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# Some non-mollusc faunal remains found from a shell midden at Kalamatiya, Sri Lanka

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## සංක්ෂිප්තය

දිවයිනේ දකුණු වෙරළ තීරයේ ස්වභාවික අවසාදිතයක් සමාශ්‍රයේ වන සිප්පි කසල තැන්පතුවක් ඇසුරින් සිදුකරන ලද අධ්‍යයනයක් ඔස්සේ අනාවරණය මානවකෘති සමුච්චයක ඇතුලත් මෘද්වංගී නොවන වෙනත් සත්ත්වාවශේෂ කිහිපයක් වර්ගීකරණ සහ විශ්ලේෂණමය පදනමකින් යුක්තව ඉදිරිපත් කිරීම මෙම පත්‍රිකාවේ අරමුණ වේ. දේහවිෂයක නව්‍ය මානවයාගේ මුහුදු සහ ඒ ආශ්‍රිත පරිසර පද්ධතීන් ඇසුරු කරගත් සංස්කෘතික ක්‍රියාවලිය වඩාත් සංකීර්ණ වූවක් සහ වෙනම පර්යේෂණයට ලක්කළ යුත්තක් වශයෙන් මෑතකාලීනව අවධානයට ලක් වී ඇත. වෙසෙසින් මෙම වෙරළාශ්‍රිත සංස්කෘතීන් යනු අපසාමුද්‍රික ප්‍රදේශයන්හි ජීවත් වූ මිනිසුන්ගේ තවත් එක් දිගුවක් නොව විවිධ සංස්කෘතික මට්ටම් වලදී ආවේණික වූ ලක්ෂණ සහිත වූවක් බව ඒ ඔස්සේ සංවාදයට ලක් කෙරේ. අධ්‍යයනයට පාත්‍ර වූ ස්ථලයේ ස්වභාවික සහ සංස්කෘතික සකස් වීමේ ක්‍රියාවලිය වෙන් වෙන් ව හඳුනාගැනීමට තරම් ප්‍රමාණවත් සාධක පවතී. මුහුදු හා ඒ ආශ්‍රිත පරිසර කලාපය සමුද්ධරණයේදී මධ්‍යශිලා යුගයේ දඩකරු - අන්නගවේෂක මානවයා අපසාමුද්‍රික ප්‍රදේශයන්ට වඩා වෙනස් ආකාරයකට අනුවර්තනය වූ බව හා උද්ධරණ තාක්ෂණයන් ජනනය කළ බව එම සාධක ඇසුරින් පැහැදිලි වේ. තව ද වාර්තාකරණය කරන ලද භුක්තාවශේෂ සමූහය එතරම් විශාල නොවූව ද විවිධ පාරිසරික

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කලාපවලින් අල්ලාගන්නා ලද සතුන්ගේ සාධක එයට ඇතුලත් වීම සුවිශේෂී වේ.

**මුඛ්‍ය පද** - සිප්පි කසල තැන්පතු, සත්වාවශේෂ, වෙරළාශ්‍රිත ස්ථල

## Introduction

This paper discusses some of the non-mollusc faunal remains found from a shell midden located at Kalamatiya, Southern Province on the Southern Coasts of Sri Lanka. The original research was undertaken to examine the sedimentary properties, to establish stratigraphic sequence and the frequency of material remains in a shell midden. For the purpose, a ground survey was done from shoreline to inland, ca. 1.9 $km^2$ in the Kalamatiya sanctuary and ca. 1.8 $km^2$ between Miniathiliya and Lunama by ground walking for locating the possible coastal sites. The survey produced fifteen natural shell accumulations and one shell midden (map). Geological and archaeological provenance of these mid-Holocene formed shell accumulations have been confirmed by some previous studies. The present paper expects to emphasis the value of studying the non-mollusc faunal remains recovering from shell middens, which are usually subjected to ignorance. This study will present some data on fish otoliths and teeth what could be the first such record from a midden in the country.

In the region, several earlier attempts are recorded to study the shell accumulations in the region geologically (Deraniyagala, P.E.P., 1968, 88., 1958,15, Pethiyagoda & Jayawardana, 1978, 02; Weerakoon & Somadasa, 1985, 01, Katupotha, 1994,1995,1995a) and archaeologically (Deraniyagala, S.U. 1992, 612,627,628,701, Kourampas et al., 2012, 09, Somadeva et al., 2001,63, Somadeva & Ranasinghe,2006,15; Somadeva, 2006, 319, Ranaweera, 2002., Perera, 2010, Kulatilake et al., 2014., Adikari & Risberg, 2007,01). Although this previous research provides baseline data on shell deposits on the southern coast, data on species diversity, the presence/absence of non-edible species, shell size ranges, fragmentation and disarticulation, as well as other materials in the middens have been either completely absent or only discussed in a cursory fashion.

There are few exceptions to this general rule. One is a shell midden site at Patirajawela, Siran Deraniyagala recorded 328 artefacts and a deer bone within the shell stratum (Deraniyagala in Kourampas et al., 2012). A re-excavation on a face of a ca 4.25 m deep trench, which exposed backfill of previous excavations juxtaposed with undisturbed Iranamadu Formation deposits of the site was done by Kourampas et al. (2012), but they were unable to find any non-molluscan animal or plant remains, stone tools or any other macroscopic evidence for human input in the intershell matrix within the trench of the deposit (Kourampas et al., 2012, 09). We believe this should be re-examined. A study focussed on human skeletal remains found within a shell midden in Pallemalala also provides an inventory of animal remains, including sambur (*Cervus unicolar*), spotted deer (*Axis axis*), wild water buffalo (*Bubalis bubalus*), wild pig (*Sus scrofa*), elephant (*Elephas maximus*), hard-shelled terrapin (*Melanochelis trijuga*), balaya (*skipjack tuna*), monkey and bird remains (Ranaweera, 2002,55). Apart from the above species, another study carried out in Pallemalala reports mongoose (*Herpestes* sp.), flap shell turtle (*Lessimys punctate*), monitor (*Varanus* sp.) and fish species such as mackerel tuna (*Euthynnus affinis*) and skipjack tuna (*Katsuwonus pelemis*) in association with human remains (Somadeva and Ranasinghe, 2006, 22). These data suggest a continuum of coastal occupation and resource use by Mesolithic hunter-gatherers throughout the Holocene period, and as such, proper study of the economic structures should be undertaken with these available data, and with refined via further excavation of shell deposits in the region. The data presenting in this paper is for enriching the above lists of fauna and to emphasise the value of using micro-level data retrieving methods in the shell midden studies. Such profound measures could provide data to rethink about the subsistence economic strategies of coastal dwellers.

### *Site 01 - Kalamatiya Sanctuary*

Shells were exposed in a near-vertical bank of a shell mining pit in the site located (6$^0$ 04' 56.9" N - 80$^0$ 56' 08.6" E) on a headland between sea and lagoon. The bank extends from a rock outcrop for a distance of ca. 12m. During the first visit to this site in 2013, a trowel clearing of the face of the bank revealed features of a possible midden. By the time of

the second site visiting June 2014, the stratigraphic sequence previously recorded (fig. 1) had been disturbed by extensive shell mining. As the site was in a threat of further disturbance through digging by local people for shell extraction, one meter along the bank and half a meter into the bank section of the 190cm deep were excavated by using a trowel to acquire as much as data as possible from the remaining deposit.

Inspection of in situ shells and preliminary analysis of the shells on site (and from the 2013 sampling) revealed relatively large shells within a particular layer which we established as a parameter to recognise a shell midden. Gill (1954, 251) and Attenbrow (1992, 15) notes the molluscs which are non - edible are defined based on their size, i.e. when they considered too small to provide a reasonable amount of flesh. Edibility often depends on the maximum size to which a particular species grow. Gill states it as "*in the emerged shell beds there are numerous shells of species too small for food*". Diagnostic elements representing each taxon is determined, then sorted and counted for estimate the minimum number of individuals (MNI) and the number of individual specimens (NISP). The section of the in situ deposit includes some bone fragments and possible waste from lithic manufacturing, and these inclusions indicated it could be a '*shell midden*'. As it appears, the possible shell midden is a small, relatively shallow and vertical lens, which could distinguish from the natural shell layers in beneath of it. The shell midden formed a lens of a maximum of ca.15cm thickness and was buried underneath 90cm of overburden layers. Asiatic hard clam (*Meretrix meretrix*) shell is the dominant constituent in this assemblage.

The material analysed in this study comes from the systematic recovery of the shell deposit. The sediment was screened using a sieve with 1-mm mesh. The shell matrix was bulk sampled from layer 6, and the shell midden material was bagged in total for analysis. The total sampled volume from the site is 44 kg collected by hand, out of which 14.5 kg were excavated from layer 6. Mollusc remains were then identified using modern reference collections as well as published atlases (Campana, 2004, 183).

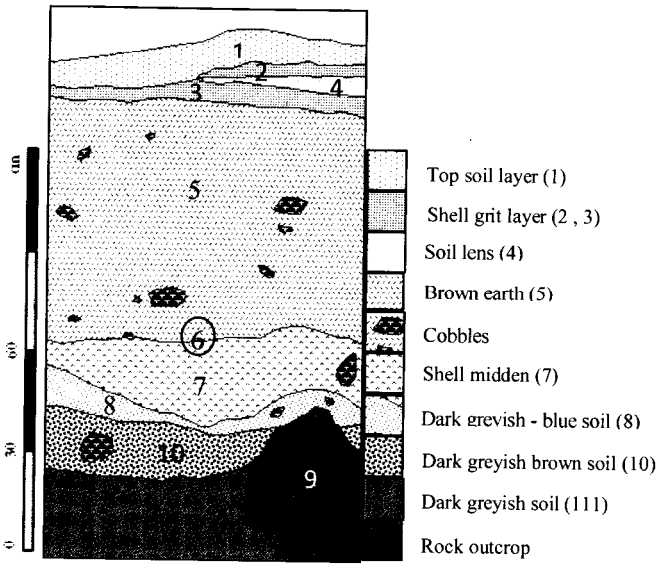



***Figure 1 Stratification of Site 01 - after excavation (Numbers given are for the contexts)***

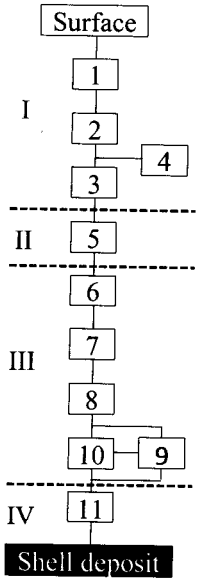
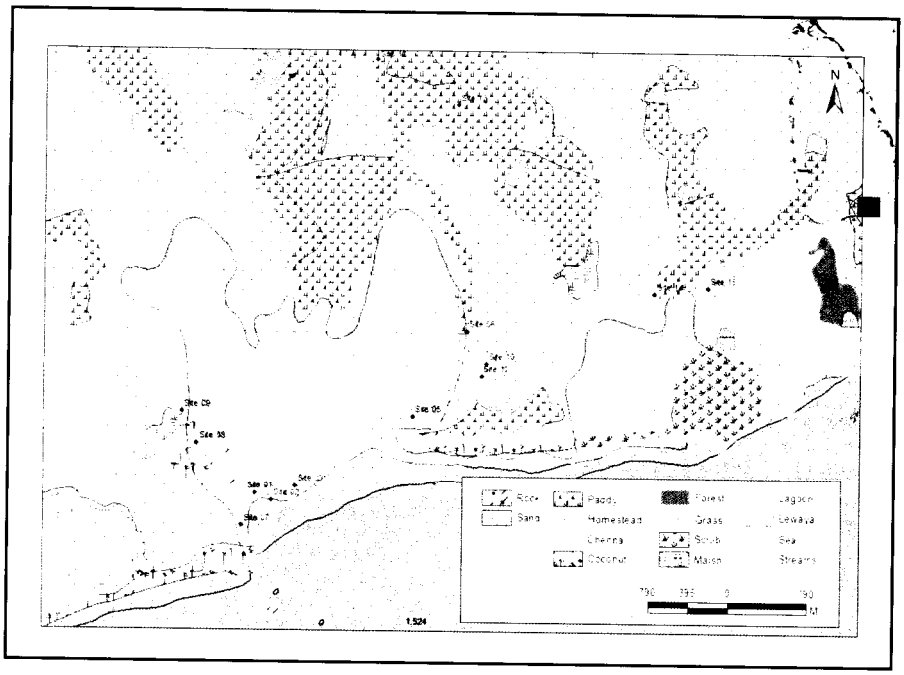



***Figure 2 Harris matrix of the Site 01***




***Map 1 Location of research area, locations of sites and land use***

## The Stratigraphy

The excavation undertaken within the research presented here reached a depth of ca. 190cm, and layers below unit 11 were recognised as natural shell accumulation. The sounding did not reach to the bedrock due to the lack of time. The stratigraphic section of the Site 01 is shown in figure 1.

The contexts at Site 01 can be classified into three main types (after Kipfer, 2007, 23) as use related primary contexts (e.g. Context 6-8 with faunal and lithic remains), transposed primary contexts (e.g. context 7 as result of depositional activity by midden creation) and natural secondary contexts (e.g., termite hole in the context 5 caused natural disturbance to that layer, including intrusive material). Eleven contexts were identified within the stratigraphic sequence. Context 2, 3 and 4 represents recent dumping of small shell particles. According to local sources, this was related to modern shell extraction, with small fragments being left behind and only large fragments/shells left in the sieve were collected for sale. The top shell layers, therefore, could be a dumping of such discarded. No observable, recent processes of re-deposition or taphonomic alteration could be determined from and below context 5, therefore we regarded this portion of the site as undisturbed and therefore be archaeologically valuable. Context 6 is the interface of context 7 and shows the termination of the Mesolithic habitation at the site. The context 7, 8 and 10 form a part of the cultural stratigraphic sequence. Context 9 lies above the shell deposit. All eleven contexts are divided into four phases based on the interpretation of the stratigraphy in combination with the nature of the material recovered from the excavation. No exact time frame could establish for the early phases due to the lack of scientific chronological data.

Phase I - Recent (possibly since 1900 AD)

Phase II - Historical period

Phase III - Mesolithic habitation

Phase IV - pre-occupational phase

Data from the Phase III will be focal in the present study.

The shell deposit proved to consist of shallow layers, which was no greater in depth than initially visible on the exposed face of the deposit, i.e. 10 - 25 cm. The shell deposit's non-sedimentary content consisted number of individual specimens (NISP) of 4918 of the shell Asiatic hard clam (*Meretrix meretrix*), 242 of the shells of other species (described below) fragments of bones, charcoal, lithic and production waste of quartz and chert (two types), stone and four potsherds. The bones recovered from the excavation include the remains of fish and terrestrial animals.

## Mollusc species richness and diversity

A total of 18 mollusc species from the nine layers of a single site at Kalamatiya (Named site 01) is discussed here. The most frequent species recorded was Asiatic hard clam (*Meretrix meretrix).* The context 07 of site 01 displays a higher species richness (number of taxa) within the site in comparison to the low numbers of taxa identified in the lower layers. The context 07 itself contained 12 species, i.e., *Meretrix* sp., *Anadara* sp., *Donax cuneata, Saccostrea* sp.*, Cerithedia cingulate, Acavus heamestoma, Aulopoma hofmeisteri, Beddoma trifasiatus, Papyridea soleniformis, Eunaticina* sp., and two unidentified bivalve species (nacreous and calcareous). Therefore, it seems that none of the middens in these formations consists of only one species. The NISP of this context was 2,393, with 96.5% of this assemblage comprised of *Meretrix* sp. (NISP = 2309, MNI = 1226) and the other 11 species combined represented within the remaining 3.5%. This suggests that the midden deposit is comparatively rich (relatively to the rest of layers), but with an increased number of taxa the level of diversity is quite low, due to the fact that single taxon is dominating the asseblage to such a high degree. The species identified from the other layers are *Umbonium vestiarium, Oligospira polei, Lissachatina fullica, Tapes sulcarius, Purpura persica* and *Cryptonatica operculata.* Except the *Lissachatina fullica* which were introduced at some point in the recent past, all other shells are archaic and were recovered from the contexts covered by thick brownish sediment. These species are from a wide range of environments, such as littoral muddy sand, coastal sands, terrestrial and arboreal habitats. Four of the species are

represented by a single occurrence (n=1), while another four species appear less than eight in number (Siriwardana, 2015, 125). Existence of Acavus, Aulopoma and Oligospira in these shell middens should be re-examine by an extensive study. Habitats of these species are limits to the wet and the intermediate zones. Live specimens of these are not recorded from the dry zone.

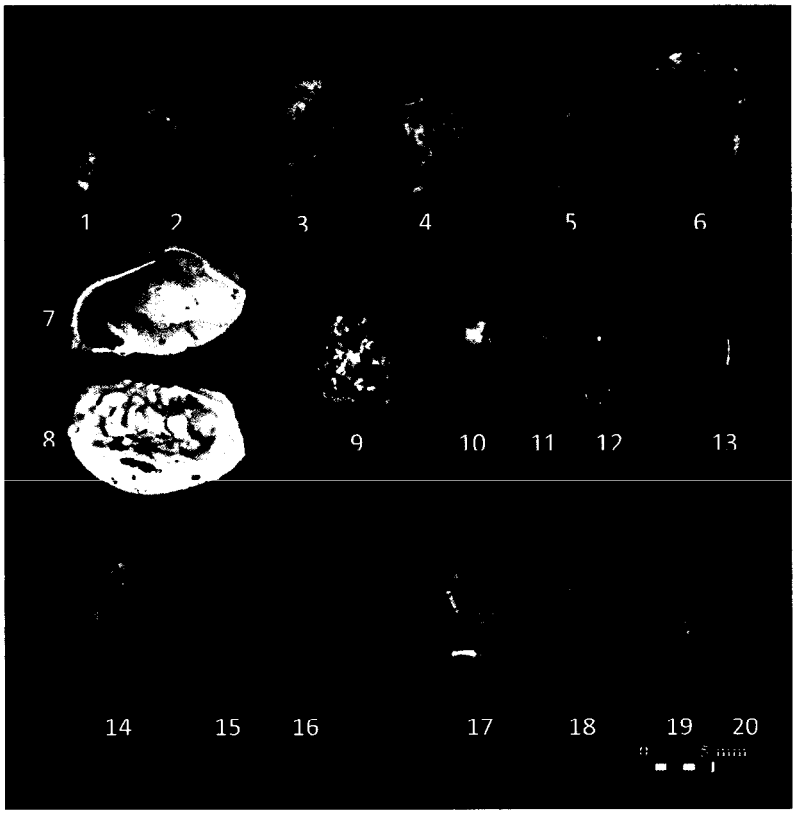



***Plate 1 - Otoliths (1-6 and 9 = astericii , 7 and 8 = sagittae), teeth (10 = fish, 13 = rodent) and small vertebrae bones (14 - 20), some unidentified inclusions (11 and 12) from the Site 01***

## Non-mollusc fauna from the site

The assemblage of faunal remains consists of 82 specimens (including nine vertebrae, 10 fish otoliths, two teeth) from all contexts (Table 1) (figure 01). Two faunal remains could be identified accurately to species

level, i.e. *Rusa unicolor* (sambur) by its right astragalus bone and *Epinephelus malabaricus* (*Eng.* - Malabar grouper, *Sin* - Gas Bola / Gal Kossa) from its otolith. All the fish vertebrae, otoliths, and teeth are from the individuals belonging to the superclass of *Osteichthyes* (bony fishes), but none except the one taxon noted above-identified to its species or genus. One piece of a Rodentia incisor tooth was also recorded.

***Table 1 Faunal remains from Site 01 - Kalamatiya***

| | Stratigraphic sequence (context) | Metrics (mm) | | NISP | Description |
|---|---|---|---|---|---|
| | | Length | Width | | |
| 01 | 06 | 59 mm> | | 05 | Unidentified mammal bones |
| 02 | 07 | 54 | 29 | 01 | right astragalus bone of a *Rusa Unicolor* |
| 03 | 07 | 71 mm > | | 04 | Unidentified mammal bones |
| 04 | 07 | 12 | 8 | 02 | Fish otolith of *Epinephelus malabaricus?* |
| 05 | 08 | 66 | 35 | 01 | Fish vertebrae |
| 06 | 08 | 4 | 2 | 01 | Fish vertebrae |
| 07 | 08 | 3 | 2 | 01 | Fish vertebrae |
| 08 | 08 | 11 | 5 | 01 | Fish vertebrae |
| 09 | 08 | 3 | 1 | 01 | Fish tooth |
| 10 | 08 | 19 mm > | | 31 | Unidentified mammal bones |
| 11 | 10 | 7 | 4 | 01 | Fish vertebrae |
| 12 | 10 | 5 | 5 | 01 | Fish vertebrae |
| 13 | 10 | 5 | 3 | 01 | Fish vertebrae |
| 14 | 10 | 3 | 2 | 01 | Fish vertebrae |
| 15 | 10 | 8mm> | | 06 | Fish otolith |
| 16 | 11 | 6 | 3 | 01 | Piece of Rodentia incisor tooth (mouse ?) |
| 17 | 11 | 7 | 5 | 02 | Fish otolith |
| 18 | 11 | 18 mm> | | 21 | Unidentified bones |

## Vertebrate faunal remains

Bones recovered from the site belonged to both terrestrial and aquatic species. They can be classified as long tubular bones (limb and rib bones), short tubular bones, vertebrae, and unknown. A large number of vertebrae were identified as *Osteichthyes* (bony fishes) based on the distinct centrum and transverse process in vertebrae. Only one larger trunk vertebra from context 07 retained a neural spine, belonged to a bony fish possibly as large as ca. 1.5m. Other vertebrae could be identified as belonging to *Rusa unicolor* (sambur) by the right astragalus bone. Rib bones and limb bones are possibly from birds (?), and the patellar, malleolus, and condyle of remaining bones are similar to that of bird's bones. These require further analyses with a comparison to physical reference collections to identify its species.

Large fragmented bones from terrestrial mammals were also recovered (fig 3), although the degree of fragmentation inhibits identification to species. As the region has high biodiversity, consisting of 24 mammals and 168 bird species, and especially turtles are still considered as a delicacy for their eggs and meat, the mid-Holocene coastal inhabitants of this region possibly had good alternative food sources. Further, a large number of marine (n=185) and lagoonal-freshwater (n=35) fish species provide significant food sources.

Two taphonomic processes can be identified macroscopically on the bone surfaces, namely, sedimentary deposition and adherence to the surface and fracture patterning. The surface of all the bones, except that of the astragalus bone of *Rusa unicolor* (sambur), were covered with a layer of sand - mud highly bonded to the bone. This can occur on bone buried in the soil, and silty environments tend to accumulate earth debris within cracks in the bone and their trabecular matrix. Such sedimentary accumulations would be easily lost in highly energetic aquatic environments. If a bone is exposed to a sandy beach environment, it will tend to accumulate sand grains within cracks present on their surfaces (DeBattista et al., 2013, 774). These features on the bones of Site 01 indicate they were once submerged in soil and silty environment, and they were also possibly covered with water for the considerable period. This suggests the site was located at the edge of a lagoon. However, an astragalus bone found from the lower horizon of

Context 06 shows no deposition on it, and therefore which might indicate a date after the recession of water margin.

The reasons for bone fracture cannot be assumed based only on the fracture patterns. The stratigraphic sequence and associated materials also need to be considered here. The lithic remains suggest there was a human occupation occurring on the site during the formation of the 10th stratigraphic level. All significant faunal remains were recovered from this layer and the contexts above. It can be suggested that the inhabitants had an ichthyophagy focussed subsistence. Though the large percentage of bones of small individuals could suggest that fishing may have been limited to the littoral zone, other researchers have suggested the possibility of off-shore fishing during the Mesolithic (Somadeva and Ranasinghe, 2006, 22). Inhabitants of the site then relied heavily on small terrestrial game hunting in addition to that of small fish. The exploitation of shell sources was not frequently visible at these levels and becomes dominant only in context 07. Inhabitants might have discarded the bones of small animals around the camp floor, after which they were subjected to trampling, weathering and scavenging by animals, causing the bone fractures to occur. With sharp edges and the nature of the fracture which could commonly see from modern samples, the larger bones show an intentional breaking of the bones which could be linked to marrow extraction. Features of the remains of Cervus also show burning and marrow extraction marks, suggesting they were discarded as human food refuse. One large bone piece (from a large mammal) recovered from the site shows a characteristic rounding, with a symmetrical shape to the edges and at the core. It seems abraded intentionally, but for an unknown reason (fig. 3.3). It might have been intended to become an anthropomorphic figurine as some recent studies in the country suggested such figurines were used by Mesolithic hunter-gatherers (Somadeva et al, 2017, 52).

Some unstratified faunal remains could also be recorded from other sites. A conical shaped bone from the surface of Site 08 could be identified as belonging to a sea mammal. The only human remains recorded in the study were a skull cap. The small assemblage size of animal the remains, and the degree of taxonomic richness inhibits further detailed analysis of the sites.

## Otoliths

The stratigraphic sequence of Site 01 provides insight into a coastal deposit containing certain types of faunal remains, and otoliths (n=10) were one of the most significant ecofacts recovered. Otoliths are quite common in archaeological sites where fish was processed, but they were rarely recorded in Sri Lankan archaeological studies. Commonly, otoliths recovered from the site come from teleosts, or so-called bony fishes. Each bony fish produces six otoliths, one in each of the three pairs of chambers in the head. Three otoliths in each pair fall within three sizes found in the three chambers of the head; lagena (smallest), utriculus (middle) and sacculus (largest). In otolith studies, these three are respectively referred to as lapilli, astericii, sagittae. The otoliths from the lagena (lapilli) are not generally preserved in the archaeological record due to their structure and frequent chemical weathering (Campana, 2004, 03, Weiner, 2010, 154-6). As the shape of the otolith is unique to each species, otoliths provide for identification to species level, and potentially enable identification of the season of the occupation of the site, and enable reconstruction the environment in which the fish lived and had been caught.

Otoliths recorded in this study belong to two types of above, i.e. sacculus (sagittae) (n=2) and eight otoliths from utricŭlus (astericii), all of which are well preserved and provide an excellent record of these taxa. Otolith studies are highly lab-based analysis, but here no such measures were taken at this moment. Especially, the growth varves of the otolith can use to define the age of the animal, and the seasonal changes occurred at the time. No 'otolith database' yet exists for common Sri Lankan fish. The two large otoliths (sagittae) were therefore checked against the common marine - lagoon fish list of Sri Lanka along with *Campana's Photographic Atlas of Fish Otoliths of the Northwest Atlantic Ocean* (2004). These otoliths could be identified as being similar to that of *Epinephelus hiveatus* of the Atlantic Ocean (Campana, 2004,

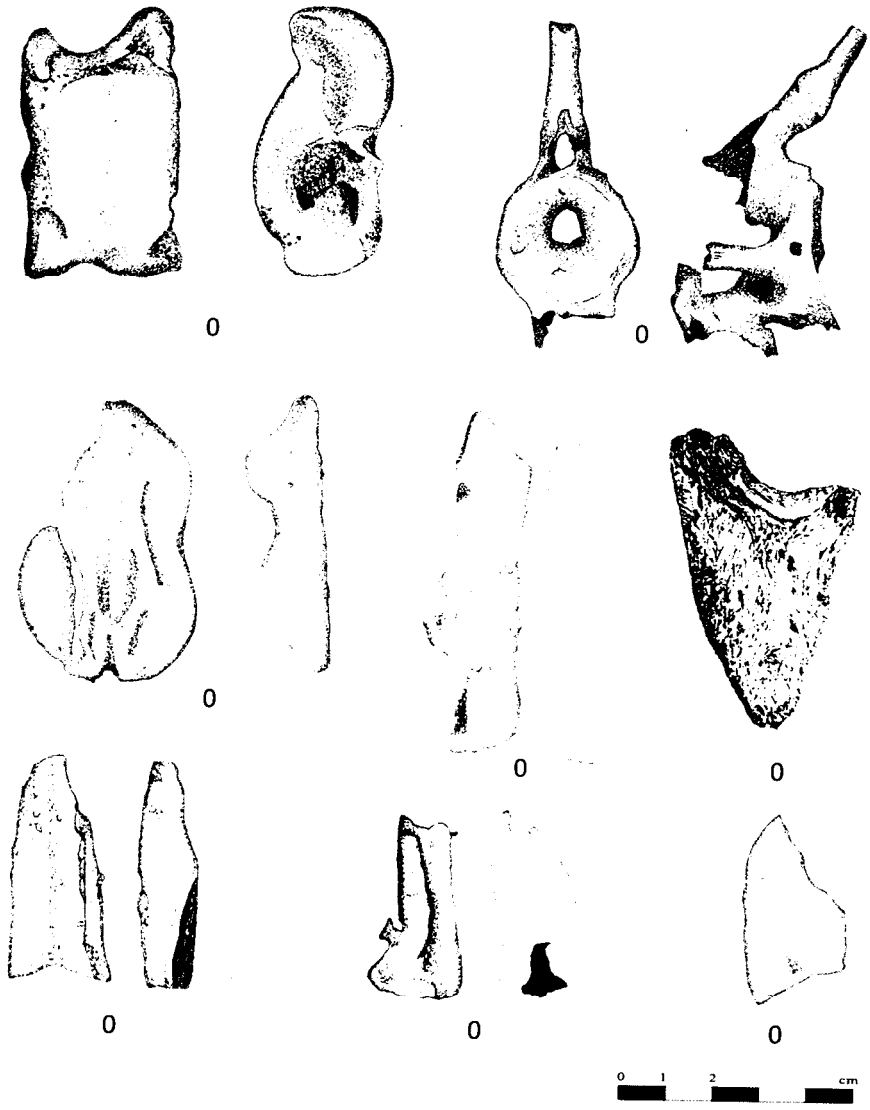



*Figure 3 - Bones found from the research area. 01 - 04, 06 - 08 - from Site 01, 05 - from Site 08 (1=context 6, 2-4, 6-8= context 7)*

183), which its common relative subspecies recorded in tropical seas is known as *Epinephelus malabaricus* (Malabar grouper) or as Gas Bola / Gal Kossa in Sinhala. *E. malabaricus*'s juveniles are found in estuaries and among mangroves. Mature adults migrate towards near shore and outer reef systems to depths up to 120 m, and the adults grow up to 130 cm in

length (Rome and Newman, 2010, 07). Further, this species is famous as a spearfishing target (Schembri and Tonna, 2001, 131).

Astericii otoliths were not examined as there being no reference collection for identification. However, it can be assumed that the inhabitants of site 01 had access to the nearshore - lagoonal fish sources and potentially exploited these taxa via spearfishing (?). Therefore, the inhabitants of this site did not strictly depend on molluscs while they had abundant fish sources. Their 'ichthyophagy' or fish-eating lifestyle combined with the all available aquatic life forms. Therefore, people has a relatively broad-based subsistence strategy, encompassing a range of resources and habitats. Foraging for larger molluscs was thence important, but not the sole resource exploited.

## Teeth

A tooth of a fish (context 08) and a mammal (context 11) were recovered from Site 01. The fish tooth could not be identified to species level as there are no reference collections available. Dentition of fish is more complicated than that of mammals, and there is significant variation in each class. Teeth in the palate of bony fishes are divided into several types, such as vomerine, palatine, ectopterygoid, and parasphenoid. The tooth found at the site could be identified as a vomerine teeth, which are flat and broad in shape. These types of teeth are commonly recorded as patches of small teeth for grasping or large molariform (rounded, molar-like) used for grinding food such as molluscs (Etnier and Starnes, 1993, 45). The fish could be a wrasse that has grinding plates for feeding off rock and coral (pers. comm. Faulkner, 2017). The recorded fish tooth possibly belonged to that of a fish that feeds on shells lived in lagoon floor? If so, this will strengthen the argument on lagoon-dwelling fishes and further, about the paleoenvironment in the region. Context 8 from where the tooth was recorded is associated with other cultural evidence as well. However, it is unknown if the tooth was transported to the site by human inhabitants or by an animal.

The mammal tooth could be identified as an incisor tooth of a mouse like rodent, although the species-level could not be identified. It is

possible that this represents natural deposition by a rodent that lived on the same floor.

## Chronology

The oldest available date for marine shellfish use in Sri Lanka comes from Batadombalena dated to 37,000 BP and is an ornament made on shell. Other Mesolithic sites with evidence for the use of marine shellfish are Belilena Kitulgala dated to 18,000 BP, Hungama to 7730 BP, Kalametiya to 6410 BP, Matota to 3950 BP, (Deraniyagala, 1992). The Hungama, Kalamatiya and Matota evidence are much relevant here where those coming from midden deposits.

No radiocarbon dates could be obtained for this research due to financial constraints. Therefore, the contexts recorded at Site 01 are cross-referenced with the known stratigraphic sequences provided by other researchers. Two chronological datasets are available for the sites at Kalamatiya from Deraniyagala (1992) and Perera (2010). Siran Deraniyagala reports a midden site near to Site 01, named Henagahapugala (site 57 in Deraniyagala, 1992, 701), a Grumusol containing Mesolithic habitation underlain by a shell midden. The site was probed only to the midden layer and found to be devoid of artefacts, and a radiocarbon date has been obtained on *Meretrix casta* lagoon-habitat shells, the calibrated age is 3190 BP (1240BC) (Deraniyagala, 1992, 97, 701). Another date for an assumed midden at Mini-athiliya, located north of the present site, has been radiocarbon dated (on charcoal) to 4400 - 3800 cal BP (Perera, 2010). Based on the available chronological data form these sites, in combination with an assessment of the assemblages recovered from those dated contexts, it may be possible to assume that context 07 at Site 01 also reflects late Holocene human occupation, although this would need to be confirmed via absolute dates.

The upper four contexts can be dated to the period after 1900 AD, as these units contain shells of *Lissachatina fulica,* a species which introduced to Sri Lanka during the early twentieth century as described

by D Robinson in his *The Giant African Snail (Lissachantina fulica); its history and reported* (Robinson, year not mentioned, 07).

## Conclusion

As the present short study shows, there is a high potential for the investigation of the subsistence of hunter-gatherers during the late Mesolithic period. The region possesses a diverse range of edible flora and fauna, and the regional variations in available food sources were a decisive factor in structuring the pattern of subsistence. As hunter-gatherer societies do not raise domestic crops or animals, they entirely depended on the available natural biomass for their diets. Marine and littoral environments markedly differed from an ecological point of view from inland locations and were treated as distinct contexts that had a particular effect on the foraging communities that inhabit them. Some show that the littoral areas were marginal environments, and human groups inhabiting these locations may have been forced via demographic pressure to locate more favourable ecological niches. However, some have argued (Ballbe and Escalera, 2002, 90, Bird et al., 2002, 457, Bodley, 2011, 426) that coastal environments are highly productive, and therefore since at least the Middle Pleistocene these areas were focal points for human occupation. Often the coastal birds, mammals, turtles, large reef fish, and molluscs become key sources for subsistence (Rainbird, 2007, 170). The available remains show coastal and marine resources would have contributed a significant amount to past subsistence structures. The coastal vegetation of Sri Lanka would not have contributed much to the survival of human settlements of the system (Somadeva, 2006, 78), and with available data from this study, it can be assumed the environment structure during the time of human habitation was a Holocene mangrove forest in a river mouth.

In the environmental report of IUCN, Kalamatiya introduced as follows (Perera and Weerakkody, 2004, 12),

> *The beach-seine site at Kalametiya is one of the most productive fishing grounds in the area. The near-shore waters are constantly enriched by nutrients from the Kalametiya lagoon attracting important fishery species to the area. The water in the area is often turbid, and the substrate is mostly rich mud supporting a thriving soft bottom community.*

Data from elsewhere on the island corroborate the importance of marine resources at this time, with the local diet including shellfish, in-shore fish, and also the occasional turtle and shark. The remains of bones suggest a regular use of animals and birds. Somadeva suggests the reduction of the sizes of the implements in the Mesolithic phase of Sri Lanka can be due to hunting small animals like birds (Somadeva, 2014, 25). The subsistence pattern of the inhabitants living at site 01 cannot be considered to represent the complete picture of the overall economy, as marine resources, terrestrial faunal remains and botanical remains may be under-represented or absent due to poor preservation in tropical conditions (e.g. Faulkner and Clarke 2004, 28). Coconut (*Coco nucifera*) was undoubtedly present, and the assumption can be made that they were also exploited on a regular basis. Also, the mangroves provide much potential. Therefore, further research should be conducted to fill these gaps.

As we indicated above, the coastal shell middens could produce a diverse range of non-mollusc faunal remains. Apart from the species richness and diversity, such remains could use to identify the nature of the economy and subsistence structure of the people as well as the depositional process which the sites went through. The focal point of the essay was to emphasize the value of sampling the inclusions in the middens disregarding its size which could use for a rethink about the subsistence and the environment of the Mesolithic coastal inhabitants.

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