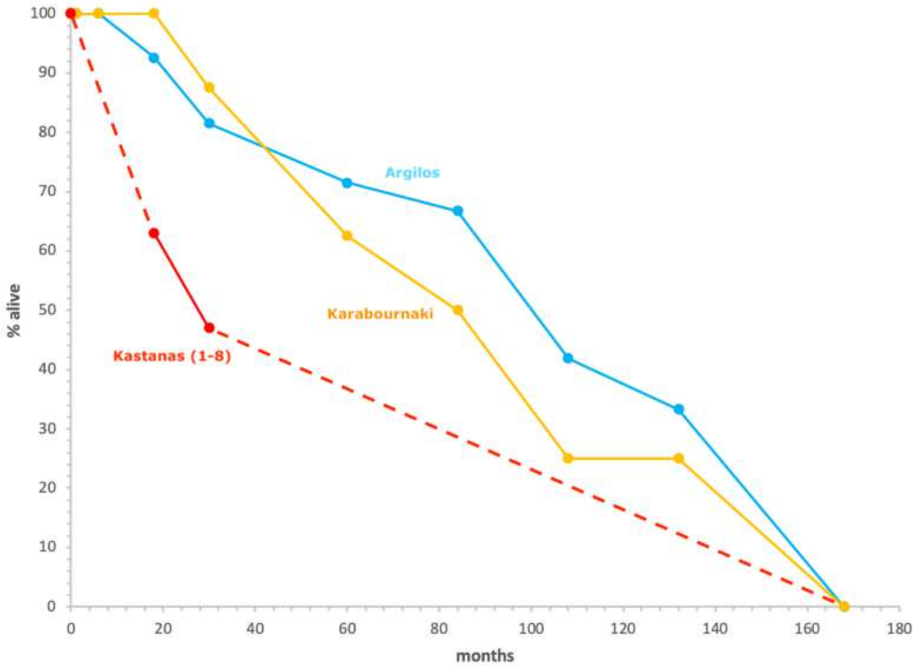

Fig. 4.8. Cumulative age curves based on eruption and wear of mandibular cheek teeth of cattle at Archaic and Classical Argilos (MinAU 27; Table 3.44), Karabournaki (MinAU 8; Table 3.79) and Kastanas 1-8 (NISP 81; Becker 1986: 31, Table 5; dotted lines indicate use of broader age categories)

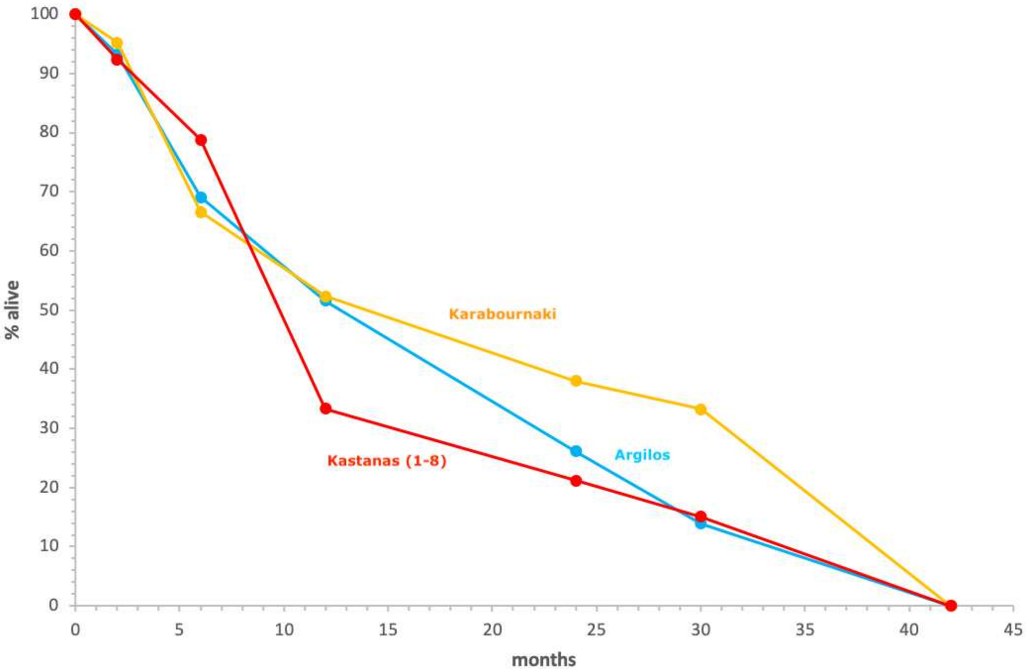

Fig. 4.9. Cumulative age curves based on eruption and wear of mandibular cheek teeth of pig at Archaic and Classical Argilos (MinAU 73; Table 3.48), Karabournaki (MinAU 21; Table 3.83) and Kastanas 1-8 (NISP 198; Becker 1986: 64, Table 24)

As regards the rest of the domestic animals, dog was present in all the Early Iron Age to Classical settlements in the mainland and on the island of Thassos.[364] Given the husbandry of domestic animals and the presence at least on the mainland of wild carnivores (e.g. wolf; below, 4.1.1.2), dogs, apart from perhaps being kept as pets, could have been used to guard herds. The finding in all sites of game species, such as deer, hare, and boar (below, 4.1.1.2), suggests that dog could also have been used in hunting. Furthermore, dogs contributed to waste removal within the settlements, and at Argilos, Karabournaki and Kastanas[365] alike some dog specimens bore traces of consumption by humans (below, 4.2). In relation to equids, horse was identified at Argilos, Assiros, Kastanas and Kastri, donkey at all settlements, and mule only at Kastanas.[366] Horse and donkey at Argilos and donkey at Karabournaki were found in both Archaic and Classical layers. For Kastanas, horse, donkey and mule are reported in Early Iron Age to Classical deposits, while donkey and horse were also represented in the Bronze Age layers.[367] Finally, at Assiros, like Kastanas, donkey was present also during the Bronze Age.[368] The introduction of equids to the region of Macedonia, which occurred at much the same time throughout Europe,[369] is probably related to the use of these species as draught (e.g. for chariots) and riding/pack animals (potentially aiding in the capture and transport of game animals). Moreover, at Argilos, Karabournaki and Kastanas, there are indications of equid consumption (below, 4.2). Apart from the terrestrial domestic animals, chickens must also have been exploited. In Argilos, although the 203 (NISP) recorded bird bones have not been studied yet, at least 15 specimens were identified as *Gallus* sp. by P. Colangelo,[370] while in Kastanas only one bone was attested in the Archaic-Classical period and more specifically in the latest occupation layers.[371] At Karabournaki the recorded bird specimens (NISP 4), apart from one identified as mallard, were not identified to species level, at Kastri no bird bones were found, and there are no available data for Assiros.

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[364] Becker 1986: 88-97; Table 3.20 (Argilos); Table 3.55 (Karabournaki); Table 3.91 (Kastri).
[365] Becker 1986: 90, Fig. 30.
[366] Becker 1986: 71-88; Table 3.20 (Argilos); Table 3.55 (Karabournaki); Table 3.91 (Kastri).
[367] Becker 1986: 72, Table 30.
[368] Halstead and Jones 1980.
[369] Sherratt 1981: 261-305; For the introduction of horses to North Greece, see Creuzieux 2013.
[370] Colangelo 2007: 52, Table XI.
[371] Becker 1986: 98.

Synthesis

The heterogeneity in species composition between the EIA and Archaic-Classical sites, as well as between contemporary settlements in the Macedonian region (**Fig. 4.10**), is most probably related to both the location and the animal management priorities of each settlement. As mentioned above, the difference in frequency of cattle between Argilos and Karabournaki, two contemporary coastal settlements, is probably because the latter lay in a landscape better suited for cattle grazing (i.e. extensive wetlands). The mortality data for cattle both at Argilos and Karabournaki, however, suggest management primarily for breeding and traction (**Fig. 4.11**), the latter suggestion perhaps supported by the identification of pathological traces, compatible with traction stress, on a first phalanx of cattle from Classical Argilos. The use of cattle as a draught animal in Archaic and Classical Greece was common and is mentioned in written sources: for example, Hesiod around 700 BC suggested that a modest farmer would maintain a pair or oxen. The maintenance of cattle for ploughing requires a sizeable area of land for cultivation, consistent with the location of Karabournaki, explaining its higher percentage of cattle compared to Argilos. Argilos perhaps expanded the use of cattle in the Classical period, when the percentage of cattle is higher and when Argilos cattle would have had access to the nearby wetland of the Strymon delta. More specifically, based on stable carbon and nitrogen isotopic analysis[372], the diet of cattle at Classical Argilos included a significant quantity of C_4 plants in comparison with the previous, Archaic period, when cattle seem to have grazed, along with sheep, on less C_4-rich plants (**Fig. 4.12**). The increase of C_4 plant consumption by cattle during Classical times is unlikely to have been solely due to foddering on millet, which was the only C_4 cultivar available in the region at the time[373] and has as yet not been identified at Argilos.[374] A significant source of C_4 vegetation could have been found, however, in the nearby salt marshes of the Strymon delta which did exist during Classical times. Pollen evidence from the Classical/Hellenistic period indicates an increase in salt marsh vegetation including potential C_4 taxa, while in the Archaic period pasture indicators in the Strymon delta are scarce.[375] Thus, cattle in Argilos during the Archaic period were probably grazing on arable fields, while in the Classical era they could have grazed on C_4 pasture located in the nearby Strymon river

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[372] The isotopic analysis was made by R. Alagich at the Department of Archaeology, University of Sydney, Australia.

[373] Valamoti 2016.

[374] Gkatzogia and Valamoti 2021.

[375] Chapter 1, Fig. 1.7.

delta. Thus, both zooarchaeological and palynological data suggest that the location of cattle pasture, and possibly the size of the herd, changed during the Classical period at Argilos. Given that exploitation of dairy products from cattle was not a priority (**Fig. 4.11**) and that pig, lacking secondary products, was a major source of meat (**Fig. 4.16**), perhaps the changes in cattle management were related to the needs of more extensive husbandry at Argilos of the cultivated plants attested archaeobotanically (i.e., the cereals wheat and barley; and the pulses bitter vetch, grass pea, and lentil).[376] Ploughing with cattle is also likely at Karabournaki, Assiros and Kastanas, where grain growing is attested by rich archaeobotanical remains, some found in storage rooms.[377]

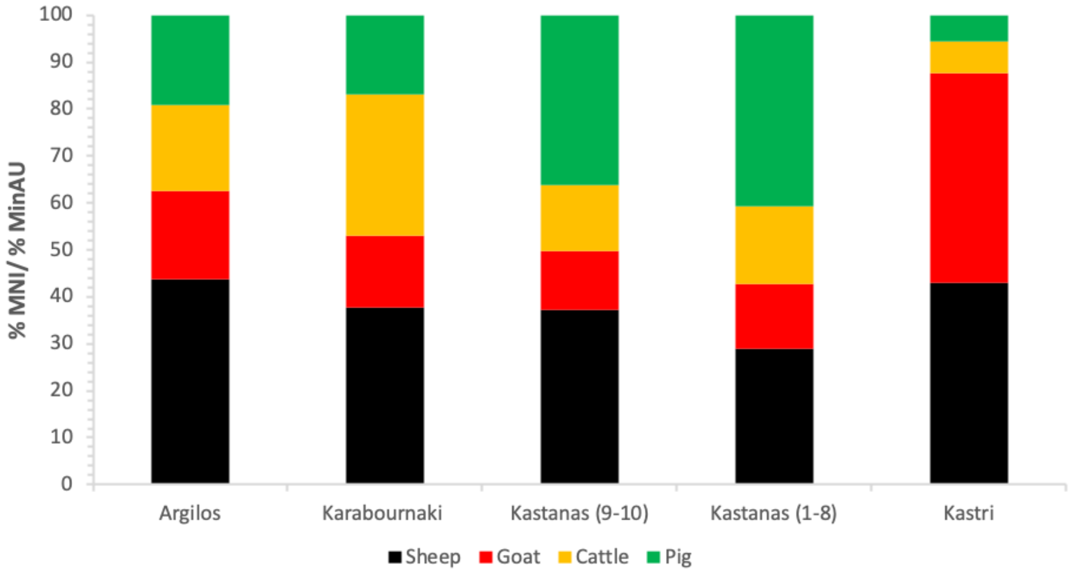

Fig. 4.10. Representation of sheep, goat, cattle, and pig at Early Iron Age to Classical sites in the region of Macedonia (MNI/MinAU; Appendix IV: Table IV.1): Argilos (MinAU 3,742; Table 3.21), Karabournaki (MinAU 563; Table 3.56), Kastanas (9-10) (MNI 191; Becker 1986: 48, Table 14; 335, Table IV), Kastanas (1-8) (MNI 267; Becker 1986: 48, Table 14; 335, Table IV) and Kastri (MinAU 1,239; Table 3.91)

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[376] Gkatzogia and Valamoti 2021.

[377] Kroll 1983; Halstead and Jones 1980: 265-7; Jones et al. 1986: 99.

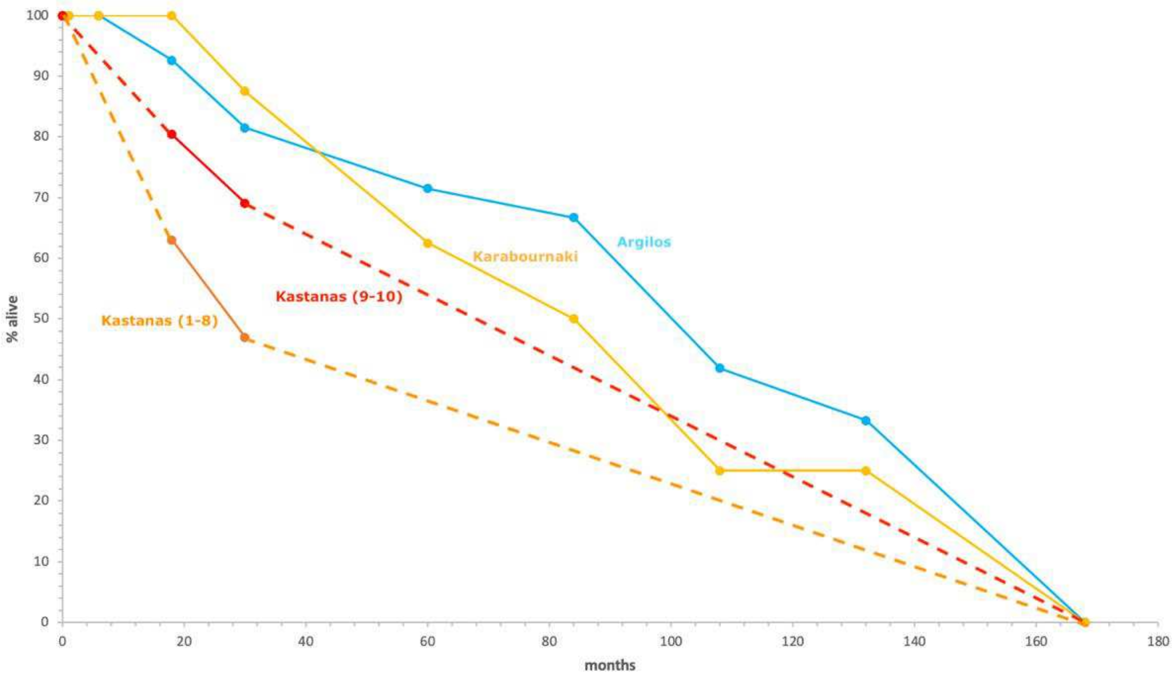

Fig. 4.11. Cumulative age curves based on eruption and wear of mandibular cheek teeth of cattle at EIA to Classical sites in the region of Macedonia: Argilos (MinAU 27; Table 3.44), Karabournaki (MinAU 8; Table 3.79), Kastanas 9-10 (NISP 51; Becker 1986: 31, Table 5) and Kastanas 1-8 (MNI 81; Becker 1986: 31, Table 5); dotted lines indicate use of broader age categories at Kastanas

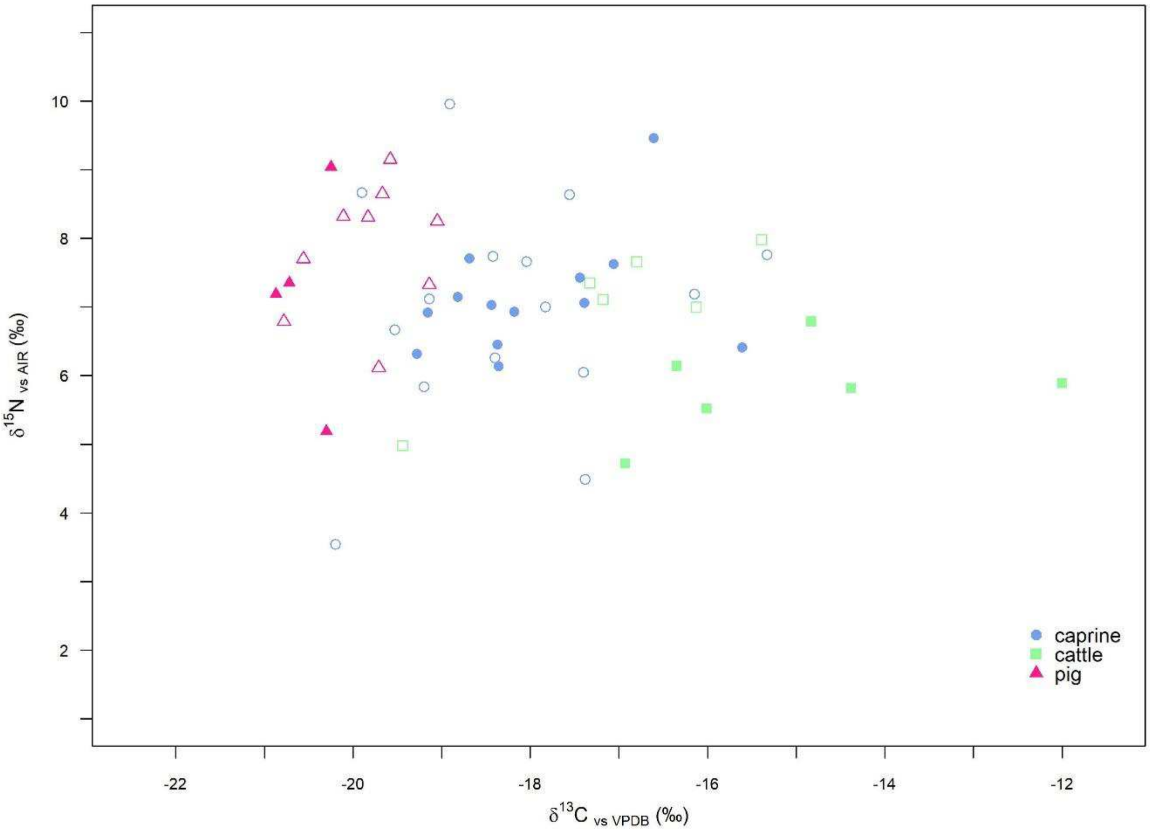

Fig. 4.12. Plot of δ^{13}C and δ^{15}N values of caprines, cattle and pig from Archaic and Classical Argilos. Open shapes represent Archaic period samples and closed shapes Classical period samples (Alagich et al. forthcoming, Fig. 6)

Cultivated plants were evidently very important in human diet from the EIA to Classical period in the region of Macedonia. Apart from the rich archaeobotanical remains mentioned above from Assiros and Kastanas, the isotopic analysis of human skeletons from the EIA cemeteries of Kastri, namely Tsiganadika, Vrisoudes, Kentria and Larnaki, indicates a diet mainly based on plants, such as cereals, with a C3 photosynthesis pathway, while animal protein consumption was assessed to have comprised less than 10% of the diet.[378] Thus, despite a lack of archaeobotanical data from Kastri, the isotopic analysis from its cemeteries suggests that meat was a minor, supplementary nutritional source to a plant-based diet. At Argilos, isotopic analysis of dog remains from Classical

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[378] Angelarakis 1999: 452.

deposits (**Fig. 4.13**) suggests that harvested cereals and pulses left over from human consumption may have played a significant role in the diet of dogs, reflecting indirectly aspects of human diet.[379] Moreover, the isotopic analysis of human remains from the Early Iron Age sites of Agios Dimitrios in Fthiotis, Central Greece, and from Karitsa and Makriyalos in the Macedonian region suggest a plant-based diet and low consumption of animal protein in comparison with the previous Bronze Age and subsequent historical periods.[380] Apart from isotopic analysis of human and animal populations, literary sources stress the importance of the consumption of products of plant origin over the consumption of products of animal origin.[381] All these lines of evidence converge on a 'common' dietary regime among the Early Iron Age to Classical populations of the Aegean basin, dominated by cultivated plants.

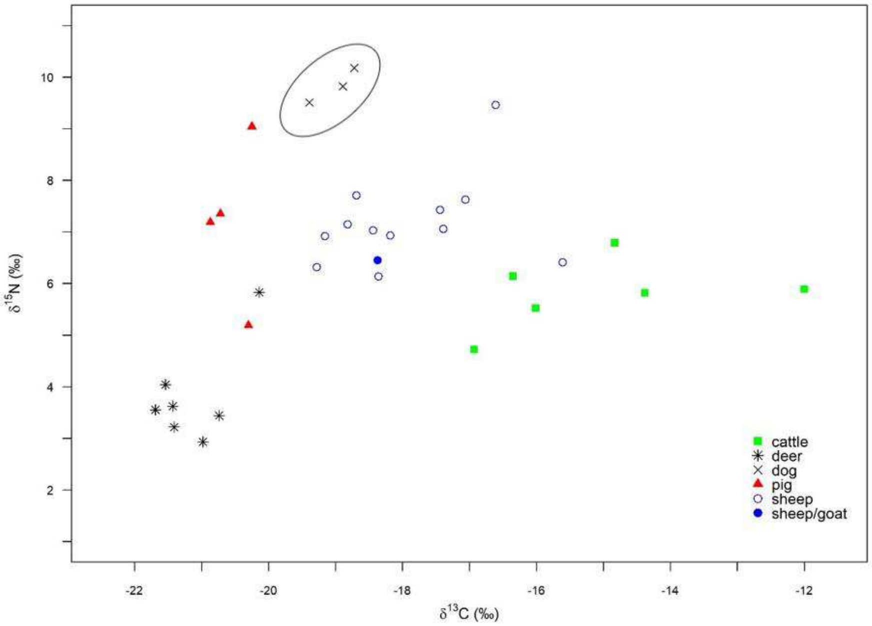

Fig. 4.13. Plot of $\delta^{13}C$ and $\delta^{15}N$ values of domestic and wild animals from Classical Argilos; dog samples are circled (Alagich et al. forthcoming, Fig. 5)

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[379] Alagich et al. 2021.

[380] Papathanasiou and Richards 2015; Papathanasiou et al. 2013.

[381] E.g., Halstead 2012; Hodkinson 1988.

In regard to caprines, sheep clearly outnumber goat in all settlement sites, apart from Kastri where goat dominated (above, **Fig. 4.10**). The high percentage of goat at Kastri, as already mentioned, is probably because goat is better suited than the remaining domesticates to the rugged terrain of Thassos with a greater wealth of browse than graze. This would also be consistent with the indications of possible feral goats at Kastri.[382] Although, sheep and goat were largely analysed together as caprines, due to the sparse data at Argilos, Karabournaki and Kastri, and the lack of relevant information from Kastanas, there are indications that sheep and goat were used differently. At Argilos, sheep seems to have been kept mainly for wool, especially during the Classical period, and goat for meat,[383] while a similar difference in management between the two species is even clearer at Karabournaki.[384] Finally, at Kastri, wool from sheep and meat, mainly lambs and adult goats, were mostly exploited.[385] In the case of Kastanas, where the management priorities for sheep and goat cannot be disentangled, combined caprine mortality suggesting a blend of meat and fibre production may conceal a similar distinction to that already noted at the other three settlements (**Fig. 4.14**). Fibre production is also confirmed by the discovery of numerous loom weights in all four sites. Although it is not known whether these settlements were production centres or textiles were merely produced on a household scale (and for domestic use), at Argilos there are indications of large-scale textile production from the Classical period at least. More specifically, more than 600 loom weights were recorded at Argilos, of which 38 were derived from Room L7 of Building L and dated from the Classical period.[386] According to the excavators, the rooms of Building L comprised the city's *agora*, functioning primarily as stores and workshops, and, thus, Room L7 probably served as a weaving workshop[387] (**Fig. 4.15**). Thus, the increase of sheep exploitation for wool in Classical Argilos could be related to the existence of at least one weaving workshop during the same period. In literary sources there are references to sheep breeds with desirable wool and an elite concern with luxury textiles,[388] while to improve the wool and to select certain characteristics, regional breeds of sheep were crossed with other types.[389] Although ancient texts

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[382] Chapter 3, Table 3.88.
[383] Chapter 3, Figure 3.73.
[384] Chapter 3, Figure 3.112.
[385] Chapter 3, Figure 3.140.
[386] Perreault and Bonias 2021: 15.
[387] Perreault and Bonias 2021: 15.
[388] Halstead 2012: 34.
[389] Chandezon 2015: 136.

refer mainly to the city of Athens, the needs of the market at Argilos, as a Greek *polis*, may not have been very different.

In regard to milk, dairying with caprines in EIA to Classical settlements was at most a low priority (**Fig. 4.14**), as with cattle. The isotopic analysis of dog bones from Classical Argilos indicates that dairy products from caprines and cattle were consumed by dogs infrequently. This might have indirectly recorded the diet preferences of the citizens of Argilos at least in that period (above, **Fig. 4.13**).[390] Based on historical sources, milk was a beverage characteristic of barbarians,[391] and its consumption in Classical Greece was accepted only in the diets of infants and the sick.[392] Thus, in ancient Greece, dairying seemed to have aimed mostly at cheese production, while little milk was drunk fresh.[393]

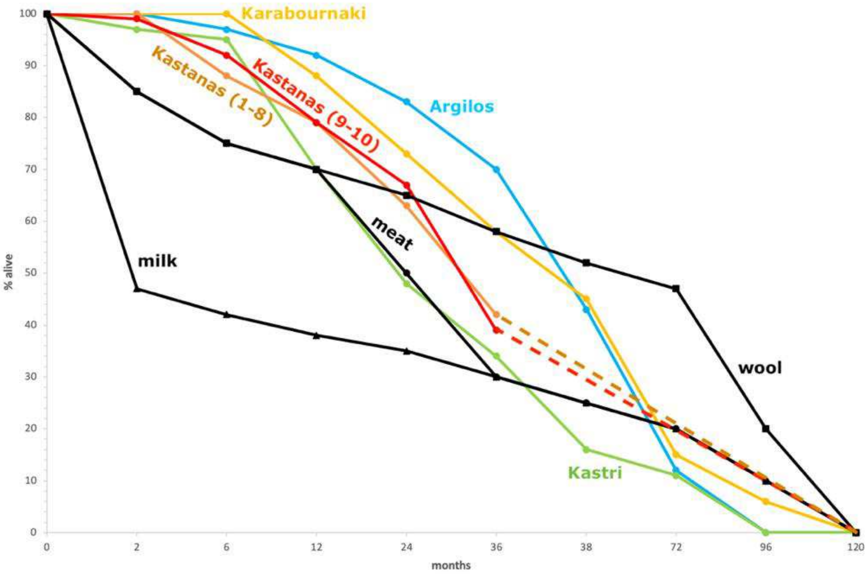

Fig. 4.14. Cumulative age curves based on eruption and wear of mandibular cheek teeth of caprines at EIA to Classical sites in the region of Macedonia: Argilos (MinAU 126; Table 3.40), Karabournaki (MinAU 33; Table 3.74), Kastanas 9-10 (NISP 107; Becker 1986: 49, Table 15), Kastanas 1-8 (NISP 91; Becker 1986: 49, Table 15) and Kastri (MinAU 37; Table 3.108), compared with Payne's production models (after Payne 1973: 282-284, Figs 1-3); dotted lines indicate use of broader age categories at Kastanas

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[390] Alagich et al. 2021.

[391] Auberger 2001.

[392] Chandezon 2015: 143.

[393] Chandezon 2015: 137.

Fig. 4.15. The interior of Room L7 (weaving workshop) of Building L at Classical Argilos as vied from the South (Argilos excavation archives)

In relation to meat, animal protein eaten by dogs in Classical Argilos was mostly derived from pig, while the consumption of caprine and cattle meat was infrequent (above, **Fig. 4.13**).[394] Historians agree that pork was the best and healthiest of meat, and thus was the main source of animal protein in ancient Greece.[395] Based on the zooarchaeological data from the region of Macedonia, pig was also a staple meat source for all settlements in both the EIA and Archaic-Classical periods, while older culls may also have provided fat (**Fig. 4.16**). There are no notable differences between the EIA and Archaic-Classical phases at Kastanas, while at Karabournaki pig was kept alive for longer compared to the other settlements, most probably for its fat, and Kastri has more young deaths than the rest of the sites. The latter may reflect local environmental restrictions on crop husbandry. Thus, if pigs were reared mainly or substantially on stubble fields, crop processing by-products and food waste, they may have been killed relatively early in their first year if the local environment limited the scale of agricultural production at Kastri. The data from isotopic analysis from Argilos' pigs is consistent with the above suggestion, as pig diet, in both the Archaic and

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[394] Alagich et al. 2021.

[395] Chandezon 2015: 141.

Classical periods, primarily consisted of C_3 food sources, including manured cereals (above, **Fig. 4.12**).

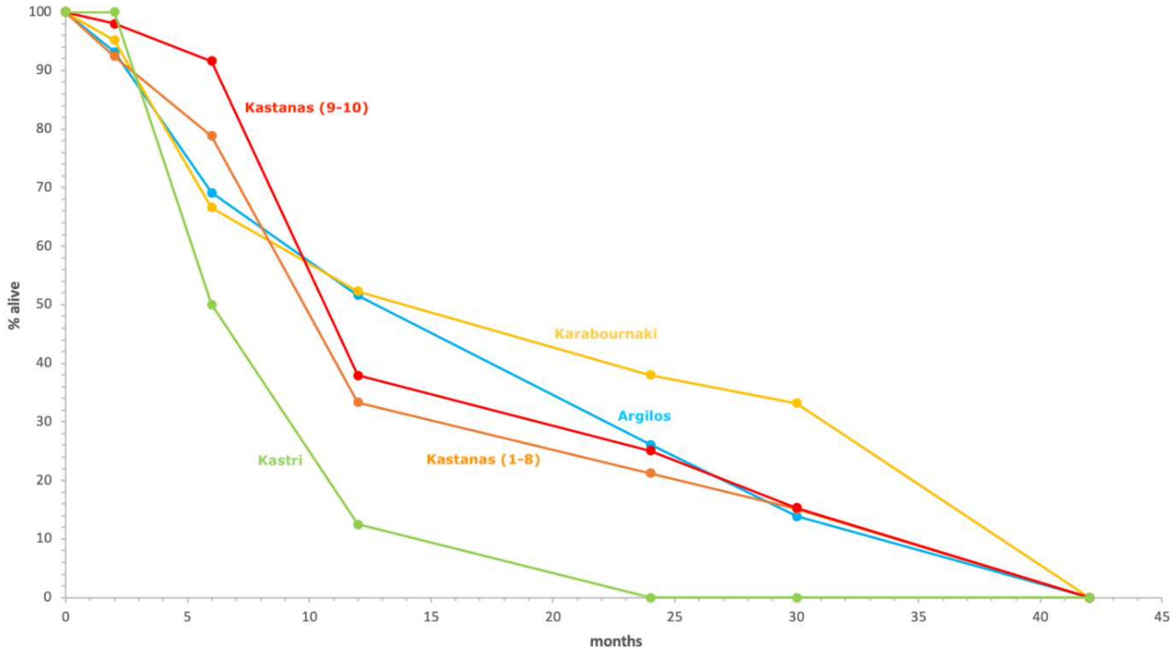

Fig. 4.16. Cumulative age curves based on eruption and wear of mandibular cheek teeth of pig at EIA to Classical sites in the region of Macedonia: Argilos (MinAU 73; Table 3.48), Karabournaki (MinAU 21; Table 3.83), Kastanas 9-10 (NIPS 203; Becker 1986: 64, Table 24), Kastanas 1-8 (NISP 198; Becker 1986: 64, Table 24) and Kastri (MinAU 8; Table 3.115)

However, the virtual absence of newborn pigs (only one specimen recorded) at Kastri[396] may indicate that most breeding stock were kept at some distance from the site, in contrast with the remaining settlements where the presence of newborns suggests that breeding stock were kept in or very close to the settlements.[397] If this was the case, pig farming at Kastri may have been carried out in the forested areas of the island, suggesting a difference in husbandry practices from the mainland settlements. This type of farming was developed in certain regions of Greece, such as Arcadia, while according to Homer, the herds of Odysseus on the island of Ithaca were reared by

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[396] Chapter 3, Table 3.116.

[397] Becker 1986: 64, Table 23; Chapter 3, Argilos: Table 3.49 and Karabournaki: Table 3.84.

the swineherd Eumaeus away from the palace.[398] Considering the lack of wild carnivores such as wolves on Thassos, as well as the probably limited scale of agricultural production which could have provided fodder for pigs, pig husbandry in the forest is a plausible suggestion. If so, the high young mortality and the low levels of fat exploitation could be related with the fact that free grazing animals are leaner and have tougher meat than those raised in limited spaces within or close to the settlement.

Although written sources mention pork as the main meat consumed by ancients Greeks and imply that beef was unknown to Greeks and the flesh of sheep and goat little appreciated, the indications of exploitation for meat of sheep, goat and cattle cannot be ignored. Caprines and cattle evidently contributed to human diet, but it is debated whether they were consumed in connection with ritual sacrifice (below, 4.2) or were slaughtered to cover a practical need for meat in the local market. However, the results of isotopic analysis of dogs at Classical Argilos, where pig seemed to be the main source of animal protein for the inhabitants, may overestimate the importance of pork consumption in Classical Argilos. A possible preference of dog for protein from pig is consistent with the frequency of diaphysis cylinders, typical products of dog gnawing, which in the Classical period at Argilos are higher for pig than the remaining taxa.[399] In practice, such a preference might be due to the high young mortality in pigs, as a result of which their bones, containing only modest amounts of marrow fat, were discarded relatively intact and then preferentially gnawed by dogs. This scenario is supported by a higher percentage of complete bones in pig than in the remaining taxa, but would also imply that pig bones were heavily underrepresented relative to caprines and cattle as a result of attrition by dogs. The latter implication, however, contradicts the earlier interpretation of the taphonomic data as indicating only modest attrition by dogs.[400] Moreover, if dogs did indeed largely consume human food waste, their distinctive $\delta^{13}C$ and especially $\delta^{15}N$ values might be due to intake of agricultural products from manured land rather than marrow or meat of pigs (above, **Fig. 4.13**).

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[398] Hom. Od. 14 passim.
[399] Chapter 3, Table 3.33.
[400] Chapter 3, Table 3.31.

In addition to sheep, goat, cattle and pig, chicken must also have been exploited as a source of protein through its meat and eggs. The presence of chickens is attested to date only at Classical Kastanas and probably Argilos, consistent with the theory that chickens appeared in Greece by the mid-first millennium BC from southeast Asia. Apart from their consumption on a household scale, chickens, in the Classical era, were also favoured in certain sacrificial contexts such as in sanctuaries of Asklepios.[401] The importance of the chicken in the diet and economy of human societies in the region of Macedonia is uncertain, as, generally, the bird bones were not studied systematically and their presence within the faunal assemblages is certainly underrepresented due to survival and retrieval biases. However, we can assume that, due to their small size, they could be easily reared and consumed with low cost.[402]

Apart from meat, fibre, traction, and perhaps dairy products, all four common domesticates were doubtless also exploited for their dung. At Karabournaki, there are archaeobotanical indications that dung cakes may have been used for fuel for cooking and heating,[403] while the raised $\delta^{15}N$ values observed in pigs at Archaic and Classical Argilos may be attributable to consumption of forage from manured land (above, **Fig. 4.12**). Moreover, skeletal parts of domestic species, including dog and equids, were also exploited as raw materials. The worked bones were mainly long bones of medium- and large-sized animals and tali, mostly of caprines. The latter is the most abundant worked bone and was widely used in the eastern Mediterranean from the Chalcolithic period onwards.[404] According to ancient literary sources, tali were used for various purposes, such as toys,[405] for divination,[406] as grave offerings[407] and as offerings in sanctuaries.[408] After the 1st c. AD, they were also used as a whip accessory. Apart from tali, few finished bone artifacts were identified, mostly from Classical Argilos, and included rings, styluses, spindle whorls and plate fragments, for which the original bone cannot be verified.

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[401] Villing 2017.

[402] Halstead 2012.

[403] Tiverios et al. 2013: 212.

[404] Reese 2000: 398-401; Affami 2008: 77-92; Sériadès 1992: 99-119; Trantalidou 2006: 223-241.

[405] *Anthologia graeca* VI, 308.

[406] Amandry 1984; Reese 1985: 389.

[407] E.g., Lilimpaki-Akamati 1994: 249.

[408] Reese 1985: 382-390; 2000: 398-401; Trantalidou and Theodoropoulou 2015: 229-245; *IG* IV^2, 1 121: 68-70.

The heterogeneity in taxonomic composition between the Early Iron settlements of north Greece, and more specifically between the mainland settlement of Kastanas and the settlement of Kastri on Thassos island, conforms with the heterogeneity in taxonomic composition of EIA settlements in the rest of the Greek mainland (e.g. Athens Agora, Messene, Nichoria and Oropos) and the Aegean islands (e.g. Knossos, Profitis Ilias Gortys, Vronta and Kastro Kavousi in Crete; Zagora on Andros) (**Fig. 4.17** and **Fig. 4.18**). In most cases, caprines are the most common taxon, while in some publications there are no separate datasets for sheep and goat. When sheep and goat were distinguished, one of these species was typically the most numerous at a settlement. For example, sheep outnumber goats at Knossos, Nichoria, Prinias and Profitis Ilias, while goats outnumber sheep at the Athenian Agora, Azoria, Kastri Thassos, Oropos and Smari. However, at Zagora and Nichoria cattle reportedly dominate[409] (**Fig. 4.18**).

The regionalism evident on Early Iron Age settlements in such forms of material culture as ceramics and architecture[410] may also have affected pastoral strategies, causing the observed heterogeneity in taxonomic composition. There are indeed regions where settlements display similar taxonomic composition, such as Azoria, Kastro and Vronta in East Crete or perhaps Kastanas (9-10) and Assiros (for which only very preliminary data are available) in the region of Macedonia. Some settlements in the same region, however, such as Knossos and Profitis Ilias in Central Crete or the Athenian Agora and Oropos in Attica, are dissimilar in taxonomic composition (**Fig. 4.18**), so regionalism is at best only a partial explanation for the taxonomic composition of Early Iron Age assemblages across the Aegean.

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[409] Dibble 2017.

[410] Kotsonas 2006; Snodgrass 2000; Whitley 1991.

Fig. 4.17. Map of sites mentioned in the text (©Apple Maps)

1: Zone, 2: Rigio, 3: Herakleion, 4: Kastri, Kentria, Larnaki,Tsiganadika, 5: Oisyme, Nea Iraklitsa, 6: Drama Industrial Area, 7: Argilos, 8: Amphipolis, 9: Akanthos, 10: Thermi, 11: Karabournaki, 12: Assiros, 13: Kastanas, 14: Makriyalos, 15: Karitsa, 16: Vergina, 17: Mikro Livadi Mavropigi, 18: Ivani Prionia, 19: Palia Volos, 20: Agios Dimitrios, 21: Thermos, 22: Kalapodi, 23: Eleusis, 24: Athens (Agora, Kerameikos, Areopagus), 25: Oropos, 26: Lefkandi-Xeropolis, 27: Eretria, 28: Plakari Karystos, 29: Helike, 30: Corinth, 31: Stymphalos, 32: Nemea, 33: Argos, 34: Asine, 35: Olympia, 36: Tegea, 37: Pylos, 38: Nichoria, 39: Messene, 40: Eleutherna, 41: Prinias Patela, 42: Profitis Ilias, 43: Knossos, 44: Smari, 45: Karphi, 46: Chalasmenos, 47: Azoria, Kastro Kavousi, Vronta Kavousi, 48: Minoa, 49: Xobourgo, 50: Zagora, 51: Zeytin Tepe, Kalabak Tepe

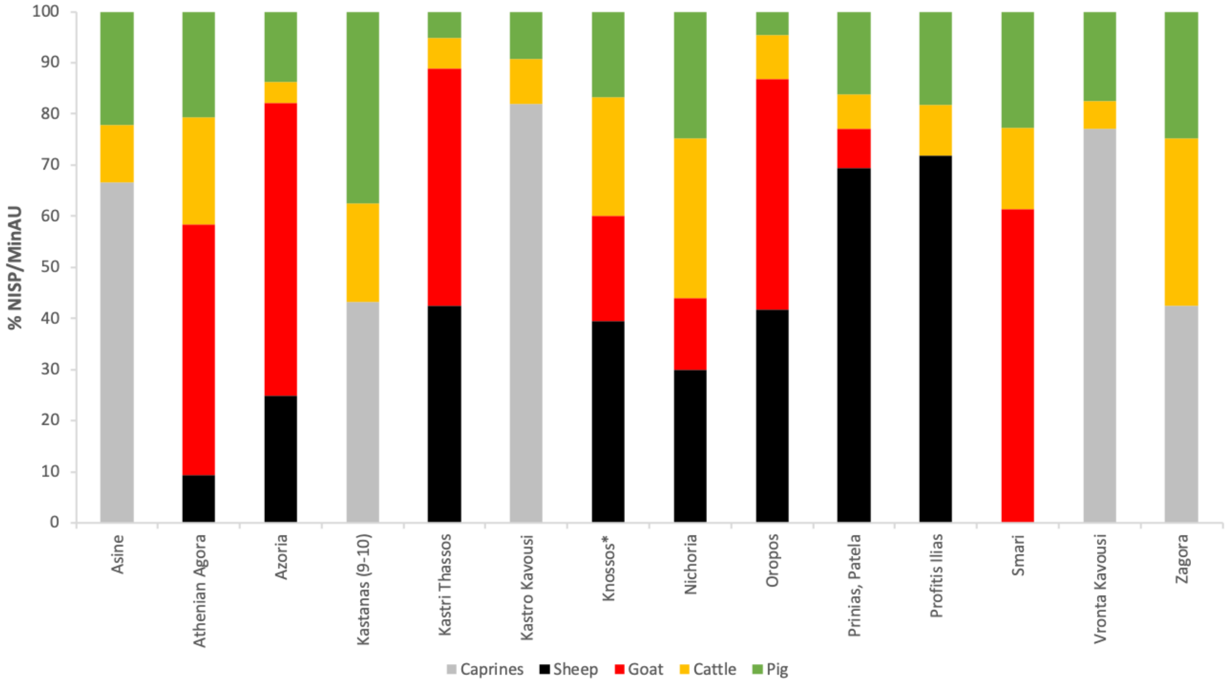

Fig. 4.18. Representation of caprines, sheep, goat, cattle and pig in the Early Iron Age sites of the Aegean basin (NISP/MinAU[1]; Appendix IV: Table IV.2): Asine (NISP 18; Moberg 1996: 67), Athenian Agora (MinAU 445; Dibble 2017: 381, Table 5.6), Azoria (MinAU 918; Dibble 2017: 379, Table 5.4), Kastanas 9-10 (NISP 4,82; Becker 1986: 335, Table II), Kastri Thassos (NISP 2,172; Table 3.91), Kastro Kavousi (NISP 2,640; Klipper and Snyder 1991: 180, Table 1), Knossos (*EIA-Archaic; MinAU 513; Dibble 2012: 81, Table 1.1, 84, Table 1.4), Nichoria (MinAU 2,113; Dibble 2017: 378, Table 5.3), Oropos (NISP 4,097; Trantalidou 2007: 390, Fig. 1), Prinias Patela (NISP 105; Wilkens 2003: 87, Table 8.3), Profitis Ilias (NISP 110; Wilkens 1996: 249, Table 20.5), Smari (NISP 570; Tsoukala 1996: 273), Vronta Kavousi (NISP 1,087; Klippel and Snyder 1991, Table 1), Zagora (NISP 125; Alagich 2012: 95, Table A2.1)

[1] Where publications have distinguished between sheep and goat remains, the specimens identified only to the level of sheep/goat have been assigned to these two species proportionately

Taphonomic processes may also have contributed to differences in taxonomic composition between Early Iron Age sites. Especially on settlements that were permanently abandoned during the Early Iron Age, post-abandonment processes have significantly affected the preservation and identifiability of animal bones near the surface, potentially distorting taxonomic composition.[411] For example, at Nichoria the dominance of cattle is artificial due to severe taphonomic issues,[412] while the Iron Age layers at the Palace of Nestor in Pylos,[413] at the sites of Vronta,[414] Karphi[415] and Chalasmenos[416] in East Crete, and at Lefkandi-Xeropolis[417] on Euboea are extremely poorly preserved. In the region of Macedonia, however, only the settlement of Kastri was abandoned in the Early Iron Age and here the faunal assemblage must have been significantly protected by architectural collapse, as processes of erosion and soil formation were rather limited.[418]

The observed heterogeneity in animal husbandry strategies is paralleled by a high level of diversity in the archaeobotanical records from Early Iron Age sites[419] and may be a result of multiple aspects of local physical geography but also of local political economy, as the beginning of the Early Iron Age was a period of major environmental and cultural transformations. Culturally, human populations were more scattered and mobile and less unified than before,[420] and had to adapt different agropastoral strategies to fit various regional environmental niches. One result of diversity in husbandry strategies may have been exchange of foodstuffs between communities if one settlement experienced a short- or long-term shortage and another a surplus of a particular resource. However, despite the heterogeneity in faunal taxonomic composition and the high level of diversity in cultivated plants, the dietary isotopic signature of Early Iron Age populations seems very uniform, suggesting a plant-based diet and low consumption of animal protein.[421]

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[411] Dibble 2017.
[412] Dibble and Fallu 2020.
[413] Dibble 2017: 129.
[414] Klippel and Snyder 1991.
[415] Mylona 2020.
[416] Dibble 2018.
[417] Mulhall 2016.
[418] Chapter 3, 3.3.2.2.2.
[419] Livarda 2012.
[420] Coldstream 2003; Desborough 1972; Hornblower and Spawforth 2003; Snodgrass 2000.
[421] Papathanasiou and Richards 2015; Papathanasiou et al. 2013.

The heterogeneity in taxonomic composition in the Early Iron Age period seems to persist, and potentially intensify, in the Archaic and Classical periods throughout the Aegean (**Fig. 4.19**). Goat is the most common species at both Azoria[422] and (together with pig) the Athenian Agora,[423] pig is the most common species at Kastanas (1-8), and sheep is the most common at Argilos, Kalabak Tepe, Karabournaki and Knossos.[424] Moreover, although caprines are the most prevalent taxon, most literary sources from this period refer to cattle, rather than pig, sheep, or goat (**Table 4.1**). This inconsistency between the zooarchaeological data and the literary records is most probably because the majority of literary sources refer to animals in the context of food production rather than consumption.[425] Thus, this discrepancy might relate to the difference between livestock (production) and deadstock (consumption) records.[426] Both as agricultural work animals and as the centrepiece of the largest public sacrifices/feasts, however, cattle were also highly valued in elite culture and as such prominent in literary sources.[427]

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[422] Dibble 2017, Table 5.2.
[423] Dibble 2017, Table 5.3.
[424] Dibble 2012, Table 6.1.
[425] Dibble 2017.
[426] Albarella 1999; Davis 1987; Halstead 2003.
[427] McInerney 2010.

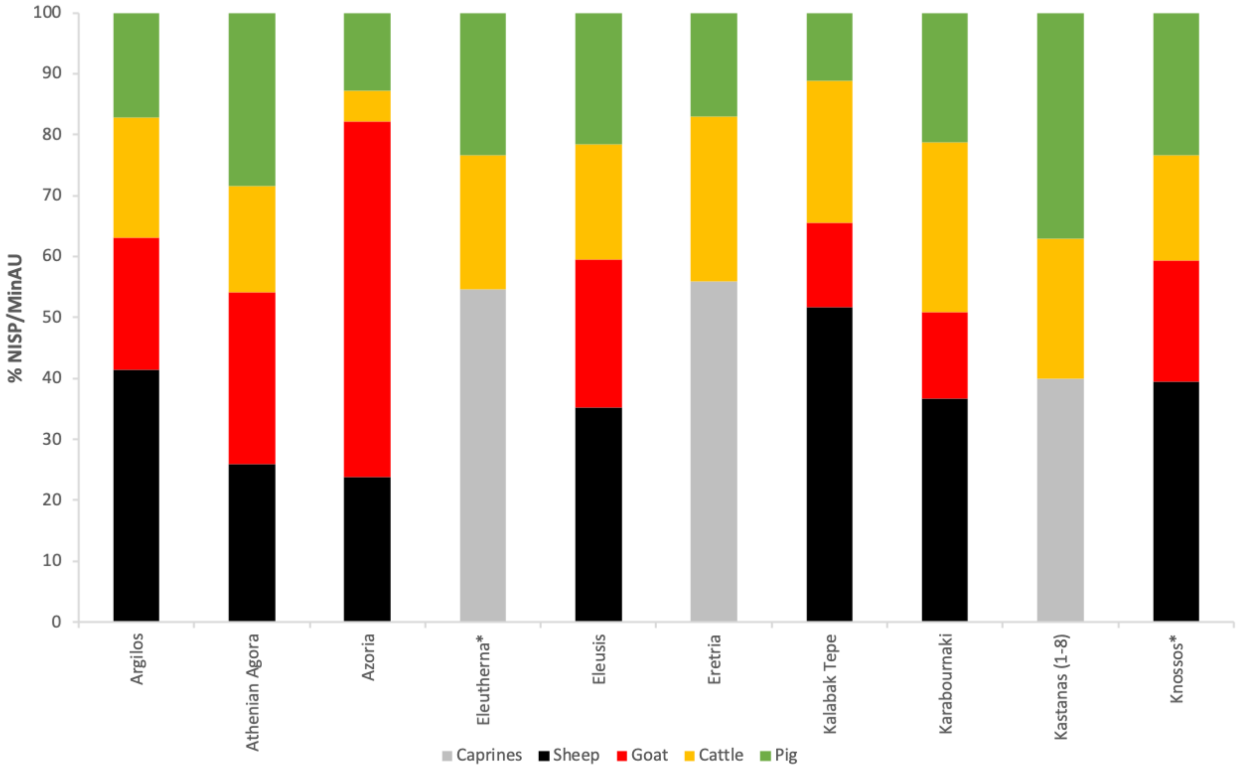

Fig. 4.19. Representation of caprines, sheep, goat, cattle and pig in the Archaic and Classical sites of the Aegean basin (NISP/MinAU[1]; Appendix IV: Table IV.2): Argilos (NISP 7,993; Table 3.20), Athenian Agora (MinAU 2,936; Dibble 2017: 382, Tables 5.7 and 5.8), Azoria (MinAU 5,956; Dibble 2017: 380, Table 5.5), Eleutherna (*Classical-Hellenistic; NISP 2,983; Nobis 2003: 94, Table 9.5), Eleusis (NIPS 37; Cosmopoulos et al. 2003: 146, Table 15.2), Eretria (NISP 100; Gkotsinas 2019b: 170; Fig. 45), Kalabak Tepe (NISP 3,484; Peters 1993: 93, Table 1), Karabournaki (NISP 1,005; Table 3.55), Kastanas 1-8 (NISP 5,056; Becker 1986: 335, Table II), Knossos (*Classical-Hellenistic; MinAU 848; Dibble 2012: 82, Table 1.2, 85, Table 1.5)

[1] Where publications have distinguished between sheep and goat remains, the specimens identified only to the level of sheep/goat have been assigned to these two species proportionately

Literary genres	Authors
Epic Poetry	Homer (8th BC)
	Hesiod (8th-7th BC)
	Homeric Hymns (8th-6th BC)
Tragedy	Aeschylus (6th-5th BC)
	Sophocles (5th BC)
	Euripides (5th BC)
Comedy	Aristophanes (5th-4th BC)
Philosophy	Plato (5th-4th BC)
	Aristotle (4th BC)
History	Herodotus (5th BC)
	Thucydides (5th BC)
	Xenophon (5th-4th BC)
Medicine	Hippocrates (5th-4th BC)
	Hippocratic corpus (5th-4th BC)
Legal Speeches	Andocides (5th-4th BC)
	Antiphon (5th BC)
	Lysias (5th-4th BC)

Table 4.1. List of genres and authors included in *TLG* Queries. Author chronology derives from the *TLG* database (after Dibble 2017)

In sum, food production strategies shift from a fairly homogenous set of pastoral strategies at the end of the second millennium BC to a fairly heterogenous set of pastoral strategies in the first millennium BC across the Aegean. It is perhaps possible to conceive of this shift as an adaptation to the environmental restrictions of each area, with heterogenous strategies a better fit for various ecological niches and political and social changes. These heterogenous production strategies, whereby different settlements practised different productive strategies, perhaps contributed to an increase in connectivity in the Mediterranean.

4.1.1.2. Wild fauna

In the region of Macedonia wild fauna consists of two animal categories, terrestrial and marine animals. The first category relates to mammals (Artiodactyla, Carnivora, Rodentia, Lagomorpha), birds and reptiles. In relation to mammals, in the Early Iron Age the identified species at Kastanas (9-10) were red, fallow and roe deer, boar, beaver, lynx, wolf, lion, marten, badger, hare, red fox and wild cat.[428] In Assiros the wild mammals consisted of red, fallow and roe deer and hare,[429] whereas in Kastri only red deer and hare were found. In the Archaic and Classical eras, the terrestrial species exploited at Kastanas (1-8) were red, fallow and roe deer, boar, hare, red fox, beaver, polecat, squirrel, wild cat, and lion; red deer, boar, fallow deer, hare, roe deer, wolf and red fox were identified at Argilos; and at Karabournaki, only red deer, roe deer and hare were identified (**Table 4.2**).

For birds, data is only available from Kastanas (1-10) and relates to various species of several orders including Pelecaniformes, Anseriformes, Gruiformes, Strigiformes and Passeriformes. At Argilos, apart from some specimens identified as *Gallus* sp.,[430] and at Karabournaki, bird remains have not yet been studied, although one specimen at Karabournaki has been attributed to mallard (*Anas platyrhynchos*). Finally, reptiles are represented only by tortoise, which was found in all the settlements.

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[428] Becker 1986: 333-334, Tables II and III.
[429] Halstead and Jones 1980: 265-7.
[430] Colangelo 2007.

	Argilos		Karabournaki		Kastanas (1-8)		Kastanas (9-10)		EIA Kastri		Total	
	NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %	NISP	NISP %
Red deer	171	49.6	28	84.8	155	17.0	360	22.3	3	25.0	717	24.6
Fallow deer	5	1.4	-	0.0	443	48.6	594	36.8	-	0.0	1,042	35.8
Roe deer	12	3.5	2	6.1	133	14.6	328	20.3	-	0.0	475	16.3
Boar	39	11.3	-	0.0	135	14.8	277	17.2	-	0.0	451	15.5
Hare	111	32.2	3	9.1	21	2.3	8	0.5	9	75.0	152	5.2
Red fox	2	0.6	-	0.0	12	1.3	18	1.1	-	0.0	32	1.1
Lion	-	0.0	-	0.0	1	0.1	2	0.1	-	0.0	3	0.1
Wolf	5	1.4	-	0.0	-	0.0	3	0.2	-	0.0	8	0.3
Lynx	-	0.0	-	0.0	-	0.0	1	0.1	-	0.0	1	0.0
Badger	-	0.0	-	0.0	-	0.0	3	0.2	-	0.0	3	0.1
Beaver	-	0.0	-	0.0	7	0.8	6	0.4	-	0.0	13	0.4
Wild cat	-	0.0	-	0.0	2	0.2	5	0.3	-	0.0	7	0.2
Marten	-	0.0	-	0.0	-	0.0	7	0.4	-	0.0	7	0.2
Squirrel	-	0.0	-	0.0	2	0.2	-	0.0	-	0.0	2	0.1
Polecat	-	0.0	-	0.0	1	0.1	-	0.0	-	0.0	1	0.0
Total	345	100.0	33	100.0	912	100.0	1,612	100.0	12	100.0	2,914	100.0

Table 4.2. Wild species composition (NISP) at Argilos (Table 3.20), Karabournaki (Table 3.55), Kastanas (Becker 1986: 333-334, Tables II and III) and Kastri (Table 3.91)

As for marine fauna, shellfish were found at all the settlements, but fish was only found at Argilos, Karabournaki and Kastanas. At Kastanas, the fish comprised of freshwater species, such as catfish and carp, and saltwater species, such as jewfish and gilthead bream. The lagoon cockle and the thick shelled river mussel were found in salt- and freshwater areas, respectively.[431] At Assiros, shellfish are represented by cockles, some of which appeared to be of estuarine origin, and at Kastri the recorded shellfish were derived exclusively from the sea (e.g. Mediterranean limpet and common cockle).[432] At Argilos, freshwater fish and shellfish were most prevalent (e.g. catfish, carp, mussel), followed by marine species (e.g. tuna, cockle, otter shell, mussel).[433] Finally, at Karabournaki, marine animals (e.g. horn, purple-shell, pen shell, cockle) were derived mostly from lagoons.[434]

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[431] Becker 1986.

[432] Karali 1999: 389-399.

[433] Colangelo 2007.

[434] Tiverios et al. 2013: 207-210.

Synthesis

Wild fauna comprised a large variety of terrestrial and marine animals. Their exploitation was more extensive in the Early Iron Age, at Kastanas (9-10) and Assiros, than the Archaic and Classical eras. The wild animals were hunted and collected mainly for purposes of food consumption, as related butchery and burning traces suggest. Apart from offering a complementary source of protein, some species were also exploited for the raw materials of fur, skin, bones, antlers, and shell valves. The carnivores, such as lion, wolf, and red fox, may have been taken primarily for their fur or in defence of livestock. Use of bone, antler and shell raw material is confirmed archaeologically by traces of working and the finding of related artifacts. For example, worked shells were found at Karabournaki, some serving as ornaments and some probably used as spoons.[435] Only a small amount of working debitage and a few finished objects were found at each site, so any inference regarding the scale of production (e.g. within the household) is difficult, especially since some artifacts could have been imported as perhaps in the case of a single pierced sea snail, *Murex trunculus*, found at the inland settlement of Assiros.[436] However, the assemblage of antler debris revealed in Room L8 at Classical Argilos suggests this room could have served as an antler workshop, indicating local manufacturing activity.[437]

In regard to species composition, red deer was the main game species at all sites, followed by a range of big (e.g. fallow deer, boar) and small (e.g. hare) animals in different proportions between sites. Red deer hunting at Kastri was limited, while at Argilos it became more frequent during the Classical period – conceivably due to a change in hunting methods, as the horse was better represented at Argilos during the Classical era.[438] According to literary sources, game in the Classical period was part of any fine banquet of the elite.[439] Fallow and roe deer were mainly found at Kastanas, with the former the most abundant species in both the EIA and Archaic-Classical periods. Boar, although the fourth wild species in EIA Kastanas and the third in Archaic-Classical Argilos and Kastanas, was classified by historians as a noble game, as, in contrast with the deer, it

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[435] Tiverios et al. 2013.
[436] Halstead and Jones 1980: 266.
[437] Gkotsinas and Gardeisen 2021.
[438] Chapter 3, Table 3.21.
[439] Chandezon 2015: 138.

defends itself against the hunter, allowing the hunter to demonstrate his *areti*.[440] For the remaining species, both terrestrial and marine, the differences in their representation at each site are mainly related to their location and the potential of the surrounding natural environment of each site in each period. However, taste preferences and traditions cannot be excluded, while post-depositional factors, such as carnivore activity and recovery method, could have affected the presence of small sized species of Rodentia, Lagomorpha, birds and fish. Finally, in regard to tortoise, although its consumption was attested at Kastanas and Argilos, at the other settlements it could have been a later burrowing intruder.

In relation to the potential of the settlements' surrounding natural environments, the location of the sites, the ecology of the terrestrial and marine species and the available palynological data provide information on the biotopes and vegetation present at the time. In regard to the ecology of the wild species, red, fallow and roe deer, boar, badger, lynx, lion, marten, and squirrel are forest animals, living either near or in mixed woodland. Wolf and red fox are ubiquitous and thus not bound to any particular biotope. Hare prefers a more open landscape, while beaver's natural habitat is water environments close to dense vegetation. Finally, the identified bird species belong mainly to the type that seeks proximity to open water with reedy or wooded banks, water meadows, fields, and sandbanks.

Looking at the location of the settlements, Assiros was located in close proximity to small streams and fairly close to Lake Langadas, while Kastanas, which had been an islet during the foregoing period,[441] was located close to a marine bay and large freshwater areas and lagoons with corresponding bank vegetation and fringe forest. Based on regional pollen diagrams,[442] the hills and mountains around the two settlements were wooded. At low and medium altitudes, Ostryo-Carpinion vegetation and oak forests dominated, while land at higher altitudes was covered by coniferous forests of pine and fir. Thus, the surrounding environments of both Kastanas and Assiros support the presence of the above-mentioned forest animals, birds, and marine species.

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[440] Chandezon 2015: 139.
[441] Hänsel 1989: 365-6.
[442] Chapter 1, 1.3.2.

Karabournaki is located on the shore of the Thermaic Gulf, where lagoons existed, and is surrounded by the plain of Thessaloniki and the Anthemous valley. This environment supported the presence of hare, tortoise, lagoon fish and shellfish. However, the forest animals, namely red and roe deer, were most probably from the Chortiatis mountain, east of the settlement. Argilos, which is located on the coast of the Strymon Gulf, is surrounded by grasslands of small extent and the wooded mountain range of Kerdylia, while in the immediate vicinity is the Strymon river and its delta with corresponding bank vegetation. The variety of biotopes may explain the variety of species represented. Although Argilos is a coastal city, the marine fauna mainly comprises freshwater species, most probably derived from the Strymon river.[443] Finally, Kastri, on the island of Thassos, is a rural site on a plateau. The insular environment limits the variety and abundance of terrestrial mammals, plausibly accounting for the finding of only red deer and hare, but, despite the distance of the settlement from the sea, the inhabitants of Kastri also exploited marine resources. The presence of red deer in the assemblage suggests that it must have been imported to the island, alive or dead, by humans.

Despite the passage of more than two millennia and radical changes in physical geography (e.g. shifts in coastlines, drainage of lakes, deforestation, etc), most of the Iron Age terrestrial wild species are still present in the wider area of the Macedonian region, although lynx is endangered,[444] and fallow deer and lion are locally extinct. Fallow deer, which had been present in the Macedonian region since Palaeolithic times,[445] seem to have existed in the area until the middle of the 19th century AD,[446] while lions occupied the Balkan peninsula before their extinction during the first millennium BC under human pressure.[447] Literary sources[448] refer to the presence of lions in this period and their hunting by humans, which was considered an act of heroism[449] – and scenes depicting lion hunting are found in iconography. In contrast with the mainland, red deer no longer

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[443] Mylona (unpublished preliminary report).
[444] Legakis and Maragou 2009.
[445] Yannouli and Trantalidou 1999: 247.
[446] De Heldreich 1878.
[447] During the first millennium BC, the Balkan peninsula was the last habitat of the subspecies *Panthera leo*, which now survives mainly in India (Asiatic lion).
[448] E.g., Homer *Il*. 12.298-306; Herodotos *Hist*. 7.125, 7.126; Xenophon *Cyn*. 11.1
[449] Trantalidou 2017: 641.

exists on Thassos today. It probably occupied the island during the last Glacial Period, when Thassos was joined to the mainland.[450]

The presence of wild species, both terrestrial and marine, in the EIA and Archaic-Classical sites in the Aegean basin is also related with the ecology of their surrounding environments, as well as their access to specific natural environments such as fresh water and the sea. For example, in EIA Zagora the evidence of hunted terrestrial fauna is limited to only hare, as the island environment of Andros is unable to support larger species of wild mammals.[451] Conversely, in EIA Kastro Kavousi in Crete, fallow deer, feral goat (*agrimi*), hare, badger, weasel, beech marten and wildcat were recorded,[452] representing the Cretan wild terrestrial mammals that existed in the area during the Early Iron Age. The variety of species in Crete is entirely the result of human intervention[453]. Thus, large mammals were either imported for hunting (e.g. fallow deer) or appeared as a result of the escape of domestic animals which may have been able to establish feral populations (e.g. the *agrimi*).[454] Similarly, the presence of red deer at Kastri on Thassos, if not a remnant of the insular Pleistocene population, must have been imported by human, dead or alive, while the existence of feral goats is very likely.

4.1.2. Sanctuaries

Zooarchaeological data for ritual sites in the Macedonian region is available only from the Archaic and Classical faunal deposits at the cave sanctuary of Nea Irakleitsa, located on a small peninsula between the bays of Eleutheron (Nea Peramos), and the Archaic sanctuary of Hercules (Herakleion) on the island of Thassos, while some preliminary observations are also available for the Archaic sanctuary of Athena[455] on the Acropolis of Oisyme located west of the Eleftheron bay (above, **Fig. 4.1**). The cave at Nea Irakleitsa, based on the archaeological finds, was used as a

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[450] van Andel and Shackleton 1982: 445-454.
[451] Trantalidou 2017: 636.
[452] Klippel and Snyder 1991.
[453] Jarman 1996.
[454] E.g., Isaakidou 2005f.
[455] Giouri and Koukouli-Chrysanthaki 1988: 372–3; Koukouli-Chrysanthaki and Papanikolaou 1993: 490.

sanctuary dedicated to the Nymphs.[456] An inscription found inside the cave refers to animal sacrifices and feasts,[457] so the bone remains found there most probably relate to these events. The recorded animals were mostly caprines, with goat more prevalent than sheep, followed by cattle, pig and edible marine shellfish (e.g. *Patella* sp., *Spondylus* sp.).[458] At the Herakleion on Thassos, caprines (mainly sheep) were also dominant, followed by cattle and pig.[459] The dominance of caprines is common to both ritual sites, with goat more abundant at Nea Irakleitsa and sheep (and cattle) more abundant at the Herakleion (**Fig. 4.20**). In the Archaic sanctuary of Athena at Oisyme, caprines also dominate, followed by cattle and pig, while horse remains were also discovered.[460] The differences between the Archaic sanctuaries may be due to the sacrificial protocols of each ritual context and/or the relative abundance locally of the different livestock species. However, the latter alternative cannot be tested due to the lack of faunal data from neighbouring settlements.

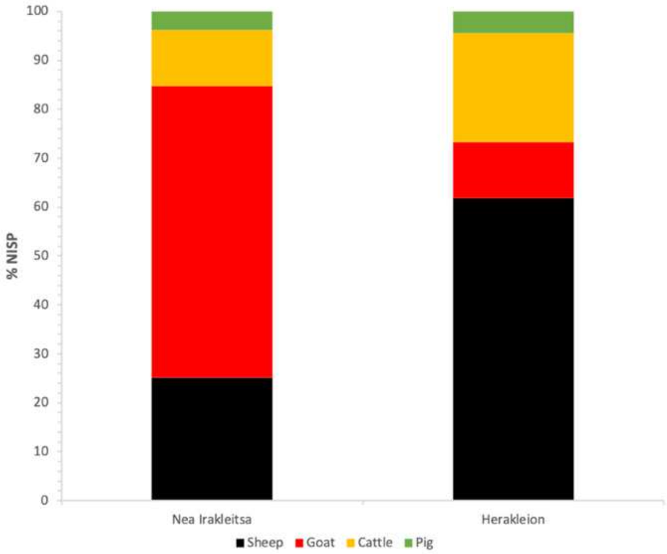

Fig. 4.20. Representation of sheep, goat, cattle, and pig at Archaic sanctuaries in the region of Macedonia (NISP; Appendix IV: Table IV.3): Nea Irakleitsa (Gkotsinas 2020, Table 3), Herakleion Thassos (Gardeisen 1996, Table 2)

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[456] Georgiadis 2020; Bakalakis 1938: 90-96.
[457] Bakalakis 1938: 90-96.
[458] Gkotsinas 2020: 265-266.
[459] Gardeisen 1996: 804, Table 1.
[460] Gkotsinas (study in progress).

A similar picture emerges from numerous assemblages from sanctuary, temple, altar, or ritual contexts from across the Aegean basin ranging in date from the Geometric (Early Iron Age) to the Archaic-Classical period. Caprines, either sheep or goat, dominate in some sanctuaries, while pig dominate in the Archaic sanctuaries of Demeter at Corinth and Knossos. This heterogeneity in the taxonomic composition of sanctuary assemblages is partly related to the ritual preference for particular species associated with different deities. However, there are also differences between sanctuaries of the same deity such as those of Apollo in Eretria, and Kalapodi (**Fig. 4.21** and **Fig. 4.22**).

The kind of species and the number of animals to be sacrificed depended not only on the deity, but also on who was sacrificing, on what occasion, and on the availability of resources.[461] The diversity of sacrificial victims is also seen in vase painting, votive reliefs and inscriptions: cattle are best represented in Attic vase-paintings, pigs on votive reliefs, and sheep on inscriptions in the form of sacrificial calendars and sacred laws.[462] In vase paintings, the dominance of cattle, the most expensive and prestigious victim, probably represents major civic sacrifices; in votive reliefs, pigs, as the least expensive animal, represent mainly private offerings by individuals or families; and sacrificial calendars and sacred laws, dominated by sheep, concern local communal or state sacrifices and record what was to be sacrificed at particular sanctuaries on particular occasions.[463] Thus, the taxonomic composition of sacrificial victims at each sanctuary across the Aegean also reflects in large measure the nature of the occasion (private or public) and, in both cases, the economic status of the individuals or institutions responsible for the sacrifice.

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[461] Ekroth 2014: 330-331.

[462] van Straten 1995: 170-86.

[463] Ekroth 2014: 331.

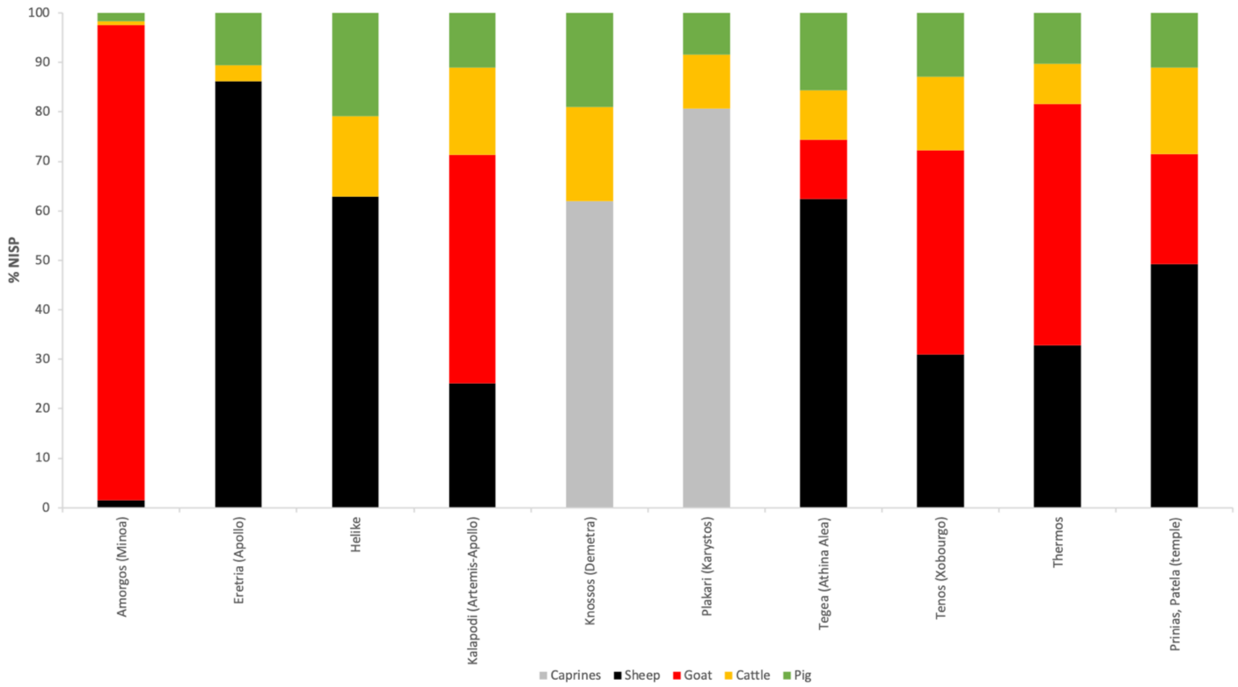

Fig. 4.21. Representation of caprines, sheep, goat, cattle and pig at Geometric (Early Iron Age) sanctuaries in the Aegean (NISP[1]; Appendix IV: Table IV.3): Amorgos Minoa (NISP 4,084; Trantalidou 2011: 1079-1083, Tables 6a-e), Eretria Apollo (NISP 94; Chenal-Velarde 2001: 29, Table 1), Helike (Psathi 2011: 243, Table A2), Kalapodi Artemis-Apollon (NISP 1,439; Stanzel 1991: 14, Table 1), Knossos Demeter (NISP 21; Jarman 1973: 178), Plakari Karystos (NISP 1,571; Groot 2014: 33, Table 1), Tegea Athina Alea (Vila 2014: 548, Table 1.a), Tenos Xobourgo (NISP 1,469; Trantalidou 2011: 1103, Table 11), Thermos (Gardeisen 2008: 311, Table 2), Prinias Patela (NISP 425; Wilkens 2003: 87, Table 8.3)

[1] Where publications have distinguished between sheep and goat remains, the specimens identified only to the level of sheep/goat have been assigned to these two species proportionately

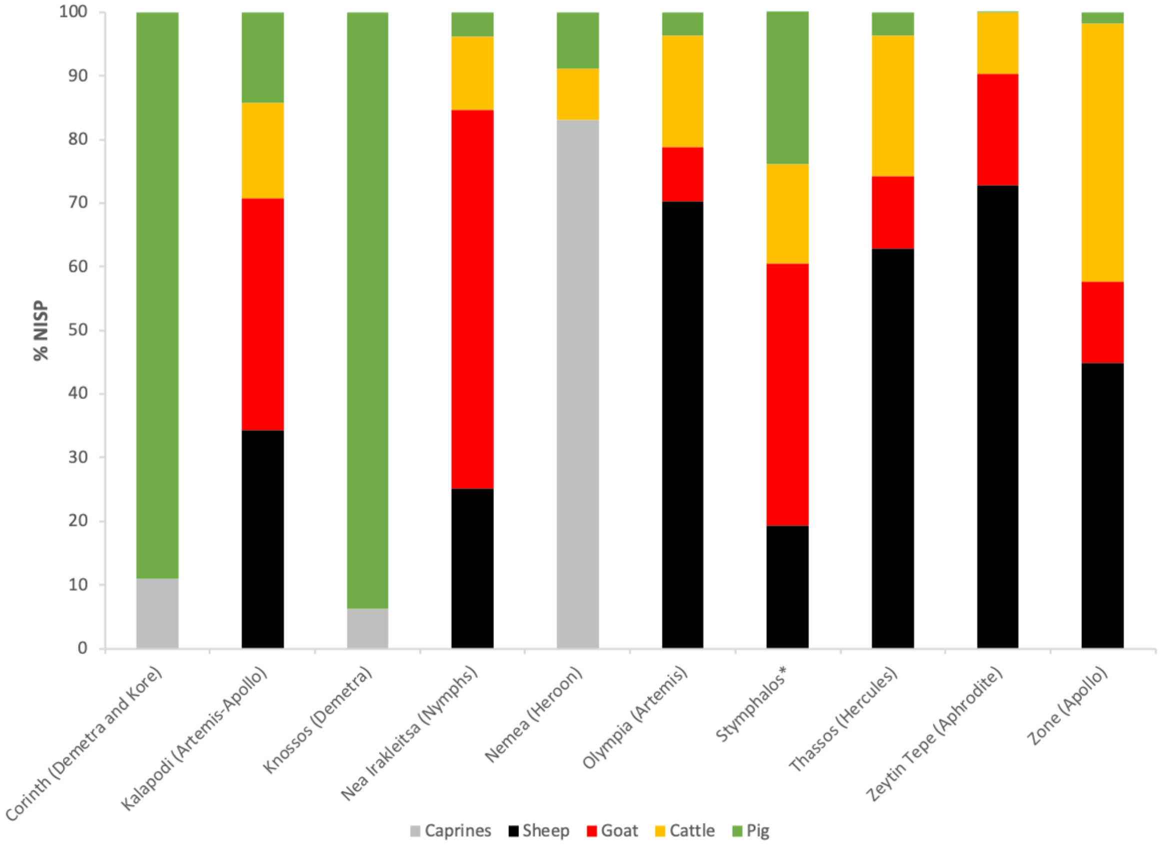

Fig. 4.22. Representation of caprines, sheep, goat, cattle and pig at Archaic to Classical sanctuaries in the Aegean (NISP[1]; Appendix IV: Table IV.3): Corinth Demeter-Kore (NISP 100; Bookidis et al. 1999: 43, Table 7), Kalapodi Apollon-Artemis (NISP 2,073; Stanzel 1991: 14, Table 1), Knossos Demeter (NISP 32; Jarman 1973: 178), Nea Irakleitsa Nymphs (NISP 235; Gkotsinas 2020a: 266, Table 3), Nemea Herron (NISP 124; Mackinnon 2018: 85, Table 5), Olympia Artemis (NISP 749; Benecke 2006: 155, Table 1), Stymphalos (*Classical-Hellenistic; NISP 2,122; Ruscillo 2014: 254-259, Tables 13.2-13.9), Thassos Hercules (NISP 588; Gardeisen 1996: 804, Table 1), Zeytin Tepe Aphrodite (NISP 5,507; Peters 1993: 93, Table 1), Zone Apollo (NISP 1,400; Veropoulidou and Nikolaidou 2018: 90, Table 7.1)

[1] Where publications have distinguished between sheep and goat remains, the specimens identified only to the level of sheep/goat have been assigned to these two species proportionately

4.1.3. Cemeteries

Faunal remains were also found in seven cemeteries in the Macedonian region, spanning the Early Iron Age to Archaic-Classical times. These cemeteries were at Akanthos, Drama Industrial Area, Ivani Prionia, Kentria, Larnaki, Mikro Livadi Mavropigi and Tsiganadika (above, **Fig. 4.1**). The cemeteries of Kentria, Larnaki and Tsiganadika date from the Early Iron Age and are located in the immediate vicinity of Kastri on the island of Thassos. According to the excavator, these cemeteries serviced the settlement of Kastri. Ivani Prionia and Mikro Livadi Mavropigi are located in the administrative region of Western Macedonia (hereafter 'West Macedonia'). The former is located south of the city of Grevena and dates from the Archaic and Classical periods.[464] The latter is located southeast of the city of Ptolemaida, in the wider area of the now dry Yellow Lake, and dates from the Archaic era.[465] The cemetery of Akanthos dates from the Classical period[466] and is located in the modern town of Ierisos. Finally, the cemetery found in the industrial area of the city of Drama dates from the Archaic era[467] (above, **Fig. 4.1**).

The zooarchaeological finds from the Early Iron Age cemeteries of Kastri contain the remains of caprines, cattle, pig, one specimen of equid and a variety of marine shellfish (e.g. Mediterranean limpet and common cockle),[468] and most species have evidence of consumption. Caprines dominate at all three cemeteries. Cattle is the second most prevalent species at Tsiganadika and Larnaki and the third most prevalent at Kentria. Pig occupies second place at Kentria, third place at Tsiganadika and is absent from Larnaki[469] (**Fig. 4.23**). Finally, a single specimen of equid was found at Tsiganadika (below, 4.2). The prevalence of caprines corresponds with the species composition of the Kastri settlement, while the differences in the representation of the remaining domestics is most probably due to the small sample size of the animal bones from the cemeteries (**Fig. 4.23**). Moreover, the wild fauna, comprised only of marine species, is the same as that of the settlement, reinforcing the similarities between the consumers of Kastri and those buried in the cemeteries.

The small number of faunal remains in the cemeteries of Kastri suggests occasional consumption of meat, which could have been related to ceremonial events, either private or public. Furthermore, the discovery of cattle right femora in some of the burials implies animal grave offerings[470]. Taking into account that the femora were one of the preferred sections of the animals offered in the Olympic sacrifice,[471] the femora found in the cemeteries of Kastri imply similar behaviour but in a funeral context, suggesting that the practice of thigh offering dates back to the Early Iron Age

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[464] Karamitrou-Mentesidi 2007: 24.
[465] Karamitrou-Mentesidi 2005: 520.
[466] Trakasopoulou-Salakidou 1997.
[467] Koukouli-Chryssanthaki 1979: 333-4.
[468] Halstead and Jones 1992: 753-5; Karali 1999: 389-399.
[469] Halstead and Jones 1992: 753-5.
[470] Halstead and Jones 1992: 755.
[471] Ekroth 2007:250.

and concerns beliefs of the wider population. Apart from Archaic and Classical Greece, the thigh was the portion to be offered to the gods also in the Homeric world.[472] The single specimen of equid is also a right femur and, if not an unintended inclusion in the grave fill, could also be related to ritual practices, as a consumed species, although the possibility of it being part of a lost equid burial cannot be excluded. Finally, the presence of marine fauna in funeral contexts suggests consumption of shellfish most probably in ceremonial events, just as the terrestrial species. The use of marine fauna in ritual events is attested in literary sources as well as zooarchaeologically across the Aegean basin.[473]

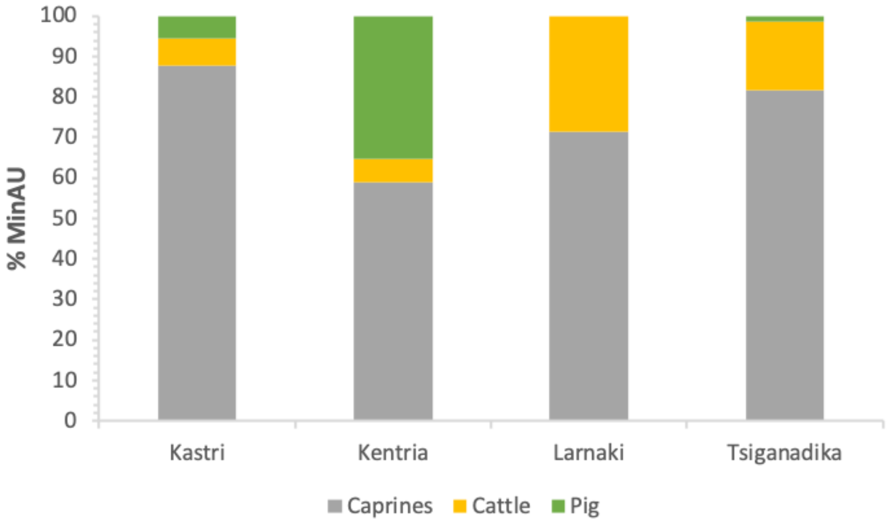

Fig. 4.23. Representation of the main domestic species in Kastri (MinAU 1,239; Table 3.91) and its cemeteries (Kentria: MinAU 17, Larnaki: MinAU 7, Tsiganadika: MinAU 71; Halstead and Jones 1992)

In contrast with the Early Iron Age cemeteries, the faunal remains from the Archaic and Classical cemeteries, namely Akanthos, Drama Industrial Area, Ivani Prionia and Mikro Livadi Mavropigi, represent animal burials. At Archaic Mikro Livadi Mavropigi, 11 burials of equids, eight of dogs, four of pigs, three of cattle, and one of sheep or goat were discovered (**Fig. 4.24**).[474] The skeletons are complete or almost complete and represent animals of all age groups, but mostly adults.

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[472] Bruns 1970: 47.
[473] E.g., Theodoropoulou 2013; Veropoulidou and Nikolaidou 2018.
[474] Gkotsinas 2019a: 89-96.

Similarly, in Archaic-Classical Ivani Prionia, five burials of dogs, three of sheep or goat and scattered bones of cattle and pig were revealed.[475] In Classical Akanthos, six horse and four dog burials were found,[476] and in Archaic Drama Industrial Area one dog burial was discovered.[477] Although burials of equids and dogs are attested in West Macedonia since the Early and Middle Bronze Age,[478] those of the principal productive domestic animals found in the cemeteries of Ivani Prionia and Mikro Livadi Mavropigi are uncommon. Dog and equids were animals with special status and importance for human society over time and thus more likely to accompany their owners after death. A particular example is horse burial 17 (τζ.17), from Mikro Livadi Mavropigi, in which the skull of a horse was found in contact with the skull of a human male skeleton, accompanied by an iron spearhead (**Fig. 4.25**). In Mikro Livadi Mavropigi, the animal remains do not bear any signs of consumption. In some of them, however, there are indications of possible ritual acts, such as in the cases of cattle burial 12 (τζ.12), where a decapitated cattle skull was found alongside a complete cattle skeleton, and cattle burial 19 (τζ.19), where there is a rearrangement of the amputated front leg (**Fig. 4.26**). Although the zooarchaeological study in Mikro Livadi Mavropigi and Prionia Ivani is ongoing, it can be assumed that the presence of productive domesticate skeletons among human burials relates to special practices within the context of regional burial customs in West Macedonia during the Archaic era.

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[475] Karamitrou-Mentesidi 2007: 24.
[476] Trakasopoulou-Salakidou 1997.
[477] Koukouli-Chryssanthaki 1979: 333-4.
[478] Gkotsinas 2018: 65-79.

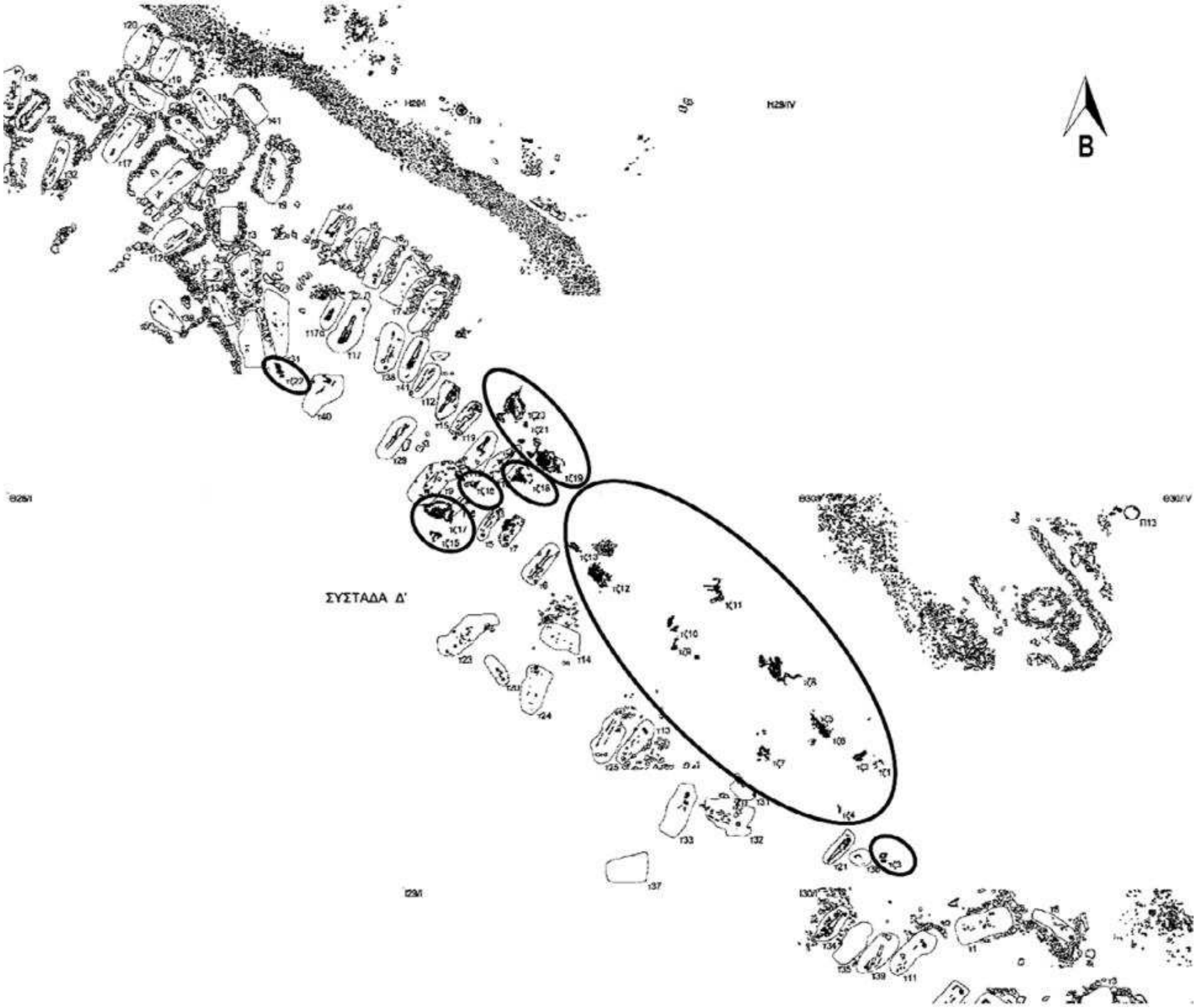

Fig. 4.24. Archaic cemetery at Mikro Livadi Mavropigi, Group Δ΄. Black- circles indicate animal burials (Gkotsinas 2019a: 91, Fig. 2)

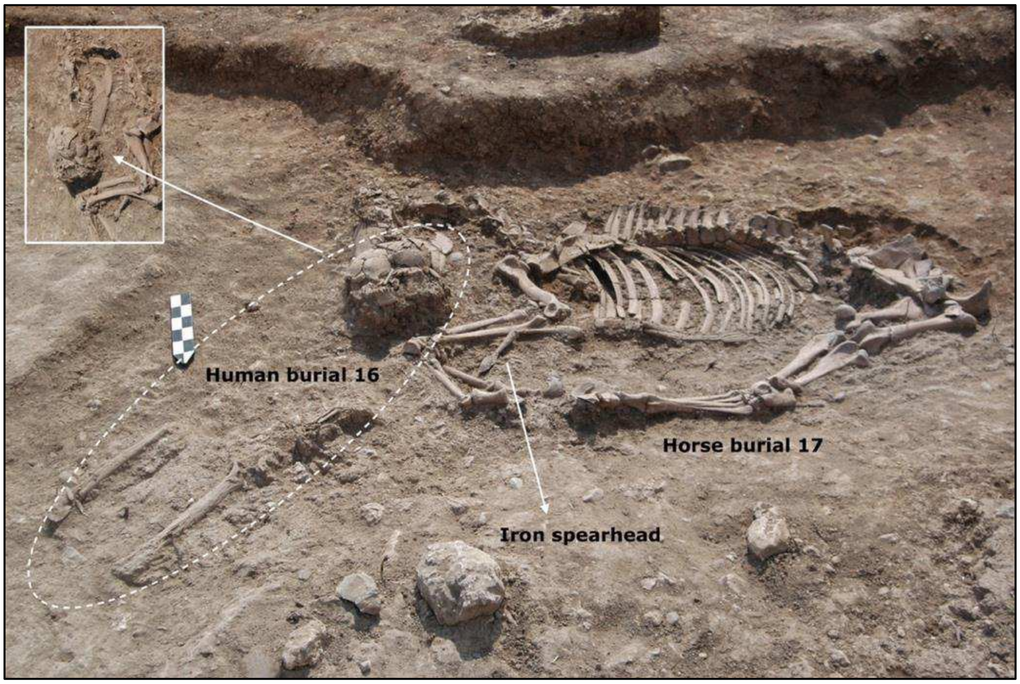

Fig. 4.25. Archaic cemetery at Mikro Livadi Mavropigi, horse burial 17: the point of contact of human and horse burials and the iron spearhead are indicated (Gkotsinas 2019a, Fig.3)

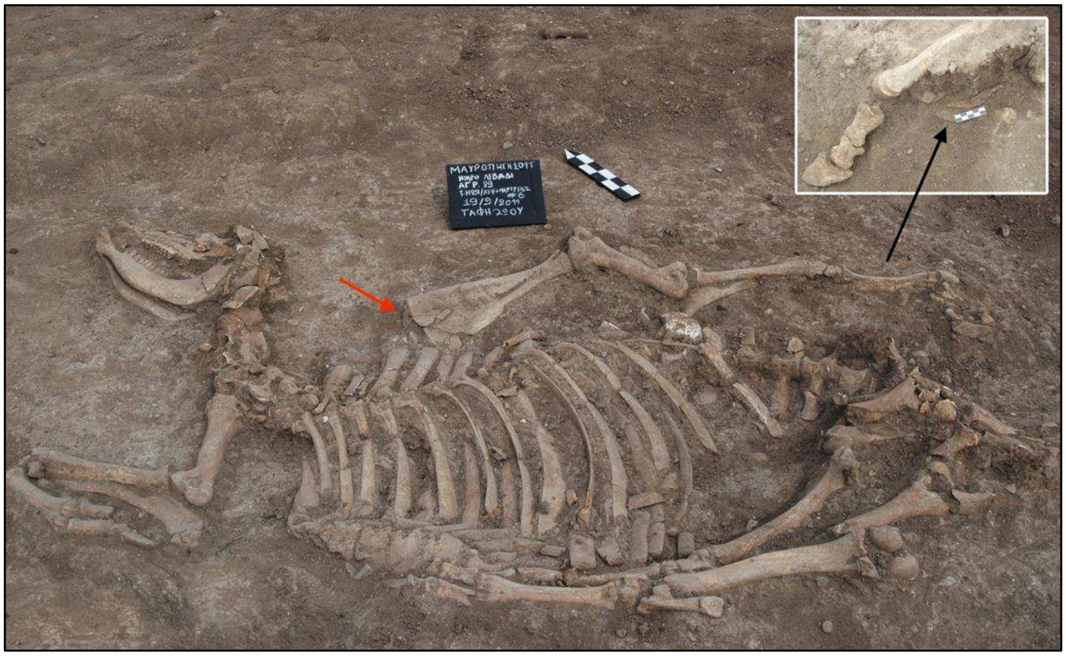

Fig. 4.26. Archaic cemetery at Mikro Livadi Mavropigi, cattle burial 19: rearrangement of the amputated front leg. The red arrow shows the possible amputation point of the left front leg, and the black arrow indicates an iron knife found beside the metacarpal (Gkotsinas 2019a, Fig.8)

Beyond the Macedonian region, animal burials are found all over the Aegean mainland and islands of Late Bronze Age and later date.[479] In Geometric to Classical era cemeteries, animal burials, mostly of horses and to a lesser extent dogs, seem to have accompanied human burials, while in some cases bone remains from other species such as pig and cattle were also found (**Table 4.3**). Judging by iconographic representations, horses were used in war and for hunting and to draw chariots or carriages. Only wealthy people could own horses which were thus considered a status symbol, highlighting the significance of their burial alongside humans (e.g. Lefkandi, Knossos, Prinias, etc.). Moreover, horses may have been used for the funeral procession (*ekphora*) of the lifeless body as seen on funerary vases of the period. As in all Eurasian societies, these rituals legitimised and strengthened the position of local elites in the context of developing socio-political hierarchies.[480]

Period	Cemeteries	Horse	Donkey	Equid	Dog	Cattle	Pig	Caprines	References
Geometric (Early Iron Age)	Siderospilia Prinias, Crete	x			x				Rizza 1978, 1979, 1985; Day 1984; Reese 1995
	North cemetery Knossos, Crete	x			x				Catling 1976; Day 1984; Cavanagh 1996; Wall-Crowther 1996
	Vronta, Crete		x[1]		x				Gessell et al. 1983
	Tekke-Knossos, Crete		x		x	x[1]			Catling 1976; Day 1984;
	Lefkandi, Euboea	x			x[1]				Lemos 2002
	Areopagus, Athens				x[1]				Smithson 1974
	Kerameikos, Athens				x				Smithson 1974
	Rembelos plot, Argos				x				Barakari 2014
Archaic Classical	Palia, Volos				x				Trantalidou 2006b
	Industrial area, Drama				x				Koukouli-Chryssanthaki 1979
	Akanthos, Chalkidici	x			x				Trakasopoulou-Salakidlou 1997
	Rigio Didimoticho, Thrace	x			x				Triantafyllos and Terzopoulou 1998
	Mikro Livadi Mavropigi, Kozani			x	x	x	x	x	Gkotsinas 2019a
	Ivani Prionia, Grevena				x	x[1]	x[1]	x[1]	Karamitrou-Mentesidi 2007
	Thermi, Thessaloniki	x							Antikas 2005
	Amphipolis, Serres	x							Malama and Gardeisen 2005
	Vergina, Pieria	x							Antikas and Alifakiotis 2002

Table 4.3. Animal remains in human burials in the Geometric to Classical Aegean (after Trantalidou 2006b)

[1] Only bones, not skeletons

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[479] Indicative: Stais 1892; Antikas 2005; Boessneck and von den Driesch 1984; Deshayes 1966; Marketou 1998; Pappi and Isaakidou 2015; Sakellarakis and Sakellaraki 1997; Stikas 1958.

[480] Trantalidou 2017.

In regard to dogs, the exact purpose of their burials is unclear: they may have been part of purification ceremonies, or they too may reflect the close relationship with humans, thus accompanying their owners after death. Dog bones found in human graves in Athens (Areopagus)[481] and at Vronta[482] may be related to purification ceremonies, and the dog burials found among human burials in the cemetery of Mikro Livadi Mavropigi could be related to the companionship between dogs and their owners.[483] In the first case, the excavators concluded that dog remains were connected to purification ceremonies based only on the archaeological context where they were found as well as literary sources, without any relevant taphonomic documentation. The latter case was based on the fact that the dogs' skeletons were found almost complete and were arranged neatly. Companionship may also be the reason for a series of burials on the Aegean mainland (e.g., Didymoteicho, Drama, Akanthos, Volos) and the islands (e.g., Lefkandi, Sidirospilia Prinia, Knossos: Tekke, north cemetery). In most of the cases mentioned above, the dog burials were found along with horse burials. A more complete study of dog burials will undoubtedly contribute additional information to our knowledge regarding the use and importance of dogs in first millennium BC societies across the Aegean.

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[481] Smithson 1974: 334–362.

[482] Day 1984; Gesell et al. 1983: 409.

[483] Gkotsinas 2019a.

4.2. Consumption patterns

Consumption patterns in the region of Macedonia are explored for the Early Iron Age and the Archaic and Classical periods based on available data from settlements, that is Argilos, Karabournaki, Kastanas and Kastri. These data concern only macroscopic observations of faunal material (anatomical representation, bone fragmentation, butchery marks and burning traces), as related archaeological evidence, such as from the study of cooking pots, is not yet available.

Judging by anatomical representation, carcass processing of the main domestic animals, namely sheep, goat, cattle and pig, took place within the settlements at Kastri, Karabournaki and Argilos, while at Kastanas only pig was slaughtered on site.[484] However, although carcass processing at Argilos, Karabournaki and Kastri took place within the settlements, it is unknown if the killing of the above animals was done right next to the butchers' establishments and meat markets or on the urban outskirts. However, the meat in the market could be derived from ritual sacrifices.[485] Thus, bearing in mind that meat for the Greeks was strongly connected to religion and animal sacrifice, it is interesting to investigate the relationship between animal sacrifice and the consumption of meat in the EIA to Classical Macedonian region. Based on literary sources, meat eaten by the Greeks came from sacrificial victims within the context of Olympic sacrifices, involving all the main domesticates, namely sheep, goat, cattle, and pig. The main body parts offered in Olympic sacrifices were the thigh bones and the tail.[486] Thus, as these body parts were burnt on an altar, the remains of sacrificial meals (consumption debris within the settlement) should include femur, caudal vertebrae, and sacrum bones in small quantities or not at all. Among the offered body parts, the femur is best represented in archaeological deposits. Thus, a comparison of the ratio between femur and tibia, two long bones from the back leg, of caprines, cattle and pig could be a reasonable approach to explore whether the animal bone remains in Argilos, Karabournaki and Kastri were linked to the sacred sphere or not. As **Table 4.4** shows, the ratio of femur to tibia for all four main domestics is 1:1 at Karabournaki, 1:2 for Kastri and 1:4 for Argilos. In Argilos the deviation between the survival of femur and of tibia is high. More specifically, in Argilos the ratio of femur to tibia in caprines is 1:4 in contrast to the ratio at Karabournaki and Kastri of 1:2. Although the

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[484] Becker 1986.
[485] Ekroth 2007: 253.
[486] Ekroth 2007: 250.

low number of femora could be related to taphonomic factors, the modest dog attrition[487] and the low percentages of chops marks in caprines from Argilos imply that the difference in the ratio between femur and tibia may be related to other causes such as ritual sacrifice. Moreover, as the femora offered to deities in the context of Olympic sacrifice were heavily burnt, carbonised, and calcined or even complete destroyed, the discovery of one uniformly burnt caprine femur from the area of Building C in the SE sector at Argilos dated to Phase III could be related with the above treatment. Given that all four main domesticate animals were used in Olympic sacrifices, the femur: tibia ratios of 1:2 and 1:3 in Argilos cattle and pig respectively could be also related with sacrifices. Finally, the fact that only in Argilos are there strong indications of sacrifice may be because Argilos was a Greek *polis*, sharing common values and protocols with the southern Greeks in regard to ritual ceremonies. On the other hand, Karabournaki and Kastri, as settlements which were occupied mainly by local populations, seem to have differed from Argilos in relation to meat consumption purposes and practices.

	ARGILOS (all phases)			**KARABOURNAKI** (all contexts)			**EIA KASTRI**		
	Femur (MinAU)	Tibia (MinAU)	Ratio F:T	Femur (MinAU)	Tibia (MinAU)	Ratio F:T	Femur (MinAU)	Tibia (MinAU)	Ratio F:T
Caprines	89	374	1:4	21	40	1:2	66	140	1:2
Cattle	45	98	1:2	18	14	1:1	6	8	1:1
Pig	36	99	1:3	10	3	3:1	8	7	1:1
Total	170	571	1:3	49	57	1:1	80	155	1:2

Table 4.4. The ratio of femur to tibia (F:T) in caprines, cattle and pig at Argilos, Karabournaki and EIA Kastri (MinAU, Appendix I: Tables I.1-I.6)

In regard to butchery practices, skinning, dismembering and filleting cut-marks are common in all four species, albeit to different degrees. Skinning marks were observed on the foot (phalanges, metapodials) and skull bones, dismemberment at the articulation points of cranial and postcranial anatomical units, and filleting on mandible, ribs, scapula, pelvis, and long bone diaphyses. Chopping was also observed in all four species and on almost the entire skeleton, namely skull, vertebral column, ribs, and limb bones. In the Archaic and Classical eras, chopping traces were

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[487] Chapter 3, Tables 3.31, 3.65 and 3.98.

most prevalent in cattle. Extensive chopping in cattle probably related to the need to reduce the size of their carcass parts for cooking, as cattle are much larger than the other species. Moreover, cattle bones contain larger amounts of marrow than those of the smaller species and so may well have been chopped more intensively for marrow extraction.

In relation to cooking techniques, at all four sites part of the meat consumed seems to have been roasted over an open fire. The sparse number of black burning marks suggests that roasting was practised only occasionally for all four common domesticates. However, in the case of caprines and cattle and, to a lesser extent pig, the specimens bearing burning traces suggest that the entire carcass, either in pieces (e.g. cattle) or whole (e.g. sheep), was roasted, probably on a spit. The low incidences of roasting traces suggest that this practice was not common and may have been related to special events. Although roast meat was very important in the diet of Homeric heroes,[488] in Classical Greece, boiling was considered superior to roasting, as it was a further step away from raw meat, while the latter was a characteristic of barbarism.[489] However, as the material from Argilos, Karabournaki and Kastri was identified as consumption debris in a secular context (e.g. market, private houses, streets, etc), the low amount of burnt bones is expected, contrary to the deposits from ritual contexts, such altars, where the bones would expect to be carbonised and calcined.[490] Moreover, if not cooked fresh right away, meat has to be preserved by salting or drying, which could be accompanied by smoking.[491] In the case of cattle, that yield large amounts of meat, their consumption probably took place in large-scale (e.g. ceremonial/ritual) meals, rather than in a household context.[492]

The carcass processing and cooking techniques used for the main domestic species seem to have been common also for dogs, equids and wild mammals bearing consumption traces. In relation to the latter, large game animals such as red deer were probably brought into the settlements of Argilos and Karabournaki intact, while at Kastanas only the meat-yielding parts were brought back.[493] Cut marks on dog specimens were identified at Kastanas, Karabournaki and Argilos, on

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[488] Bruns 1970: 46-50.
[489] Detienne 1977:177-181.
[490] Ekroth 2007:267.
[491] Chandezon 2015: 140.
[492] Mainland and Halstead 2005; Pappa et al. 2003.
[493] Becker 1986.

donkey at Argilos and Karabournaki, and on horse at Argilos. The low proportion of dog and equid bones found at all the sites indicates that their consumption was occasional, while some skinning marks could be related with the exploitation of their hides. Equid flesh was considered edible in the ancient Greek world, and dog consumption is confirmed by literary sources for some tribes, such as the Thracians[494] in the region of ancient Thrace. However, the consumption of equids and dogs, if not individual incidents, may also be related to special occasions, probably in religious or medical contexts. In regard to the former, according to literary sources, dogs were sacrificed to certain deities, such as Enyalios, Eileithyia at Argos and Ares and Hekate at Sparta,[495] where sacrifices to Hekate, known as Hekate's meals, included puppy meat and were subsequently consumed by the poor.[496] In contrast, equids were rarely sacrificed for ritual purposes.[497] In relation to medical contexts, dog flesh was restricted to special diets[498] as described in inscriptions relating to the sanctuaries of Asklepios,[499] and equids were also eaten for medicinal reasons.[500] A single specimen of equid found in the cemetery of Tsiganadika may also have been eaten. Other than at Argilos, Karabournaki and Kastanas, scattered equid and dog specimens bearing consumption traces have been found in many settlements and sanctuaries dating from the first millennium in the Aegean basin, such as the settlements of Eretria[501], Kastro Kavousi[502] and Kalabal Tepe,[503] and the sanctuaries of Apollon at Delphi[504] and Eretria,[505] of Athena at Tegea,[506] of Poseidon at Isthmia[507] and Tenos,[508] and of Hercules at Thassos.[509]

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[494] Pellegrin 1997.
[495] Mainoldi 1984: 51-59; Merlen 1971: 86; Scholz 1937: 14-24.
[496] Von Rudloff 1999: 85-6; Scholz 1937: 14-22.
[497] Bevan 1986: 195-200, 204-213; Burkert 1985: 138, 297-9; Georgoudi 2005: 139; Malten 1914; Simoons 1994: 181-182; Apollod. *Bibl.* 1.7.8; Paus. 8.7.2.
[498] Garnsey 1999: 83-4; Luce 2008: 281-283.
[499] LiDonnici 1995: 98-9, 104-5; Farnell 1970: 240.
[500] Grant 2000: 154-190; Dalby 1996: 60-1; Simoons 1994: 180-3; Garnsey 1999: 83-5.
[501] Chenal Velarde 2001: 124; 2006; Gkotsinas 2019b: 169-170.
[502] Becker 1986; Snyder and Klippel 2003.
[503] Peters 1993: 88.
[504] Luce 2008.
[505] Studer and Chenal Velarde 2003: 108.
[506] Vila 2000: 198; 2014: 554.
[507] Gebhard and Reese 2005: 140.
[508] Leguilloux 1999: 451.
[509] Gardeisen 1996: 819.

4.3. Discard management

Discard management concerns the way inhabitants in the Macedonian region managed waste within their settlements. Discussion here concerns mainly the settlements of Argilos and Karabournaki and is based on the spatial distribution of animal bone remains and their post-depositional taphonomic traces.

The faunal remains at Argilos and Karabournaki were discarded in numerous specific refuse points within the city. These included abandoned rooms in building interiors, such as rooms H12 and L1 in Argilos (**Fig. 4.27**), or abandoned structures, such as the structures A02 and C09 in Karabournaki. Open spaces without human circulation were also used, at least in the case of Argilos, such as the open space between buildings E–F and the SWH1. Furthermore, there are cases of refuse points being created in the ground, such as the dump in the NR sector in Argilos and the pits in Karabournaki. However, there are also cases of bones – usually small in number and size – found inside buildings in Argilos. These bones could have entered by chance as components of the earth fill during floor construction or repair.

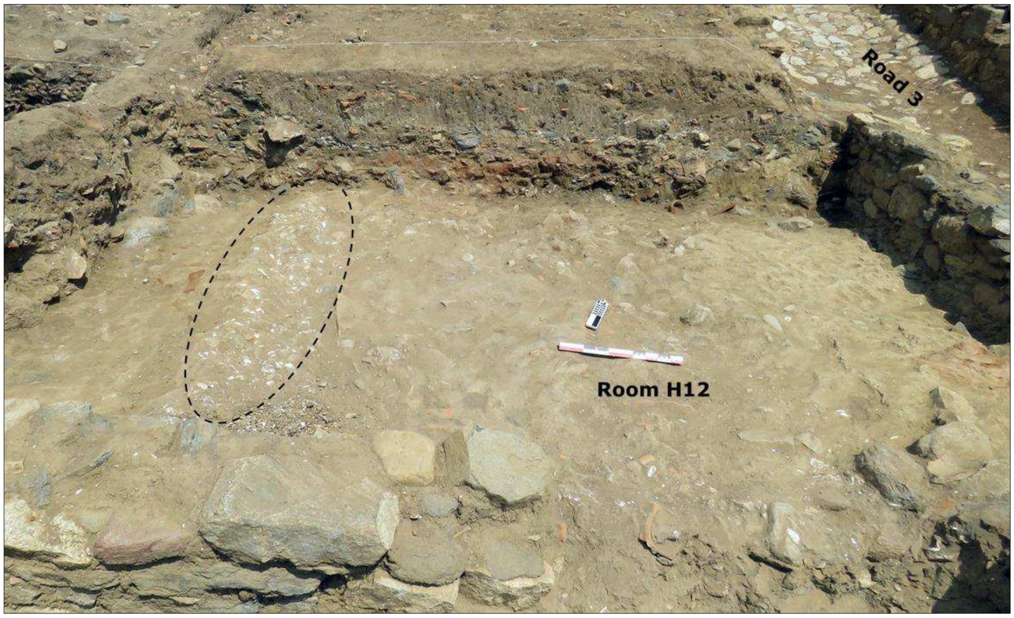

Fig. 4.27. The interior of Room H12 (south half) of Building H at Late Classical Argilos when it was used as a refuse area; the deposition of shellfish remains is indicated by the dashed circle (Argilos excavation archives)

The variety of implied depositional pathways for animal bones at Argilos and Karabournaki suggests that, for the most part, each depositional context received waste discarded from different sources. The archaeobotanical study at Karabournaki also corresponds with this interpretation.[510] Based on the taphonomic data, deposition of bones at both sites involved both immediate and delayed burial. The former is supported by the discovery of articulating elements which suggest burial before decomposition of soft tissue or disturbance by external agents. On the other hand, specimens bearing dog gnawing marks and weathering traces suggest delayed burial sometime after discard. Animal bones bearing gnawing traces could have been fed to dogs or merely discarded in areas to which dogs had access. The presence of dogs is also attested by the finding of digested bones. Incidences of weathering traces are very low at both sites, suggesting that the bones did not remain in open-air spaces exposed to weather conditions (e.g. rain, sun) for a long period of time. The gnawed and weathered bones imply that the relevant specimens were deposited in the refuse points later, probably during cleaning of the open spaces where they were initially discarded. These open areas may have been private or public, and therefore the remains' exposure to human trampling in some of them cannot be excluded.

The bone remains found inside the refuse points in Argilos and Karabournaki derived from various processes, namely butchery, cooking, consumption, and craft production. Butchery waste is confirmed by the presence of anatomical parts that are usually rejected during the first stage of carcass processing – some of them bearing skinning traces –- and concerns the parts with little meat, such as metapodials and phalanges. Cooking waste may be represented by uniformly burnt bones from various anatomical parts, which were probably used as fuel for cooking and/or heating. The representation of these bones in both Argilos and Karabournaki is very low, implying that the use of bones as fuel was rare or that bones rarely survived such use. The surface colour of these bones ranges from black to blue and white, confirming their exposure to high temperatures, which could also have destroyed them. At Karabournaki, in addition to animal bones, plant by-products from early and late crop processing stages seem also to have been used as fuel.[511] Consumption waste refers to the bulk of the bones, some of which bear cut marks and black burnt patches; and

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[510] Tiverios et al. 2013: 212.

[511] Tiverios et al. 2013: 210-12.

craft production waste refers to the bones, teeth and antlers used as a raw material that bear sawing or other working marks.

For the above processes, the bulk of bone waste seems to have been derived from household activities (e.g. cooking, eating) and, to a lesser extent, from butcher's shops and workshops. Apart from household consumption, instances of waste production during large-scale meals, which could have taken place in a communal space in the context of a public event, cannot be excluded. Taking into consideration the location of the refuse points within the settlement of Argilos, the creators of the waste (households, butcher's shops, workshops) were probably located in their immediate vicinity. Thus, Room L1 and the open space between buildings E–F possibly received waste from the nearby buildings, namely buildings E and F, in the case of the open space E–F, and Building L, in the case of Room L1. At Karabournaki, although the studied assemblages concern only the refuse points (structures and pits), the link between the residential area and the refuse points is expected to be similar. However, the ownership status (private or public) of the abandoned rooms, buildings, and structures, as well as those of the dumps and pits at Argilos and Karabournaki, is unknown. Additionally, it is unknown who was responsible for waste management and cleaning, whether the city or individual inhabitants.

The bone remains at Kastri seem to be derived from similar processes, although information is not yet available on the nature of the contexts of deposition. At Assiros, butchery and consumption waste seem to have been deposited mostly in the midden and road deposits on the side of the toumba, and less in the central part of the toumba.[512]

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[512] Halstead and Jones 1980: 265-6.

4.4. Conclusions & Epilogue

The study of animal bone remains from Argilos, Karabournaki and Kastri investigated for the first time as a whole the issue of animal husbandry - a crucial domain of the primary economy - and the relationship between people and animals through the latter's exploitation and consumption in the region of Macedonia from the Early Iron Age to the Classical era. The new data were combined with already published data from the Macedonian region in order to address gaps in our knowledge of animal husbandry in North Greece in the first seven centuries of the first millennium BC. To date, previous zooarchaeological research in the region of Macedonia has focused mostly on material from Neolithic and Bronze Age sites. Moreover, this study will contribute to ongoing discussions regarding animal husbandry and mobility and the exploitation of natural resources during the first millennium BC. in the wider region of the Aegean basin.

The results of zooarchaeological analysis in the Macedonian region from the Early Iron Age to Classical period suggest a rather common pattern of animal exploitation in the settlements of Argilos and Karabournaki, while animal management at Kastanas and Kastri seems to have been different. In general, the pattern at mainland settlements includes a meat-based strategy of management for goats, some emphasis on wool production for sheep, and meat-oriented management, possibly combined with traction, for cattle. Finally, pig was exploited for its meat and in some cases also for its fat. In addition to these commonest domesticates, in the mainland settlements equids and dogs were also consumed, albeit only occasionally, while chicken must have been exploited too in Classical Kastanas and probably in Argilos. Animal management at Kastri seems to have been adjusted to the distinctive environmental conditions of its insular location: goat was almost equal to sheep, and both species were kept mainly for meat and secondarily for fibre, while the existence of feral goats is also possible; cattle were exploited for breeding and perhaps traction; and pork was derived mainly from young pigs, which were probably reared in the forests.

Zooarchaeological evidence for the exploitation of the main domestic animals in the region of Macedonia seems in several respects to mirror what is described in literary sources. According to historians, sheep was exploited mainly for fibre, while cattle were mainly used as draught animals.

Moreover, dairy production in Classical Greece was mostly destined for cheese making, with little milk being drunk fresh. Written sources stress the importance of pig in the Greek diet as the main source of meat, with the meat from the other common species consumed mainly in sacrificial contexts. Given that the history of meat-eating in ancient Greece has often been written in the context of religious practices and elite cultural contexts, it is not unlikely that animal remains from EIA to Classical deposits in the region of Macedonia should represent, at least in part, private meals of wealthy households. Chicken meat and eggs were an additional source of domestic animal protein, which could be consumed also by poor households.[513] Although meat was consumed by the inhabitants of the Macedonian region, the diet was predominantly plant-based as reflected in the isotopic signature of human remains from North (and likewise Central) Greece, consistent with the literary sources which favour a diet based on grains rather than meat.

Changes over time in vegetation, as a result of climate change (especially during the Late Bronze Age and beginning of the Early Iron Age) and human activity (notably through felling of trees for timber and clearing of woodland to create open land for cultivation and pasture), also affected animal herding and feeding strategies and thus human dietary choices. The herding strategies of the Archaic and Classical periods are a subject of considerable debate among historians and archaeologists. One crucial question concerns the extent to which the relationship between arable farming or arboriculture and animal husbandry was one of symbiosis or simply of coexistence.[514] Two opposing models have been proposed regarding animal herding in antiquity. The first assumes that lowland arable farming was dominated by the alternation of cereal crops with fallow ploughed bare in spring. This regime creates an abundance of winter pasture but scarcity of summer grazing in the lowlands, thereby enforcing the seasonal transhumance of sheep and goat with caprines maintained from spring to autumn on mountain pastures and returning in winter to the lowlands.[515] The second model emphasizes the rotation of cereals and legumes in arable cultivation, thus reducing the availability of winter pasture in the lowlands and thereby removing the rationale for transhumance.[516] Isotopic analysis at Argilos suggests that sheep grazed on arable fields, which were probably manured, but this result is compatible with either model. Lowland palynological

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[513] Halstead 2012.

[514] Hodkinson1988: 38.

[515] Hodkinson1988: 38.

[516] Hodkinson1988: 38.

data from the Aggitis river (plain of Serres), the plain of Drama - Tenaghi Philippoi and Lake Volvi suggest agro-pastoral activity in these areas, but again this is compatible with either year-round herding or the presence of livestock only seasonally. As for higher altitudes, the palynological data from Mount Lailias, located above the Strymon plain, suggest absence of human activity until the late 4th c. BC., while the palynological data from Mount Paiko, above the plain of Thessaloniki-Giannitsa, implies pastoral activities during the EIA and Archaic periods, which were reduced in Classical times. The data from Paiko would fit better to a transhumant model, which is not supported in the case of Mount Lailias. The above isotopic and palynological data thus leave open the possibility that both models of animal husbandry were practised across the region of Macedonia in the 1st millennium BC. However, the indications of pastoral activity at high altitudes do not necessarily indicate movement of large herds over long distances, akin to later medieval and early modern large-scale transhumance. Although it is unknown how distant was the winter base of herders on Mount Paiko, the geographical relief of the Macedonian region, comprising big plains between mountains, some of them reaching a considerable altitude, does not impose any necessity for long-distance transhumance. Moreover, as large-scale mobile herding involved mainly sheep and goat, which are more suited to grazing both the short summer pasture of the high mountains and winter pasture of lowland fallow fields,[517] high percentages of these two species would be expected in faunal assemblages. Instead, sheep are clearly dominant only at Argilos, while goat is the third or fourth most abundant species at Argilos and Karabournaki, respectively, and at Kastanas pig dominates. Thus, in the Archaic and Classical periods, although short-distance mobility may have been practised, most sheep herding probably took place on or near cultivated land at all times of the year. In the case of cattle, isotopic data from Argilos suggest grazing in arable fields during the Archaic period and in nearby wetlands during the Classical era, while goats most probably accompanied sheep and pigs were apparently reared in proximity to the settlement. At Kastri the herding strategies were probably different from the mainland settlements, in response to the insular environment: pigs were perhaps reared in forested areas, while the indication of feral goats implies that this species at least may also have ranged at a distance from the settlement. There are many ancient sources with direct or indirect mentions of herd management, that in general support the model of symbiosis between arable farming and animal

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[517] Halstead 2012.

husbandry, combined with small-scale movement to nearby uplands.[518] In practice, the form of animal husbandry pursued was doubtless influenced by the type of settlement (urban or rural), the availability of land for agriculture, the status of the owners of livestock (arable farmer, specialist herder, sanctuary or state), and the needs of the local market.

A wide variety of terrestrial and marine wild fauna provided a complementary source of nutrition. The 'menu' consisted of red, fallow and roe deer, boar, and hare. The list was completed by various species of birds (including Pelecaniformes, Anseriformes, Gruiformes, Strigiformes and Passeriformes), and fresh- and saltwater species such as catfish, carp, jewfish, gilthead bream, cockles, tuna, and mussel. The exploitation of wild animals was apparently most extensive at Kastanas, followed by Argilos, Karabournaki and Kastri. The composition of the wild species at each settlement and the level of exploitation of these faunal resources, for both nutrition and raw materials reflected the local environmental potential (e.g. proximity to fresh and saltwater bodies; access to different types of vegetation). For example, Kastanas was surrounded by a variety of extended biotopes, including wooded mountains and freshwater environments, explaining the variety of species found there (e.g. beaver, lynx, wolf, lion, marten, squirrel, badger, and red fox). Conversely, the insular environment of Kastri on Thassos island limits the variety and abundance of wild fauna. Among the contribution of terrestrial animals, apart from Kastanas, game made up a very small part of the meat intake in the diet, while shed antlers of red deer seem to have been collected regularly, at least at Classical Argilos, and of course did not involve slaughter or the consumption of the carcass.

The differences between sites in domestic and wild species compositions and in strategies of animal management and herding probably reflect adjustments to local social, economic, and environmental conditions rather than contrasts between the local populations and southern Greek settlers. Argilos, a Greek *polis*, and Karabournaki, inhabited mainly by a local population, seem to have had more similar patterns of animal management than Kastanas and Kastri, both inhabited by local populations. The observed differences in animal management were thus most likely due to type of settlement than the origins of the inhabitants. Argilos and Karabournaki, two coastal settlements, were urban centres of probably outward-looking nature. In the case of Argilos, where

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[518] E.g., Chandezon 2003; Hodkinson 1988; 1992; Skydsgaard 1988.

more data are available, wool production for large-scale textile working and the manufacturing of artifacts from deer antler are, as might be expected, attested in the *agora*, the heart of an organized *polis* where manufacturing played a significant role in the city's economy and social structure. The same can be assumed for Karabournaki, where craft workshops for pottery and metalworking have also been detected. In contrast to Argilos and Karabournaki, Kastanas and Kastri were rural settlements, with different economic models which, in the case of Kastri was heavily influenced by its local environmental setting.

Cooking techniques, consumption practices and discard management seem to have followed common principles in all four settlements. Regarding cooking practices, meat roasted directly over fire seems to have been consumed occasionally, consistent with the belief of Classical Greeks that boiling was superior to roasting. Meals were mainly consumed in a household context, but large-scale meals, ceremonial or not, also probably took place in a more communal context. In the case of ceremonial meals, meat consumption in Argilos seemed to be also related with animal sacrifice, in the context of Olympic sacrifice, implying a lack of shared cultural practices with the local settlements of Karabournaki and Kastri in regard to animal slaughtering and consumption. In relation to discard management, the main bulk of bone food waste was deposited directly in specific refuse points (e.g. abandoned rooms, pits, dumps) after carcass processing and consumption, implying similar intra-communal arrangements between the settlements. Moreover, common burial practices regarding the deposition of horse and dog in human cemeteries suggest the existence of some shared perceptions regarding the significance of these animals in the Archaic and Classical societies of the Macedonian region.

Some questions regarding the inter- and intra-communal organization of the settlements and discard management, based on taphonomic traces and the spatial distribution of animal bone, have not been completely answered, mainly because excavation and the study of associated material culture are still ongoing at Argilos, Karabournaki and Kastri alike. The future provision of complete stratigraphic and chronological data and the completion of faunal study for Argilos (e.g. Acropolis sector) and Karabournaki (e.g. residential structures), however, will allow further investigation of the possible uses of rooms, buildings, and structures (e.g. kitchen facilities, ritual spaces) through associated animal bone remains. Moreover, it will be possible to 'connect' the zooarchaeological data with the main historical events of the Early Iron Age, Archaic and Classical periods (e.g. Greek colonization, the rise of the Macedonian royal house of the Temenids, the Persian Wars and the Peloponnesian War) that caused significant changes and developments in the social, economic, and political structures of the local communities. Additionally, data from the study of cooking pots at all three settlements and their potential chemical analysis will also contribute significantly to the investigation of cooking practices, such as the importance of dairy products to the diet. Finally, the study of birds, reptiles and possibly microfaunal remains from wet sieving will add more information regarding the consumed species, hunting practices and the micro- and macro-environments and climate.

During the analysis, new questions arose regarding the diet of the common domestic animals as a central aspect of their management. To answer these new questions, 2-D dental microwear analysis of the mandibular teeth is proposed for all three sites, to determine the diet of the domestic animals and also illuminate potential differences between them, between the three sites and between the habitation phases in each settlement. Additionally, completion of the ongoing isotopic analysis in Argilos, which includes Carbon ($\delta^{13}C$), Nitrogen ($\delta^{15}N$), Oxygen ($\delta^{18}O$) and Strontium ($^{87}Sr/^{86}Sr$), will contribute significantly to the exploration of the animals' long-term diets, as dental microwear analysis reflects diet only in the days immediately before death. Isotopic analysis could also provide information on animal mobility and thus on the exploitation of the natural environment in terms of the use of space as well as of different vegetation types as pasture. This will hopefully give some answers to the questions regarding transhumance in the region of Macedonia in the first millennium BC. Lastly, the data from the ongoing study of plants and marine faunal remains from Argilos and Karabournaki will also add to understanding of the exploitation of wild animals and the natural environment, and the use of land, including the possible involvement of domestic animals in crop-husbandry processes such as ploughing and the use of their dung for manuring.

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Appendix I

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Table I.1. Anatomical and taxonomic breakdown in Argilos, Phase I (NISP–MinAU)

Table I.2. Anatomical and taxonomic breakdown in Argilos, Phase II (NISP–MinAU)

Table I.3. Anatomical and taxonomic breakdown in Argilos, Phase III (NISP–MinAU)

Table I.4. Anatomical and taxonomic breakdown in Argilos, Phase IV (NISP–MinAU)

Table I.5. Anatomical and taxonomic breakdown in Argilos, Phase III-IV (NISP–MinAU)

Table I.6. Anatomical and taxonomic breakdown in Karabournaki, A01 (NISP–MinAU)

Table I.7. Anatomical and taxonomic breakdown in Karabournaki, A02 (NISP–MinAU)

Table I.8. Anatomical and taxonomic breakdown in Karabournaki, A03 (NISP–MinAU)

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