Review Article

A review of the Pleistocene Deposits in the SouthWestern Coast of Malta

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Summary: *The various cave-fissure and coastal deposits described along the Southwestern coast of Malta have been shown to have had a fossil repertoire which corresponds with the 2nd faunal association described from Sicily dated to circa 455 +/- 90 ka and the 3rd Sicilian faunal association dated to circa 200 +/- 40 ka. The latter probably corresponds to the Gliridae/Hippopotamus Assemblage Biozone of Ghar Dalam Cave in Malta.*

Keywords: Pleistocene, paleofaunal assemblage

Introduction

The Pleistocene chronological sequence in Malta has generally been restricted to studies of the Ghar Dalam cave-floor deposits. These deposits have been described as consisting of four definite assemblage biozones which have been dated by absolute and relative dating to the Upper Pleistocene (Savona-Ventura & Mifsud, 1998). There has been very little attempt to assign a chronological sequence to deposits that may have different earlier faunal associations. This paper reviews the Pleistocene deposits of the Maghlaq and Benghisa regions to compare the sequence in this region with that at nearby Ghar Dalam Cave and with the Sicilian faunal assemblages.

Material and methods

A literature search was conducted in the various melitensia-holding libraries (the National Library, the University and Archaeology Museum Libraries) in Malta to identify the publications relating to the original descriptions of excavations carried out in the region. Several formal excavations and site descriptions were identified, these being published by several workers, notably T.A.B. Spratt and A.L. Adams. The Maghlaq deposits were reviewed by Galea Bonavia (1999). Still existent Quaternary sites in the locality were visited and studied with special attention being made as to the presence or absence of fossil remains.

Geology of the region

The Southwestern coast of Malta is characterized by a series of high cliffs caused by a major fault, named the Maghlaq Fault, which extends parallel to the coast in a NW-SE direction trending averagely N 120o. The stratigraphical evidence of the region suggests that the Maghlaq Fault is a relatively young tectonic feature (Reuther, 1984), possibly Middle Pleistocene. The effects of this fault can be noted by the preserved remnants of Upper Coralline Limestone deposits in the region of Halk it-Tafal close to Lapsi Cave and below Mnaidra. The fault line can also be clearly noted by the presence of escarpments in the region exhibiting very good examples of slickensides. During the Pleistocene, the region was characterized by some phases of increased water flow which helped cut out a number of valleys in the cliffs and which contributed to the deposition of the alluvial and cave-fissure deposits of the region. The arid climate of the glacial periods resulted in the deposition of aeolian soils. After these deposits were laid down, undercutting of the fault remnant resulted in a landslip into the sea with a breaking up of the Pleistocene deposits and exposure of the fault line, particularly evident in the region below Mnaidra. The area has also been extensively modified by human intervention through quarrying for Upper Coralline Limestone.

Pleistocene deposits

The Maghlaq region was characterized by three cave-fissure deposits which were intimately associated. None of these deposits are extant at present (though Pleistocene conglomerate hard rock fragments containing bone and land shell fossils can still be encountered among the rocks of the region). The location and interrelationship of these cave-fissure deposits can only be extrapolated from the descriptions given by the original excavators. T.A.B. Spratt's (1867) description of Mnaidra Gap appears to be unreliable and his estimates of distances an exaggeration. His sea-view sketch of the area, depicting these deposits as being widely separated, is quite inaccurate. On the other hand the sketch prepared by Captain Goff and published by A.L. Adams (1865,1870) is quite precise, and landmarks such as boulders, rubble walls and tafoni depicted by the artist can all still be readily identified today. In this sketch, all the three deposits are shown very close together indeed.

All the three cave-fissure deposits were associated with the valley sides of Wied Maghlaq. The Maghlaq cave with its associated terrace-deposit was located about 60 metres ("less than a stones throw") west of Mnaidra Gap. The Middle Cave was described to be some 3.5 metres below Mnaidra Gap and about 18 metres SE of the terrace deposit associated with the Maghlaq Cave (Adams, 1865; Adams 1870).

The Maghlaq region is also characterized by Pleistocene remains deposited at the mouth of the valley Wied Maghlaq. This deposit is still extant and available for study. Though best developed at the mouth of Wied Maghlaq, this deposit extends all the way from the cliff

face of Ghar Lapsi up to the Mnaidra region. Other valleys along the SW coast of Malta - Wied il-Mixta and Wied ix-Xaqqa - have also enabled the deposition of alluvial Pleistocene deposits notably that still extant at Benghisa (Adams, 1870; Cooke, 1896; Trechmann, 1938). A cave deposit at Wied il-Bieni at Kalafrana in the region close to Benghisa also yielded fossil Pleistocene remains (Zammit, 1921).

Maghlaq Cave

The Maghlaq Cave (or Qrendi Cave of Spratt) was originally described by T.A.B. Spratt (1867) and re-described by A.L. Adams (1865,1866,1870) and J.H. Cooke (1892). The cave floor deposits were noted to consist of a series of three layers (Table 1). The uppermost layer consisted of a "calcareous grey sinter and small bands of a dark brown loam" containing remains of grilids (*Myoxus melitensis* = *Leithia melitensis*), avian bones (some of a large species), and land shells (Spratt, 1867; Adams, 1865; Adams, 1870). The middle layer consisted of a stalagmitic hardened conglomerate containing similar fossil remains as the previous layer. The lowermost layer consisted of a well-cemented, poorly sorted conglomerate containing remains of *Hippopotamus pentlandi, H. minutus* and remains of large birds (Spratt, 1867; Adams, 1870 p.307). This deposit extended outside the cave as a terrace deposit about twenty meters broad. Among the finds made by T.A.B. Spratt was a small canine or outer incisor of a carnivore the size of a fox, while A.L. Adams also notes the excavation of an incisor tooth described as being similar to that of a seal (Adams, 1870 p.204-205). Adams also described the presence of one solitary molar of Pigmy elephant *Palaeoloxodon sp.* (rolled and adherent to a large rounded pebble) discovered by C.A. Wright (Adams, 1865 p.259; Adams, 1870 p.1205). This specimen is suspect since Wright in an annotation in his copy of Adams' book commented that the specimen had not originated from this site but from amongst the debris of the Mellieha Cave (Zammit-Maempel, 1989 p.192 ftnote 36). It was commented by Adams "*that in no instance were the remains of the rodent (Myoxus melitensis) found in connection with the Hippopotamus, whereas they were always intimately associated with bones & teeth of the Proboscidian, and not only in this cave, but in several other localities in the island*" (Adams, 1865) including the Mellieha Cave. Adams further noted the Maghlaq Cave deposits to be similar to those from the Mellieha Cave. It is noteworthy that Adams, on the basis of the rounded pebbles and fragmented pachyderm bones, considered the lowermost level of the Maghlaq Cave floor to have been deposited by the influence of running waters. These were subsequently exposed to dry out and become sealed with a stalagmitic sheet. The upper deposits were considered to have been deposited *in situ*. The fossils of this drier period were considered by A.L. Adams to have possibly been deposited by predators (Adams, 1866, 1870).

Mnaidra Gap

The Mnaidra Gap deposit, situated within a few yards of the Maghlaq Cave and excavated by AL Adams (Adams, 1865; Adams, 1866; Adams, 1870). In contrast to the Maghlaq Cave in the vicinity, no *Hippopotamus sp.* remains were excavated from this cave. The Mnaidra Cave was characterized by a series of three fossiliferous layers overlying a series of sterile layers (Table 2). The sterile layers were considered by Adams to have been deposited through the gradual process of accumulation. In contrast the upper fossiliferous layers were deposited by the action of running water with the inclusion of rounded stones and pachyderm remains. The fossil content of these upper layers were similar throughout containing remains of gliridae - *Leithia melitensis, L. cartei,* and *Maltamys gollcheri*; elephant *Palaeoloxodon* sp. including *P. falconeri, P. mnaidrensis,* and *P. melitensis*; unidentified chiropteran remains; giant turtles *Geochelone robusta* and *G. spratti*; and several species of birds including *Grus grus, Grus melitensis, Cygnus falconeri* and large raptor species. Land shells were also abundant (Adams, 1865; Adams, 1865a; Adams, 1866; Adams, 1870; Adams, 1877; Borg, 1999; De Bruijn, 1966). The elephant remains in the lowermost fossiliferous layers was noted to be of large dimension (Adams, 1865; Adams, 1866; Adams, 1870; Adams, 1877). Amphibian remains attributed to Mnaidra Gap were assigned to the species *Discoglossus pictus* (Parker in Bate, 1935), though the specimens in question most likely referred to the amphibian remains excavated by Adams from the Middle Cave. Mnaidra Gap is the type locality for a number of giant dormice species including *Leithia melitensis* ADAMS 1868 (= *Myoxus melitensis*), Leithia cartei ADAMS 1868, and Maltamys gollcheri DE BRUIJN 1966. In addition the region is also the type locality of *Palaeoloxodon mnaidrensismnaidrensis* ADAMS 1870.

	MAGHLAQ CAVE STRATIGRAPHY
Maghlaq-C1	Thinly stratified stalagmitic layers with red earth/clay between them FOSSILS: *Leithia melitensis*; large and small sized avian sp.; land shells
Maghlaq-C2	Stalagmitic layer. Fossil remains similar to above. No *Hippopotamus* sp. Fossils
Maghlaq-C3	Indurated brownish stalagmitic clay as hard as flint or jasper containing well-rounded pebbles of native rock FOSSILS: *Hippopotamus pentlandi*; *Hippopotamus minutus*; carnivore size of a fox/seal; large avian species; reported *Palaeoloxodon* remains suspect as to providence.

Table 1. Maghlaq Cave Stratigraphy

	MNAJDRA GAP STRATIGRAPHY		MIDDLE CAVE STRATIGRAPHY
Mnajdra-1	Superficial drift with masses of parent rock FOSSILS: *Leithia melitensis Leithia cartei, Maltamys gollcheri*; a chiropteran species; *Palaeoloxodon falconeri, Palaeoloxodon mnaidrensis, Palaeoloxodon melitensis; Geocelone robusta*; *Grus grus, Grus melitensis, Cygnus falconeri*; land shells	Middle-1 Middle-2	stalagmitic infill Influx of Red earth
Mnajdra-2	Shelf of stalactite FOSSILS: land shells; *Leithia melitensis; Palaeoloxodon melitensis*; avian species	Middle-3	Shelf of stalactite FOSSILS: *Leithia melitensis*; *Anseres sp.* (=? *Cygnus sp.*) and other smaller avian species, and an abundance of recent land shells
Mnajdra-3	Red clay and rounded stones FOSSILS: *Palaeoloxodon* sp (larger dimension ?*P. mnaidrensis*); avian species; *Leithia melitensis*		
Mnajdra-4	Shelf of stalactite and rounded stones at bottom; without organic remains		
Mnajdra-5	Red loam; without organic remains	Middle-4	Red earth; without organic remains
Mnajdra-6	Yellow band; without organic remains	Middle-5	seam of yellow earth interspersed with shelves and hardened masses of dripping, without organic remains
Mnajdra-7	Reddish black loam; without organic remains	Middle-6	reddish black loam hardened by stalagmitic infiltrations. FOSSILS: *Arvicola (?)pratensis*; *Discoglossus pictus*; avian sp.; pisces sp.
Mnajdra-8	White calcareous dripping with black seam on top; bare of organic remains	Middle-7	White calcareous dripping with a black seam on top with no organic remains

Table 2. Mnaidra Gap and Middle Cave Stratigraphy

The Middle Cave

While in stratification, the Middle cave was similar to the Mnaidra Gap, this infill was, in contrast to the previous one comparatively rather poor in fossil remains (Table 2). The mode of deposition of the entire sequence was assessed by A.L. Adams to have been that of a gradual accumulation of soil, derived from infiltration into the cave via fissures and from weathering of the cave walls and roof. Dripstones and flowstones were also present (Adams, 1865; Adams, 1870). The upper layer consisted of red earth devoid of fossil remains. The middle layers contained remains of glirids (*?Leithia melitensis*), fragments of *Anseres sp.*, other smaller birds and an abundance of land shells. The lower layers contained only remains of Arvicola pratensis (*?Microtus Pitymys* sp.), frog bones (*?Discoglossus pictus*), fragments of bird bones and those of fish. No megamammals were recorded for the entire deposit. There were also two well abraded Miocene *Carcharocles megalodon* (AGASSIZ) teeth. It should be noted that its physical location precluded its being reached by flowing waters, hence its complete lack of high-energy beds (Adams, 1865, 1870; Parker in Bate, 1935).

The Maghlaq Coastal Deposit

The breccia talus-like deposit along the coast was described by A.L. Adams and subsequent geologists to consist of at least two or three layers (Adams, 1870; Cooke, 1892; Cooke, 1896; Trechmann, 1938). The lowermost strata was described (Adams, 1870) as composed of alluvial deposits and breccia formed of red earth containing angular and rounded native rock. This was overlain by an alluvial deposit. Adams (1870) describes finding *Palaeoloxodon* remains in this sequence, assigning these in 1870 to *P. falconeri* and in 1874 to *P. mnaidrensis* (Adams, 1870; Adams, 1874). The later deposit yielded remains of birds and two teeth of an unidentified ruminant similar to a goat/sheep (Adams, 1870). J.H. Cooke subdivides the deposits into

a tripartite division. Lying on the Upper Coraline Limestone was a deposit composed of yellowish clays containing small subangular fragments of rock without any evidence of organic remains. This is overlain by a talus of 6-10 feet in thickness consisting of angular and subangular boulders including *Paleoloxodon* sp. remains and a *Geochelone robusta* tibia. The uppermost layer of the deposit consists of angular rock fragments embedded in an extremely calcareous cement (Cooke, 1896; Cooke, 1890). C.T. Trechmann described this deposit as consisting of alternating horizontal beds of larger fragments and of red pebbly material. The uppermost less pebbly red matrix contained remains of land shells (Trechmann, 1938).

The present shore deposit consists of four definite strata (Table 3). The earliest stratum is found as patches infilling solution hollows in the karstic surface of the downthrown Upper Coralline Limestone. This deposit, previously described by J.H. Cooke (1896), is extremely indurated and appears to be devoid of vertebrate remains. These patches are obviously the remnants of a much thicker and more extensive deposit that was almost completely eroded away before the overlying beds were laid down. A long period may be inferred between deposition of this and the earliest overlying beds, an inference further supported by its induration which is much more advanced than that of any of the overlying beds.

This deposit is followed by a fluvial series some 3.9 metres thick, which infills the lower part of a shallow palaeochannel incised by Wied Maghlaq in the Upper Coralline bed. Each stratum of this series consists of very poorly sorted rounded (only Globigerina) and angular (the Corallines and Globigerina) pebbles, cobbles and boulders embedded in Terra Rossa. Several discrete lenses of Terra Rossa are also present. The presence of Palaeoloxodon sp. remains in this deposit has been confirmed.

Resting unconformably on these beds is another series that completes the burial of the palaeochannel and also extends laterally on both side. Vertebrate remains in this series are extremely scarce. Adams (1870) refers only to fragmentary bird bones and two teeth of a sheep/goat-sized unidentified ruminant (= ?*Cervus elaphus siciliae* Pohlig). It should be noted that both the two deposit sequences, besides exhibiting features indicative of water flow (e.g. channelling and imbrication), also show evidence of drier periods (e.g. caliche horizons and root-casts).

Benghisa Gap Deposit

The Maghlaq coastal deposit is similar in structure to that found at Benghisa Gap deposited in association of another old waterway - Wied ix-Xaqqa - about five miles away from the Maghlaq deposits [bearing 584632]. The Benghisa Gap thirty-two foot deep deposits (Table 3) were described by Adams as being composed of six layers made up of distinct alterations of bands of large water-worn blocks and seams of pebbly loam, representing periods of turbulence and periods of comparative quiescence. The fossil remains characterized the middle layer composed of rounded large stones bound by red soil. The vertebrate remains included *Paleoloxodon* sp. remains, gliridae, *Cygnus falconeri, Cygnus equitum, Otis tetrax, Branta bernida, Geochelone robusta,* and *Lacerta siculomelitensis.* Several species of land shells were also present (Adams, 1870; Adams, 1877; Borg, 1999). J.H. Cooke also described the deposits as containing "*large, water-worn boulders with a black lustre occurring at different depths .... Intermixed with boulders and fragments of other colours .... Found as well-defined layers of several feet in thickness, alternating with beds of a rich red soil, containing elephant remains*" (Cooke, 1892a). C.T. Trechmann described the deposit as consisting of large angular blocks at the base, overlain in the middle part by a series of alterations of brown clay and layers of pebbles. The uppermost layer was composed of a well calcreted red calcareous laminated soil with small stones. A *Palaeoloxodon* tooth fragment was excavated from the middle of the deposit (Trechmann, 1938). A review of the site confirmed the presence of several strata. The lowermost layers are made up of alluvial deposits containing rounded stones of variable sizes bound by a red loam. Fossil root casts were evident in this deposit. Bands of red earth layers containing pebbles and gravel suggest a subdivision of this alluvial deposit into two horizons. Overlying this alluvial deposit is a red stratified loam deposit containing small stones and pebbles. The uppermost layer consists of a whitish red soil containing variably sized stones. The uppermost two deposits extended inland under the road and into the industrial excavation at the Freeport.

Il-Mara Deposit

Close to Benghisa Gap in association with another old waterway termed Wied il-Mixta and close to the stack known as Il-Mara [bearing 576628] is another superficial layer of breccia deposit made up of a conglomerate of rounded Globigerina, occasional Black Limestone and Lower Coralline rocks bound together with soil matter. The Il-Mara area is now inaccessible for study since it was used as a dumping site for coal ash, building materials and other waste items.

Wied il-Bieni Cave Deposit

The cave detritus of a narrow cave in Wied il-Bieni near the shore of Kalafrana consisted of a red soil with contained animal bones in a semi-fossilized state. The bones were identified by Dr. Smith Woodward of the British Museum of Natural History as belonging to sheep (? *Ovis aries*), goat (? Capra *hircus*), donkey (*Equus asinus* = ? *E. hydruntinus*), and deer (*Cervus barbarus* = ? *C. elaphus*). The presence of domesticated animals including sheep and goat remains suggests that these remains may have been deposited during Neolithic times (Zammit, 1922).

Discussion

The Pleistocene deposits in the SouthWestern region of Malta can be interpreted as representing at least three definite assemblage biozones. The earliest faunal assemblage would be the ***Palaeoloxodon falconeri assemblage biozone*** represented by the beds of the Maghlaq Coastal Deposit, of Mnajdra Gap, and the Benghisa Gap deposit bearing *Palaeoloxodon falconeri* (Busk) and its associated fauna which shows a high

	MAGHLAQ COASTAL DEPOSITS		BENGHISA GAP DEPOSITS
Maghlaq-G1	Red ferruginous earth containing several variable sized stones, contained the remains of land shells and teeth of ruminant.	Benghisa-1	White calcareous drift soil with absence of organic fossil remains
		Benghisa-2	Pebbles and red earth layer
Maghlaq-G2	Compact red ferruginous earth		
Maghlaq-G3	Another similar layer containing small dimension rounded stones containing organic remains of *Palaeoloxodon* sp and also possibly *Geochelone robusta.*	Benghisa-3	Rounded large stones (some 15 ft circumference); rich in organic remains including *Palaeoloxodon* sp., gliridae *(?Leithia melitensis), Geochelone robusta, Lacerta siculomelitensis, Cygnus falconeri, Cygnus equitum, Otis tetrax, Branta bernida.*
Maghlaq-G4	Alluvial breccia containing large rounded boulders bound together by a stalagmitic hardened red loam	Benghisa-4	Compact ferruginous red earth intermixed with a few pebbles and stones
		Benghisa-5	Gravel and rounded pebbles bounded by soil. Contains fossil root casts
		Benghisa-6	Large blocks of rock bounded by red soil and silt
Maghlaq-G5	Patches of an extremely indurated colluvium infilling solution hollows in the karstic surface of the Upper Coralline Limestone.		

Table 3. Maghlaq and Benghisa Gap costal deposits

degree of endemism including *Leithia melitensis, Leithia cartei, Maltamys gollcheri,* a unidentified chiropteran species; *Grus grus, Grus melitensis, Cygnus falconeri; Cygnus equitum, Otis tetrax, Branta bernida, Geochelone robusta,* and *Lacerta siculomelitensis.* On the basis of the very strong faunal similarities, this assemblage can with confidence be assigned to the Sicilian *Palaeoloxodon falconeri - Leithia melitensis* faunal assemblage of the early Middle Pleistocene which has been dated to about 500 k.y.a. by amino acid racemisation (Belluomini & Bada 1985, Bada et al. 1992).

It has traditionally been held or implied - e.g. Adams (1870:p.205,208), Zammit Maempel (1989a) - that the *Hippopotamus sp.* and the *Palaeoloxodon falconeri* fauna were sympatric and merely occupied separate niches. However it is inconceivable that such an ecological separation should have been so sharp that it only allowed *Hippopotamus* to accumulate in the Maghlaq Cave, while the *Palaeoloxodon falconeri* fauna only accumulated in the Mnajdra Gap just a few metres away. The evidence presented by the Maghlaq Pleistocene deposits points towards a temporal rather than an ecological or depositional separation. A temporal separation suggests two distinct faunal assemblages in the Pleistocene mammal sequence (c.f. Hunt & Schembri, 1999).

The second assemblage biozone would thus be the ***Hippopotamus assemblage biozone*** represented by the basal conglomerate of the Maghlaq Cave and apparently characterised by the occurrence of *Hippopotamus* sp. as the dominant megamammal. This was apparently associated with a fox/seal-sized carnivore, and a large avian species. The *Hippopotamus* sp. was also apparently contemporary with *Palaeoloxodon* sp. even though the providence of the solitary elephant molar remains suspect. A providence from the Mellieha Cave rather than the Maghlaq Cave still confirms a contemporanity of the two magamammals. The animals were also possibly contemporaneous at Ghar Dalam

SPECIES	MALTESE SOUTHWESTERN REGION					
	SW Coastal deposits; Mnaidra & Middle Cave			Maghlaq (&Mellieha) Caves		Wied il-Bieni
	Upper I	Middle II	Lower III	Upper I	Lower II	
Amphibia						
Discoglossus pictus	-	-	+	-	-	-
Reptilia						
Geochelone robusta	-	+	-	-	-	-
Lacerta siculimelitensis	-	+	-	-	-	-
Aves						
undetermined sp.	-	+	+	+ *(Small)*	+ *(Large)*	-
Cygnus equitum	-	+	-	-	-	-
Cygnus falconeri	-	+	-	-	-	-
Anseres sp.	-	+	-	-	-	-
Branta bernicla	-	+	-	-	-	-
Grus melitensis	-	+	-	-	-	-
Grus grus	-	+	-	-	-	-
Otis tetrx	-	+	-	-	-	
Chiroptera						
undetermined sp.	-	+	-	-	-	-
Rodentia						
Eliomys (Maltamys) gollcheri	-	+	-	-	-	-
Leithia cartei	-	+	-	-	-	-
Leithia melitensis	-	+	-	+	-	-
Arvicola ?pratensis (?Microtus sp.)	-	-	+	-	-	-
Carnivora						
undefined sp. ?fox/seal	-	-	-	-	+	-
Proboscidae						
Palaeoloxodon sp.	-	+	-	-	+	-
Palaeoloxodon falconeri	-	+	-	-	-	-
Palaeoloxodon melitensis	-	+	-	-	-	-
Palaeoloxodon mnaidriensis	-	+	-	-	-	-
Perissodactyla Equidae						
Equus asinus	-	-	-	-	-	+
Artiodactyla						
Hippopotamus pentlandi	-	-	-	-	+	-
Hippopotamus melitensis	-	-	-	-	+	-
undetermined ruminant sp.	+	-	-	-	-	-
Capra hircus	-	-	-	-	-	+
Ovis aries	-	-	-	-	-	+
Cervus elaphus	-	-	-	-	-	+

Table 4. Paleontological remains from the various sites

Cave, though it has been suggested that the Ghar Dalam fauna in the Bone Breccia deposit was probably a mixed one (Hunt & Schembri, 1999). This faunal assemblage may possibly represent the Gliridae faunal assemblage (=*Maltamys* sp. faunal assemblage of G. Storch) described from Ghar Dalam (Stroch, 1974; Storch in Savona-Ventura & Mifsud, 1998). It may also represent the Carnivora faunal assemblage as described for Ghar Dalam (Savona-Ventura & Mifsud, 1998). Though the data is rather inadequate, it has been proposed that the *Hippopotamus* assemblage biozone (probably equivalent to the Ghar Dalam Gliridae faunal assemblage) may in fact be a hitherto unrecognised faunal assemblage biozone separate from the Sicilian *Hippopotamus-Palaeoloxodon* faunal assemblage (probably equivalent to the Ghar Dalam Carvinora faunal assemblage) (Galea Bonavia, 1999).

The relationship between the *Palaeoloxodon falconeri* faunal assemblage and the *Hippopotamus* assemblage cannot be determined on the evidence of the Maghlaq Pleistocene deposits. The presence of glirid remains above the *Hippopotamus*-containing layer in the Maghlaq Cave is not a useful observation for chronological dating, since glirids have been associated with both the *Palaeoloxodon falconeri* faunal assemblage and also with the *Hippopotamus pentlandi - Palaeoloxodon mnaidrensis* faunal assemblage in Sicilian deposits (Belluomini & Bada 1985, Bada et al 1992).

In Sicily, *Hippopotamus pentlandi* and *Palaeoloxodon*

mnaidrensis form an faunal association characterizing a continental European affinity fauna, containing carnivores and as well as other herbivores. This association ranged from the late Middle Pleistocene to the early Late Pleistocene. Absolute dating of Sicilian *Hippopotamus pentlandi* and *Palaeoloxodon mnaidrensis* molars has given ages of 200 k.y.a.. by amino-acid racemisation from various sites (Bada et al 1992) and an E.S.R. date of 88 k.y.a.- 146.8 k.y.a. for a series of molars from Contrada Fusco (Syracuse) (Rhodes 1996). A Maltese *Hippopotamus pentlandi* molar from Ghar Dalam - dated by E.S.R. and uranium series disequilibria by Bouchez et al (1988) has been variously reported in the literature as 110 k.y.a. - 130 k.y.a. (Reese 1996) and as 190 k.y.a. (Bonfiglio 1992). The exact stratigraphical providence of the specimen has not been defined and may have originated from the Ghar Dalam Lower Red Earth layer - Carnivora faunal assemblage or the Bone Breccia layer - Gliridae faunal layer (Savona-Ventura and Mifsud, 1998; Hunt and Schembri, 1999).

The significance of the glirid bed of the Maghlaq Cave, overlying the *Hippopotamus* bed, is difficult to interpret since the correlation of this deposit to the rest is by no means clear. The taphonomy of this bed is different from those containing the *Hippopotamus* faunas, which are clearly of a flowing water origin. Adams suggests that the Maghlaq Cave Glirid beds represent the food remains of predators, the glirids being taken selectively from a more diverse fauna and carried to the caves for consumption (Adams, 1866; Adams, 1870). A major problem in establishing a correlation for these beds is the fact that the glirid/s species involved were not specifically identified by the excavator. The absence of megamammals in these beds can be ascribed to the fact that megamammals were generally deposited by flowing water, and this had ceased to reach the Maghlaq Cave. Unfortunately the deposit is no longer extant. Certainly the stratigraphic location of the micromammal bed argues for a younger age for the Maghlaq Cave glirid layer than the *Hippopotamus* bed. The evidence suggests that the gliridae inhabited the Maltese Islands throughout a long span of the Pleistocene, certainly during both the *Palaeoloxodon falconeri* assemblage biozone assigned on the basis of the Sicilian faunal associations to circa 455 +/- 90 ka and the *Hippopotamus* assemblage biozone assigned to circa 200 +/- 40 ka (Zammit Maempel and de Bruijn, 1982)

The third faunal assemblage biozone - ***Ruminant assemblage biozone*** - represented by the deposits of this region includes the aeolian remains noted at the Maghlaq Costal and Benghisa Gap deposits. The former yielded two teeth of a sheep or goat-sized unidentified ruminant possibly belonging to the dwarf deer *Cervus elaphus siciliae* Pohlig. The evidence of these two non-identified teeth is far too sparse to allow any firm conclusions to be drawn, but this faunal assemblage may have been contemporaneous with the *Cervus* or *Pitymys* assemblage biozone described from Ghar Dalam (Savona-Ventura and Mifsud, 1998). The remains found at Wied il-Bieni Cave deposit may have belonged to this same faunal assemblage or to a later Neolithic deposit. Both the horse and the deer have been described from the Xemxija Neolithic tombs (Zammit, 1922; Pike, 1971).

The Maghlaq Pleistocene deposits highlight several problems relating to the mammalian faunal succession, particularly the clarification of stratigraphic relationships between the two *Hippopotamus* spp., with the phylogenetic, palaeogeographical and other implications. These problems need to be addressed before a reasonably accurate faunal assemblage sequence can be worked out. Furthermore a thorough revision of the Siculo-Maltese Gliridae is absolutely essential, since this would help to more precisely and with a finer resolution define the mammalian assemblage biozones involved (Kotsakis 1995).

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SICILIAN FAUNAL ASSEMBLAGE BIOZONES	MALTA Ghar Dalam	MALTA Maghlaq-Benghisa
Equus hydruntinus assemblage	*Cervus – Pitymys* assemblage	Ruminant assemblage
P.mnaidriensis – Hippopotamus assemblage - dated circa 200 k.y.a.	Carnivora assemblage Dated circa 150 k.y.a.[1]	*Hippopotamus* assemblage
	Gliridae assemblage	
Palaeoloxodon falconeri assemblage dated circa 500 k.y.a.		*Palaeoloxodon* assemblage
Pellegrinia panormensis assemblage	Unrepresented	Unrepresented

[1] stratigraphic providence of *Hippopotamus* molar not defined. May have originated from the Carnivora or the Gliridae layers (quoted dates are approximate).

Table 5. Faunal assemblage correlations

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