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EXTINCTION OF QUATERNARY MAMMALIAN HABITATS OF MEGAFAUNA IN SABARAGAMU BASIN, SRI LANKA

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ABSTRACT

The Quaternary period of the geographic history of the earth includes two geologic epochs *viz*., the Pleistocene and the Holocene. Both epochs divided the faunal stages and human cultural phases based on climate and sea level changes that took place during these periods. The Quaternary ice age began roughly about 2.58 MYO with cool and dry climate conditions. The extinct Australopithecines and many other extinct genera of mammalian mega fauna appeared during this time. Thus, the Quaternary period shows the extinctions of numerous predominantly larger, especially mammalian mega faunal species, many of them lived during the transition from the Pleistocene to the Holocene epoch. The debate on the demise of the mammalian megafauna is often characterized by two highly polarized points of view: (1) climate-induced extinction; and (2) human-induced extinction. In Pleistocene period most parts of the Northern Hemisphere of earth were covered with glaciers creating a cold climate. Due to this glacial formation the main sea level was much lower than it is today. The low sea level facilitated the connection of Sri Lanka with the Indian mainland with a land bridge. Therefore, a number of mega fauna and micro fauna were able to cross to Sri Lanka from India along this land bridge. The last land bridge was emerged around 7500 years BP. During the Pleistocene Period Sri Lanka experienced heavy rainfall causing the emergence of rain forest in the country. The heavy rainfall in the Sabaragamu Basin also provided habitats for a number of marsh loving animals including mammals. However, at the end of the Pleistocene epoch, drastic climatic changes were occurred resulting in the extinction of a number of animal taxa. Pleistocene fauna in Sri Lanka is known as Rathnapura Fauna. Their fossils are found in alluvial deposits in the Sabaragamu basins

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Key Words: Quaternary mammalian fauna, Sabaragamu Basin, Ratnapura fauna, Extinction

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1. INTRODUCTION

The Pleistocene is generally recognized as a time of gigantism in terrestrial mammals. “The causes for such gigantism are not completely understood, but they most likely include a response to colder conditions and an improved ability to resist predators and reach food higher on shrubs or buried beneath snow” (https://www.britannica.com/science/Quaternary/Quaternary-life). Ninety percent of the animals represented by Quaternary fossils were recognized by Charles Lyell (1820) as being similar to modern forms including many genera and even species of shellfish, insects, marine microfossils, and terrestrial mammalian mega fauna living today are similar or identical to their Pleistocene ancestors (https://www.britannica.com/). Many Pleistocene fossils demonstrate spectacular differences from 1833 to up-to-date by palaenotologists, geologist, sedimentologists, the International Union for Quaternary Research (INQUA), International Geological Correlation Programmes (IGCPs), International Union for Geological Sciences (IUGS) and individuals from different disciplines and geographical locations have been discussed by Chalrs Lyells findings (1830), and have found extinct and new marine and terrestrial fauna emphasizing the Quaternary period. Such studies are very useful for further investigation of extinction of the mammalian megafauna from different regions of the world. The Indian subcontinent represents a rich source of diverse paleoanthropological data in the form of pollen assemblages, various isotopic records, vertebrate and invertebrate fossil assemblages, and prehistoric stone tools in a range of palaeoecological contexts (Metzke et al.,2010). Most of the Quaternary fossil evidence, including hominin specimens comes from the fluvial sediments of the Narmada and other similar rivers (Chauhan, 2008). During the Quaternary climate and sea level changes, which were followed the glacial and interglacial stages, allowed to fauna migrating or lodging in continents as well as nearing islands (Katupotha, 2013). Therefore, a number of mega fauna and micro fauna were able to cross to Sri Lanka from India. The last land bridge was emerged around 7500 yr BP (Katupotha, 1995). The diverse paleoanthropological records, vertebrate and invertebrate fossil assemblages, and prehistoric stone tools in a range of palaeoecological contexts found in Sri Lanka from Gem pits and coastal deposits proved by Deranigala (1958) and Deraniyaga (1992).

2. METHODS

Fossil identification was carried out according to the special characters that found in those fossils and anatomical comparisons were also done (EASL Research Center, Kuruwita 2015). *Relative dating* was used to place those fossils in correct positions of the geological time scale (i.e., the age of an object in comparison to another). Biostratigraphy was used to place them in a correct order, but we do not yield any numerical estimates, which related to carbon dating or thermo

luminescence (TL). As primary sources, such as early research and publications were utilized. For fossil characterization and studying of special features, digital vernier caliper (150 mm : 6 inch), and Scale bars were used. For locating those fossil bearing places, Garmin 30 GPS with BaseCamp GIS were also used.

2. RESULTS AND DISCUSSION

Pleistocene fossils were discovered in association with "Ratnapura (alluvial deposits) gem pits" from Sabaragamu Basin in the Ratnapura district of Sri Lanka (Fig. 1) . Fossils were described as the "Ratnapura Fauna" by Deraniyagala (1958), and he attempted to identify, classify, and taxonomically describe their palaeoecology, palaeoclimatology and palaeoenvironment. Table 1 shows the list of extinct mammalian megafauna in Sri Lanka during the Quaternary period. A pictorial representation of fossils found in the Sabaragamu Basin during 1990-2013 is given by Figures 2, 3, 4, 5, 6, 7 and 8.

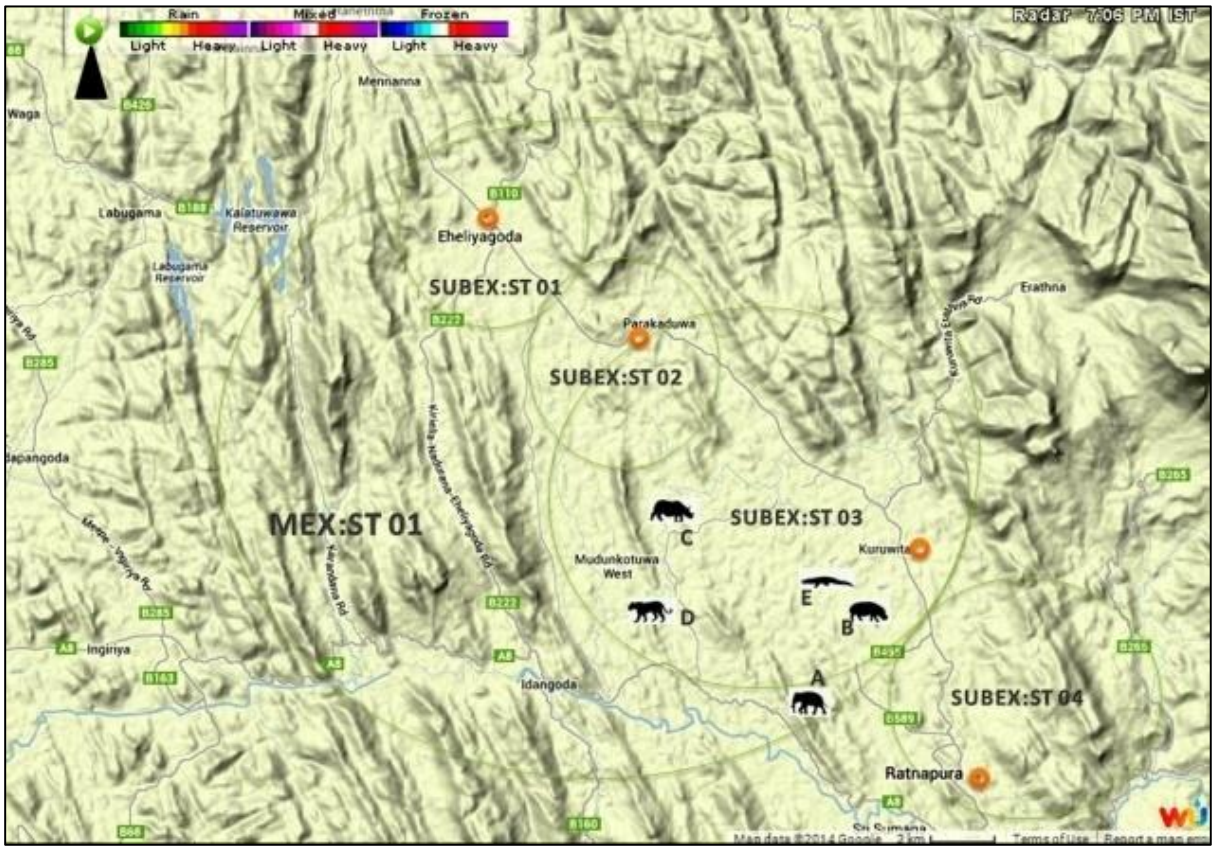

Figure 1: Geological view of Sabaragamu Basin, which shows the extinctions of mammalian distribution in Sabaragamu Basin in Ratnapura District, Sri Lanka.[**S**UBEX:ST01-Sub excavation point Eheliyagoda, SUBEX:ST02- Sub excavation point Parakaduwa, SUBEX:ST03-Sub excavation point Kuruvita, SUBEX:ST04-Sub excavation point Rathnapura, Most abundance animal fossils of main excavation site (MEX:ST01)-A: *Elephas* spp., B: Hippopotamus, C: *Rhinoceros* spp., D:Tiger or leo, E: *Crocodiles* spp.

Table 1. Extinctions of mammalian megafauna species during the transition from the Pleistocene to the Holocene epoch in Sri Lanka

Familia	Sub familia	Genus	Species	Subspecies	English Name & Locality	Other References
Felidae	Pantherinae	*Panthera*	*Panthera leo* **(extinct)**	*Panthera leo sinhaleyus* (Deraniyagala, 1939) 39,000 yr	Sri Lanka Lion	**Kelum et al., 2005**
Felidae	Pantherinae	*Panthera*	***Panthera tigris*** **(extinct)**	16,500 yr	Tiger	*Panthera tigris sudanensis* Deraniyagala, 1951 ?
Felidae		*Panthera*	*Panthera pardus*	*Panthera pardus kotiya*	Tiger ?	
Canidae	Caninae	*Canis*	*Canislupus*		?	
Bovidae	Bovinae	*Boselaphus*	*Boselaphus tragocamelus* **(extinct)**		Four-horned Antelope	
Bovidae	Antilopinae	*Antilope*	*Antilope cervicapra* **(extinct) *?***		?	
Bovidae	Bovinae	*Bos*	*Bosgaurus* **(extinct)**	*Bibos sinhaleyus, 1962*	Sri Lankan Gaur	
Canidae	Caninae	*Cuon*	*Cuon alpinus*		Wild Dog ?	
Hippopota-midae		*Hippopotamus Linnaeus*	*Hippopotamus amphibious* **(extinct)**	*Hexaprotodon sinhaleyus, 1937*		
			(extinct)	*Rhinoceros sinhaleyus, 1936*		
			(extinct)	*Rhinoceros kagavena, 1956*		
			(extinct)	*Elephas maximus sinhaleyus*		Sri Lankan Elephant
Bovidae	Bibos	*Bovinae*	*Bovinae sinhaleyus*			

Source: Action plan for conservation & sustaninable use of palaebiodiversity in Sri Lanka, 2016: Biodiversity Secretariat, Ministry of Environment & Renewable Energy and Personal Observations.

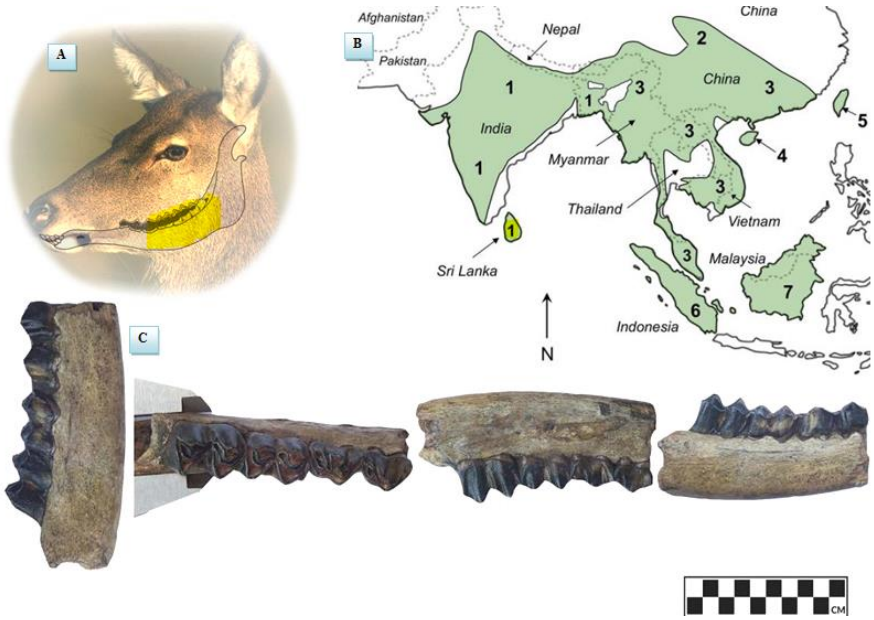

Figure 2. A: Mature female *Rusa unicolor* and lateral view of mandible, B: Distribution of *Rusa unicolor* in Sri Lanka, India, southern China, and southeastern Asia (1. *R. u. unicolor*; 2. *R. u. dejeani*; 3. *R. u. cambojensis*; 4. *R. u. hainana*; 5. *R. u. swinhoii*; 6. *R. u. equina*; and 7. *R. u. brookei*). *C. Rusa unicolor* (Fossil No PSLSA01) – Right mandible, outer or ducal expects with 2 pre molars and molars. Location- Edandawela (Gem Pit), Kuruwita, Sri Lanka, by Kamal & Aravinda 2007.

Figure 3. A1: Continental tiger (*Panthera tigris tigris*), A2: Sunda tiger (*Panthera tigris sondaica),* A3: Indochinese tiger (*Panthera tigris corbetti),* B: Representative images of Cranium and Mandible of Saber tooth cat (S*milodon fatalis*; left) and Bengal tiger which approximately related to Sri Lankan's extinct one (*Panthera tigris*; right). C: *Panthera tigris or Panthera leo sinhaleyus* (Fossil No PSLSA02) – Canine tooth in right lower mandible. Location- Galukagama MahaEla, Puwakattaovita (Gem Pit) Kuruwita, Sri Lanka by Kamal & Aravinda 2008, D: Side view of Lions Skull.

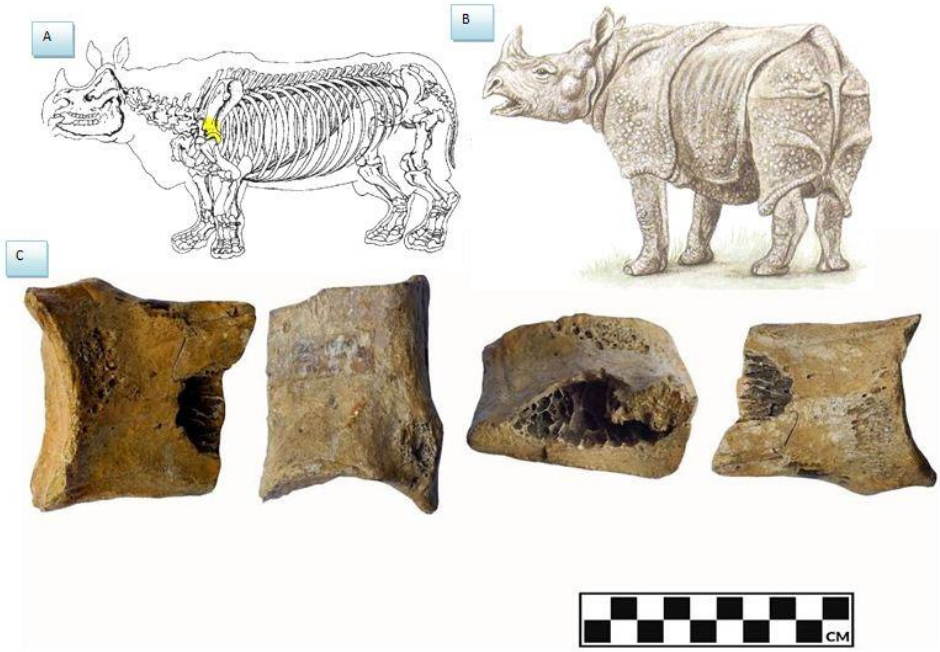

Figure 4. A: Skeleton of *Rhicocéros unicorne*, B: *Rhinoceros sondaicus* Desmarest 1822- Java-Nashorn - Javan Rhinoceros [Bildquelle: Horsfield, Thomas: Zoological researches in Java, and the neighbouring islands, 1824], C: *Rinoceros sinhaleyus* (Fossil No PSLSA03) =**(**Proximal portion of Scapula. Location- Kuruwita, Sri Lanka. By Kamal & Aravinda 2007

Figure 5. A: Reconstruct image of the pre hisroric Crocodylu species in Sri Lanka, B: *Crocodylu* ssp. Tooth **(**Fossil No PSLSA04), Location - Khengama, Ovita Kumbura (Gem pit), Kuruwita, Sri Lanka, by Kamal & Aravinda 2013 March.

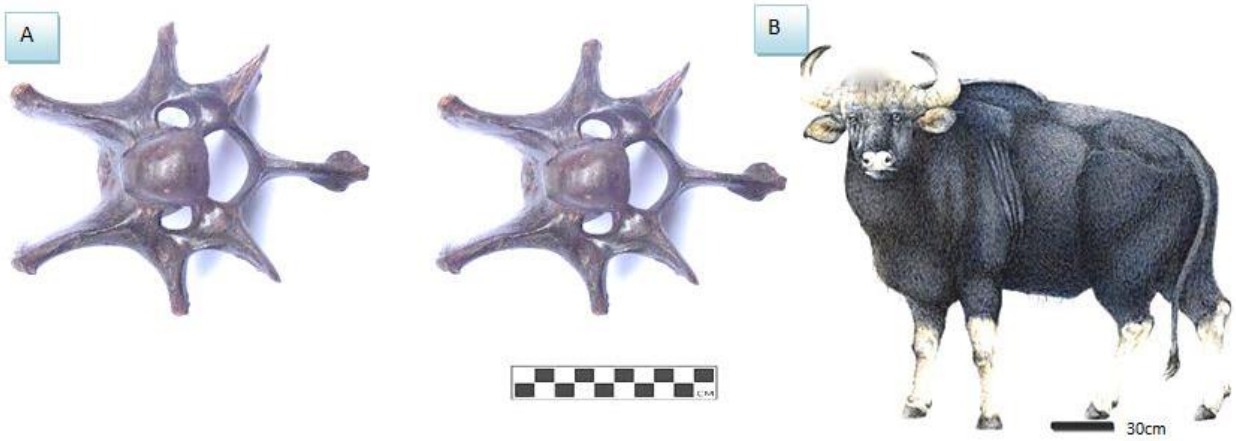

Figure 6. A: Bovine vertibra of *Bibos sinhaleyus* (Fossil No PSLSA05), Location- Ovita Kumbura, Khenagaa West (Gem pit-20 feet below) Kuruwita, Sri Lanka by Kamal & Aravinda 2005, B: Illustration of Gaur, Indian *Bibos gauris*.

Figure 7. Frist upper molar tooth of *Rhinoceros* spp. (Fossil No PSLSA06), Location: Galukagama, Maha ela (Gem Pit) Kuruwita,Sri Lanka, By Kamal & Aravinda 1994

Figure 8. Premolars of ***Elephas maximus sinhaleyus*** (Fossil No PSLSA07), Location : Kiriwee Kubura (Gem pit) , Kuruwita, Sri Lanka, By Kamal & Aravinda 1993

3.1 *Panthera leo sinhaleyus (extinct)*

Panthera leo (the lion) fossilis laid upon the gem field at a depth of 6.5m below the surface from a gem pit about four miles away at Pahala Vela, Galadande Mandiya, Gonapitiya, Kuruwita near the Kuru Ganga. The holotype is a third lower left carnassial in the Deraniyagala collection at the British Museum (Deraniyagala, 1958). This race is restricted to Sri Lanka; originally the lion appears to have inhabited Sri Lanka and India and was possibly replaced by the Bengal tiger that invaded India from the Northeast. The similarity between the African name is "Simba" meaning Lion, and the Indian equivalent Simha suggests that one is derived from the other. The lack of lion fossils in Africa suggests that the African is derived from the Indian *Panthera leo sinhaleyus* also known as the Sri Lanka Lion, was a prehistoric subspecies of lion,which endemic to Sri Lanka. It appears to have become extinct prior to the arrival of culturally modern humans, 39,000 years ago. This lion is only known from two teeth, found in alluvial deposits at Kuruwita. Deraniyagala cited fossils of three lion teeth found from the island; first in 1936, second in 1947 and the third in 1961. Manamendra-Arachchi et al. (2005) described that Deraniyagala did not explain explicitly how he diagnosed the holotype of this subspecies as belonging to a lion, though he justified its allocation to a distinct subspecies of lion by its being "narrower and more elongate" than those of recent lions in the British Natural History Museum collection.

The lion has been one of the most widespread mammals, having enjoyed a Pleistocene range that included Africa, Eurasia, North America and tropical South America, while the fossil record confirms that the species range in the Indian subcontinent did extend south to the 21º N and east to 87º E (Pilgrim 1931; Dutta 1976), approximately a line joining Gujurat to Bengal, but there is no evidence of the existence of the lion in Asia east of Bengal or anywhere in peninsular India and Sri Lanka, except for *Panthera leo sinhaleyus. Panthera leo fossilis,* also known as the Early Middle Pleistocene European cave lion, is an extinct feline of the Pleistocene epoch.

3.2 ***Panthera tigris*** **(**extinct)

Panthera tigris is a member of the Felidae family and the largest of four "big cats" in the genus *Panthera*. The *Panthera tigris tigris* (Bengal tiger) is a tiger subspecies native to India, Bangladesh, Nepal and Bhutan (Fig. 3). The pattern of genetic variation in the Bengal tiger corresponds to the premise that tigers arrived in India approximately 12,000 years ago. Kitchener and Dugmore (2000) considered that the changing biogeographical range of the *Panthera tigris* through the last glacial-interglacial cycle, based on habitat associations of modern tiger specimen records, and environmental reconstructions from the LGM. These cycles indicate that the numerous glacial cycles that span the evolutionary history of the tigers since its appearance in the fossil record about 2 Ma ago and the oldest tiger fossils (around 2 Ma old) are from northern China and Java. The key issue is to

determine the extent to which ancestral populations of the tiger were geographically isolated. However, Pleistocene glacial and interglacial fluctuations and other geological events probably caused repeated geographic restrictions and expansions of tigers. Hemmer (1987), Kitchener and Dugmore (2000) estimated the most recent common ancestor for tiger mtDNA haplotypes was 72,000–108,000 years ago, with a lower and upper bound of 39,000 years and 157,000 years, respectively. Recent history of tigers in the Indian subcontinent is consistent with the lack of tiger fossils from India prior to the late Pleistocene and the absence of tigers from Sri Lanka, which was separated from the subcontinent by rising sea levels in the early Holocene. However, a recent study of two independent fossil finds from Sri Lanka, one dated to approximately 16,500 years ago, tentatively classifies them as being a tiger (Manamendra-Arachchi, 2005).

However, the discovery of the Ratnapura tiger in alluvium, together with hippopotamus and rhinoceros fossils, demonstrates that tigers did indeed occur in the island. Nine fossils and sub fossils were identified that belonging to Tiger. Five of the fossils dated among those and identified 14,000 – 20,000 years old. One fossil that belonged to Lion was identified . The tiger was living 17,000 years ago (Manamendra-Arachchi, 2009). The Holocene range of the tiger extends to the southernmost tip of the peninsular India and to all of tropical continental Asia. The apparent absence of evidence of tigers in Sri Lanka and Pleistocene peninsular India has led to the conclusion that tigers arrived in south India “too late to get into Ceylon” (Pocock, 1930) as a result of the India-Sri Lanka land bridge having been submerged since the Late Pleistocene. On the basis of the few known Indian tiger fossils dating to the Holocene and the recent literature too, dates of the arrival of tigers to the Indian peninsula were occurred in the last glacial maximum, ca. 19,000 years BP.

Panthera tigris probably differentiated in the early Pleistocene (1.806–2.588 Ma ago) in northcentral and northeastern China. The earliest forms averaged smaller than those of later Pleistocene times. Thus it seems that the species has reached it’s maximum size in the living subspecies *P. tigris altaica*. The early Pleistocene species *Panthera palaeosinensis*, from northern China, appears to represent an early tiger or a form ancestral to the tiger (Mazak, 1981).

Researches on fossil remains have been conducted by many scientists, for example, Mazak (1981) summarized the fossils records in Sri Lanka. Accordingly fossil remains, definitely identified as *Panthera tigris*, are of lower to upper Pleistocene age and originated from the Altai caves in central Asia, eastern and northern China, including Choukoutien localities, Japan, Jana River in northern Siberia, the Ljachov Island situated off the northern coast of Siberia, and from Sumatra and Java. In addition, several sub-Recent tiger remains were found in Caucasus region, India, and Borneo. **It** is not clear whether the material from Borneo represents a member of the native late Pleistocene fauna or a later introduction by humans (there is no reliable evidence of tigers on Borneo within historic times).

3.3 *Elephas maximus sinhaleyus* (extinct)

The Asian elephant (*Elephas maximus*) is one of the most seriously endangered species of large mammals in the world. Given its enormous size and body mass, it is also one of the few species of terrestrial mega herbivores still exist. Its present geographical distribution extends from the Indian subcontinent in the west to Indo-China in the east across 13 countries including islands such as Sri Lanka, Sumatra and Borneo. The entire population in the wild is estimated to be between 35,000 and 55,000. Even optimistic figures indicate that there are only about one tenth as many Asian as African elephants (Hendavitharana et al., 1994).

Deraniyagala found one Fossil and explained the extinct Sri Lankan elephant as subspecies of *Elephas maximus sinhaleyus* (Deraniyagala, 1958). Deraniyagala explained the tusks usually present, molars smaller and mandibular spout wider than in forma typical. In addition, he explained that there were three recently extinct subspecies of *Elephas maximusasurus* (Mesopotamia), *Elephas maximus eondaicus* (Java) and *Elephas maximus rubridens* (China).

The extinct elephant species were living 100,000 years ago have been reported as *Hypselephas hysudricus sinhaleyus* (Fig. 9) by Deraniyagala (1937) and as *Elephas hysudricus* by Manamendra-Arachchi (2008). *Elephas maximus sinhaleyus* was secured in 1947 from a gem pit about four miles away at Pahala Vela, Galadande Mandiya, Gonapitiiya, Kuruwita near the Kuru Ganga. The fossils were laid upon the gem field at a depth of 6.5m below the surface, and yielded *Elephas maximus sinhaleyus* (Deraniyagala, 1958). It frequently occurs in association with hippopotamus fossils from Gatahatta as far as Ratnapura, and with rhinoceros from Gatahatta to Pelmadulla.

The origin of *Elephas maximus* remained unknown until 1936, when its fossils were discovered in Sri Lanka, and even as recently as 1942 the general opinion was that nothing was known of its origin except that it appeared suddenly rather late in the age of man. It is true that a few isolated fossil proboscidean molars were assigned to an extinct Japanese race of this elephant named *Elephas maximus buski* (Deraniyagala, 1958), however, those belong to *Palaooloxodon namadicua naumanni* (Fig. 10), and no *Elephas maximus* fossils were found in Japan. In various other countries also isolated and often fragmentary teeth have been ascribed to *Elephas maximus*, but in every instance these have proved to be either those of the extinct *Palaeoloxodon namadicus* or the remains of some subspecies of *Elephas maximus* that had become extinct during prehistoric or historic times.

Since its earliest remains occur only in Sri Lanka, *Elephas maximus* apparently evolved from some Plio-Quaternary proboscidean, which had become isolated here upon the Island's separation from

Asia. During a Pleistocene reconnection with India, the Ceylon animal had invaded the mainland and wandered northwards until it encountered the Himalayan mass if, whereupon it had spread along its base eastwards as far as Wallace's line (the Wallace's Line is a boundary that separates the eco-transitional zone between Asia and Australia). West of the line is found organisms related to Asiatic species; to the east, a mixture of species of Asian and Australian origin is present, and westwards until checked by the Mediterranean sea and the deserts of Arabia and North Africa. Over this vast expanse in a belt stretching from 40 degrees north to 10 degrees south, land subsidence, changing river systems, deepening river gorges and expanding deserts, assisted the mountain ranges as barriers, and resulted in the evolution of twelve (12) subspecies (Deraniyagala,1958).

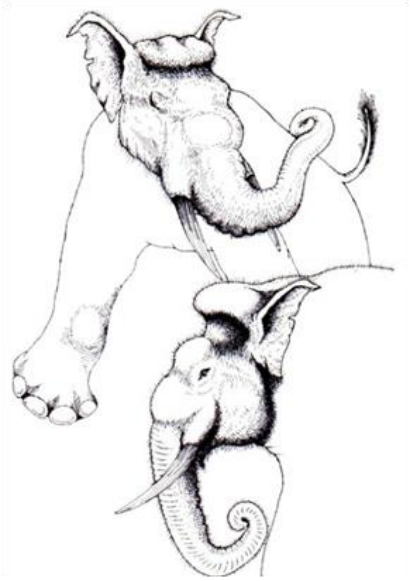

Figure 9. *Hypselephas hysudricus sinhaleyus* is one of extinct elephant species in Sri Lanka.Illustreated by Deraniyagala (1958)

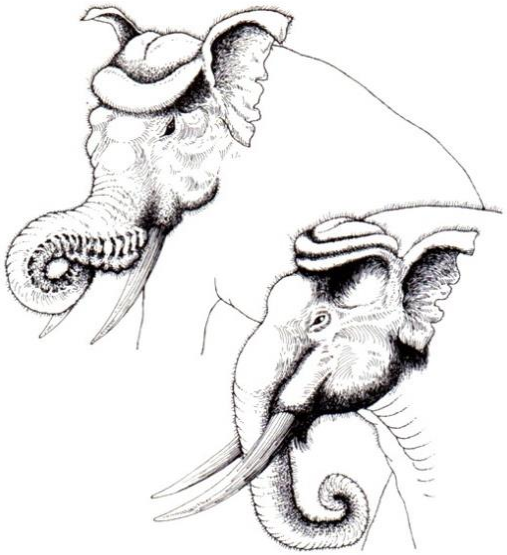

Figure 10. *Palaeoloxodon namadicus sinhaleyus* is one of extinct elephant species in Sri Lanka**.** Illustreated by: Deraniyagala (1958)

The distribution of the Asian elephant *Elephas maximus maximus* is confined to the island of Sri Lanka, *Elephas maximus sumatranus* to the island of Sumatra, and *Elephas maximus indicus* occupies the rest of the range. Ten fossil species of *Elephas* were recognized; the earliest is from the middle Pliocene Ekora beds, southeastern Turkana, Kenya, formed about 4.5 million years ago (Shoshani and Eisenberg, 1982). Two of these species are native to Africa and three to southern Asia.

3.4 Rhinoceros Spp. (extinct)

The rhinoceros family is characterized by its large size (one of the largest remaining megafauna), with all of the species able to reach one tonne or more in weight; an herbivorous diet; and a thick protective skin about 1.5–5 cm thick, formed from layers of collagen positioned in a lattice

structure; relatively small brains for mammals this size (400–600g); and a large horn. They generally eat leafy material, although their ability to ferment food in their hindgut allows them to subsist on more fibrous plant matter, if necessary. Unlike other perissodactyls, the African species of rhinoceros lack teeth at the front of their mouths, relying instead on their powerful premolar and molar teeth to grind up plant food. Both African species and the Sumatran Rhinoceros have two horns, while the Indian and Javan Rhinoceros have a single horn. Rhinoceros was living 80,000 years ago.

Most known fossil remains of *Rhinoceros unicornis* appear to be of probably middle Pleistocene (Fig. 4) . The direct precursor of the living Indian rhinoceros was *Rhinoceros unicornis fossilis* (synonyms *R.sivalensis* and *R. palaeindicus*), from the upper Siwalik beds, within the known historic range of the species. *Rhinoceros namadicuss* from the Narbada or Narmada beds is probably synonymous with *Rhinoceros unicornis fossilis*. *Rhinoceros kendengindicus* Dubois from Java was closely related to the present species and should probably be regarded as a subspecies of it. *Rhinoceros unicornis kendengindicus* occurred in the Djetis and Trinil beds alongside *Rhinoceros sondaicus*, but has not been found in the Upper Pleistocene Ngandong deposits where the latter is the only rhinoceros. The various fossils of this genus from China can be referred to two species: the Pleistocene *Rhinoceros sinensis* Owen, which though in many respects is intermediate between the two living species, shows progressive characters linking it to *Rhinoceros unicornis* and the Upper Pliocene species *Rhinoceros oweni* Rmgstrom, which was placed in a separate genus *Sinorhinus* (Laurie et al., 1983).

3.5 *Rhinoceros sinhaleyus*, 1936 (extinct)

Rhinoceros is also known as rhino. The finding about rhinoceros indicated as two species by Deraniyagala, the older, less developed one, the *Rhinoceros sinhaleyus* Deraniyagala (1936), which has squarer and lower teeth that the more rectangular-toothed *Rhinoceros kagavena* in the Ratnapura fauna of Sri Lanka. The former became extinct earlier, in Deraniyagala view (1958). *Rhinoceros* fossils were found from Kuruwita gem pit, 6.0m beneath from the surface at Hiriliyadda, Talavitiya (Kuruwita), which is undated but probably Middle Pleistocene (Deraniyagala 1958). This form shows few characters to differentiate it from *Rhinoceros unicornis*, and like the Javanese fossil occurs alongside a race of *Rhinoceros unicornis*.

Rhinocerotidae of large heavyset herbivorous perissodactyl mammals of Africa and Asia that have one or two upright keratinous horns on the snout and thick gray to brown skin with little hair. The order Perissodactyla is only represented in Sri Lanka by the superfamily Rhinocerotidae

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3.6 *Hexaprotodon sinhaleyus, 1937* (extinct) **Hippopotamus**

The hippopotamus (*Hippopotamus amphibius*), or hippo, from the ancient Greek for "river horse", is a large, mostly herbivorous mammal in sub-Saharan Africa, and one of only two extant species in the family Hippopotamidae, the other is the Pygmy Hippopotamus. After the elephant, the hippopotamus is the largest land mammal and the heaviest extant artiodactyls, despite being considerably shorter than the giraffe. The hippopotamus is semi-aquatic, inhabiting rivers and lakes where territorial bulls preside over a stretch of river and groups of 5 to 30 females and young. During the day they remain cool by staying in the water or mud; reproduction and childbirth both occur in water. They emerge at dusk to graze on grass. While hippopotam uses rest near each other in the water, grazing is a solitary activity and hippos are not territorial on land.

In 'the Pleistocene of Ceylon' Deraniyagala (1936, 1939, 1944 and 1958) explains his findings of *Hexaprotodon sinhaleyus* and *Hexaprotodon sivalensis sinhaleyus* based on gem pits in the Ratnanapura area about seven kilometers away at Pahala Vela, Galadande Mandiya, Gonapitiiya, and Kuruwita near the Kuru Ganga. The fossils were laid at a depth of 6.5m below the surface.

Accordingly, Deraniyagala revealed the fossilized remains of the lower jaws and teeth of a Sri Lankan hippopotamus. The lower jawbone of the hippopotamus reveals six incisor teeth, whereas the hippopotamus that survives in Africa has only four incisors. The extinct Ceylon hippopotamus has been named the *Hexaprotodon sinhaleyus*. The change in climate from heavy rainfall that fed numerous large rivers and lakes to a more moderate rainfall that reduced the island's waterbodies was probably responsible for the extinction of the world's second heaviest land mammal in the island (Deraniyagala 1958).

The earliest known hippopotamus fossils, belonging to the genus *Kenyapotamus* in Africa, date to around. Hippopotamus and Rhinoceros was living 80,000 years ago. The extinction of this animal might have occurred sometime shortly after the middle Pleistocene times, since its nearest a relative, the extinct Indian hippopotamus from former lake beds which are now traversed by the Nerbudda (Narmada) River, became extinct in middle Pleistocene times about 50,000 years ago.

4. CONCLUSIONS

End of Pleistocene the climate change resulted in the extinction of a number of animals and fossilization in alluvial beds. The last ice age ended about 14,000 years ago (temporary), but we cannot be certain that this was related to the Earth's precession. The Earth's axis rotates (processes) just as a spinning top does, the period of precession is about 26,000 years. Therefore, the North Celestial Pole will not always be pointing towards the same star field, precession is caused by the gravitational pull of the Sun and the Moon on the Earth. However, earth's precession was tend to

stimulate the increase of temperature and patterns of extinction, distribution, evolution as a result of changing geomagnetic field. This extinction wave did not stop at the end of the Pleistocene, but continued due to the sea level fluctuations, especially on isolated islands in Holocene epoch. Among the main causes hypothesized by paleontologists and sedimentologists are natural climate change and overkilled by humans. With the technological and cultural development of the humans, who appeared during the Middle Pleistocene and invaded many previously uninhabited regions of the world during the Late Pleistocene and Holocene.

Eminent paleontologist, zoologist, and also an artist, Deraniyagala from Sri Lanka has been specialized in fauna and human fossils of the Indian subcontinent. By Late Jurassic Period of Sri Lanka was positioned within 67°S - 65°S and 32°E - 36° E in the southern hemisphere and by the end of Miocene Period Sri Lanka located itself between 4°N - 8°N and 77°E - 79°E in northern hemisphere (Katupotha, 2013). Jurassic and Miocene fossils from Sri Lanka are very significant to compare those with other locations of the world and very useful to the study of evolutionary stages through the climate changes of Sri Lanka. But, whole the country has subjected to Quaternary glacial cycles due to the advancing and retreating continental glaciers; warmer, cooler and dry climatic conditions; evolution of hominids and associated cultures, and also extinction the megafauna; deposition of terrestrial and marine deposits, and the development of soil. Due to this evolutionary process some ancestors of former geologic periods were extinct, some were adopted and others were newly evolved.

Fossils found in Sri Lanka from different eras. Though we have number of fossils yet there is no law or an act has been made to protect and preserve these fossils. Therefore, palaeo – Biodiversity heritage in Sri Lanka is being gradually destroyed bydirect human activities. Today for gem industry people using bacos to dig gem pits in Sabaragamuwa basin. Because of using bacos fossils that are in Pleistocene era are getting destroyed. Therefore, Eco Astronomy Organization has started to preserve the animal and plant fossils that have been found in Sabaragamu basin during 1990-2013. As a first step of this the main information of Sabaragamu basin fossils has published as a research papers. The Eco Astronomy Organization have planned to exhibit and preserve fossils through Project Batadomba Cave Geo Tourism with help of provincial council and other government organization.

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