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ISLAND ARCHAEOLOGY AND THE ORIGINS OF SEAFARING IN THE EASTERN MEDITERRANEAN

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THE TRANSPORTATION OF MAMMALS TO CYPRUS SHEDS LIGHT ON EARLY VOYAGING AND BOATS IN THE MEDITERRANEAN SEA

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Abstract

Our interest here is in studying the history of the relationships between human being and animals on islands for reconstructing prehistoric voyaging and boats. The chapter aims to examine how the considerable amount of new evidence that archaeozoology has accumulated over the two last decades on Cyprus can throw new light in the Eastern Mediterranean on the poorly known questions of the intensity and the capabilities of early seafarers in the time between 12,500 and 9,000 cal. BP. It first revisits the paleogeographical framework of Cyprus in the light of recent geographical and geological approaches. In particular, it addresses the question of the presence of stepping stone islets between Cyprus and the mainland at the end of the Late Glacial. Then, it presents a brief review of the archaeozoological data, peculiarly those from the early sites of Aetokremnos, Klimonas and Shillourokambos. They indicate a marked increase of the immigration rate of mammals, which begins in the 13th millennium BP and culminated during the first half of the 10th millennium BP (the time of the Middle PPNB). Based on this scenario and on the biological constraints that are connected with the transportation by boat of large ruminants and with the evolution of mice in island conditions, we conclude that voyagers, in all likelihood, constituted separate and specialized human groups. Starting from 10,500 cal. BP at least and probably going back to 11,000 BP, they were controlling the voyages being made between the mainland and Cyprus so well that they were able to cross the sea several times each year and to cope with the difficult problem of the transportation of large ruminants. This implies that the boats in use were already much more sophisticated than one suspected before. They were likely sailing boats, fast and big enough for transporting weaned calves standing in the boat.

Key words: early navigation, Pre-Pottery Neolithic, island biogeography, archaeozoology

INTRODUCTION

The Near East is one of the main Eurasian regions of innovation between the end of the Late Glacial and the beginning of the Holocene. Cyprus is the only large and remote island in this area. Therefore, the history of its settlement by human beings plays a major role in the reconstruction of the beginnings of seafaring in the Mediterranean basin.

Less than 25 years ago, the earliest evidence for the frequentation of Cyprus by human beings went back only to the 8th millennium BP: that is, with the Khirokitia culture. It was considered to be an impoverished and marginal version of the first pottery Neolithic cultures on the adjacent areas of the Near East. In short, the Khirokitian was characterized by a combination of anachronisms and unique island traits: round houses and a rough lithic industry; the absence of pottery, obsidian, cattle and dogs; a high level of deer hunting; special burial practices; paintings and figurines (e.g., Le Brun *et al*., 1987; Ronen, 1995). All of this suggested that Cyprus was not closely linked with the continent, and that voyaging on the open sea was surprisingly poor there at a time when it had even a much deeper history going back some 30,000 years in Southeast Asia.

Since the 1980s, the discoveries made at several new archaeological sites have shown that the prehistory of Cyprus began at a much earlier time, and they led to the documentation of a series of older cultures that are, on the whole, far less divergent from those on the mainland than the one found at Khirokitia. Thus, there is now a completely different story – and it drastically modifies the image of maritime exchange and interaction between Cyprus and the mainland at the boundary of the Late Glacial and the early Holocene. After 25 years of intensive research by various archaeological teams conducting surveys, excavations and analyses, not all the questions, of course, have been solved and not all the information obtained has been exploited. However, it is now possible to draw up a series of new assessments, including the latest inferences with regard to the transportation of people, materials, animals and plants to the island, and to discuss in wider terms their implications for the nature of early seafaring (what many of the specialists who took part in the Wenner Gren Workshop now prefer to call "voyaging") in the years between 12,500 and 9,000 BP.

As S.J.M. Davis (1984) already emphasized in his research on the mammals at Khirokitia, paleontological and archaeozoological information is of utmost importance not only for the study of the times, rhythms and intensity of prehistoric navigation, but also when it comes to the main characteristics of the boats (at a time when we have no wreck and not even any one representation of an boat or vessel). By taking a more general approach to several large Mediterranean islands, one of us strengthened and broadened this statement (Vigne, 1998, 1999; see also Vigne in this issue). The present chapter aims to take advantage of the huge amount of new archaeozoological data recovered on Cyprus during the last three decades and to draw up an assessment of the existing evidence on early seafaring. At the same time, we shall try to compare what we have learned from the experimental evidence that is currently available (in particular, that of the Monoxylon 2 expedition; Tichý, 1999), together with knowledge about traditional Mediterranean boats of reasonably old age, and to put forward a reconstruction, as a first approximation, of what the earliest boats in the Mediterranean would have looked like. Before doing that, it will be useful to revisit briefly the basic paleogeographical and paleontological frameworks, 25 years after the pioneering work of S.O. Held (1989).

PALEOGEOGRAPHICAL UPDATE

At least for its southern part, Cyprus is a typical oceanic island (in the geological sense of the term): it rose up from the bottom of the oceanic floor starting from the early Tertiary Era due to the Eastern Mediterranean subduction; it was built up around a core of volcanic material coming from oceanic plates; and it was never land-bridged to any of the surrounding continents (Henson *et al.*, 1949; Held, 1989; Geological Survey Department, 2013). However, it is of the utmost importance for our purpose to know as precisely as possible the paleogeographical and paleo-oceanographic conditions that seafarers faced during the span of time that we consider in this chapter. Held (1989) rightfully insisted on the importance of what he called the island's "geometric properties": distance/currents, target size, coastline, coastal morphology, and the existence of stepping-stone islands. In this first section, the plan is to return to questions that concern the distances, the stepping stone islands and the currents.

Today, the shortest distance, as the crow flies, between Cyprus and the mainland is 69 km: from Cape Anamura, on the south coast of Anatolia, to Cape Kormakiti, at the western end of the Kyrenia chain. Towards the east, the distance then increases to 80 km (Cape Ovacik) and more, and all of the strait line distances between the east coast of Cyprus and the adjacent west coast of the Levant seashore are more than 100 km. This makes it quite clear that the easiest way to cross the sea to Cyprus is to start from the coast of Anatolia. In fact, on clear day, Cyprus can be seen from the mainland and vice versa (Schüle, 1993), but only from a certain elevation in the mountains and not from the coastlines. Whatever place on the mainland the early voyager chose to go out to the island, it was definitely not an easy or routine matter to cross over successfully to Cyprus.

The Bathymetric Chart of the Mediterranean of the International Oceanographic Commission, as reproduced by numerous authors, shows that Cyprus is surrounded by 1,000-3,000 m deep basins. They are raised by three main undersea ridges, which are orientated SW-NE by the line of subduction: the Latakia ridge, the Larnaka ridge and the Misis-Kyrenia ridge. The first two are always below – 400 m deep, and, even with strong tectonic movements, they have never been emerged. Conversely, the third one emerges in the form of the Kyrenia chain to the West and the Misis mountains to the North-East (at the boundary of Anatolia and the Levant). In between, it runs under the sea. It is the edge of a horst, which is tectonically active since the Miocene at least (Robertson, 2000; Aksu *et al.*, 2005; Calon *et al.*, 2005; Hall *et al.*, 2005) and therefore it should have changed in altitude through time. Based on the observations by Okyar and co-worker*s* (2005), who recently refined the data upon which Held (1989) based his map, the top of this ridge is deeper than 200 to 800 m along most of its length, but it rises above 200 m below present sea level (bsl) in two small sea mounts off the Cyprus Cape Andreas. The westernmost of them remains, however, very deep (more than 100 m), but the easternmost one, which is also the largest, is higher, and culminates at –69m bsl (Okyar *et al.*, 2005).

Could one or two of these sea mounts have emerged during the Late Glacial and the Early Holocene and played the role of one or two stepping stone islets between 12,000 and 9,000 years ago? To our knowledge, there are no precise data about the sea level change around Cyprus for these periods (though there are a lot for Protohistorical and Historical times). However, recent investigations by Lambeck and Purcell (2005), who brought together observations in the earth sciences with glacio-hydro-eustatic models, give a general idea of the sea level changes during that time in the Mediterranean basin, especially for the Peloponnese (Greece) and the Mount Carmel (Israel) coasts. It appears that the sea level was between 40 and 65m lower 12,000 years ago, depending on which area of the Mediterranean one is studying. As we do not know precisely the eustatic and tectonic movements within the Misis-Kyrenia ridge, we have to consider, as Held did it in 1989, that the sea mount that is today 69m bsl could have emerged during the Late Glacial Maximum and, though reduced, it might have still been just above sea level at the time of the first known voyages to Cyprus around 12,500 BP. The sea-level rise in the case of the Peloponnese and the Mount Carmel coasts by 8,000 years ago (at 10 to 20 m bsl; Lambeck and Purcell, 2005) does shows, however, that this sea mount would have been submerged very rapidly after the 11th millennium cal. BP.

In other words, we can conclude that a stepping stone islet might have existed on the way to Cyprus until ca. 10,500 BP (Late PPNA-Early PPNB), reducing the distance from the mainland to two steps: respectively, 42 km plus 25 km for a sea level of –100 m, and then 70 km plus 25km for a sea level of –50m (in the latter case, more than the distance between Anamur and Cyprus of 65 km; Held, 1989). In short, at least by the start of the Holocene, there would have been no stepping-stones between the mainland and Cyprus. Moreover, at least for the last 14,000 years, what has always been called for is one "long" step over the sea of more then 40 km (that is, at the time when sea level once stood at –100 m).

Concerning the sea surface currents that could have helped or hinder various forms of movement on the sea (swimming, rafting or voyaging), we know that Cyprus is edged Southwest and Northwest by two terminal branches of the Mid-Mediterranean jet, coming from the West. The third main current is the Cypriot circulation, which turns around the island from the South to the North and then East, along the Levantine coast and then toward the East along the South coast (Malanotte-Rizzoli *et al.*, 1999; Robinson *et al.*, 2001). More precise monitoring after Poulain (no date) shows that: the currents that run along

Egypt and the Israel-Palestine coasts bump into the southern stream of the Mid-Mediterranean jet, and they can hardly help to go from there to Cyprus, while strong currents along the North Levant coasts (ca. 3 meters per second or 11 km/h) would have complicated the straight line crossing of the sea to Cyprus. Indeed, a current of this strength might even have provoked such a drift towards the North that the swimmer/rafter/voyager could have missed the Cypriot coast and become lost in the Cilicia channel, where a strong current (3 meter per second) running from ENE to WSW would have helped out on a voyage starting from the Anatolian coast near the Adana plain on the Anatoalian coast and running to the north coast of Cyprus. This current is known today to bring floating objects (including dead human bodies; Muge Şevketoğlu, personal communication) over to the coast of Cyprus. This current would have precluded sea crossings on a straight N-S line from Anatolia to Cyprus (e.g., from Cape Anamura to Cape Kormakiti). More likely is a route from a point further to the east on the Anatolian coast and moving on a line toward the South-West (Fig. 1). By taking such a route, the length of a crossing would increase to 80-90 km.

It seems to be quite beyond our reach today to take into account the winds at that time, not only because climate was different than the modern one (especially at the time of the Younger Dryas, ca. 12,800 to 11,600 BP), but also the system of sea/land breezes is quite sensitive to the conformation of the coastal topography, which was significantly different from the modern one due to the fact that sea level was lower and, therefore, the coastal plains were larger.

PALEONTOLOGICAL UPDATE

Forty years after the founder assessment of the terrestrial Cypriot paleontological record by Boekschoten and Sondaar (1972), the composition of the Pleistocene mammal communities is still unchanged. It is characterized by a very small taxonomic diversity and a very high degree of endemism, as a consequence of isolation since the formation of Cyprus. On the positive side, paleontological record involves a large corpus of information – collected from 32 sites as well as 14 locations of more isolated finds (Held, 1989; Simmons, 1999; Theodorou and Panyaidis, 2003; van der Geer *et al.*, 2010:37-41). Altogether, they concern several thousands of bone specimens. The most important (and at least partly published) collection is the one at Akrotiri-*Aetokremnos*, composed of more than 200,000 specimens. It gives a good idea of the composition of the mammal fauna on the island shortly before the earliest attestation of human beings on the island: *Phanourios minutus, Elephas cypriotes, Genetta plesictoides* and *Mus cypriacus* (Simmons, 1999; Cucchi *et al.*, 2006; Vigne *et al.*, 2009; see also Theodorou *et al.*, 2007).

EARLIEST INTRODUCTION OF MAMMALS TO CYPRUS: *AETOKREMNOS* 12,500 BP

The small rock shelter of Akrotiri-*Aetokremnos* was excavated over three field seasons (1987, 1988 and 1990) by Alan Simmons (1988, 1999; see Simmons in this issue). It is located near the top of the southern cliff of the Akrotiri peninsula, which might have been periodically separated from the main Cypriot island by a shallow sea arm (Ammerman and Noller, 2005). The fillings or deposits that were excavated consist of three layers. The lowest one, stratum 4, is a dense bone accumulation of endemic Cypriot pygmy hippos and elephants, which Simmons considers to have been made by hunters. Taphonomic observations (Olsen, 1999; Davis, 2003; see also Binford, 2000) and stratigraphic re-assessment (Bunimovich and Barkai, 1996) suggest, however, that it is a natural accumulation, which was likely due to the trapping of animals in an opening in the roof of a cave. This is a very common process of accumulation of terrestrial vertebrate fossils in karstic areas. This basal deposit likely dates to the Late Pleistocene, but it is still not precisely dated for three reasons: (1) because there is no biochronological seriation for Cyprus (van der Geer *et al.*, 2010:37-41), (2) because precise radiocarbon dating of the assemblage has remained elusive so far since bone collagen is not preserved, and (3) because the dates obtained from charred bone organic matter and carbonate in bone apatite are too young due to diagenetic alteration (Simmons,

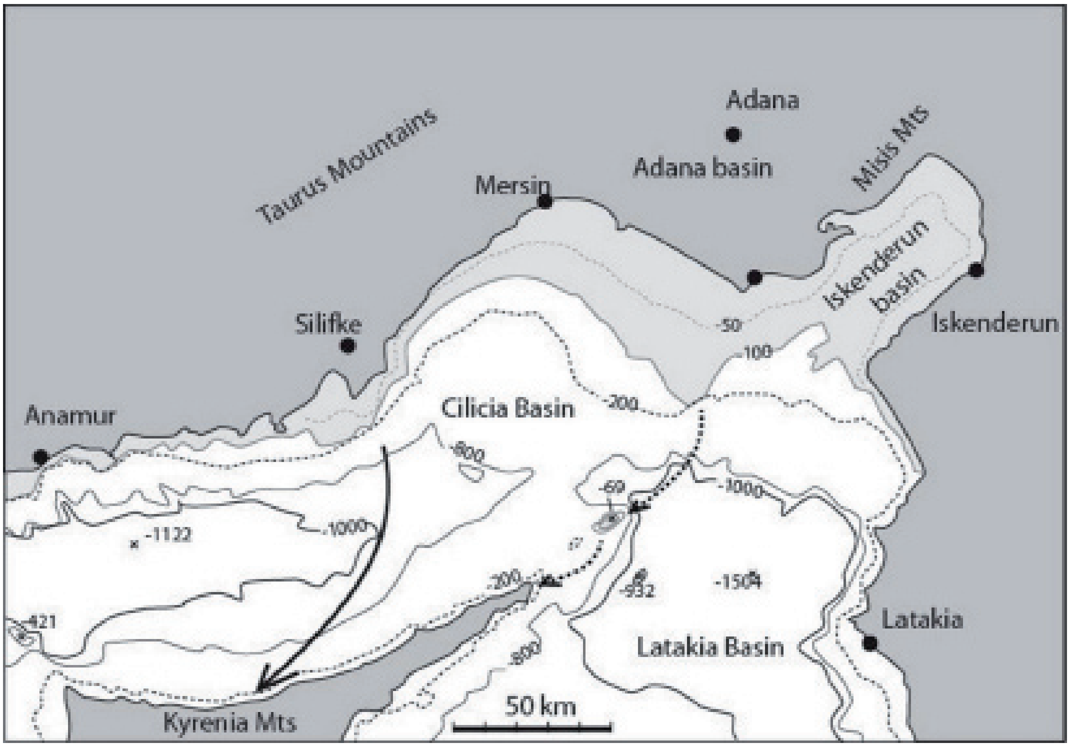

Fig. 1. Simplified bathymetric map of the Mediterranean Sea between Anatolia, the Northern Levant and Cyprus, showing the Cilicia and the Latakia basins, separated by the Misis-Kyrenia ridge, which may have emerged as a stepping-stone island during the last Pleniglacial Maximum (simplified after Okyar *et al.,* 2005). The dotted line arrow represents a possible route taking advantage of the possible stepping-stone islet (before 10,000 cal. BP; 42 km plus another 25km for a sea level of -100 m). The solid arrow represents one of the possible shortest routes from Anatolia (80-90 km)

1999; Simmons and Mandel, 2007). Thus, it is risky to rely on any of them.

The middle layer is composed of a thin sterile deposit of sand, which was blown in by the wind from the dunes that formed between the cliff and the shoreline, on a broad coastal plain created by the marine regression (Ammerman and Noller, 2005). The absence of any similar deposit in the cavity before this middle layer was laid down indicates that the cave was suddenly opened to the south, likely due to the erosion of the cliff and, starting from then, became a rock shelter.

The upper layer, which is called stratum 2, has, no doubt, accumulated as a consequence of the activities of human beings, who frequented the shelter around 12,500 cal. BP (9 charcoal dates cluster broadly in the 13th millennium BP [12,776-12461]); Simmons, 1999; Simmons and Mandel, 2007; Ammerman, 2010:fig. 7.2; see Manning in the next issue). This layer yielded both a flake-based chipped stone assemblage and food refuse mainly composed of shellfish, fish and bird bones (Simmons, 1999). In addition, 18 enigmatic suid remains were recovered, and most of them come from layer 2 (Vigne *et al.*, 2009). Two of us (Vigne and Zazzo) recently re-examined the entire collection of bones from Aetokremnos and checked that it contained no additional remains of suids. These 18 items being exclusively bones of the extremities of the limbs (and one incisor), they are interpreted to be the remains of at least two hides coming from animals that were probably hunted on the main Cypriot island and brought back to the site.

The osteometric study confirms that these suid bones are 10-20 percent smaller than the Younger Dryas Levantine boars of the near continent and also much smaller than the Early and Middle PPNB domestic suids from the sites of Cafer or Aswad. In fact, they are of the same size as the small domestic pigs of Pottery Neolithic age in Palestine (Vigne *et al.*, 2009). One of us (Zazzo) was able to extract degraded collagen from one of these bones and dated it to [11,396-11,746] cal. BP (AA-79923: 10,045±69 BP). This excluded any modern or historical contamination. As this date is probably a bit rejuvenated because of contamination by more recent organic matter, it can be considered as compatible with the date of occupation of the site at ca. 12,500 cal. BP (Vigne *et al.*, 2009).

Though not numerous, these bones demonstrate that small suids were living on the island by 12,500 years ago: that is, the time coeval with the period known as the Late Natufian in the Levant. In light of this date, some 20 centuries before the earliest known evidence of pig domestication at Nevalı Çori (Peters *et al.*, 2005), the small size of these suids should be interpreted as a consequence of isolation (the second syndrome of insularity according to van Valen, 1973), rather than as a the consequence of early domestication. Size decrease occurs very fast for isolated mammals (Raia and Meiri, 2006), especially for a species with a short generation time such as this suids. Since there are no suids in the vast Late Glacial paleontological record of Cyprus (see Section II above), it is clear that the small boars at Aetokremnos immigrated to the island between the time of hippo's extinction, sometime between the Late Glacial and 12,500 years ago. Even if there was still stepping-stone islet off Cap Andreas at that time, the distance between the mainland and the islet would have been more than 42km, and the islet itself was located at a distance of some 25 km from Cyprus (see Section I; Fig. 1). Both of these distances are obviously too long for a swimming wild boar (a maximum distance would be 10 km; see Vigne in this issue). Taking into account the very low probability for a natural colonization of the island, intentional human introduction appears to be the most parsimonious explanation (Vigne *et al.*, 2009, 2011a). This means that, during the Late Natufian/Epipaleolithic, somewhere on the adjacent mainland, people were controlling wild boars well enough to transport them overseas, that the island was more intensively frequented at that time than is suggested by the small number of known sites (see Ammermanin this issue), and that a fairly abundant and even attractive animal food was available on Cyprus already in the time of the Younger Dryas.

THE FIRST NEOLITHIC WAVE: KLIMONAS AND ASPROKREMNOS, TWO LATE PPNA VILLAGES

For a long time, there was no evidence for the presence of people on Cyprus or of the mammal fauna living there over the next 2,000 years: that is, until the earliest deposits at Shillourokambos and Mylouthkia, dating respectively to [10,343-10,297] cal. BP (12 charcoal dates; Guilaine *et al.*, 2011) and [10,696-10,253] cal. BP (6 charcoal dates; Peltenburg, 2003). However, in 2003, we discovered the site of Ayios Tychonas-*Throumbovounos*, with a lithic assemblage of Khiamian tradition; its chipped stone tools have close parallels with Mureybet II. Unfortunately, no bones or other organic materials suitable for radiometric dating could be found (Briois *et al.*, 2005; Guilaine and Briois, 2007). At the same time, McCartney and co-workers (2007, 2008) discovered another site in the PPNA tradition, Agia Varvara-*Asprokremnos,* which could be dated to [10,846-10,675] cal. BP (3 AMS dates of high quality; Manning *et al*., 2010; see now Manning in the next issue). The last excavation seasons brought to light the presence of a semi-embedded house (McCartney *et al.*, 2009, 2010). Unfortunately, animal bones at the site are poorly preserved. P. Croft (in McCartney, 2008; and personal communication) has been able to identify only about 300 specimens so far: 93.6 percent suids, 6 percent birds and less than 1 percent freshwater tortoise (*Mauremys* cf. *rivulata*).

Starting in 2009, the excavations conducted at the settlement of Klimonas produced much more abundant archaeozoological evidence (Vigne *et al.*, 2011b, 2012). The presence of a shaft straightener, and the lithic industry – with unidirectional blade debitage, with a high proportion of burins as well as the presence of small arrowheads with a short tang – point to the PPNA tradition. Eleven radiocarbon dates confirm that the site was occupied between [10,800-10,600] cal. BP. The architecture at Klimonas includes a large circular building with a 10 m diameter, which is semi embedded in the ground. It shows similarities with the community structures placed in the centre of a number of Late PPNA villages on the mainland such as Tell Abr' (Yartah, 2004, 2005), Jerf El Ahrmar and Mureybet (Stordeur and Abbes, 2002; Stordeur, 2006, 2012) in Syria, Qermez Dere in Iraq (Watkins *et al.*, 1989), and Wady Faynan 16 in Jordan (Mithen *et al.*, 2011). Above and besides this building were found the remains of what appear to be a domestic structure, which probably correspond with the houses of the village around the communal building. Botanical remains indicate that emmer wheat (brought over from the mainland) and perhaps barley were cultivated. In short, Klimonas is definitely a Late PPNA village of hunter-cultivators already settled on Cyprus as early as the first half of the 11th millennium cal. BP.

Among the 2,977 identified animal-bone specimens, 94.6 percent belong to *Sus scrofa* (Table 1). The preliminary age profile suggests hunting or control in the wild rather than husbandry. The initial osteometric study indicates that both dental and post-cranial measurements are 13 to 16 percent smaller than the ones of the Levantine Natufian and PPNA wild boars. They are the same size as those found at Aetokremnos (Vigne *et al.*, 2012). These data confirm that a small insular wild boar was living on Cyprus at least from 12,500 to 10,500 cal. BP. And at that time, it was the only ungulate on the island.

The other identified bones comprise 2.4 percent of medium size birds, 1.1 percent of domestic dog (*Canis familiaris*; the same size as the ones of the PPNA on the mainland) which lived in the village (based on the presence of digested and gnawed bones) and 28 remains of smaller carnivores. Except for one cat phalanx (*Felis silvestris* cf. *lybica*), most of the latter are quite small in size (comparable to the bones of a fox or cat). They may represent the remains the endemic genet (*Genet plesictoides*), but no specimen allows us to confirm this hypothesis at the present time. Mouse is also attested by 8 specimens, some of which are probably *Mus cypriacus* (Cucchi, unpublished), but the presence of *M. m. domesticus* cannot be ruled out at this stage of the analysis. In addition,

NISP		2009 Sond. 168.3-5	2011 (without US10.1)	2012 Preliminary	Total 2009-2012	%
Fish	Teleostea		1		1	0,03
Fresh water tortoise	cf. *Mauremys rivulata*	1	5		6	0,2
Lizard	Sauria		9	1	10	0,3
Skink	cf. *Eumeces*		1		1	0,03
Snake	Ophidia			3	3	0,1
Bird	Aves	11	32	29	72	2,4
Mouse	*Mus* sp.	0	2	6	8	0,3
Small carnivore	Felidae/Viveridae	2	20	5	27	0,9
Cat	*Felis s. lybica*		1		1	0,03
Domestic dog	*Canis familiaris*	2	23	8	33	1,1
Wild boar	*Sus scrofa* ssp.	223	1385	1207	2815	94,6
Total identified		239	1479	1259	2977	100,0
Unidentified (2011: subsample)		384	3390	3628	7402	
% unidentified (2011: subsample)		61,6	78,8	74,2	71,3	

Table 1. Preliminary faunal spectrum of the vertebrates in the PPNA layers of Klimonas

there are small numbers of remains of fresh water tortoise, lizards and snakes, and, surprisingly, only one fish vertebra (grouper; cf. *Epinephelus*), even though the site is located only 2 km from the coastline today.

The Klimonas villagers (much like those who lived in Asprokremnos) were the cultivators of wheat and the hunters of wild boar. Whether or not they had brought domestic dogs to the island recently is still an open question, since dogs already could have been introduced on Cyprus at the time when Aetokremnos was frequented. The presence of cat now means that this species was introduced by the early years of the 11th millennium cal. BP: that is, several centuries before its earliest occurrence at Shillourokambos (Vigne, 2011a). Some marks of rodent gnawing on the bones demonstrate that mice, either the endemic *M. cypriacus* or already the commensal *M. m. domesticus*, were living in the village, and they were potentially pests for the cereal stocks. This strengthens the hypothesis that cats could have been introduced to the island for fighting pest rodents (Vigne *et al.*, 2004; Vigne and Guilaine, 2004), that cat domestication begun much earlier than we suspected before, and that it was closely connected with the onset of the cultivation of annual plants (Vigne, 2012).

The data from Klimonas show that, in accordance to the general pattern of the large "true" Mediterranean islands (see Vigne in this issue), the beginning of the Neolithic on Cyprus (PPNA) entailed an increase in the introduction of new mammal species (Fig. 2) – with a global rate in the range of 1.5 and 2 species per 1,000 years for the span of time between 12,500 to 10,500 BP.

EARLY DOMESTICATES, COMMENSAL AND CONTROLLED WILD SPECIES: MYLOUTHKIA AND SHILLOUROKAMBOS PPNB VILLAGES

The first step of the Cypro-PPNB, which runs more or less parallel in time with the Early PPNB on the mainland, is represented by one well in Kissonerga-*Mylouthkhia* (Pertenburg *et al.,* 2001; Peltenburg, 2003) and by 3 wells, a series of pits (including post holes) and a number of horizonal stratigraphic units at Parekklisha-*Shillourokambos* (Guilaine *et al.*, 2011). They are respectively dated to [10,696-10,253] cal. BP (3 charcoal dates) and to [10,343-10,297] BP (12 charcoal dates), which means that they have calibrated ages not significantly different from one another. In well 116 at Mylouthkia, Croft (in Peltenburgh *et al.*, 2001) identified 12 wild boar and 7 goat specimens (*Capra* sp.), and Cucchi *et al.* (2002) documented the earliest evidence for the house mouse (*M. m. domesticus*) on Cyprus, together with the endemic mouse, *M. cypriacus*, and also some lizards bones (Bailon, forthcoming). At Shillourokambos, where the small vertebrates are no well preserved, we found 282 large mammal specimens. In addition to the suids (comprising 87 percent of the NISP), dogs and cats were still present in small quantities, and we recorded the arrival of a domestic goat (slightly smaller in size than the wild ones in the Taurus; Vigne, 2011b) and early domestic cattle (Vigne, 2011c), both of them having recently become domestic taxa (i.e., morphologically modified due to domestication; Vigne, 2011d). This means at least two or even three (with mice) new introductions to the island's fauna or a total of five introductions for the 11th millennium (equivalent to 5 per 1,000 years).

The rate of introduction continued to increase during the first half of the 10th millennium, with the new introduction of two wild animals, fox (*Vulpes vulpes*) and the Persian fallow deer (*Dama d. mesopotamica*), and one new domestic taxon, sheep (*Ovis aries*), plus perhaps a new domestic lineage of pigs (Fig. 2). This now makes two or three additional taxa introduced over a span of 500 years: that is, an even higher rate of 6-8 species per 1,000 years.

By around 9,200 BP, the Neolithic mammalian terrestrial fauna on Cyprus had become well established. Except for the extinction of cattle on the island in the years between 9,000 and 8,500 BP (compare Davis, 2003 and Simmons, 2012; Vigne, 2011c), its composition would not really vary that much over the course of the next 4,000 years. Does this mean that the transportation of animals to the island slowed down or even stopped during this long period of time? Or is it due to the fact that the island's fauna had now become more or less saturated (see Vigne in this issue), and Cyprus could not go on accepting new species?

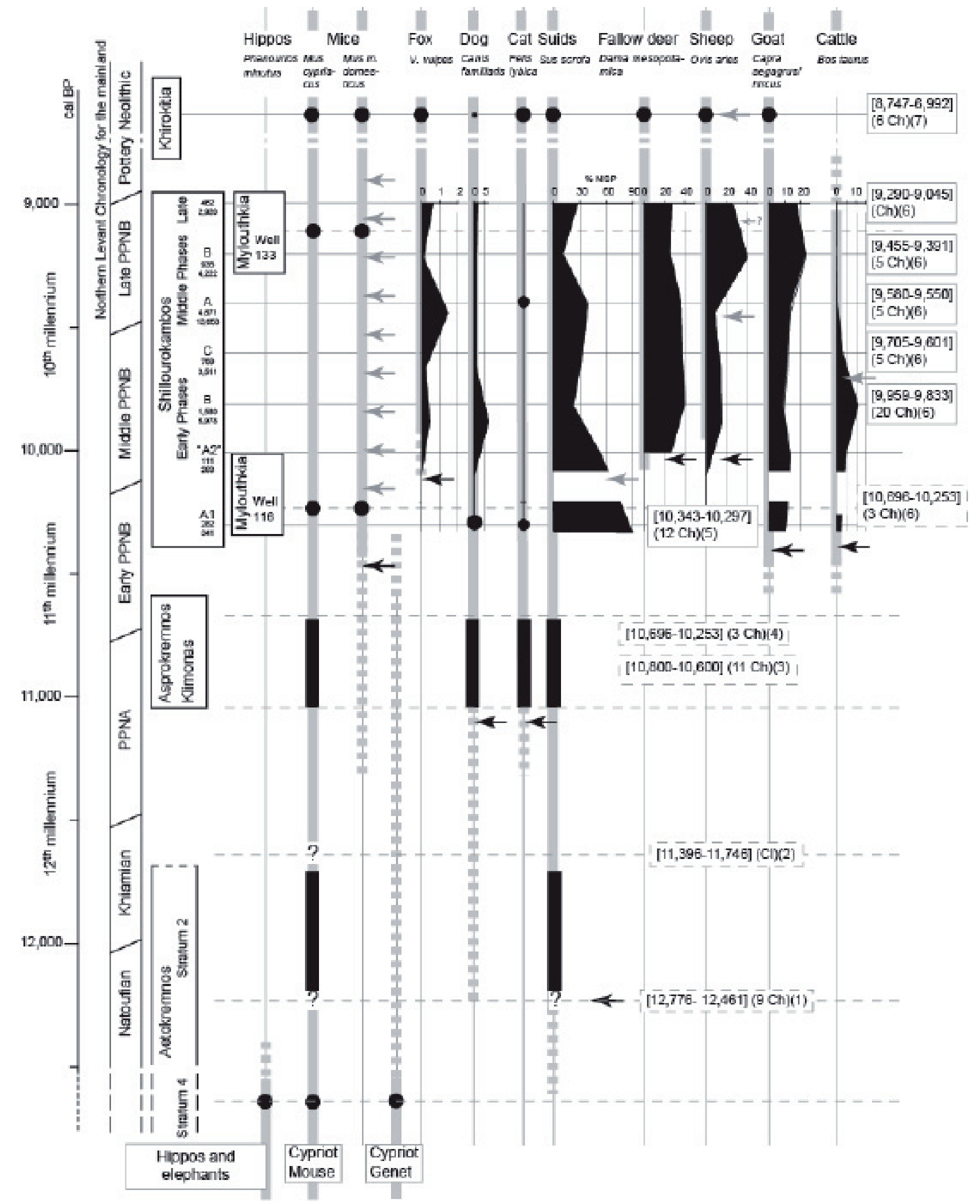

Fig. 2. Evolution of large mammals on Cyprus during the time of their introduction on the island, with a particular focus on the data from Shillourokambos

The chronocultural frame is that proposed by Hours *et al.* (1994). Radiocarbon dates are given in cal. BP and calibrated at 1σ (Calib Rev 5.0; *Reimer et al.*, 2004). For each chronological phase of Shillourokambos, a box on the left-hand side contains the following information: the total number of identified specimens (NISP) and the NISP of large mammals. On the right-hand site, boxes give information about the radiocarbon dating of each phase: the material dated (*Ch* p charcoal; *Cl* p bone collagen), and a reference (*1*, Simmons, 1999 [only the nine charcoal dates]; *2*, Vigne *et al*., 2009; *3*, Vigne *et al*., 2012; *4*, Manning *et al*., 2010; *5*, Peltenburg *et al*., 2001; Peltenburg, 2003; *6*, Guilaine, 2003; Guilaine *et al*., 2011; *7*, Le Brun and Daune-Le Brun, 2003 [Khirokitia, earliest level, G]). The Middle A1 and A2 phases of Shillourokambos are grouped together. Black arrows indicate the earliest evidence for the arrival of new species to Cyprus. Grey arrows indicate the probable introduction of new lineages of domestic or commensal animals to Shillourokambos and Khirokitia. Updated after Vigne *et al*. (2011b)

This question cannot be definitely resolved, since, in spite of several good assemblages (e.g., Croft, 1991, 2008), we are still lacking substantial data for the period between the Khirokitian phase and the Chalcolithic. It does not appear that the mammal fauna was completely saturated, since new taxa still colonized the island during the last three millennia (*Hemiechinus, Suncus, Lepus, Mustela*, at least; Vigne, 1999), perhaps because of the evolution of the Cypriot landscapes due to human activities (more open vegetation). Conversely, several more or less questionable lines of evidence from Mylouthkia and Shillourokambos suggest that the transportation of animals from the mainland to Cyprus may still have been relatively intense during the 10th millennium and perhaps continued even in the 9th millennium BP.

The best of evidence comes from the remarkable stability of the dental morphology of the domestic mice (*Mus m. domesticus*) during the 10th and 9th millennia, when it should have diversified quite rapidly, if the gene flow from the continent had been suddenly stopped or else notably slowed down. Based on modern data about the speed of morphological drift in isolated populations of this species, the implication is that, during that time, there were at least two successful arrivals on the island by new mice individuals per year in the Cypriot population (Vigne and Cucchi, 2005; Cucchi and Vigne, 2006; Cucchi *et al.*, 2012). According to the low probability of success of such migrations, this suggests rather high boat traffic between the mainland and Cyprus. Large mammal transportation is also suggested, admittedly less convincingly, by the arrival of new lineages of domestic species at Shillourokambos during the second half of the 10th millennium (Fig. 2): smaller domestic pigs, larger sheep probably coming from Syria, which may have replaced the preceding lineages (the herding of which may well have failed; Vigne *et al.*, 2011a), larger and less modified domestic cattle (also seen at Ais Yorkis), which slightly re-stimulated cattle husbandry before it finally stopped (Vigne, 2009, 2011c; Vigne *et al.*, 2011a).

If we trust such evidence for on-going introductions and make the working hypothesis that all of them come from the continent (and not from another Cypriot site), this would make 2-3 introductions for 500 years or a rate of around 4-6 per 1,000 years, which is still much higher than a natural immigration rate (less than one per 10,000 years; Vigne, 1999).

DISCUSSION: INTERPRETATION OF THE CYRIOT SCENARIO IN TERMS OF EARLY VOYAGING

Immigration rate and the intensity of voyaging

Table 2 and Fig. 3 give an overview on the increase in the immigration rate for the Cypriot non-flying terrestrial mammals from the Upper Pleistocene to the end of the 10th millennium BP. It regularly increased from 1 to 8 immigrations/1,000 years, then slightly decreased, due either to a saturation of the eco-anthropological niches or to a slowing down of the transportation/voyaging.

The phase of increase appears to begin in the 13th millennium BP – with a rate more than ten times higher than the natural one. This may be considered as a statistical bias, since we compare here the average for the 120,000 years duration of the Upper Pleistocene with a sole immigration (wild boar) during the 13th millennium. However, as we can demonstrate on the basis of paleogeographic reconstructions and the limited capability of wild boars for swimming, this immigration comprises an anthropogenic introduction, and it is reasonable to identify this time as the onset of the wave of introduction: that is, before the PPNA and even before the beginning of the Holocene. This early starting time for the introduction wave, which is contemporary with the climatic event known as the Younger Dryas, is probably due to the fact that Cyprus was at that time already part of the Near East cultural area, which was then taking its very first steps towards the Neolithic transition.

The increase of the immigration rate during the 12th through the 10th millennia cal. BP (PPNA to the Middle PPNB) involves both large and small species of all kinds. Therefore, it does not seem to reflect an improvement in maritime technology or an increase of the intensity of voyaging. It is more likely to be the consequence of the development of animal domestication and husbandry on the mainland, which produced more and more controlled or domestic populations of

Millennia cal BP	New species	New lineage	Total	Rate/10 kyrs
Upper Pleist.				0.42
13th Millen.	1		1	10
12th Millen.	2		2	20
11th Millen.	3		3	30
10th first half	3	1	4	80
10th sec. half		3	3	60

Table 2. Minimal rate of immigration to Cyprus of species and possible new lineages of domesticates, from the Upper Pleistocene, to the end of the Late PPNB (updated after Vigne, 1999). Permanent mice flow (at least two fertile individual per year) is not taken into account

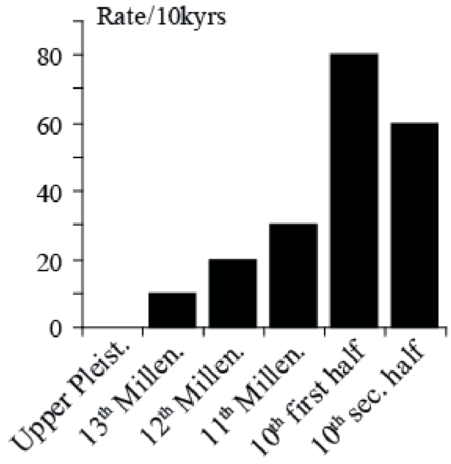

Fig. 3. Graphic representation of Table 2

a range of mammals, which, in turn, were now ready for transportation to Cyprus.

In any event, these data suggest that, at least starting around 10,500 cal. BP, voyaging to Cyprus was now intense enough in terms of the successful introduction of new wild or domestic lineages to avoid any morphological drift, as documented in the case of the house mouse populations on the island. The minimum number of two successful introductions of mice per year implies a much higher number of crossings each year than previously envisioned, since not all of the individuals setting foot on Cyprus actually contributed their genes to the gene pools of the populations living on the island.

Specialized voyager populations

Such a high rate implies that the voyagers themselves had developed considerable experience over the years. In short, they knew well the routes, the currents, the landing places, and probably many coastal landmarks (and perhaps they were starting to learn how to read the sky and the stars). All of this was only possible if sea-going knowledge and know-how were transmitted from generation to generation: that is, if some human groups were already starting to become specialized in voyaging and in exploiting what the sea has to offer.

This working hypothesis of special coastal populations – or alternatively a smaller groups of people within a given population – capable of playing the leading role in the crossings between Cyprus and the mainland, has already been formulated by Ammerman (2010) and also by Desse and Desse-Berset (2011:844), based on the very low diversity in the fish observed at Shillourokambos, where one finds almost exclusively large groupers. The specialisation of groups of seafarers is also suggested, on the flip side, by the almost complete absence of fish at Klimonas, which is located, as mentioned before, just 2 km from the coastline. Therefore, the argument can be made that such coast-oriented groups appear to have already existed at an early date. And the clear-cut differences that one observes between Khirokitia, where fish is rare, and Cape Andreas Kastros, where seafood remains are abundant and diversified (Desse and Desse-Berset, 2011), indicate that it lasted well into the 9th millennium. Perhaps sites such as Aetokremnos, Akanthou (Şevketoğlu, 2006; and personal communication), Aspros and Nissi Beach (Ammerman *et al.*, 2006, 2008), which all have a more coastal character than the sites that we focus on in this chapter and which provide, at least in the first two cases, good and diversified seafood evidence, were either the campsites or later the settlements of those who engaged in the special activity of voyaging.

What kind of boat?

The earliest known crafts that could have sailed in the Mediterranean Sea are, of course, much more recent than that time that we are dealing with. However, since they may help us in working out what is appropriate and what is not in our attempting to piece together a reconstruction of PPN boats, it is useful to take them into consideration.

The earliest known Mediterranean craft is the dugout canoe recovered at “La Marmotta” in Italy, and it dates to the first half of the 8th millennium BP. Its remains were recovered in good condition from the bottom of Lake Bracciano (north of Rome) in the context of material culture that belongs to a Tyrrhenian Cardial site (Fugazzola Delpino *et al.*, 1993). The hull of dugout canoe, which measure 10.5 m in length and just over 0.55 m in height, is reinforced with ribs (also known as "floors"). Its top edges have been heightened by gunwales, assembled with tongs and mortises. A notch in the wood of the hull is interpreted as a mast sink, and stones in the canoe may have served as ballast (Fugazzola Delpino and Mineo, 1995). They suggest the use of a pendulum to sail the boat (see the experimental vessel made by Tichý, 1999:198). Although use of the boat at sea has not been formally demonstrated, a modern reconstitution of the La Marmotta vessel (with a length of just over 9 m), experimentally navigated some 800 km along the coasts from Italy to Portugal propelled by a team of rowers.

It should be mentioned that very different types of boats were used more or less at the same time in the Persian Gulf. The site called H3 at As-Sabiyah (Kuwait), dated to the late 8th millennium BP (Ubaid 2/3), produced a 15 cm long ceramic model of a reed-bundle boat, together with a painted disc depicting a sailing boat with two footed mats and a series of 50 pieces of bituminous amalgam representing fragments of reed-bundle boats coated with bitumen (Carter, 2006; Guerrero Ayuso, 2007). Conversely, one of us (Guilaine, 2011:1205) has proposed that the boats of the middle and recent phases of Shillourokambos (9,500-9,000 BP) could have been more similar to small boats than to dugout canoes, based on two small models in picrolite.

However, it seems to be that the evidence for boats in the Mediterranean world more recent than the La Marmota vessel follows the same archetype (Guerrero Ayuso, 2006; Vigne, 2009). This is the case for the boat recovered from Despilio Lake in Thessaly, which is dated to the late 8th millennium BP, and the ceramic models found at Tsangli in Thessaly (Marangou, 2001, 2003). It is the same for the much more sophisticated Egyptian boats of the 6th millennium BP (Naqadian period), powered by rowers and equipped with a rudder, but more rarely sails. These “sewn” Egyptian burial boats were made out of wooden boards assembled with tongue and mortise and tied up by bonds made of plant fibers (Tristant, 2012). They probably sailed on the Nile, but they are only known through small-scale models, paintings or else engravings (Vigié, 1979; Pomey, 1997). It is possible that they were not very different from the boats found at Abydos (First Dynasty, ca. 5,000 BP), which were perhaps also used on the Red Sea (Ward, 2006). “Sewn” boats were also recently discovered in the Adriatic Sea, and dated to 2500-3000 cal. BP (Boetto and Rousse, 2012). Except for small scale models of boats or dugout canoes, sometimes found together, in the Balkan Neolithic (see drawings in Marangou, 1991, 2003; Guerrero Ayuso, 2006), the earliest evidence for ships that actually navigated in the Mediterranean propelled by paddles, are the carved representations seen on ceramics in Aegean Syros (Vigié, 1979; Pomey, 1997): the rostrum extending the bow and the heightened sternpost evoke the galleys of the archaic Greek world. The earliest known marine shipwreck occurs at Dokos (on the Gulf of Salamina), and it dates to the Early Helladic II period (ca. 4,200-4,150 BP; Vichos *et al.,* 1991). The next earliest wreck dates to the Bronze Age (ca. 3,300 BP). This is the famous Ulu Burun wreck (16 m long), recovered in deep water off the south coast of Turkey (Pulak and Rogers, 1994), in which mice were living (Cucchi, 2008). At Dokos, as in the case of Ulu Burun and Abydos as well, by the end of the 4th millennium, wrecks already show a sophisticated naval architecture, based on assembly with mortise and tongues, benefitting from a long technical experience.

This brief review of the scarce evidence pertaining to Neolithic and Bronze Age “naval architecture” provides a general frame of reference and emphasizes that we still know very little about the beginnings of naval architecture in the

Mediterranean world. In this context, though rough and questionable, the insights that can be gleaned in making inferences about the transportation of animals are welcome. What we plan to do here, in working out the main parameters of the boats that used for carrying animals to Cyprus, is to draw upon the quantitative information recorded by Tichý (1999) during the course of experimental voyages of the Monoxylon 2 expedition.

Space and load capacities. The transportation of 2-3 weaned calves (each one weighing 100-150 kg; see the estimations in Vigne, 2011c:1175-1176), for example, together with five rowers and their food supply would come to a maximum of 750 kg. Tichý mentions that even with a crew of ten rowers and a load of 100 kg of obsidian, a good deal of space was left in the 9 m long boat for 2 to 3 calves. Even the weight of one adult cow (at least 500 kg) could have been transported by such a boat, which can carry a load of more than 1000 kg under good sea conditions (Tichý, 1999). Accordingly, it would appear to be the case that the carrying capacity of the boat was not the limiting factor in the transportation of animals to Cyprus.

Speed. We have seen that, by around 10,500 BP, the effective distance between the nearest two points on the south coast of Anatolia and the north coast of Cyprus was at least 80-90km, without any stepping stone islet left on the Misis-Kyrenia ridge. This is far more than the maximal distance that Monoxylon 2 was ever able to cover in one full day lasting 14 hours (57 km from San Remo and Nice, using three different crews, which means an average rate of only 4 km per hour). Voyaging by night would have been far more risky. A voyage lasting two full days and the night between them would seem to be less than a promising proposition for the ruminants. Moreover, as we have discussed elsewhere (Vigne, 2009; Vigne in this issue), keeping the ruminants without movement for more than 3 or 4 hours would have entailed serious physiological disorders, lowering considerably the chance of the animals reached the island in good health.

The PPN voyagers would have had to increase the speed of the crossing by using the currents, starting from the Adana coastal plain coasts and landing on island's northern coast (Fig. 1). This hypothesis is strengthened, at least for the Middle and Late PPNB, by the Akanthou-Tatlısu site, where M. Şevketoğlu (personal communication) found many more obsidian bladelets than we did at the coeval southernmost Cypriot site of Shillourokambos (Guilaine and Briois, 2007). However, rowing together with drifting in a current moving at a rate of 1 km per hour would clearly not reduce the crossing to one of 3-4 hours. Sailing is not out of question even for such an early time, as suggested by the boats found at La Marmota and As-Sabiyah, which both date to the 8th millennium BP. However, the speed under sail being hardly more than 7-8 km per hour (or 4 knots), it would not be possible to shorten the crossing to less than 10-12 hours. Under such circumstances, the PPN voyagers certainly did not transport the ruminants laying bound on the bottom of the boat; they had to make the voyage standing up.

Superstructures. The main implication that emerges from all of this is that the boat needed for such a crossing was definitely not a simple dugout canoe. In short, we have to think in terms of boats that are larger and also more complex in character. And there is another line of evidence that encourages us to move in this direction. A small boat is not really compatible with transportation of small rodents, which would not have escaped very often the attention of those voyaging in the open space of a dugout canoe. Small stowaways need nooks and crannies for travelling quietly and unobserved. Thus, it is necessary for us to think in terms of more advanced and sophisticated kinds of boats: in short, a vessel fitted with a deck and also some sort of device for fixing a mast and handling a sail.

Synthesis. If we accept the idea that the archetype of the earliest boat in the Mediterranean was more or less a dugout canoe, then boats of this modest kind (or even reed-bundle boats) could have been used for introducing the wild boar to the island shortly before 12,500 cal. BC. Voyaging to Cyprus at that time could have been facilitated by the stepping-stone islet off Cape Andreas-Kastros. In effect, young weaned wild boars would have been easy to transport in a dugout canoe. Because they are not ruminants, they do not develop serious pathologies when they are bound and lie on the bottom of a boat for several hours, and, on the positive side, they happen to be the most prolific ungulate for stocking an island with large game. However, starting around 10,500 cal. BP (now surely without the stepping-stone islet and with an ever larger distances to cross between the mainland and Cyprus due to the marine transgression), the introduction of domestic mice, goat and cattle (Fig. 4), which took place around the same time, and then the arrival of Persian fallow deer and also sheep some two to five centuries later, must have required more sophisticated boats with sails – ones now large enough to transport standing animals. Use could have been made of some kind of wooden assemblage (Fig. 4): that is, any one of several possible technical solutions based on putting together two or more dugout canoes in various configurations, as we know from the ones built and sailed in protohistorical and historical times in Southern Europe and in South India (Pomey, 2012). In no way, however, could this have been accomplished by employing a reed-bundle boat, which would not have been stiff enough for transporting large animals (even young individuals). In other words, such transportation called for a larger and more rigid boat.

However, the arrival of the first domesticates on the island at about 10,400/10,300 cal. BP should not necessarily be taken as the starting point for more advance boat architecture: it is conversely the direct consequence of the first appearance of domesticates on the mainland, which took place just at that time (Peters *et al.*, 2005). Thus, it is not impossible that vessels of this kind had already come into existence. The recent discovery of two more or less contemporary villages of PPNA cultivators on Cyprus suggests such boats, in one form or another, may even go back to around 11,000 BP.

CONCLUSION

The vast amount of new data that have come in over the last three decades not only extend the duration of the prehistory of Cyprus by more than four millennia, but also turn upside down our perception of the history of early voyaging in the Eastern Mediterranean. More than just the movement of people or the circulation of obsidian, which could have been achieved by means of simpler boats (such as dugout canoes) and less developed navigation skills, the increasing transportation of new mammal species to the island, starting from 12,500 BP, followed then by the on-going introduction of new lineages of domesticated animals probably coming from the mainland, provide more precise evidence, even though it is still of an indirect nature, in favour of sophisticated boats and good navigational skills.

Observations deduced from the scenario of introduction of these new mammals, but also from the existence of two kinds of sites, with and without the diversified use of seafood, suggest the existence of specialised voyagers human groups who lived separately from the main populations of villagers during the PPNA and PPNB on Cyprus. This is obvious for the PPNA time, starting on Cyprus from ca. 11,000 cal. BP given the present state of knowledge, but it could even go back to the beginnings of the island's prehistory, which now take us back at least to 12,500 BP. Over the course of many generation, such groups had acquired a good deal of navigation experience, which included such things as winds, currents, landmarks, landing places and possibly even reading the stars.

The absence of evolutionary drift as seen in the case of the domestic mouse in the years between 10,500 and 9,000 BP provides unique but strong evidence during the PPNB period for at least two successful crossings each year, and in all likelihood many more voyages than this (perhaps even ten or more trips in a given year). At the same time, the transportation of large ruminants, though admittedly young but necessarily weaned (that is, more than 7-8 months old and surely weighing more than 100-150 kg), offers unique but clear evidence that the boats had to move fast enough to make the crossing from the mainland to Cyprus within a span of about 10 hours. Moreover, the boats had to be large enough, as we have argued, to carry the animal or animals in a standing position. This excludes the use of a simple dugout canoe for a voyage of this kind. This indicates that the voyagers were able to built large composite boats: most probably out of wood, perhaps by putting together two or more dugouts (by making use of the tongue and mortise technique) and then tying wooden boards on top of them (by means of strips of hide or

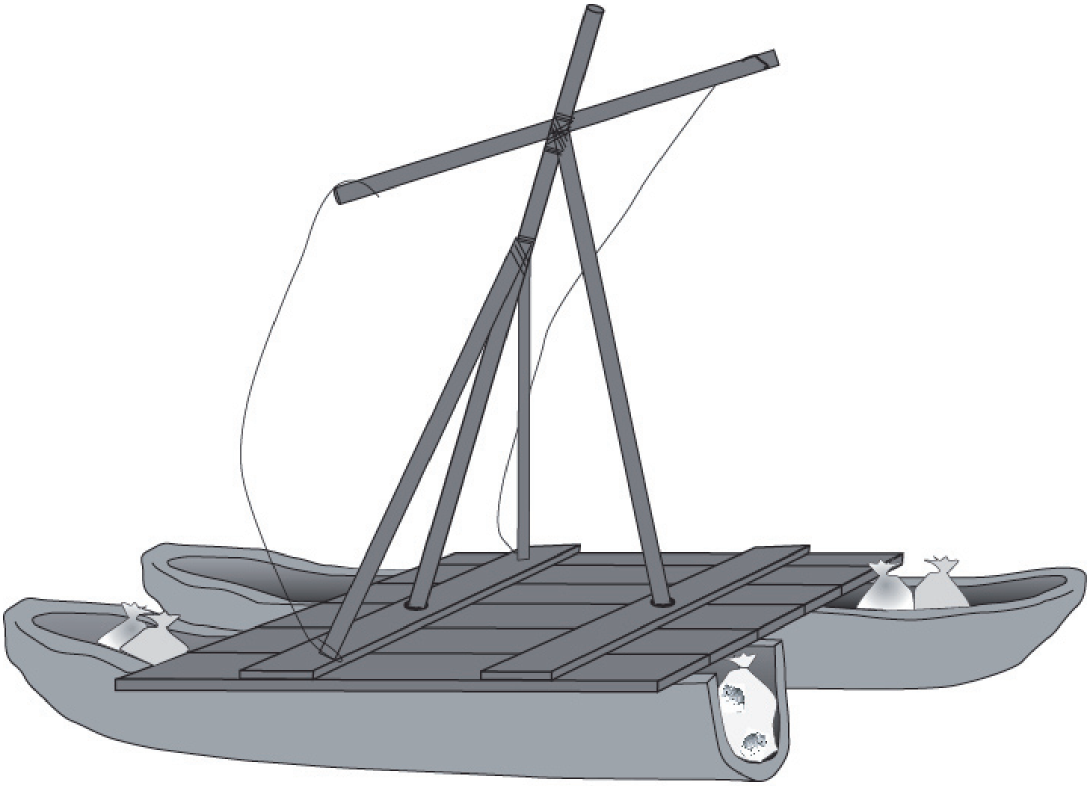

Fig. 4. Attempt at reconstructing a PPN vessels which crossed from the mainland to Cyprus with the help of wind and currents, based on bringing together two or more deep dugout canoes similar to the one at La Marmotta. After Vigne 2009

other fabrics that are available and then caulking them with grease). Why should a boat-building technology of this kind be so surprising for those who were quite capable of dig deep wells in hard rock formations without the use of metal tools (including wells that are 7 m deep at Mylouthkia and Shillourokambos; Peltenburg, 2003; Guilaine *et al.,* 2011), of domesticating aurochs where each adult animal weighs more than 800 kg, and of building remarkable monuments of the kind that have recently come to light at Göbeckli?

Before 10,500 cal. BP, on the basis of the present state of knowledge, the introduction of mammals to Cyprus was limited to the wild boar, whose introduction probably took place shortly before 12,500 BP. This introduction would have called for no more than the use of basic dugout canoes. What happened between 12,500 and 11,000 BP is still unknown; there is currently no archaeozoological evidence on Cyprus for these years. In light of what we do know today, it is reasonable to think that people did not introduce any new mammal during this interval of time, since the remains of such an animal are not seen at either Klimonas or Asprokremnos, where the main source of meat was still wild boar, which was apparently quite abundant on the island. In addition, it is worth recalling that early domestic ungulates had not yet made their appearance on the mainland, so we should not expect to find them on the island at this time. Further work in the field is, of course, called in order to fill in this gap. Hopefully, the continuation of the investigation at Asprokremnos and Klimonas will produce new and earlier evidence on the introduction of cereals, legumes, mice and cats as well.

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REFERENCES

AKSU A.E., CALON T.J., HALL J., MANSFIELD S., YAŞAR D. 2005. The Cilicia-Adana basin complex, Eastern Mediterranean: Neogene evolution of an active fore-arc basin in an obliquely convergent margin. *Marine Geology* 221(1-4), 121–159.

AMMERMAN A.J. 2010. The first Argonauts: towards the study of the earliest seafaring in the Mediterranean. In: A. Anderson, J. Barrett, K. Boyle (eds.) *Global Origins and Development of Seafaring*. McDonald Institute, Cambridge, 81–92.

AMMERMAN A.J., FLOURENTZOS P., SMADAR GABRIELI R., HIGHAM T., MCCARTNEY C., TURNBULL T. 2008. Third report on early sites on Cyprus. *Report of the Department of Antiquities, Cyprus* 2008, 1–32.

AMMERMAN A.J., FLOURENTZOS P., MCCARTNEY C., NOLLER J.S., SORABJI D. 2006. Two new early sites on Cyprus. *Report of the Department of Antiquities, Cyprus* 2007, 1–22.

AMMERMAN A.J., NOLLER J.S. 2005. New light on Aetokremnos. *World Archaeology* 37(4), 533–543.

BINFORD L. 2000. Review of *Faunal extinctions in an island society: pygmy hippopotamus hunters of Cyprus*, by Alan H. Simmons. *American Antiquity* 65(4), 771.

BOEKSCHOTEN G.J., SONDAAR P.Y. 1972. On the fossil mammalia of Cyprus. *Proceedings of the Koninklijke Nederlandse Akademie van Wetenschappen , Serie B* 75, 306–308.

BOETTO G., ROUSSE C. 2012. Traditions régionales d'architecture navale en Adriatique à l'époque romaine. *Histria Antiqua* 21, 427-441.

BRIOIS F., PETIT-AUPERT C., PÉCHOUX P., 2005. *Histoire des campagnes d'Amathonte. I. L'occupation du sol au Néolithique*. École Française d'Athènes, Athens (*Etudes Chypriotes* 16).

BUNIMOVICH S., BARKAI R., 1996. Ancient bones and modern myths: ninth millennium BC hippopotamus hunters at Akrotiri *Aetokremnos*. Cyprus. *Journal of Mediterranean Archaeology* 9(1), 85–96.

CARTER R. 2006. Boat remains and maritime trade in the Persian Gulf during the sixth and fifth millennia BC. *Antiquity* 80, 52–63.

CALON T.J., AKSU A.E., HALL J. 2005. The Neogene evolution of the Outer Latakia Basin and its extension into the Eastern Mesaoria Basin (Cyprus), Eastern Mediterranean. *Marine Geology* 221(1-4), 61–94.

CROFT P. 1991. Man an Beast in Chalcolithic Cyprus. *Bulletin of the American Schools of Oriental Research* 282(3), 63–79.

CROFT P. 2008. Animal remains from Paralimni-Nissia. In: P. Flourentzos (ed.) *The Neolithic settlement of Paralimni*. Department of Antiquities, Cyprus, Nicosia, 102–118.

CUCCHI T. 2008. Uluburun shipwreck stowaway house mouse: molar shape analysis and indirect clues about the vessel's last journey. *Journal of Archaeological Science* 35, 2953–2959.

CUCCHI T., VIGNE, J.-D. 2006. Origin and diffusion of the house mouse in the Mediterranean. *Human Evolution* 21(2), 95–106.

CUCCHI T., VIGNE J.-D., AUFFRAY J.-C., CROFT P., PELTENBURG E. 2002. Introduction involontaire de la souris domestique *(Mus musculus domesticus)* à Chypre dès le Néolithique précéramique ancien (fin IX^{e} et VIII^{e} millénaires av. J.-C.). *Comptes Rendus Palevol* 1, 235–241.

CUCCHI T., ORTH A., AUFFRAY J.-C., RENAUD S., FABRE L., CATALAN J., HADJISTERKOTIS E., BONHOMME F., VIGNE J.-D. 2006. A new endemic species of the subgenus *Mus* (Rodentia, Mammalia) on the Island of Cyprus. *Zootaxa* 261, 1–36.

CUCCHI T., AUFFRAY J.-C., VIGNE J.-D. 2012. On the origin of the house mouse synanthropy and dispersal in the Near East and Europe: zooarchaeological review and perspectives. In: M. Macholán, S.J.E. Baird, P. Munclinger, J. Piálek (eds.) *Evolution of the House Mouse*. University Press, Cambridge, 65–92.

DAVIS S.J.M. 1984. Khirokitia and its mammal remains. A Neolilhic Noah's ark. In: A. Le Brun (ed.) *Fouilles récentes à Khirokitia (Chypre) 1977-1981*. ADPF-Edition. Recherches sur les Civilisations, Paris, 147–162.

DAVIS S.J.M. 2003. The zooarchaeology of Khirokitia (Neolithic. Cyprus), including a view from the mainland. In: J. Guilaine, A. Le Brun (eds.) *Le Néolithique de Chypre*. Bulletin de Correspondance Hellénique Supplement 43, Athens, 253–268.

DESSE J., DESSE-BERSET N. 2011. Les poissons. In: J. Guilaine, F. Briois, J.-D. Vigne (eds.) *Shillourokambos. Un établissement néolithique pré-céramique à Chypre. Les fouilles du Secteur 1*. Editions Errance-Ecole Française d'Athènes, Paris, 835–846.

FUGAZZOLA-DELPINO M.A., D'EUGENIO G., PESSINA A. 1993. "La Marmotta" (Anguillara Sabazia, RM), Scavi 1989. Un abitato perilacustre di età neolitica. *Bullettino di Paletnologia Italiana* 84, 181–304.

FUGAZZOLA-DELPINO M.A, MINEO M. 1995. La piroga neolitica del lago di Bracciano (La Marmotta 1). *Bullettino di Paletnologia Italiana* 86, 197–266.

GEOLOGICAL SURVEY DEPARTMENT of the CYPRUS REPUBLIC. 2013. *Tectonic evolution* [Online]. Available at: http://www.moa.gov.cy/moa/gsd/gsd.nsf/dmlIntroduction_en/dmlIntroduction_en?OpenDocument [Access 28 February 2014].

GUERRERO AYUSO V.M. 2006. Comer antes que viajar. Pesca y barcas de base monóxila en la prehistoria occidental. *Mayurqa* 31, 7–56.

GUERRERO AYUSO V.M. 2007. Barcas de Ubaid. Navegaciones predinasticas en el Golfo Persico. *Complutum* 18, 61–78.

GUILAINE J. 2003. Parekklisha-*Shillourokambos*. Périodisation et aménagements domestiques. In: J. Guilaine, A. Le Brun (eds.) *Le Néolithique de Chypre*. Bulletin de Correspondance Hellénique Supplément 43, Athens, 3–14.

GUILAINE J. 2011. Productions artistiques et/ou symboliques du Néolithique pré-céramique: un colage idéologique et social? In: J. Guilaine, F. Briois, J.-D. Vigne (eds.) *Shillourokambos. Un établissement néolithique pré-céramique à Chypre. Les fouilles du Secteur 1*. Editions Errance-Ecole Française d'Athènes, Paris, 1195–1210.

GUILAINE J., BRIOIS F. 2007. Shillourokambos and the neolithization of Cyprus: Some reflections. *Eurasian Prahistory* 4(1-2), 159–175.

GUILAINE J., BRIOIS F., VIGNE J.-D. (eds.). 2011. *Shillourokambos. Un établissement néolithique pré-céramique à Chypre. Les fouilles du Secteur 1*. Editions Errance-Ecole Française d' Athènes, Paris.

HALL J., CALON T.J., AKSU A.E., MEADE S.R. 2005. Structural evolution of the Latakia Ridge and Cyprus Basin at the front of the Cyprus Arc, Eastern Mediterranean Sea. *Marine Geology* 221(1-4), 261–297.

HELD S.O. 1989. Colonization cycles on Cyprus. 1: The biogeographic and palaeontological foundation of early prehistoric settlement. *Report of the Department of Antiquities, Cyprus* 1989, 1–28.

HENSON F.R.S., BROWNE R.V., McGINTY J. 1949. A synopsis of the stratigraphy and geological history of Cyprus. *Quarterly Journal of the Geological Society* 105, 1–40.

HOURS F., AURENCHE O., CAUVIN J., CAUVIN M.-C., COPELAND L., SANLAVILLE P. 1994. *Atlas des sites du Proche-Orient* (*ASPO*)*: 1400–5700 BP*. Maison de l'Orient Méditerranéen, Lyon (Travaux de la Maison de l'Orient 24).

LE BRUN A., CLUZAN S., DAVIS S.J.M., HANSEN J., RENAULT-MISKOVSKY J. 1987. Le Neolithique precerarnique de Chypre. *L'Anthropologie* 91(1), 283–316.

LE BRUN A., DAUNE LE BRUN O. 2003. Deux aspects du Néolithique pré-céramique récent de Chypre: Khirokitia et Cap Andréas-Kastros. In: J. Guilaine, A. Le Brun (eds.) *Le Néolithique de Chypre*. Bulletin de Correspondance Hellénique Supplément 43, Athens, 45–59.

LAMBECK K., PURCELL A. 2005. Sea-level change in the Mediterranean Sea since the LGM: model predictions for tectonically stable areas. *Quaternary Science Review* 24(18-19), 1969–1988.

MALANOTTE-RIZZOLI P, MANCA B.B., RIBERA D'ACALA M., THEOCHARIS A., BRENNER S., BUDILLON G., OZSOY E. 1999. The Eastern Mediterranean in the 80s and in the 90s: The big transition in the intermediate and deep circulations. *Dynamics of Atmospheres and Oceans* 29, 365–395.

MARANGOU C. 1991. Maquettes d'embarcations :

les débuts. *Aegaeum* 7, 22–49.

MARANGOU C. 2001. Neolithic watercraft: evidence from Northern Greek wetlands. In: B. Purdy (ed.) *Enduring records. The environmental and cultural Heritage of wetlands*. University Press, Oxford (Warp Occassional Paper, 15), 191–205.

MARANGOU C. 2003. Neolithic watercraft in Greece: Circumstantial evidence and serius guesses. In: C. Beltrame (ed.) *Boats, ships and shipyards. Conference Proceedings of the 9th International Symposium On Boat and Ship Archaeology, Venice, 2000*. Oxbow Books, Oxford, 14–18.

MCCARTNEY C., MANNING S.W., SEWELL D., STEWART S.T. 2007. The EENC 2006 field season: Excavations at Agia Varvara-Asprokremnos and survey of the local early Holocene landscape. *Report of the Department of Antiquities Cyprus* 2007, 27–44.

MCCARTNEY C., MANNING S.W., ROSENDAHL S., STEWART S.T. 2008. Elaborating Early Neolithic Cyprus (EENC). Preliminary report on the 2007 field season: Excavations and regional field survey at Agia Varvara-Asprokremnos. *Report of the Department of Antiquities Cyprus* 2008, 67–86.

MCCARTNEY C., CROFT P., MANNING S.W., ROSENDAHL S. 2009. Preliminary report on the 2008 EENC. Excavation at Agia Varvara-Asprokremnos and regional field survey. *Report of the Department of Antiquities Cyprus* 2009, 1–16.

MCCARTNEY C., MANNING S.W., STEWART S.T. 2010. Agia Varvara-Asprokremnos 2009: Excavations, radio-carbon dating and geo-chemical analyses of chert sources *Report of the Department of Antiquities Cyprus* 2010, 77–94.

MANNING S.W., MCCARTNEY C., KROMER, B., STEWART S.T. 2010. The earlier Neolithic in Cyprus: recognition and dating of a Pre-Pottery Neolithic A occupation. *Antiquity* 84, 693–706.

MITHEN S.J., FINLAYSON B., SMITH S., JENKINS E., NAJJAR M., MARIČEVIČ D. 2011. An 11 600 year-old communal structure from the Neolithic of southern Jordan. *Antiquity* 85, 350–364.

OLSEN S. 1999. Investigation of the *Phanourios* bones for evidence of cultural modification. In: A. Simmons (ed.) *Faunal extinction in an island society*. Kluwer Academic-Plenum Publications, New York-Boston-Dordrecht-London-Moscow, 230–239.

OKYAR M., ERGIN M., EVANS G., 2005. Seismic stratigraphy of Late Quaternary sediments of western Mersin Bay shelf, (NE Mediterranean Sea). *Marine Geology* 220(1-4), 113–130.

PELTENBURG E. (ed.) 2003. *The colonisation and settlement of Cyprus. Investigations at Kissonerga-*Mylouthkia *(1976-1996)*. Studies in Mediterranean Archaeology, P. Aströms Forlag, Sävedalen.

PELTENBURG E., COLLEDGE S., CROFT P., JACKSON A., MCCARTNEY C., MURRAY M.A. 2001. Well-established colonists: Mylouthkia 1 and the cypro-pottery Neolithic B. In: S. Swiny (ed.) *The earliest prehistory of Cyprus: from colonization to exploitation*. American Schools of Oriental Research, Boston, 61–93.

PETERS A., VON DEN DRIESCH D., HELMER D. 2005. The upper Euphrates-Tigris basin: Cradle of agropastoralism? In: J.-D. Vigne, J. Peters, D. Helmer (eds.) *First steps of animal domestication. New archaeozoological approaches*. Oxbow Books, Oxford, 96–124.

POMEY P. (ed.). 1997. *La navigation dans l'antiquité*. Edisud, Aix-en-Provence.

POMEY P. 2012. A propos des navires de la Mer Erythrée : découvertes récentes et nouveaux aspects de la question. *Topoy* Suppl. 11, in press.

POULAIN P.-M. n.d. *Surface Circulation in the Northeastern Mediterranean (NEMED)* [Online], 1-6. Available at: http://www.onr.navy.mil/reports/FY11/popoulai1.pdf [Access 14 May 2013].

PULAK C., ROGERS E. 1994. The 1993-1994 Turkish Shipwreck Surveys. *Institute of Nautical Archaeology Quaterly* 21, 20–21.

RAIA P., MEIRI S. 2006. The island rule in large mammals: paleontology meets ecology. *Evolution* 60(8), 1731–1742.

REIMER P.J., BAILLIE M.G.L., BARD E., BAYLISS A., BECK J.W., BERTRAND C.J.H., BLACKWELL P.G., BUCK C.E., BURR G.S., CUTLER K.B., DAMON P.E., LAWRENCE EDWARDS R., FAIRBANKS R.G., FRIEDRICH M., GUILDERSON T.P., HOGG A.G., HUGHEN K.A., KROMER B., McCORMAC G., MANNING S., RAMSEY C.B., REIMER R.W., REMMELE S., SOUTHON J.R., STUIVER M., TALAMO S., TAYLOR F.W., van der PLICHT J., WEYHENMEYER C.E. 2004. Intcal04 terrestrial radiocarbon age calibration, 0–26 cal kyr BP. *Radiocarbon* 46(3), 1029–1058.

ROBERTSON A.H.F. 2000. Mesozoic-Tertiary tectonic-sedimentary evolution of a South Tethysan oceanic basin and its margins in Southern Turkey. In: E. Bozkurt, J.A. Winchester, J.D.A. Piper (eds.) *Tectonic and Magmatism in Turkey and surrounding areas*. Geological Society Special publications 173, London, 97–138.

ROBINSON A.R., LESLIE W.G., THEOCHARIS A., LASCARATOS A. 2001. *Mediterranean Sea Circulation, in Ocean currents*. [Online], Indira, 1-19. Available at: http://robinson.seas.harvard.edu/PAPERS/encycirc.pdf [Access 14 May 2013].

RONEN A. 1995. Core, periphery and ideology in Acerarnic Cyprus. *Quartär* 45/46, 177–206.

SCHÜLE W. 1993. Mammals, vegetation and the initial human settlement of the Mediterranean islands: a palaeoccological approach. *Journal of Biogeography* 20, 399–412.

ŞEVKETOĞLU M. 2006. Cypro-Anatolian relations in the 9th millenium BC: Akanthou/Tatlisu rescue excavation. *Anatolia* 30, 119–136.

SIMMONS A.H. 1988. Extinct pygmy hippopotamus and early man in Cyprus. *Nature* 333(6173), 554–557.

SIMMONS A. (ed.) 1999. *Faunal extinction in an island society. Pygmy hippopotamus hunters of Cyprus*. Kluwer Academy–Plenum Publisher, New York-Boston-Dordrecht-London-Moscow.

SIMMONS A.H. 2012. Ais Giorkis: An anusual early Neolithic settlement in Cyprus. *Journal of Field Archaeology* 37(3), 86–103.

SIMMONS A., MANDEL R. 2007. Not such a new light: A response to Ammerman and Noller. *World Archaeology* 39(4), 475–482.

STORDEUR D. 2006. Les bâtiments collectifs des premiers néolithiques de l'Euphrate. Création, standardisation et mémoire des formes architecturales.. In: P. Butterlin, M. Lebeau, J.-Y. Monchambert, J.-L. Montero-Fenollos, B. Muller (eds.) *Les espaces syro-mésopotamiens. Dimensions de l'expérience humaine au Proche-Orient. Hommage offert à Jean Margueron.* Subartu 17, Brepolls, Bruxelles, 19–31.

STORDEUR D. 2012. Les villages et l'organisation des groupes au Néolithique Précéramique A. L'exemple de Jerf el Ahmar, Syrie du Nord. In: J.L. Montero (ed.) *Du village néolithique à la ville syro-mésopotamienne*. Bibliotheca Euphratica 1, Proyecto Archeológico Medio Éufrates Sirio – Universidad da Coruña-Sociedad Luso-Gallega de Estudios Mesopotámicos, Ferrol (A Coruña), 35–54.

STORDEUR D., ABBÈS F. 2002. Du PPNA au PPNB: Mise en lumière d'une phase de transition à Jerf el Ahmar (Syrie). *Bulletin de la Société Préhistorique Française* 99(3), 563–595.

THEODOROU G., PANAYIDIS J. 2003. First data on the fossil Hippopotamus from Aghia Napa, Cyprus. In: J.A. Alcover, P. Bover (eds.) *Proceedings of the International Symposium Insular Vertebrate Evolution: the Palaeontological Approach*, *Palma de Mallorca 16-19 Septembre 2003*. Societat d'Història Natural de las Baleares-Institut Mediterrani d'Estudis Avançats, Palma de Mallorca, 65.

THEODOROU G.E., ROUSSIAKIS S. I., ATHANASSIOU A., GIAOURTSAKIS I., PANAYIDES I. 2007. A Late Pleistocene endemic genet (Carnivora, Viverridae) from Aghia Napa, Cyprus. *Bulletin of the Geological Society of Greece* 40, 201–208.

TICHÝ R. 1999. *Monoxylon II. Plavba po 8000 letech*. Beta, Hronov, (appendix in English:198–215).

TRISTANT Y. 2012. Une barque funéraire de la Ire dynastie (Abou Rawash). In: *Rapport d'activité 2011-12*. Institut Français d'Archéologie Orientale, Cairo, 44–46.

VAN DER GEER A., LYRAS G., DE VOS J., DERMITZAKIS M. 2010. *Evolution of Island Mammals: Addaptation and Extinction of Placental Mammals on Islands*. Wiley-Blackwell, Oxford.

VAN VALEN L.M. 1973. Pattern and the balance of nature. *Evolutionary Theory* 1, 31–49.

VICHOS Y., TSOUCHLOS N., PAPATHANASSOPOULOS G. 1991. Première année de fouille de l'épave de Docos. *Aegaeum* 7, 147–156.

VIGIÉ B. 1979. Les représentations de bateaux dans le Bassin Méditerranéen aux temps protohistoriques. In: *Navigation et gens de mer en Méditerranée, de la Préhistoire à nos joursactes de la table ronde du Groupement d'intérêt scientifique, Sciences humaines sur l'aire méditerranéene, Collioure, Septembre 1979*. Maison de la Méditerranée-CNRS, Paris, 17–32.

VIGNE J.-D. 1998. Contribution des peuplements de vertébrés insulaires à la connaissance de la navigation préhistorique en Méditerranée. In: *Pour qui la Méditerranée au 21éme siècle? Navigation, échanges et environnement en Méditerranée. Actes du colloque scientifique*. Maison de l'Environnement, Montpellier, 65–76.

VIGNE J.-D. 1999. The large "true" Mediterranean islands as a model for the Holocene human impact on the European vertebrate fauna? Recent data and new reflections. In: N. Benecke (ed.) *The Holocene history of the European vertebrate fauna. Modern aspects of research.* Archäologie in Eurasien 6. Deutsches Archäologisches Institut-Eurasien-Abteilung, Berlin, 295–322.

VIGNE J.-D. 2009. Introductions et réintroduction de mammifères à Chypre aux IXe et VIIIe millénaires av. J.-C. (Néolithique précéramique): indices indirects de l'usage de la voile au Néolithique? In: *De Méditerranée et d'ailleurs… Mélanges offerts à Jean Guilaine.* Archives d'écologie préhistorique, Toulouse, 807–820.

VIGNE J.-D. 2011a. Les petits et microvertébrés terrestres (chéloniens, squamates, oiseaux, rongeurs et carnivores): contribution à l'histoire du peuplement reptilien et mammalien de Chypre. In: J. Guilaine, F. Briois, J.-D. Vigne (eds.) *Shillourokambos. Un établissement néolithique pré-céramique à Chypre. Les fouilles du Secteur 1*. Editions Errance-Ecole Française d' Athènes, Paris, 847–870.

VIGNE J.-D. 2011b. La chèvre (*Capra aegagrus/ Capra hircus*). In: J. Guilaine, F. Briois, J.-D. Vigne (eds.) *Shillourokambos. Un établissement néolithique pré-céramique à Chypre. Les fouilles du Secteur 1*. Editions Errance-Ecole Française d' Athènes, Paris, 1001–1020.

VIGNE J.-D. 2011c. Les bovins (*Bos taurus*). In: J. Guilaine, F. Briois, J.-D. Vigne (eds.) *Shillourokambos. Un établissement néolithique pré-céramique à Chypre. Les fouilles du Secteur 1*. Editions Errance-Ecole Française d' Athènes, Paris, 1059–1073.

VIGNE J.-D. 2011d. The origins of animal domestication and husbandry: A major change in the history of humanity and the biosphere. *Comptes Rendus Biologies* 334, 171–181.

VIGNE J.-D. 2012 (first édition 2004). *Les débuts de l'élevage*. Le Pommier-Cité des Sciences, Paris.

VIGNE J.-D., CUCCHI T. 2005. Premières navigations au Proche-Orient: les informations indirectes de Chypre. *Paléorient* 31(1), 186–194.

VIGNE J.-D., GUILAINE J. 2004. Les premiers animaux de compagnie 8500 ans avant notre ère?… ou comment j'ai mangé mon chat, mon chien et mon renard. *Anthropozoologica* 39(1), 249–273.

VIGNE J.-D., GUILAINE J., DEBUE K., HAYE L., GÉRARD P. 2004. Early taming of the cat in Cyprus. *Science* 304, 259.

VIGNE J.-D., ZAZZO A., SALIÈGE J.-F., POPLIN F., GUILAINE J., SIMMONS A. 2009. Pre-Neolithic wild boar management and introduction to Cyprus more than 11,400 years ago. *Proceedings of the National Academy of Sciences USA* 106(38), 16131–16138.

VIGNE J.-D., CARRÈRE I., BRIOIS F., GUILAINE J. 2011a. The Early Process of the Mammal Domestication in the Near East: New Evidence from the Pre-Neolithic and Pre-Pottery Neolithic in Cyprus. *Current Anthropology* S52(4), S255–S271.

VIGNE J.-D., BRIOIS F., ZAZZO A., CARRÈRE I., DAUJAT J., GUILAINE J. 2011b. Preliminary data on a new early Pre-Pottery Neolithic site on Cyprus (Ayios Tychonas - *Klimonas*, ca. 9000 cal. BC). *Neo-Lithics* 1(11), 3–18.

VIGNE J.-D., BRIOIS F., ZAZZO A., WILLCOX G., CUCCHI T., THIÉBAULT S., CARRÈRE I., FRANEL Y., TOUQUET R., MARTIN C., MOREAU C., COMBY C., GUILAINE J. 2012. The first wave of cultivators spread to Cyprus earlier than 10,600 years ago. *Proceedings of the National Academy of Sciences USA* 109(22), 8445–8449.

WARD C. 2006. Boat-building and its social context in early Egypt: interpretations from the First Dynasty boat-grave cemetery at Abydos. *Antiquity* 80, 118–129.

WATKINS T., BAIRD D., BETTS A. 1989. Qermez Dere and the Early Aceramic Neolithic of N Iraq. *Paléorient* 15(1), 19–24.

YARTAH T. 2004. Tell 'Abr 3, un village du néolithique précéramique (PPNA) sur le Moyen Euphrate. Première approche. *Paléorient* 30, 141–158.

YARTAH T. 2005. Les bâtiments cummunautaires de Tell 'Abr 3 (PPNA, Syrie). *Neo-lithics*, 1(5), 3–9.