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A Pilot Project: Understanding Late Pleistocene and Holocene Sea Level, Climate Changes and Human Activities from Southeastern Sri Lanka

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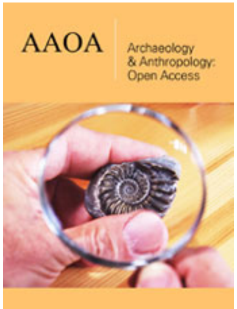

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Abstract

Preliminary fossil pollen data suggest that the globally significant Ramsar wetland site, Bundala National Park, located on the southeastern coast of Sri Lanka, has excellent potential for analysing radiocarbon-dated palynological records to understand the broad changes in the past environment. Changes in mangrove and monsoon forests appear to have been link with changes in sea level, monsoonal climate, and human activities. Pollen records of mangrove and lowland rainforests dating back to the late Pleistocene (30,000-33,000yrs BP) were well preserved in the sediment cores recovered from Lagoons in Bundala National Park.

Keywords: Pollen; Sea level; Monsoon; Mangrove

Introduction to the Project

During the Last Glacial Maximum (LGM), the global relative sea level has fallen due to the increasing tendency of the ice sheets in the northern and southern hemispheres of the world and the earth's deformation processes, decreasing the volume of water contained in the ocean basins [1-7]. Recent global sea-level data indicate a relatively slow fall in sea level from 35 to 31cal ka BP followed by a rapid fall during 31-29cal ka BP, responding to the rapid growth of ice sheets. Due to the further extensive growth of ice sheets, the sea level slowly reached its lowest at 21cal ka BP marking the LGM [1,8,9]. The onset of the melting of the ice sheet at 21-20ka marked a short episode of global sea-level rise, and it non-linearly rose up to 4.2cal ka BP at different rates [1,8-10]. Since the end of the middle Holocene (3-4cal ka), the sea level is believed to have reached nearly the same level as today [7]. However, it is still unclear how the pattern of global sea level changes has affected countries like Sri Lanka, especially due to the scarcity of clear evidence of sea level changes in the Indian Ocean.

It is assumed that the coastal environment of Sri Lanka, located in the northern Indian Ocean during the late Pleistocene and Holocene, may have been affected by sea level fluctuations and underwater geological processes such as tsunamis [7,11-13]. Sites located in southern coast of Sri Lanka have a potential to understand the impact of relative sea level changes [2,7,14-16]. There are a few records of the middle-late Holocene sea-level changes marked by the changes in geomorphological features such as lagoons, beaches and barriers, shell beds and terraces [17] coral and shell [18,19]; sedimentological [7,13,20], geochemical [21,22] and mangrove pollen proxies [23,24]. These records suggest that archives such as lagoons along the southern and southeastern coast mainly contain the Holocene environmental changes due to marine transgression [25].

Still, the impact of the late Pleistocene Sea level changes is obscure in that region of Sri Lanka, wherein paleoclimate records are extremely sparse [22]. On the southern and southeastern coasts of Sri Lanka, modern mangrove vegetation is extraordinarily discontinuous compared to the east and west coasts [20,26]. This argues that the influence of climate, sea-level changes, human activities, tsunamis, landslides, earthquakes and volcanic eruptions in the Indian Ocean since the onset of the LGM may have caused extreme inundation and destruction on the coastal landforms with mangroves [27-29]. Particularly, knowledge of tsunami impact that happened before and after LGM along the southern and southeastern coastal environment of Sri Lanka is extremely sparse [30]. Holocene tsunami history is also incomplete for the region (Bryant and Nott 2001) [30].

Sea-level change, climate and tsunami-like processes significantly influence changing the coastal landforms in Sri Lanka. Even so, in the coastal environment, the relationship among climate, sea-level changes and tsunamis, earthquakes, landslides, volcanic eruptions and tectonic derived from seismic activities is extremely obscure due to a lack of studies. It has been said that clear knowledge of the history of those changes is vital to conduct sustainable development programs as scheduled on coastal lands, but no adequate research to understand how those processes were linked with natural and anthropogenic activities in the past [31]. Therefore, understanding coastal landform evolution on a long-time scale is crucial to upgrade available environmental predictive models, developing high-resolution models, and understanding adaptation strategies for the adverse effects of coastal ecological changes.

Palynological studies have the potential to understand late Pleistocene and Holocene coastal environmental changes in the southern coast of Sri Lanka as suggested [7,24]. The current project aims to understand coastal environmental changes (sea level, climate and human activities) using radiocarbon-dated mangrove pollen evidence from Lagoons, located along the southeastern coastline (Figure 1). In the field season, stratigraphical coring and sedimentological studies have been carried out, with a series of core records collected for radiocarbon dating and palynological investigation (Figure 2). Organically rich clay-silty sediments contain well-preserved pollen evidence, and basic analyses have been performed.

Figure1: Map showing the study site. Sri Lanka is an island in the northern Indian Ocean. Bundala National Park is located on the island's southeastern side.

Figure2: Stratigraphical coring and sedimentoloigical studies in Bundala National Park. Brackish water wetlands and dry monsoon forests including the taxa such as *Manilkara hexandra* and *Drypetes sepiaria* (A) can commonly be seen in the Bundala National Park Coring has been performed in Typha spp-dominated brackish water wetlands (B).

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