PHAROS SUPPLEMENT 1

DIET, ECONOMY AND SOCIETY IN THE ANCIENT GREEK WORLD

Towards a Better Integration of Archaeology and Science

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Bioarchaeological investigations at Kolonna, Aegina (Early Helladic III to Late Helladic III)

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Abstract

The interdisciplinary bioarchaeological investigations at Kolonna, Aegina yielded significant evidence of agriculture and husbandry. A clearly recognisable emphasis on ovicaprines distinguishes the livestock associated with the MH II Large Building Complex from more broadly-based or even cattle-focused economies at other contemporaneous mainland sites. A similar emphasis on small ruminants can be found in faunal samples from Aegean islands. Mycenaean layers inside and surrounding a kiln contained large numbers of heavily crushed and partly burnt shell fragments of the common purple snail, indicating most likely the process of purple dye production. The presence of few but significant remains of large game such as red deer, wild boar and lion prove hunting activities by high-ranking inhabitants of the Large Building Complex. Hunting took place most likely in the adjacent mainland regions. Game birds are represented by cormorants and pigeons, again demonstrating similarities to Middle Minoan Kommos. Seeds of ruderal plants and microfauna remains enable cautious conclusions on environmental conditions in Middle Bronze Age Aegina.

Keywords

Aegean island; Bronze Age; bioarchaeology; integrated sciences; agriculture.

Introduction

The results discussed here are based on excavations at Kolonna, Aegina mainly carried out between 2002 and 2007, at the so-called South Slope in the centre of the prehistoric settlement.[1] The Kolonna settlement on the island of Aegina has long been known as one of the major centres of the Aegean Bronze Age.[2] Its importance is partly due to its 'ideal' geographical position in the centre of the Saronic Gulf, at the crossroads of important Bronze Age routes between central mainland Greece, the north-east Peloponnese, the Cyclades and Crete.[3] The settlement of Kolonna flourished for almost a millennium, from the advanced Early Helladic II period (hereafter EH) through the Middle Helladic period (hereafter MH) until at least the Shaft Grave period (early Late Helladic period, hereafter LH).[4] This is well illustrated by impressive fortifications (since the EH III period) and by a wealth of material remains.[5] These include the earliest known shaft grave so far in the Aegean,[6] the famous 'treasure of Aegina' now at the British Museum in London,[7] another recently found rich metal treasure,[8] a number of other 'prestige' items of various types, mainly of Cretan origin or influence, and substantial amounts of imported ceramic vessels from various sources across the central and southern Aegean.[9] This evidence indicates that Aegina was an important hub in the central Aegean network, acting both as producer and, probably, distributor of commodities in a wider region. At the same time the Kolonna community was an avid consumer of imported or exotic goods while also being open to 'foreign' practices and, possibly, craftspeople. Furthermore, the first half of the second millennium saw growing indications of wealth and prestige accumulation in the hands of a certain section of the society. A MH II monumental shaft grave was built and richly furnished with weapons, jewellery

[1] For preliminary reports, see Felten *et al.* 2003, 2004, 2005, 2006, 2007, 2008, 2009.
[2] Rutter 1993. For a recent summary on the prehistory of Kolonna, see also Gauß 2009. For the absolute chronology see Wild *et al.* 2010.
[3] See also Gauß & Kiriatzi in press.
[4] See Rutter 1993 and Gauß & Kiriatzi in press.
[5] Walter & Felten 1981.
[6] Kilian-Dirlmeier 1997.
[7] Higgins 1979, 1987; see Gauß 2006, 437 n. 2 with further references, and Phillips 2008.
[8] Reinholdt 2008.
[9] See similar summaries at Gauß & Kiriatzi in press; Gauß 2009.

and ceramic vessels,[10] while the MH I-II 'Large Building Complex' (also referred to as 'Mansion') in the centre of the settlement was already in use.[11] The settlement was surrounded by impressive fortifications throughout the MH period. This combined evidence, implying unprecedented mobilisation of a work force and complex planning and organisation of crafts and trade activities, clearly distinguishes Kolonna from a standard MH community.[12] The Kolonna settlement seems to have been one of the earliest examples of complex society in the Aegean outside Crete, and a significant commercial and possibly political centre in the Saronic Gulf.[13] Jeremy Rutter argued that "[…] Kolonna has emerged as a Middle Helladic site without peer on the Greek mainland", while Wolf-Dietrich Niemeier even assumed the emergence of a 'state' on Aegina, comparable to contemporary political entities on Crete.[14]

In the context of the long exploration history of the site the focus of this new research was to integrate archaeological and bioarchaeological studies, in order to learn more about subsistence, diet and life at this important Bronze Age site. It should furthermore be stressed that the integrated archaeological and bioarchaeological analysis of material originating from a continuous stratigraphic sequence, covering the EH III to LH I periods, is thus far limited to only a few sites in mainland Greece. Therefore our analysis will hopefully help to better understand subsistence and life (including changes in diet) in these periods. Keeping in mind the statement about Kolonna being an atypical MH site, it will furthermore be very interesting to see if this status is also reflected in the recently excavated bioarchaeological remains.[15]

Precise excavation techniques were applied during the 2003-2007 excavations at Kolonna including flotation of ca. 5m³ of soil on a 0.5-mm screen, and the sieve residues revealed huge amounts of bioarchaeological remains. Most of the material discussed here was associated with the Large Building Complex, presumably the mansion of the prehistoric settlement, and dates to MH II. The research also focused on bioarchaeological remains of the EH III and the LH III period. The aim of all these investigations was to answer economical and ecological questions from an integrated bioarchaeological point of view.

Plant remains

Agriculture certainly made an important contribution to the nutrition of the inhabitants of the island. In contrast to animal bone and molluscs, however, vegetal food remains are scarce. They mainly derive from dated layers (fills) but sometimes cannot be associated with specific contexts.

Plant remains had been preserved in two forms, mineralised and charred. In an environment rich in calcium carbonate and phosphate, as may be found in sewers or latrines, deposited plant parts will become impregnated with these carbonates and phosphates. After the decay of the organic components, the plants are present as mineral, glass-like casts.[16] In Kolonna only fig (*Ficus carica*) and grape (*Vitis vinifera*) are present in mineralised form, with fig pips dominating. They are abundant throughout the Bronze Age site but are most numerous in areas with a low concentration of charred plant remains. Charring is the result of a burning event by which the organic material is reduced to almost pure carbon. Charred plant remains in domestic contexts can usually be linked to food preparation, the use of plants as fuel or the accidental burning of structures. An unusual find comes from the late EH III phase, where a high amount of charred barley (*Hordeum vulgare*) was recovered in the burnt houses of the Kolonna V settlement.[17] The assemblage consisted of about three litres of grain and some detached glumes, while rachis segments and weeds were absent. In another location within the same destruction area about two litres of fine grey ash were recovered, and phytolith analysis revealed that cereal straw got burnt there.[18] The area seems to have served as a storage facility where highly processed and thoroughly cleaned barley, ready for consumption, plus straw were kept in separate places awaiting further use.[19] In all other areas

[10] Kilian-Dirlmeier 1997.
[11] Gauß & Smetana 2010.
[12] Gauß & Kiriatzi in press.
[13] Gauß & Kiriatzi in press.
[14] Rutter 1993, 776, 780; Niemeier 1995, 74. For similar discussions, see also Dickinson 1977, 33 and Lindblom 2001, 35.
[15] See for example analyses of material from Lerna in the Argolid (Gejvall 1969). See also analyses carried out at Pefkakia Magloua (Amberger 1979), Argissa Magoula (Boessneck 1962), Ay. Mamas/Olynthos (Becker 2008) and Asine (Moberg Nilsson 1996; Nordquist 1987).
[16] See Jacomet & Kreuz 1999, 62, among others.
[17] For the Kolonna V destruction see Walter & Felten 1981; Gauß 2009; Wild *et al.* 2010.
[18] For the find locations of barley see Walter & Felten 1981.
[19] However, such pure stock with less than 1% elements other than grain is unusual. The samples were taken at the initial stages of the excavation in the late 1960s and 1970s, when sampling for archaeobotany was no common procedure, and they may have been sieved with a coarse mesh with a mesh size larger than 2mm.

of the site the density of plant remains is very low. The average 10-litre soil sample from the Large Building Complex, for example, would yield 17 items in MH II deposits and six items in MH III strata. In both periods mineralised fig pips were dominant. Wheat (einkorn – *Triticum monococcum* and emmer – *T. dicoccum*) and barley were found in equal proportions. Pulses are represented by lentils (*Lens culinaris*) and peas (*Pisum sativum*), and also by the slightly poisonous bitter vetch (*Vicia ervilia*) and other unidentifiable legume species. Fig and olive trees – the latter rarely attested – and grape vines provided fruit. Although scarce, the plant remains indicate that the plant food economy was broad-based, with a variety of cereals and pulses providing carbohydrates and protein,[20] and fruits and nuts adding variety to the diet. The finds may point to a subsistence economy based on agricultural production,[21] with parallels on mainland Greece.

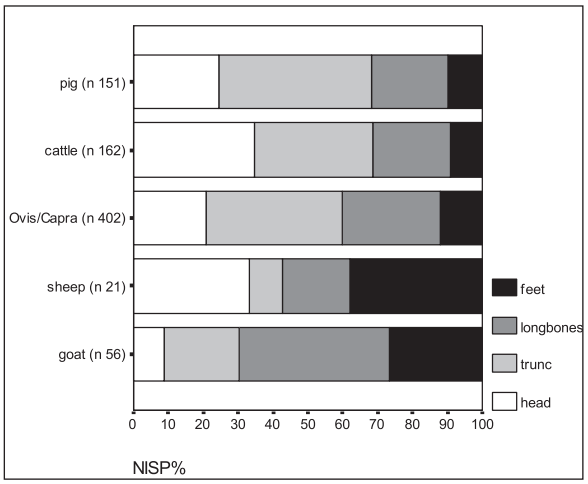

FIGURE 1. Numerical quantification of major domesticates associated with the MH II Large Building Complex.

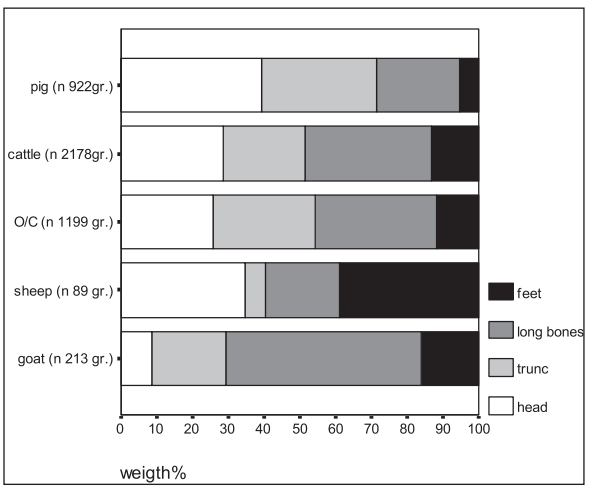

FIGURE 2. Quantification of major domesticates associated with the MH II Large Building Complex by bone weight.

Mammal and bird remains

The animal protein sources in the MH II Large Building Complex resembled those at comparable island or mainland coastal sites. They were varied but seem to have been dominated by the exploitation of the major domesticates. Numerical quantification of the major domesticates revealed an emphasis on ovicaprines, also in contexts other than the MH II Large Building Complex, with a clear preference for goats (Figures 1 and 2).[22] Even the weight distribution underlines the importance of ovicaprines at Kolonna. It displays rather high values compared to the weight distribution of cattle remains. The exploitation of pigs was certainly important but to a lesser extent. The distribution of represented body parts of the major domesticates reveals a rather unspecific use of the complete carcass of the major domesticates at the settlement (Figures 1 and 2).

Pigs were mainly slaughtered as juveniles and premature individuals, and only a few remains suggest the culling of piglets. The pattern of ovicaprines with regard to the culling of kids and lambs appears similar, but the number of premature to adult slaughtered individuals is significantly higher. As pigs were predominantly kept for meat production, the culling profile of ovicaprines allows the possibility that they were used for renewable products like dairy, hair and wool.

Cattle were predominantly culled at premature (before the late fusion of epiphyses, i.e. prior to 3.5 to 4 years) and mature ages (older than 4 years), indicating the use of the animals' work power, although only one proximal phalanx (associated with the MH II Large Building Complex) shows proximo-cranial lipping at a medium stage and widened palmar ligament bases.

[20] As in other mainland sites, such as Tiryns (Kroll 1982), Asine (Nordquist 1987) or Olynthos (Kroll 2008).

[21] Renfrew 1972, 282-284.

[22] Gamble 1978, 749-750 reports more horn cores of goat than those of sheep from MM (Middle Minoan) Thera. The MBA (Middle Bronze Age) assemblage from mainland Olynthos indicates a rather different behaviour, favouring sheep (Becker 2008, 171). Some literature on distinguishing sheep from goat: postcranial – Boessneck 1969; Boessneck *et al.* 1964; Buitenhuis 1995; Kratochvil 1969; Payne 1969; Prummel & Frisch 1986; Zeder & Lapham 2010; dentition – Brouwer 2002; Halstead & Collins 2002; Zeder & Pilaar 2010.

Exploitation and herding strategies at MH Greek mainland sites involved a more balanced use of the major domesticates,[23] while the pattern observed at the MH II Large Building Complex in Kolonna suggests live stock management similar to that on Minoan Crete. In Middle Minoan II (hereafter MM) Kommos the proportion of ovicaprines was over 60%. Reese lists several sites at Minoan Crete which show the same husbandry pattern for the three major domesticates as that at Kommos or Aegina.[24] Keeping small ruminants on small islands is certainly less problematic than to keep and feed cattle herds.[25]

A shallow pit associated with the MH II Large Building Complex contained a more or less completely preserved ram skeleton. Heavy chopping marks on the neck vertebrae probably indicate how the animal was killed. After that, the chest of this individual was carefully opened, leaving butchering marks on the sternum. This might indicate ritual activities that involved the sacrificial killing of live stock.

The thick infill layer associated with the MH II Large Building Complex contained mainly domestic refuse and yielded various remains of big game. The most outstanding find is undoubtedly a lion humerus, that suggests a rather large male individual (proximal width = 73mm, proximal thickness = 85mm). This find places Aegina Kolonna amongst the six widespread locations from the Late Neolithic to the Archaic Age that testify to the presence of lions in Greece.[26] The bone does not show any traces of dismembering, but the fracture edges reveal perimortal smashing as they still contained collagen. The proximal section certainly suggests a meat bearing part, rather than a fragment that was part of an imported trophy. Morphological analysis enabled the taxonomical assignment of the upper arm fragment to the Asian Lion (*Panthera leo persica*), which was also the case at Aegira,[27] Kalapodi,[28] and Kastanas.[29] Remains of big game associated with the MH II Large Building Complex are generally scarce. However, the postcranial bones indicate consumption of prestigious animals like red deer (*Cervus elaphus*), fallow deer (*Dama dama*), roe deer (*Capreolus capreolus*), wild boar (*Sus scrofa*) and most probably also aurochs (*Bos primigenius*).[30] While the existence of native wild boar and probably roe deer as well as fallow deer on MBA Aegina is not implausible, the ecological conditions on such a small island are definitely not advantageous for the survival of a herd of stags or a pack of lions.

Besides hunting big game the Kolonna people, and presumably especially the social elite, hunted game birds as well. A few skeletal remains associated with the Large Building Complex indicate the presence of rock partridge (*Alectoris graeca*), little owl (*Athene noctua)* and greylag goose (*Anser anser*), birds that occur in Greek mainland assemblages as well as island sites. The MH II infill of the Large Building Complex yielded pigeon (Columba sp.) (n=8, MNI=4) and cormorant (Phalacrocorax sp.) bones (n=3, MNI=2), identified by butchering marks as food remains.[31] Bones of pigeon and shearwater dominate the avian assemblage at MM Kommos.[32] Aquatic birds like cormorants or even shearwaters are mainly fish eaters and their flesh therefore tastes fishy, indicate possibly an appreciation of wildfowl dishes, in particular those containing greasy and fishy bird species such as those attested at Kommos and Aegina Kolonna.

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[23] Macedonia: Kastanas (Becker 1986), Olynthos (Becker 2008), Sitagroi (Bökönyi 1986). Thessaly: Argissa Magula (Boessneck 1962), Magula Pevkakia (Jordan 1975; Amberger 1979). Peloponnese: Tiryns (Van den Driesch & Boessneck 1990), Lerna (Gejvall 1961, Tab. 3), Nichoria (Sloan & Duncan 1978), Asine (Moberg Nilsson 1996, 400).

[24] Crete: Reese *et al.* 1995, 166. Reese compares various sites on Minoan Crete and reaches the same conclusion, i.e. that the islanders based their mammalian protein intake on ovicaprine stock. Similar patterns are reported for the Cyclades: Phylakopi (Gamble 1985, 169), Akrotiri (Gamble 1978, 750; Trantalidou 1990, 400).

[25] As discussed by Gamble 1978, 150.

[26] Evidence such as loose teeth from Pylos, Ayia lrini or Mycenae, or distal autopodial bones from Samos and Delphi were most likely imported as trophies or amulets (Thomas 2004, 190), and do not necessarily indicate the presence of lions near these sites. However, lion bones of 'meat bearing' parts like the humerus from Aegina may prove the presence of these animals in the vicinity of sites, such as at BA to Early Archaic Tiryns (Van den Driesch & Boessneck 1990, 110), Kastanas (Becker 1986, 336), Hyampolis-Kalapodi (Van den Driesch & Boessneck 1990, 110), Late Neolithic Dikili Tash (Helmer 1997, 41) and Aigira (Forstenpointner *et al.* 2010, 180-181).

[27] For a detailed description of the Asian Lion remains, see Forstenpointner *et al.* 2010, 180-181.

[28] Stanzel 1991.

[29] Becker 1986.

[30] Trantalidou 2000, 718-721 provides an overview showing that red deer and fallow deer as well as roe deer and wild boar were the usual game animals at various prehistoric Greek sites. Evidence for urochs is reported from Olynthos (Becker 2008, 87), Magoula Pevkakia (Amberger 1969), Lerna (Gejvall 1969) and Argissa Magoula (Boessneck 1962).

[31] Becker 2008, 103 presents more evidence for cormorant from Olynthos.

[32] Reese *et al.* 1995, 195, Tab. 5.9.

Shells

The frequency of shell finds reflects the importance of molluscs as a protein source in Bronze Age Aegina.[33] However, the majority of the terrestrial gastropods (*Eobania vermiculata*, Helicella sp., *Rumina decollata*) represent secondary intrusions of modern species. Even most of the shells of the large garden snail (Helix sp.) entered the archaeological contexts secondarily. A small number of *Helix* shells appeared as a regular part of the archaeological assemblages, but this does not necessarily imply they were being exploited. In general, land snails occur only in small numbers on Greek sites.[34]

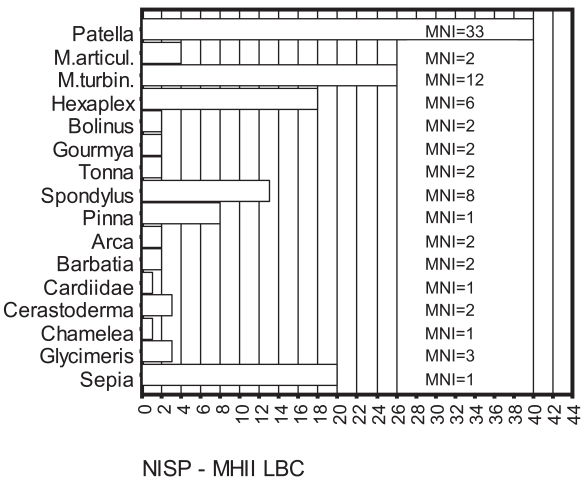

FIGURE 3. Numerical quantification of the mollusc remains from the infill of the MH II Large Building Complex.

At the MH II Large Building Complex numerous gastropods as well as bivalves and a few cuttlefish remains reflect exploitation of marine resources (Figure 3). This combination of species is largely similar to that of the assemblages at MM Kommos,[35] and it is not unusual at mainland costal sites, either.[36] A few generations earlier the Aeginetans of the EH III period had collected primarily limpets (mainly *Patella caerulea*) and top shells (*Monodonta turbinanta* besides a few *M. articluata* and Gibbula sp.; Figure 4). From the MH onwards purple snails (mainly *Hexaplex trunculus* and to a lesser extent *Bolinus brandaris*) were constantly being exploited in larger quantities (Figure 4). Other gastropods like tun snail (*Tonna galea*), triton (Charonia sp.) and ceriths (*Gourmya vulgata*) also suggest consumption.

Spondylus (*Spondylus gaederopus*), Noah's Arc shell (*Arca noae*) and few specimens of bearded Arc shell

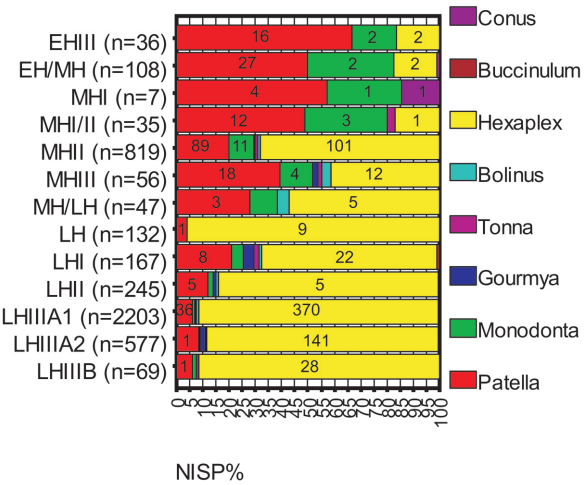

FIGURE 4. Quantification of gastropod remains by chronological subunit from trenches Q3 and Q6. The values in brackets indicate the estimated Minimum Number of Individuals (MNI).

(*Barbatia barbata*) were regularly used as food in the MH II Large Building Complex and in other Bronze Age contexts at Aegina. The numerous remains of pen shell (*Pinna nobilis*) are certainly overrepresented due to the high degree of fragmentation of their large and fragile valves, but it may also indicate intense exploitation (Figure 5). Less frequent are other species

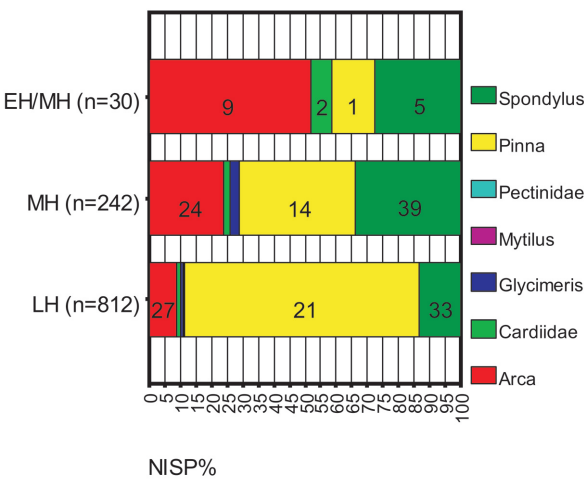

FIGURE 5. Numeric quantification of bivalve remains from trenches Q3 and Q6, by general chronological period. The values in brackets indicate the estimated Minimum Number of Individuals (MNI).

[33] As introduced, with preliminary results, in Galik 2010.
[34] Reese *et al.* 1995; Reese 1998; Karali 1999, 2005.
[35] Reese *et al.* 1995, 240, 273.
[36] Becker 2008, 110-112; Magoúla Pavlína: Prummel 2003, 57-59; Theodoropoulou 2007, 74-79.

such as mussel (*Mytilus galloprovincialis*), scallop (*Pecten jacobaeus* and Chlamys sp.), and species preferring soft grounds such as lagoon cockle (*Cerastoderma glaucum*) and a few spiny cockles (*Acanthocardia tuberculata*) as well as Venus shells (*Venus verrucosa* and *Chamelea gallina*).

In general only a few worked shells occur amongst Bronze Age mollusc material. The abundance of pen shell may suggest the use of valves as raw material. Although spondylus was a consumed shellfish and large stocks must have been available, the Bronze Age people in Aegina did not use its shell as raw material. Some modified bivalve shells of Glycimeris point towards their decorative use.[37] Rare gastropod species like dog whelk (*Buccinulum corneum*), abalone (Haliotis sp.), cone shell (*Conus mediterreanues*) and cowry (*Luria lurida*) were probably also used to produce ornaments.

An abundance of remains of purple snail shell usually indicates purple dye production. The preparation to extract the secretions of the hypobranchial gland involves intense crushing of the shells, according to ancient authors[38] and modern experimental archaeological research.[39] The area around and inside a LH IIIA kiln in trench Q3 contained much higher quantities of such remains (Figure 4).[40] Some of the fragments were burnt and probably represent a method to get rid of this kind of waste by burning it to produce lime.[41] However, the question remains to what extent purple dye was produced, since the Minimum Number of Individuals (MNI) in LH IIIA is only 370 specimens. Such a relatively small number of individuals may indicate that purple dye production was limited to the scale of individual (small) households.[42] However, the area around the LH kiln provided only limited information and the bulk of the refuse probably accumulated somewhere else. However, even in the case of household production, several households in combination would produce a substantial amount of dye, which may explain how the economy and wealth accumulation developed in Kolonna in the Bronze Age. In a wider context, MM and MH purple dye production has been recorded at Palaikastro, Kouphonisi, Ayios Mamas, Akrotiri, Asine, Aghios Kosmas and Olynthos as well as in the entries on purple production on the Linear B tablets from Knossos.[43] The EH pattern of mollusc exploitation at Kolonna differs from that indicated by the MH and LH assemblages, with increasing exploitation of purple snails beginning in the MH period, and purple dye production may also have occurred in the LH period (Figure 5).

Conclusions

Kolonna gained in importance during the MH period and became the wealthy main settlement of the island. Evidence for Cycladic connections appears around EH III in the form of imported goods. Minoan influence is detectable from the MH onwards as the appearance of imported technology and goods.[44] On the other hand, exported Aeginetan pottery turns up in many central Aegean sites in the MBA. The plant remains reflect a wide range of cereals, pulses as well as fruits like figs, vine and olives, indicating a basic agricultural economy from the EBA onwards, which was comparable to that at coastal mainland sites. The inhabitants of the Large Building Complex certainly formed some kind of elite in Kolonna, which the remains of large game may confirm.[45] For these people, Minoan influence expressed itself as exploitation of economically useful animals. Contrary to a preference for cattle on the mainland, meat production at Kolonna was based more on ovicaprine exploitation like at MM Kommos, and the inhabitants of the Large Building Complex clearly shared the surprising taste for bird meat of the Cretan people.[46] The exploitation pattern of molluscs may provide more insight into chronological changes, since the composition of mollusc assemblages alters at the transition of the EH to the MH. An increase in heavily smashed purple snail shells in the LH probably points to the production of purple dye. The archaeological as well as the bioarchaeological finds from the recent excavations at Kolonna point to an intense exchange between Minoan Crete and the Cyclades. Kolonna played undoubtedly a significant role in these well-established

[37] Reese *et al.* 1995, 240 mentions that most of the Glycimeris shells were collected when the animals lay dead on the beach, which is similar to what is indicated by the assemblage from Aegina. See for Aegean shellfish modification in the Aegean Reese 1983, 1984; Karali 1990; Karali-Yannacopoulos 1992; Becker 2008.
[38] For example Pliny the Elder (Hist. Nat. IX), Aristoteles (Hist. an. V, 547a) or Vitruvius.
[39] Ruscillo 2005.
[40] For the kiln, see Gauß 2007.
[41] Reese 1987; Reese *et al.* 1995, 206.
[42] Becker 2008, 174-175 describes similar behaviour in MH Olynthos including a possible Mycenaean influence.
[43] Reese 1987; Reese *et al.* 1995; Karali 1999, 2008; Becker 2008.
[44] Gauß & Smetana 2010, 170.
[45] As discussed by Forstenpointner *et al.* 2010, 739.
[46] Forstenpointner *et al.* 2010, 740.

trading and exchange networks, whereby the Aeginetans used their position to trade goods – and probably to control that trade – between the islands and the coastal mainland.[47]

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