The Role of Archaeomalacological Research in Sri Lanka: A Synthesis

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Abstract

This article focuses on the role of malacological research in Sri Lanka and the significance it holds within the field of archaeology. Malacology, the study of Mollusca, is an interdisciplinary field that combines elements of biology, ecology, and archaeology. We explore and synthesize the diverse applications of malacology that have been used to understand past societies and environments. In the last fifty years, malacological research has gained traction within archaeological investigations, contributing valuable insights into human-environment interactions, subsistence patterns, and cultural dynamics. By integrating data from archaeological excavations where molluscan remains have been recovered, researchers have been able to reconstruct past environments, identify resource exploitation strategies, shed light on human dietary choices, trade networks, migration patterns, and socio-economic complexities of ancient Sri Lankan societies. We summarize existing literature on archaeomalacological research worldwide, as well as specific case studies within Sri Lanka. By placing these findings in the broader context of Sri Lanka's archaeology, this paper aims to bridge existing knowledge gaps and contribute to a more comprehensive understanding of the island's rich cultural heritage, highlighting the pivotal role of archaeomalacology and its potential to enhance interpretations of past societies and environments in island Lanka.

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Introduction

Zoologists investigate live organisms, but they may also utilize shells, hides, teeth, bones, and other lines of evidence, such as stable isotopes and DNA to determine the age, gender, health status, and ancestral connections of individuals, regional populations, species, and higher taxonomic groupings. Paleontologists examine ancient animal fossils to understand more about their evolution, systematic connections, and ancient ecology, while zooarchaeologists study faunal remains associated with the human lineage within archaeological contexts. This paper examines the role of zooarchaeology in a Sri Lankan context with special reference to archaeomalacology, the study of mollusks from archeological contexts highlighting existing literature on archaeomalacological research worldwide, as well as specific case studies within Sri Lanka. This synthesis seeks to examine the potential contributions of archaeomalacology in the understanding of Sri Lanka's past. Archaeological sites in Sri Lanka have yielded large quantities of faunal remains belonging to prehistoric, protohistoric, and historic periods. A few research publications include taxonomic identification of animal species along with Mollusca.

The study of shells from archaeological sites, also known as archaeomalacology, comprises several detailed studies on selected sites in the region and within different ecological settings . Zooarchaeology (or archaeozoology) refers to the study of faunal remains found in archaeological sites (Chaplin, 1971; Lyman, 1994; Klein, 1984). The term zooarchaeology describes faunal studies aimed at answering archaeological questions on the past (Olsen, 1971). The study of animal remains requires knowledge of biology and paleontology but interpreting them for evidence of past human activity needs a unique combination of supplementary methodologies. Archaeological faunal analysis, like its counterpart field of research, paleoethnobotany, blends natural history methodologies with approaches borrowed from archaeology, anthropology, and other social sciences (Grayson, 1984; Gonzalez, 2018).

Archaeomalacology includes a wide range of aspects, such as environmental reconstruction, evaluation of subsistence tactics, foodways, and historical ritual practices. In recent research, archaeomalacology constitutes new methodologies, techniques and interpretations (Daniella & Mayer, 2005; Dijkstra et al., 2021). Globally, zooarchaeological studies have taken great strides, with new findings and interpretations being added at a fast pace to enhance our knowledge. At the beginning of the 1970s, stable isotope studies on human bones were used to reconstruct ancient food economies and foodways. Stable isotope analyses on animal bones are now being used extensively on animal remains to investigate herd management, seasonality, climate, biogeography, and paleoecology. The use of scanning electron microscopy (SEM) in the 1980s substantially aided in the determination of isotopic "signatures" present in non-human and human bone (Gonzalez, 2018).

Molluscan remains are a significant source of information for archaeological studies. They are valuable because of their widespread distribution, preservation in a variety of deposits, enormous numbers, and relative immunity from human influences, at least when contrasted with vertebrate remains (Sparks, 1963).

Molluscan remains aid in addressing a variety of archaeological issues and are listed below (after Deshpande-Mukherjee, 1998).

- Reconstruct ancient dietary patterns and nutritional status
- Reconstruct ancient economies
- Reconstruct past environments
- Detect human and animal migrations in time and space
- Identify climatic changes and seasonality cycles
- Identify rituals of ancient societies
- Identify tools and ornaments created and used in the past
- Infer ancient trade routes
- Infer connections between inland and coastal areas
- Infer demographic aspects – site use and population size

In the process of reconstructing the past and while interpreting data, rather than investigating the factors related to molluscan remains in isolation, it is reasonable to make interpretations related to the past by situating them within the context of other ancient archaeological findings.

Archaeomalacology in interpreting the past

Archaeomalacology is the discipline studying Molluscan remains from archaeological sites (Beaudoin, 2007). Mollusca can be found as individual shells, shell objects, waste pieces, or shell deposits at specific locations (Deshpande-Mukherjee, 1998). The phylum Mollusca is one of the largest of all animal phyla, including more than 110,000 living species (Pechenik, 1985). Mollusca come in a variety of forms, sizes, colors, and shapes, as well as ornamentation such as spines, ribs, and furrows. The outer shell is created by the deposition of calcium carbonate crystals in an organic matrix of a protein molecule called conchiolin. Its structure is separated into three zones:

1. Outer organic layer: periostracum.
2. A prismatic or columnar crystal layer of calcite or aragonite.
3. An inner layer of thin laminate crystalline sheets. (Deshpande-Mukherjee, 1998).

The existence of such material in the archaeological record is caused by two factors: 1) human action and 2) natural introduction by agents such as wind, insects and burrowing animals (Deshpande-Mukherjee, 1998). According to Sparks (1963), to use the Mollusca to determine the age of the beds in which they were found and the natural conditions prevailing during their deposition, the study of past distributions, occurrences, and associations of non-marine Mollusca in the Quaternary period, has two main goals of archaeomalacology.

Malacology Research in Sri Lankan Archaeology

Mollusca inhabiting land and sea have been used by humans for various purposes. Evidence of Mollusca has been found in many archaeological sites in Sri Lanka. These findings have been found in explorations and excavations in the fields of prehistoric and historic times, and this information has been reported by various researchers. Selected sites and associated data are presented in Table 1.

Table 1. Mollusca recovered from selected archaeological sites

Mollusc Species	Selected Sites (Abbreviations)*										Periods		
	ANU	JET	MNT	BDL	BEL	ALL	ALW	ALI	HMA	GOR	**Prehistoric** (Late Pleistocene-Early-Mid Holocene)	**Protohistoric** (Mid-Late Holocene)	**Historic** (Late Holocene)
Turbinella Pyrum	√	√	√						√				+
Moneta moneta	√	√	√										+
Pila lanka sp.	√	√										+	+
Lamellidens sp.	√			√						√		+	
Cryptozona sp.	√												+
Anadara sp.	√								√		+		+
Cypraea Arabica	√											+	+
Agaronia nebulosa	√												+
Certhidae cingulate	√												+
Crassostrea sp.	√												+
Polymesoda coaxans	√												+
Potamides cingulatus				√							+		
Unio Anadotino				√							+		
Acavus sp.				√	√			√			+		
Acavus roseolabiatus					√						+		
Acavus superbus						√	√				+		
Acavus phoenix						√	√		√		+		
Potamides sp.								√			+		
Aolophoma sp.								√			+		
Pila sp.								√	√		+		
Paludomus sp.			√						√	√	+		
Acavus haemastoma									√		+		
Oligospira sp.									√		+		
Meretrix meretrix									√		+		
Marcia sp.									√		+		
Gafrarium tumidum									√		+		
Cyclophorus sp.										√	+		
Pila golabosa			√										+
Achatina fulica			√										+
Amaea ducussata			√										+
Amusium pleuronectes			√										+
Anadara antiquata			√										+
Anadara scapha			√										+
Architectonica laevigata			√										+
Architectonica perspectiva			√										+
Conus quercinus			√										+
Cyprea quercinus			√										+
Cyprea annulus			√										+
Isognomon sp.			√										+
Murex sp.			√										+
Natica sp.			√										+
Paphia gallus			√										+
Pugilina bucephala			√										+
Pugilina conchlidium			√										+
Scalptia scalata			√										+
Solen brevis			√										+
Solen sp.			√										+
Strombus gibberulus			√										+
Strombus labiosus			√										+
Telescopium telescopium			√										+
Turridrupa bijubata			√										+
Umbonium vestiarum			√										+
Vexillium subdivisum			√										+
Vexillium unifasciatum			√										+

ANU: Anuradhapura Citadel
JET: Jetavana Vihara
MNT: Mantai
BDL: Batadomba-lena
BEL: Beli-lena
ALL: Alu-lena Attanagoda
ALW: Alawala-lena
ALI: Aligala-Sigiriya
HMA: Hungama Mini-Athiliya
GOR: Gorahandigala-le

√ presence of molluscan species within selected sites and + within periods

Data: Adikari & Manamendra-Arachchi, 2012; Chandraratne, 1989,1998, 2003, 2015; Deraniyagala, S, 1972, 1992; Kennedy, 1986; Kulatilake et al., 2014; Kulatilake et. al., 2018; Joglekar 2013; Perera, 2011; Perera, 2015; Ratnayake, 1990; , 1999; De Silva, et. al., 2005).

In archaeological excavations, it is of utmost importance to systematically uncover and accurately record these data. The evidence of molluscan remains has been uncovered in numerous excavations and cited in various research on ancient fauna. However, there is a need for a formal literature survey to identify the coverage of information as well as the gaps in research regarding molluscan assemblages.

For nearly a century, archaeological explorations and excavations in various climatic and geographical regions of Sri Lanka have been conducted. Mollusca found in those archeological records have been subjected to various classifications and in some cases have been used to interpret the ancient condition of the field. Therefore, pre-studies can be based on molluscan data from all these archaeological records. Attempts to interpret the past using them in each of these records are primarily under literary scrutiny. Mollusca in these records are simply additional archaeological remains and no detailed studies of them can be found.

The study of molluscs became popular all over the world under new archaeology. Aarti Deshpande-Mukherjee's study of molluscs is very important in the South Asian region. Therefore, Deshpande-Mukherjee's studies on molluscan remains belonging to the archaeological contexts are used as a model in various research in South Asia (Deshpande-Mukherjee, 1998; Deshpande-Mukherjee, Sengupta & Nath 2012, 2014; Deshpande-Mukherjee & Shinde, 2014).

Important archaeomalacological research in Sri Lanka

Concerning the Sri Lankan archaeological and zoological research history that could be identified, there have been few instances of malacological research transpiring since the middle part of the 19th century. Some British scientists have discovered and published the endemic molluscan species found in the wet zone of Sri Lanka. Layard's work (1849) can be recognized as the first attempt to analyze molluscan remains scientifically in Sri Lanka.

F.R.M.S O. Collett can be entitled as a pioneer malacological researcher in Sri Lanka. He published several articles in the Journal of the Royal Asiatic Society (Collett 1898; 1899; 1900a,b). He also conducted his research in Sri Lanka on behalf of the Malacological Society of London. His work includes an article titled "Contribution to Ceylon Malacology; Description of a new Helicoid land shell from the southern province" (Collett, 1898, pp. 153-54); He published the articles under the theme of Contribution to Ceylon Malacology and two articles were titled "The Terrestrial Mollusca of *Ambagamuwa*" and "Pearl Oyster and Pearl Fisheries". Collet's works initiated malacological research in Sri Lanka. He also refers to the endemic species of Mollusca and some fisheries adjoining them. The mentioned research couldn't be identified as an archaeological investigation although those attempts try to give researchers in malacology research experience. After his works, most zoologists have done several surveys on the identification of new species of Mollusca.

The Batadomba Lena prehistoric cave site excavation in Kuruvita has yielded significant findings, including the remains of Mollusca, which have been analyzed using scientific methods. This analysis has provided valuable information about the diet and ecological conditions of prehistoric inhabitants in the area. By studying the molluscan remains, researchers can better understand the ancient environment and the resource utilization strategies of early human populations in rainforest environments in the Pleistocene epoch (Perera, 2011).

Although not an archaeological study, Raheem (2005) can be identified as a comprehensive study of Mollusca found in Sri Lanka, making them important for the identification and classification of Mollusca. The research conducted by Ratnapala (2003) has also focused on land-dwelling Mollusca (A check-list of Land snails of Sri Lanka) which is an important classification for facilitating the current research on the molluscan species. Concerning the Sri Lankan Archaeological context, molluscan remains were vital for the food economy, making ornaments, building construction, and trade activities. According to the archaeological research history of Sri Lanka, molluscan remains can be considered as one of the most common findings from archaeological contexts. P.E.P. Deraniyagala (1958) mentioned some molluscan species belonging to the Pleistocene period, especially referring to the Paleolithic and Mesolithic cultures in Sri Lanka. Nonetheless, it is a mere record, not an interpretation of the past, especially using Mollusca. Pearls are the main variety of Mollusca and many researchers have done extensive research on the historical status of pearl oysters (Katupotha, 2019). "A Multispecies History of the Ceylon Pearl Fishery 1800–1925" was focused in more detail on the historical situation of Sri Lanka with regard to pearl Mollusca (Fernando, 2021).

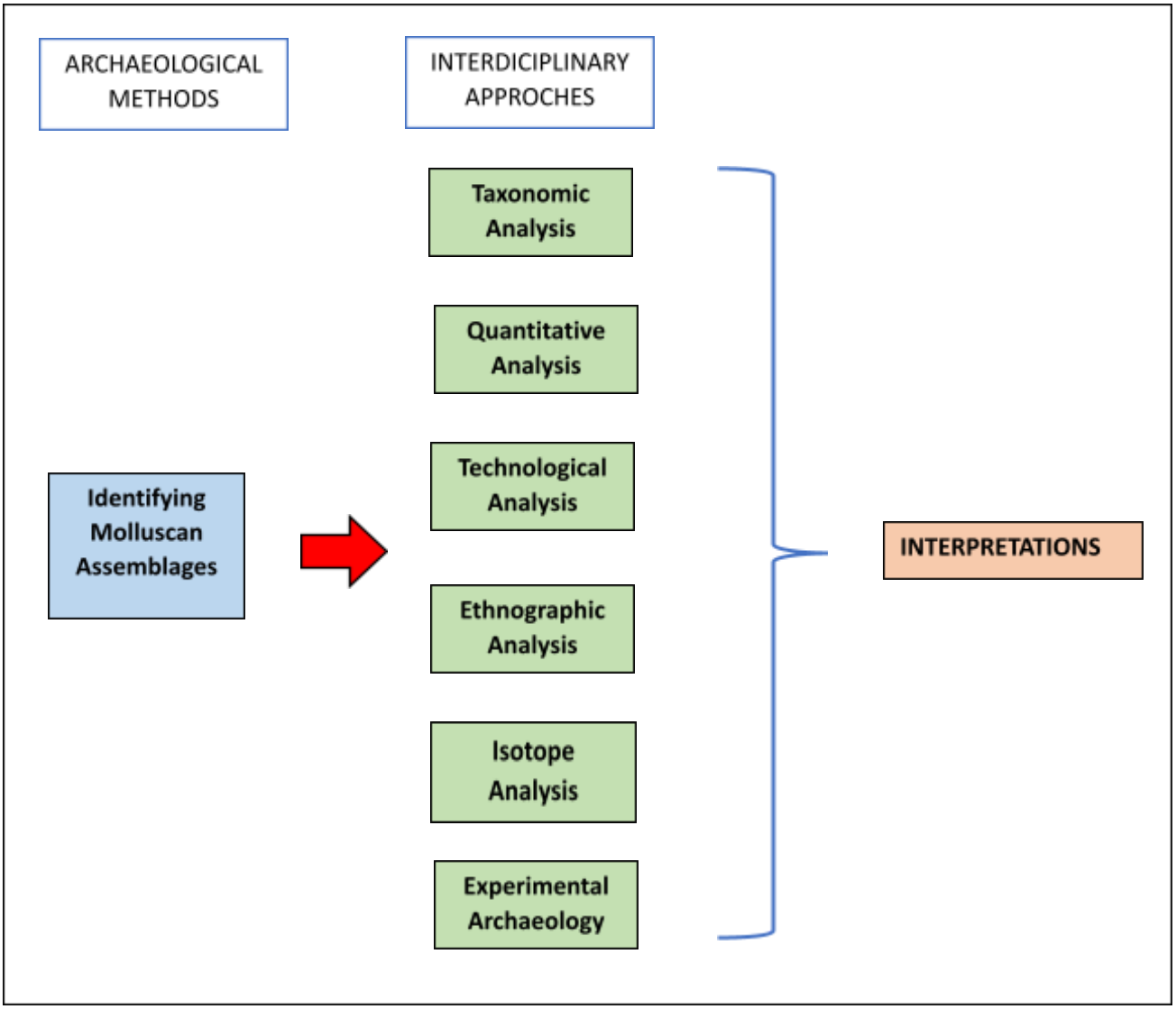
Important research in the field of malacology has been conducted by recent researchers (Siriwardana, 2009; 2010; 2013; 2014). In addition to the research mentioned above, one of authors of the article has also mentioned several molluscan species identified from the most excavated test pits at the Citadel of Anuradhapura, between 1995 and 1991 in Sri Lanka (Chandraratne, 1998). Studies on shell midden sites in the southern coastal belt of Sri Lanka have brought to light the significance of shellfish in the diets of Mid-Holocene coastal communities (Kulatilake et al., 2014; Kulatilake et al 2018; Somadeva and Ranasinghe, 2006). Concerning prehistoric and historic food economy, several analytical studies were conducted after 1984 by P. B. Karunaratne, Jude Perera, and K. Manamendra-Arachchi at the taxonomic level (Chandraratne, 1998). Recently, edible and non-edible molluscan species from archaeological sites were referred to human dietary patterns especially during the terminal Pleistocene of Sri Lanka (Perera, 2015).

A model for archaeomalacological studies

Molluscan remains, including shells and other calcareous structures, have often been overlooked in archaeological research, despite their potential as informative artifacts. This theoretical model seeks to bridge this gap by providing a structured framework for examining and interpreting molluscan remains in archaeological contexts (See Figure 1). Models are pieces of machinery that relate

observations to theoretical ideas, and they are undeniably appreciable (Clarke, 1972).

Figure 1. Theoretical Model: Archaeomalacology Research in Sri Lankan Context



The first step involves identifying and documenting Mollusca remains recovered during archaeological excavations or surveys. Proper sampling strategies should be employed to ensure representative assemblages. This includes documenting shell types, sizes, preservation conditions, and spatial distribution patterns. A taxonomic analysis is crucial for identifying and classifying mollusk species found in the assemblage. This enables researchers to understand the ecological context, habitat preferences, and geographic distribution of Mollusca, shedding light on past environments. Quantitative methods can be employed to assess the relative abundance and frequency of Mollusca species within the assemblage. This can provide insights into changes in biodiversity, environmental conditions, exploitation patterns, and potential economic importance.

Investigating the modifications and uses of Mollusca shells through technological analysis allows for understanding the range of applications they had within past societies. This includes examinations of decoration, tool use, ornamentation, and symbolic expressions, offering valuable insights into cultural practices and socio-economic systems populations (Renfrew, 2016). The use of scientific analysis in archaeological research is crucial as it allows us to objectively uncover and interpret the past, providing valuable insights into human history and cultural development. There are a number of laboratory examinations that can be used for archaeological research. Isotope analysis is a powerful tool used in archaeomalacological research to gain insights into past environments and human activities. By analyzing the isotopic composition of Mollusca shells found at archaeological sites, researchers can reconstruct past climatic conditions, as well as understand the dietary patterns and migration patterns of ancient populations (Renfrew, 2016). Isotopes such as oxygen, carbon, nitrogen, and strontium can provide valuable information about the source of food, water, and environmental conditions experienced by molluscs, which in turn, reflect the behaviors and choices of past human societies (Renfrew, 2016). This multidisciplinary approach allows us to unravel the intricate connections between humans, Mollusca, and their environments throughout history.

Collaboration between archaeologists, biologists, anthropologists, and environmental scientists is fundamental to fully understand the socio-economic and cultural implications of Mollusca remains. Integrating multiple datasets and perspectives enhances our ability to interpret human-environment interactions, trade networks, culinary traditions, and symbolic practices.

By adopting this theoretical model, archaeologists can effectively reveal the socio-economic and cultural dimensions from molluscan remains in archaeological contexts. Utilizing a systematic approach, incorporating interdisciplinary methods and perspectives, will enhance our understanding of past societies and foster a more holistic understanding of human history.

Discussion

The significance of archaeomalacology in Sri Lankan archaeology cannot be overstated. Through the meticulous study of Molluscan remains, archaeologists gain invaluable insights into the ancient coastal communities, trade networks, and environmental patterns. The identifications and analysis of these tiny shell fragments provide a wealth of information about past human behavior, resource utilization, and cultural dynamics. Furthermore, archaeomalacology contributes to a more comprehensive understanding of Sri Lanka's rich archaeological heritage, offering novel perspectives and shedding light on previously overlooked aspects of the island's history. As we continue to delve deeper into the realm of archaeomalacology, we will undoubtedly uncover even more fascinating revelations, changing the way we perceive and interpret Sri Lanka's ancient past.

By examining the distribution patterns of shell artifacts, such as beads or tools, archaeologists can infer connections between different regions and communities, facilitating a better understanding of cultural exchange and social

dynamics By employing a multidisciplinary approach, combining archaeology, biology, and ecology, this research aims to advance our understanding of ancient Sri Lanka through the lens of malacological analysis.

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