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Human Palaeontology and Prehistory

Indonesia–Southeast Asia: Climates, settlements, and cultures in Late Pleistocene

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Abstract

Late Pleistocene is one of the important periods within the prehistoric chronology of the Archipelago. Chronologically it occupied the period between the oldest one, characterized by Paleolithic culture, and the Early Holocene, characterized by Pre-neolithic culture. Referring to the evidences found so far, this period covers the time around 45000 BP to Early Holocene or around 11800 BP. Different phenomena have colored this period. Natural phenomenon was marked by climate and sea level fluctuations, which brought changes to paleogeography and paleoenvironment. The second phenomenon was related to the appearance of early modern human (the oldest *Homo sapiens*) replacing the early human, *Homo erectus*. The emergence of *Homo sapiens* brought cultural phenomenon, such as (1) the exploration of wider geographical area within the archipelago, even to the other parts of Southeast Asia, western Melanesia, and Australia, (2) the change of activity orientation from open air to natural niches, such as caves and rock shelters, and (3) the development in technology and subsistence. ***To cite this article: T. Simanjuntak, C. R. Palevol 5 (2006)***.

Résumé

Indonésie – Sud-Est asiatique: climats, colonisations et cultures au Pléistocène récent. Le Pléistocène récent est l'une des périodes importantes de la chronologie préhistorique de l'archipel. Chronologiquement, il constitue une charnière entre la période la plus ancienne, caractérisée par la culture paléolithique, et l'Holocène récent, caractérisé par la culture pré-néolithique. En référence aux preuves récoltées jusqu'à présent, cette période s'étend sur environ 11 800 ans. Différents phénomènes marquent cette période. En termes de phénomène naturel, des fluctuations du climat et du niveau marin ont apporté des changements dans la paléogéographie et le paléoenvironnement, le second phénomène ayant trait à l'apparition de l'homme moderne récent (le plus ancien des *Homo sapiens*) en remplacement de l'homme moderne (*Homo erectus*). L'émergence de l'*Homo sapiens* a provoqué un phénomène culturel, comportant (1) l'explosion de zones géographiques plus vastes dans l'archipel ou dans d'autres parties du Sud-Est asiatique, de la Mélanésie occidentale et de l'Australie, (2) le déplacement des activités du plein air vers les niches naturelles, et (3) le développement des technologies et des moyens de subsistance. ***Pour citer cet article : T. Simanjuntak, C. R. Palevol 5 (2006)***.

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1. Introduction

The term Late Pleistocene in this paper refers to a period of time near the end of the Pleistocene, not to be confused with the Upper Pleistocene, which is a geological period that spans between ± 120000 BP and Early Holocene. Late Pleistocene was a period of cultural development within the prehistoric chronology of Indonesia, after the oldest period (the life-span of *Homo erectus*). Based on evidences found until recently, the period began with the emergence of the oldest modern human around 45000 BP up to the Early Holocene, which is – according to geologists – at about 11800 BP (see [12]).

There were a number of phenomenon that are typical to this period, for instance fluctuated climate condition and sea level, as well as the appearance of early modern human (*Homo sapiens*) in replace of *Homo erectus*. The appearance of *Homo sapiens* gave birth to several cultural phenomena, such as: (1) more extensive geographical exploitation all over the archipelago and even up to the other parts of Southeast Asia, western Melanesia, and Australia; (2) change in mode of habitation from life on the open air to activities in natural niches like caves and rock shelters; and (3) technological development, particularly in lithic technology and subsistence.

2. Sea-level fluctuations

Climate condition is influenced by what is called for high and middle latitudes, glacial and interglacial periods. These phenomena are caused mainly by the modification of several parameters in the position of the Earth in relation to the sun. The periodic changes have influenced variations in the total amount of energy received from the sun as well as in the sharing of this energy between the various regions of the Earth [32]. During the glacial period (often known as the Ice Age) – in which the Earth's temperature dropped – water was collected in its frozen form at both poles and the mountains, so that the volume of seawater decreased and thus the sea level became lower. During the interglacial periods, the Earth's temperature rose, which caused the ice at the poles and mountains to melt and thus increased the seawater volume, so that the sea level became higher.

The sea-level fluctuation along the Pleistocene period is a global phenomenon that affected various aspects of life. During the Upper Pleistocene, the sea-level fluctuations were very prominent. After the Riss–Würm interglacial period around 130000–120000 BP, when the sea level was assumed to be in similar position to the level nowadays, the sea surface fluctuated with its low points at ±115000 BP, ±90000 BP, ±55000 BP, ±35000 BP, and ±18000 BP, while its high points are at ±105000 BP, ±80000 BP, ±60000 BP, ±40000 BP, and ± 28000 BP. The lowest sea level was recorded around 18000 BP and it reached 100–150 m below the recent sea level. Since then there were a number of temperature fluctuations with the peak at ±8000 BP that resulted in the rise of sea level until it reached its recent condition [5].

The afore-mentioned fluctuated climate and sea level greatly influenced the changes of human settlement and adaptive patterns. The rise and drop of sea level brought changes in the geography of the archipelago in the form of land reduction and expansion. The alterations of land dimension affected the existence of natural sources. Sea-level fluctuations have changed the environment, for instance from inland to coastal land, or vice-versa. These conditions influence the activities and mobility of human and other creatures. The rise of sea level will sink parts of lands and drove human and fauna to new places. Sea-level drop, on the other hand, urged both human and fauna to move so they can exploit new coastal areas. Life in those new areas calls for adaptation processes that in turn will influence cultural pattern and development.

The drop of sea level can also narrow the distance between islands; it leads to the emergence of 'land bridges' or unite a number of islands into a huge land. The sea-level drop during the glacial period has immensely changed the paleogeography of the archipelago. The western part of the archipelago formed a vast land (the Sunda Shelf) where Sumatra, Java, and Kalimantan were connected and united with Asia. In the east, Australia joined Papua New Guinea and Tasmania and formed the Sahul Shelf. Between those plates lies the Wallacea Zone, separated by a deep ocean. It was during this period that the migrations of fauna (and human) as well as flora took place more intensively from the Continental Asia to the Sunda Shelf.

3. Early Modern Human

The second phenomenon deals with the emergence of early modern human, which is more popularly known as the *Homo sapiens*. Their appearance at this period did not happen merely within the archipelago, but also include other areas in Southeast Asia and even Australian and western Melanesia [9,34]. When they appeared, the *Homo erectus* – that inhabited Java since millions of years before – seems to have been extinct. We have not been able to explain the process of the extinction of *Homo erectus* and the emergence of *Homo sapiens* satisfyingly. Some experts relate the extinction of *Homo erectus* to their inability to adapt to the environmental change. It is believed that between 126000 BP and 81000 BP, the climate in Java became hot and humid, and it changed the environment from open landscape to tropical rain forest. In this environment, it is assumed that *Homo erectus* could not exploit the arboreal resources that were available above the ground and required nocturnal activities to obtain them [40].

The origin of *Homo sapiens* has not been able to be explained thoroughly. Thus far the most popular opinion is that they were originated from the African continent (the Out-of-Africa theory). Around 100000 BP, they left Africa and dispersed to various directions. In the new places they reproduced and replaced the local archaic population [10]. Polymorphism study on Y-chromosomes of 12127 individuals from 163 population groups in Southeast Asia, Oceania, and East Asia confirms the theory. Analysis on three marks on the Y-chromosome (*bialelic*) (YAP, M89, M130) tells us that all the individuals show mutation on one of the marks of the chromosome. The three mutations are followed by another mutation (M 168T), which is known to be originated from Africa since ±89000–35000 BP [25].

According to the Out-of-Africa theory, the earliest modern human have at least inhabited the archipelago before they migrated to Australia. Storm [40] stated that *Homo sapiens* entered the archipelago between 126000–81000 BP when the Southeast Asian rain forest expanded southward. B. Thiel [42] said that the migration of *Homo sapiens* to the archipelago (especially to the East and Australia) occurred in the Upper Pleistocene. The rise of sea level at the time caused the land to reduce in size, and thus lessen the food supply. This condition urged human to migrate in search of new habitation area. Based on this assumption, in the islands in the eastern part of Indonesia – which are separated from the Sunda Shelf by a deep ocean – there were remains of human occupation more than 50000 BP.

In relation to the above opinion, it is interesting to present the evidences of the earliest arrival of *Homo sapiens* in Australia. The oldest date with thermoluminescence is from the Malakunanja II site, which is about 60000–50000 BP [31,37]. An older date, which is about 120000 BP, was reported from Jinmium site in western Australia [15], but it is still debatable. Based on the dates, experts tend to believe that the colonization of Australia took place earlier than 50000 BP [1]. If we relate the assumption to the colonization of Australia from Indonesia (Birdsell), the appearance of *Homo sapiens* in Indonesia should have been earlier than in Australia, or before 50000 BP.

Aside from the above hypothesis, one thing that we must never forget in the process of migration is the paleogeographical condition. The most reasonable mode of migration of *Homo sapiens* from continental Southeast Asia to Indonesia was when the Sunda Shelf was connected to continental Southeast Asia by 'land bridges' that were formed due to the drop of sea level. In this regard, it is interesting to observe the studies of oxygen isotopes in deep ocean that were conducted by Chappel and Sackleton [11] at the Huon Peninsula, Papua New Guinea. The graphic of sea level fluctuation that took place in that area since around 140000 BP shows that there was a significant drop of sea level at around 70000–60000 BP. We do not know whether the sea level drop also happened in Indonesia and Southeast Asia in general. However, if we relate it to the dates from Australia, there is a possibility that the migration of *Homo sapiens* to Indonesia happened around that period. It is a very hypothetical assumption; therefore, more researches are still needed to prove it.

4. Cave occupation (Fig. 1)

The third phenomenon – in accordance with the emergence of *Homo sapiens* – deals with the change of occupational orientation. If *Homo erectus* from the previous period tends to roam in open landscape around rivers and springs, *Homo sapiens*, on the other hand, has used natural caves and rock shelters to perform various activities although there is still a possibility that at certain areas, wandering in open landscape could still be found. The discovery of traces of activities in various caves or rock shelters during this period is the evidences of extensive exploitation of the archipelago and its surroundings. Some experts are of the opinion that during that period caves and rock shelters have not been used as permanent settlement but more as a temporary occupational place by small groups of hunters

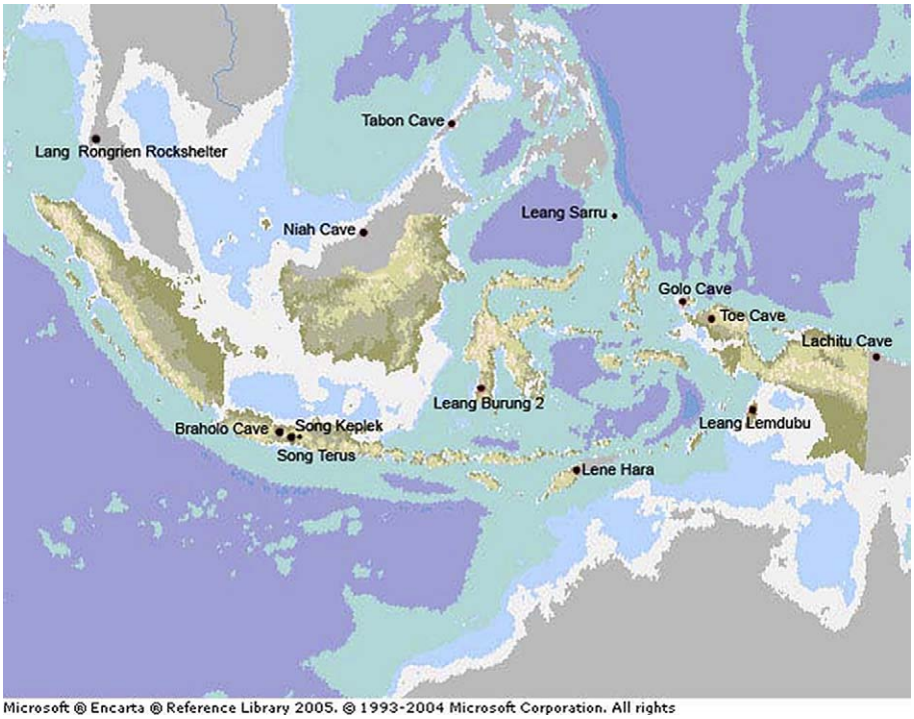

Fig. 1. Distribution of caves and rockshelters occupied inside and outside Indonesia by *Homo sapiens*.
Fig. 1. Répartition des grottes et abris sous roche occupés en Indonésie et hors d'Indonésie par *Homo sapiens*.

[3]. The assumption is not entirely true. In the anthropic layer that dates back to around Late Pleistocene, (especially approaching Early Holocene layer) remains of human activities (artifacts, ecofacts, features) were frequently found quite abundantly. One thing that is more certain is that at the beginning of the period, human beings have not inhabited the caves and rock shelters permanently, as proven by the sparse finds at the lower part of occupational layer. Through adaptation process, they gradually use caves as their permanent and sustainable habitation place.

Why did they prefer caves and rock shelters? From the spatial/architectural point of view, caves and rock shelters provide more ideal condition than open landscape, because they have permanent chambers that can accommodate numerous daily activities. Caves and rock shelters can protect the inhabitants from various weather condition (hot, cold, rain, storm, etc.) and wild animals. Inside a cave or rock shelter, the inhabitants can make fire to warm the chamber and reduce humidity. Fire was also used to provide light and to cook food. The communities of hunters that used caves and rock shelters at that time are assumed to consist of small groups of 30 to 50 individuals [23,38].

Different types of finds, such as artifacts, ecofacts, and features proved that cave and rock shelters have been used to perform various activities. The discovery of quite complete skeletal remains of deer at the Braholo and Song Keplek caves (Gunung Sewu) in association with lithic implements indicates that sometimes game animals were slaughtered in caves during the period. The discovery of lithic assemblages like stone implements, core tools, and waste flakes in the occupational layer in caves usually shows that caves were also serve as places to make tools. The most recent evidence of tool manufacture is found at the Song Terus cave in the form of flakes made of chert and limestone, as well as core tools in association with broken animal bones [33].

Although no evidence has been found, it is assumed that burial activities in caves have been practiced during the period, as indicated by the discoveries outside Indonesia, such as at Niah cave (Sarawak) and Tabon cave (Philippines). At the Niah cave – at its west opening – Harrison [20] found human skeletons and other bones in the lower layer that contains charcoal from around 40000 BP. A research team led by Graeme Barker recently has managed to identify the location of Harrison's discovery, which is at the depth of 106–112 inches below the surface. Two ^{14}C dates from charcoal samples from the layer where the human skeleton was found show a date of 42600 ± 670 BP (Niah 310)

and 41800 ± 620 BP [4]. Other finds are from the Tabon cave, which are human mandible and frontal bones that show resemblances with Australian inhabitants from ±20000 and 22000 BP [13].

The cave occupation during this period covers a vast area, with evidences found at Leang Burung 2 (Burung cave 2) in South Sulawesi [16], Leang Sarru in Talaud Island [41], Golo cave in Maluku [7], Lemdubu cave in Aru islands [39], Toé cave in Papua [30], and a number of caves at Gunung Sewu [33,35]. Absolute dating by ^{14}C shows that those caves have been inhabited around 40000–30000 BP.

Evidences of cave occupation from the same period in other parts of Southeast Asia are found among others at Niah cave in Sarawak [4,20], Lang Rongrien rock shelter in Southern Thailand [2], Nguom and Tham Khoung rock shelters in Vietnam [19], and Tabon cave in Philippines [14]. In Western Melanesia traces of cave occupation are found among others at Lachitu cave in Papua New Guinea, Buang Merabuk and Matenkupkum in the Islands of Bismarck [17,22]. The discovery in Australia is far denser and quite evenly dispersed. Some of them are Mandu-mandu Creek and Pilgonoman Creek at the coastal area of West Australia, Malakunanja II and Nauwalabila I in the highland of North Australia, Puritjarra in Central Australia, and Sandy Creek in Eastern Cape, New York Peninsula [37].

It is interesting to note that open site with similar cultural characteristic, thus far has not been found in Indonesia. Open sites show the Paleolithic character (particularly lithic technology). Based on the difference, it is assumed that those sites were not inhabited by *Homo sapiens*, but more likely were inhabited by *Homo erectus*, which lived in the previous period. The phenomenon of the sparseness of open sites is found in Southeast Asia in general. By far reports on open sites came from Tingkayu, Sabah, from ±28000 BP [5] and Tampan, Malaysia from ±30000 BP [27], but the assemblage of lithic artifacts that still show Paleolithic characteristics suggests that the inhabitants of those sites are still questionable up to the present.

Open sites are more prominent in West Melanesia and Australia, with lithic assemblages that are unique to those areas. Unlike in Indonesia and other areas in Southeast Asia, those areas show similarities of lithic artifacts from open sites and cave sites, which indicates similarities of culture and the people who bear it. Examples of open sites are for instance the Fortification Point in the Huon Peninsula (40000 BP) and Kosipe (±25000 BP) in Papua New Guinea, Yombon (35000 BP) in New Britain [17], Kilu in Buka island at the northern point of Solomon islands with a date of about 28000 BP [26]. In Australia, open sites are quite prominent, such as Keilor (36000–25000 BP), Mungo Lake (32750 ± 1250 BP), Greenough River (37000 BP), Arumpa Lake (38500 BP), and Upper Swan (38000 BP) [24].

5. Development of lithic technology

The fourth phenomenon is the development of lithic technology that shows significant changes. The previous products of lithic technology are characterized by core tools and big-sized flakes, but during this period the tools produced are mostly smaller flakes with more regular shapes. Advancements in retouching techniques have resulted in tools like borers, points, scrapers, concave scrapers, serrated scrapers, blades, and used flakes, although waste flakes are still more dominant. Tool manufacturing tends to use direct flaking technique, as shown by the generally protruding bulbs of percussions. Using a hammer stone (percutors), flakes were separated from the core stone after a striking platform is prepared as a flaking place. The distribution of this group of tools are more common and widespread in Southeast Asia and flourished into its peak in the Holocene in more regular shapes as a result of more advanced retouching techniques.

The assemblage of lithic tools at Leang Burung 2 (Burung Cave 2) in South Sulawesi show the dominance of chert flakes with prominent used and waste flakes. All along the occupational layer between 30000 BP and the Holocene, there are no significant change in terms of tool technology and metric. In the layer advancing 20000 BP, flake tools are more abundant with more varied types like simple points, various types of scrapers, associated with used flakes [36]. The development of lithic technology in Maluku is presented by the finds from Golo cave at Gebe Island. The cave with the earliest occupation, which dates back from about 33000 BP, shows flake tools and waste flakes made of volcanic and metamorphic stones, as well as chert. Other tools include corral and burnt volcanic rocks that were probably used to cook, as proven by the existence of partly burnt marine mollusks [6].

The development of lithic technology in Papua is shown by the discovery from Toé Cave in the Ayamaru highland, Kepala Burung. Like in other places, the manufacturing technology of tools is relatively stable during the Late Pleistocene period; there was no new development until the Holocene period. The sparseness of artifacts in the occupational layer and the absence of

big sized flakes, core tools, and wastes (*debitage*) indicate that caves were used as temporary transit places [30]. Various stones were used, for instance silicified calcrete, chert, silcrete, chalcedony, and obsidian. Data on technology from Timor Leste were obtained from results of investigation by Australian researchers soon after Timor's independence. Further excavations at Lene Hara cave recently yielded a cultural layer from 35000–30000 BP. In this layer were found artifacts made of chert associated with fossils of vertebrates and marine mollusks. An interesting fact is that among the lithic tool assemblage there are very prominent unretouched flakes. Like in Leang Lembudu, Aru Island, the tool assemblage bears similarities with the one from North Australia [29,43].

The finds from the caves in the Gunung Sewu area – particularly Braholo and Song Keplek caves – show unique characteristics, aside from the flake tools that were mentioned above. The lithic tool assemblage in those caves is associated with the existence of groups of atypical tools with simple manufacturing techniques and cruder shapes than Paleolithic tools. A tool is produced using merely one or two flaking on a piece of material. The flaking location is not specific, but depends on the maker's wish. The tools are usually longer (their average length is more than 5 cm). The group of tool consists of core tool and flakes made of various kinds of rocks, according to their availability in the surrounding environment, but the most frequently used is chert and other silicified stones.

The development of lithic technology during the period covers a vast area in Southeast Asia with specific characteristics in each location. The assemblage of lithic artifacts from Lang Rongrien rock shelter in Thailand shows that flakes are more dominant than core tools. The flakes include scrapers, blades, borers, as well as used and waste flakes. Core tools are very rarely found; some of them are choppers, hand adzes, and unused or slightly used pebbles [2]. A unique thing is that in the Holocene occupational layer, the product of technology changed with the appearance of Hoabinhian tools among the group of lithic tools.

Finds at Niah cave is dominated by flake tools that consist of concave flakes, semi-circular flakes, and point flakes similar to those found at Lang Rongrien rock shelter. The most-dominant type is end scraper. The tools from Tabon cave are not much different from those found at Niah cave; they are usually flakes manufactured through flaking with percutor. Fox [13] classified lithic artifacts from this cave into five groups with no significant change during the occupational period. Flakes are the dominant type. Made from chert, the tools are very rarely retouched. They usually consist of various types of flakes.

The development of lithic technology in Oceania – especially West Melanesia and Australia – shows similarities and differences with those in Southeast Asia. The assemblage of lithic artifacts in this area consists of two groups: Australian core tool and scraper tradition, as well as Australian small tool tradition [21]. The types of tools include horse hoof typed choppers, edge-ground tools, and waisted blades [44]. The similarities are seen in flake tools, especially scrapers, and the difference is seen in the existence of a unique technological product, waisted tools. The difference between tools in those two areas can be seen as the local development that was influenced by environmental condition, site exploitation, and availability of raw material [8].

6. Subsistence

Subsistence during this period is very much influenced by environmental condition. Coastal environment tend to encourage the development of fishing or the exploitation of other marine biota. Savannah, on the other hand, encourages the development of hunting of herbivores that live in the surrounding environment. Based on the discoveries in the occupational layer, which were dominated by remains of various fauna, we can assume that animal hunting was the main subsistence at that time. The animals hunted are very varied, depending on their availability in the surrounding environment. But the most common animals are deer (*Cervidae*), pigs (*Suidae*), and buffaloes (*Bovidae*). The discoveries of fish bones and marine and fresh water mollusk's shells are the evidences of fishing activities and other marine biota exploitation, besides hunting activities.

The discovery of faunal remains from the 'Tabuhan Layer' at Song Terus cave suggests that various kinds of animals like *Cuon javanicus*, *Papadoxorus*, *Felix*, big *Felid*, *Muscus*, *Elephas* [28] were hunted in the past. The most dominant game animals were presbytis and macaque monkeys. That is not the case in the Braholo and Song Keplek caves, where most of the fauna were big games like *Bovidae*, *Cervidae*, *Elephantidae*, and *Rhinoceridae*, while monkeys were only found in the uppermost and the Holocene layers.

The change of faunal composition during the Upper Pleistocene and Holocene at both caves is in accordance with the climatic change from dry climate in the Upper Pleistocene to the wet climate in the Holocene. The dry

climate, which tends to create open landscape, has enabled big animals, particularly herbivores, to thrive. The wet climate has created dense landscape, which was suitable for arboreal animals.

In the eastern part of Indonesia, hunting activities were also dominant, but the animals differ as a result of different environment. The finds at Leang Lemdubu in the islands of Aru show that the main animals hunted there were marsupials, some of which have now extinct in that area, such as megafauna (*Protemnodon*), *Geloina coaxans*, wallabies, and giant kangaroos [39,43]. The remains found at Golo cave in Gebe Island, North Maluku, tell us that animal hunting was the main subsistence, as proven by the remains of marsupials (*phalanger* and wallabies), which were found in larger amount than fish remains [6].

Data from Toé cave in Papua gives us a rather different picture. The game animals there were small and medium in size, such as wild wallabies (*Dorcopsulus spp*), *Phalanger spp*, *Spilocuscus spp*, smaller possum (*Pseudocheirops spp*), *Dactylopsila spp*, giant rat (*Malloney sp*), python, monitor lizards, and megapodes. There is a possibility that tree kangaroos (*Dendrolagus spp*) and echidnas (*Zaglossus bruijnii*) were also hunted though occasionally. Nowadays some of the species can still be found in remote places within the Kepala Burung area, but were extinct in the area around the cave [30].

Exploitation of marine biota was an interesting subsistence and its traces were found at Leang Sarru (Sarru cave) in Talaud Islands, North Sulawesi. The change of sea level during the occupational period at this site has influenced the condition of mollusks' habitat and the types of mollusks that were exploited. Daud Aris Tanudirjo [41] observed the change of species during the occupational period. At the beginning of the occupational period (30000–21000 BP), mollusks were usually collected from infralittoral habitat (*Turbinidae*), littoral rocky shore (*Cellana ornata*), and supralittoral rocky shore (*Nerita sp*). During the most intensive occupational period (21000–10000 BP) the infralittoral species were still dominant, while species from the littoral rocky shore were severely decreased. Species from supralittoral rocky shore were drastically increased during the coldest period (20000 BP) but then diminished and then increasing again at the end of the period. Regarding the littoral species, the trend was totally different. The two groups of species were complementing each other as a result of environment variation. During this most intensive occupational period, the types of species collected were more varied, particularly those from the littoral mangrove forest and littoral sandy beach, including among others *Cerithium articulatum* and *Vasum turbinellum*.

Outside Indonesia, hunting was also the main subsistence, as evidenced by the types of fauna with different grades of density at each site. The discovery at Lene Hara cave in Timor Leste, which consists of vertebrae and marine mollusks, besides stone artifacts [29] show that the groups of humans that inhabited the cave and its surroundings also exploited marine mollusks from the neighboring environment, as well as hunting. Very intensive exploitation of marine biota is demonstrated by the finds from Nguom rock shelter in Vietnam, with a huge amount of marine mollusks' shells [18].

The finds in the lower layer of Niah cave show diverse game animals, with wild boar (*Sus barbatus*) and rodents as the dominant species. Harrison's excavations yielded remains of extinct giant pangolin (*Manis palaeojavanicus*) and fauna that can still be found up to now in Kalimantan, such as bats, wild rats, porcupines, apes/monkeys, orangutans, wild boar (*Sus barbatus*), wild oxen, and reptiles. A research conducted by Barker et al. [4] at this cave yielded other species like birds, rodents, turtles, snakes, and stingrays. The entire fauna illustrates the paleoenvironment of the Niah cave and its surrounding, which is a rainforest interspersed by bushes, marshland, lake, and rivers. The absence of marine mollusks indicates that the cave inhabitants at that time had limited access to the sea.

Aside from hunting and exploiting marine biota, other subsistence was probably gathering fruits and wild tubers. The easily perished nature of those plants makes it difficult for us to obtain evidences regarding the food collecting activities at that time. Fortunately, by observing traditional communities that exploit fruits and tubers, we can assume that there is a possibility that during the Upper Pleistocene period people also exploited the edible plants available in their surrounding environment. Discoveries outside Indonesia support this assumption, for instance the discovery in the lower layer of the Niah cave, which consists of fragments of charcoal and burnt fruits, peas, and tubers, besides partly burnt faunal remains [4]. The discovery proves that during the Upper Pleistocene–Holocene period, cave inhabitants have exploited plants in their surrounding environment as sources of food.

Traces of tubers on the stone tools from New Britain and New Ireland sites at the northeast part of Papua New Guinea prove that forest gatherers had collected tubers at around 28000 BP. Interesting evidence is found from Kilu cave in the Solomon Islands. Micro-

scopic analysis on stone artifacts from a 28 000-year-old layer of this site provides evidence of traces of *Colocasia esculata* and *Alocacia macrorrhiza* [26]. The plants, which were probably originated from India or Southeast Asia, are thought to be the main diet of the Kilu cave inhabitants at the period. Other evidence from around 15000 BP was found at the Gua 2 site in Daeo, Morotai, which is canari nut among stone flakes and rat bones [7]. It reminds us to a similar discovery at Sepik Ramu in Papua New Guinea (14,000 BP). Canari trees are even thought to have been exploited along the coast during that period [17].

7. Conclusion

The various phenomena that happened at the end of the Pleistocene period has put this period into a unique one in the prehistoric chronology of Indonesia. The phenomena are interrelated. In other words, one phenomenon tends to open the possibility for the other phenomenon to occur. The glacial–interglacial phenomenon seemed to be the catalyst that urged the mobility of both human and fauna at that time. Human migration to the archipelago is assumed to take place during the glacial period, when the Sunda Shelf was connected to continental Southeast Asia. The appearance of the earliest modern human acted as a motor to the emergence of some cultural phenomenon.

In terms of cultural development, we witnessed a significant change from life in the open landscapes to the exploitation of natural caves and rock shelters. Human occupation in caves and rock shelters have decreased the wandering instinct and therefore created the prospect for intensive activities in natural caves and rock shelters. The discoveries of dense artifacts, faunal remains, and traces of fire usage in occupational layers are evidences of intensive activities in workshops (ateliers) inside the caves/rock shelters: manufacturing tools, processing hunted animals, and exploiting fire.

In terms of technology and subsistence, there are regional similarities, aside from local peculiarities. The development of lithic technology to produce flake tools is common to the Southeast Asia – West Melanesia – Australia regions, while local peculiarities are shown by variations of types of tools, manufacturing techniques, and raw material. Evidences also showed that hunting and marine biota exploitation, as well as nut collecting, as the types of subsistence at the period, with different types of game animals according to their availability in the exploitation areas. Those conditions have given birth to a cultural mosaic of this period, with diversities in unity. Those conditions have made the Late Pleistocene a unique period within the prehistoric cultural development chronology in the archipelago and Southeast Asia in general.

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