FAUNA FROM THE OLDEST OCCUPATION LAYER IN SONG TERUS CAVE, EASTERN JAVA, INDONESIA

Biochronological significance of Terus Layer

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Année académique 2009/2010
Contents

INTRODUCTION ............................................................................................................................. 7

CHAPTER 1. Gunung Sewu and Song Terus site ......................................................................... 12
   1.1 Gunung Sewu ................................................................................................................... 12
       1.1.1. Geology ................................................................................................................... 12
       1.1.2. Research History ................................................................................................... 14
   1.2. Song terus site ................................................................................................................. 15
       1.2.1. Geomorphology ..................................................................................................... 15
       1.2.2 Research history ...................................................................................................... 16
       1.2.3 Stratigraphy and Chronology of the site ................................................................ 17

CHAPTER 2. Materials and Methods of Study ........................................................................... 21
   2.1 Material used for this study ............................................................................................. 21
   2.2. Methods ......................................................................................................................... 24
       2.2.1. Taxonomy ............................................................................................................... 24
       2.2.2. Taphonomy ............................................................................................................ 27
       2.2.3. Archaeostratigraphical preposition ....................................................................... 29

CHAPTER 3. Analysis ................................................................................................................... 31
   3.1. Taxonomical characteristic of Terus assemblage ........................................................... 31
       3.1.1. Artiodactyla ............................................................................................................ 31
       3.1.2. Carnivora ................................................................................................................ 38
       3.1.3. Insectivora .............................................................................................................. 39
       3.1.4. Rodentia ................................................................................................................. 41
       3.1.5. Reptilia ................................................................................................................... 51
       3.1.6. Chiroptera ............................................................................................................... 52
       3.1.7. Primata ................................................................................................................... 53
   3.2. Quantification ................................................................................................................. 55
   3.3. Bone modification ........................................................................................................... 58
   3.4. Taphonomy ..................................................................................................................... 60
4. CONCLUSION AND PERSPECTIVES ........................................................................................................ 65

BIBLIOGRAPHY ........................................................................................................................................ 67
Acknowledgement

Praise to Almighty Allah (Who is very kind and merciful), Who bestowed upon me the wisdom and strength to complete this work.

This work involved many people. Hence, I take this opportunity to thank all of them.

I am highly grateful to my respected research Supervisors, Professor François Sémaah and Doctor Anne-marie Sémaah for their guidance, their support and their constant encouragement during these two years of Master. They assigned me this passionating topic and I enjoyed working on it.

I wish to acknowledge the kindness of my honorable teacher, Doctor Anne-Marie Moigne, for her highly valuable suggestions, her precious knowledges and her many constructive comments.

My special gratitudes goes to Professor Truman Simanjuntak for offering me the opportunity to get involved into the Song Terus research team which basically, that was the starting point that lead me to all this studies.

Equally thankful to Professor H. De Lumley, Director of the Institut de Paléontologie Humaine, and to Professor D. Vialou and Professor F. Semah for allowing me to take part to this master Erasmus Mundus in Quaternary and Prehistory.

I thank Professor T. Djubiantonon and Professor H. Widi for their strong support and guidance.

I am gratefull to Professor Salvador for helping me with microfauna identification.

My special thanks goes to F. Detroit, X. Gallet, T. Ingico and B. Brasseur for expressing much interest into my research topic and for their pertinent comments.

I am also very gratefull C. Falguères, D. Pleurdeau, F. Tosca and Y. Badday for their patience and their help during my stay at the Institut de Paléontologie Humaine.

Thank you to all of my friends, Kasman, Budiman, Abi, Cholawit, Archie, and all who I cannot mention one by one.

Finally, I would like to thank the colleagues here involved with me in this Master program, with a special thank to Alice, Aude, Alik, Phonn and Ping.
Song Terus cave is one of the most important sites in the Southeast Asia that records a long archaeostratigraphic sequences, from the Middle Pleistocene period up to the Holocene periods. The very intensive excavation in this site gives a big potential field in understanding the history of cave occupation by early humans. The latest excavation have reached the more ancient layer (Terus Layer) that associated with the earliest culture that present in the site. Based on the certain absolute dating, the age of this layer ranged from +/-300-80 ka, that confirm the Middle Pleistocene age for the oldest Terus archaeological assemblage. This studies focused on the faunal assemblages in the upper part of Terus Layer as the primary data, consist of macro and microfauna assemblages dated to 80-120 ka that represents the Late Pleistocene periods. Taphonomic and taxonomic methodologies were applied on this research. The paleontological analysis to the animal remains in this layer have revealed the close resemblance of Terus assemblage with what have reported by Badoux as the Punung fauna. The paleoenvironmental reconstruction based on the composition of the faunal assemblage suggest a forested area which is not in contrast with the paleoenvironmental studies to the Punung fauna. The archaeostratigraphical analysis based on the taphonomic factors that presented in the animal remains have divide the Terus assemblage into two different type of deposition: (1) the cave deposition in the upper most of this layer consist of in situ materials, together with the traces of human activities marking the oldest occupation layer in this site; (2) alluvial deposits in the lower part of layer, that represented by the rounded bones and several taphonomical factors that indicate the transported materials.

Résumé

La grotte de Song Terus est l’un des sites les plus importants d’Asie du Sud-Est. Elle comporte une longue séquence archéostratigraphique, depuis le Pléistocène moyen jusqu’à l’Holocène. Les fouilles intensives qui y sont conduites montrent le grand potentiel de ce site pour comprendre l’histoire des occupations en grotte par les hominidés anciens. La dernière campagne de fouille a atteint la couche la plus ancienne (Terus Layer) associée à la plus ancienne culture présente sur le site. Cette couche a été datée entre 300 et 80000 BP, ce qui confirme l’âge Pléistocène moyen du plus ancien assemblage archéologique de Song Terus. L’étude présente concerne les assemblages micro- et macro-fauniques provenant de la partie supérieure de la couche Terus, datée du Pléistocène supérieur entre 80 et 120 000 BP. Les analyses taphonomiques et taxonomiques ont été mises en oeuvre. L’étude paléontologique des restes osseux de
Cette couche a montré la forte ressemblance entre l’assemblage de Terus et ce qui a été défini par Badoux comme la faune de Punung. La reconstruction paléoenvironnementale basée sur la composition de l’assemblage faunique est celle d’un environnement forestier, ce qui n’est pas en désaccord avec les études paléoenvironnementales conduites pour la faune de Punung. L’analyse archéostratigraphique des facteurs taphonomiques ayant affecté les restes osseux a permis de diviser l’assemblage de Terus en deux groupes, correspondant à deux types de dépôt différents : (1) le dépôt de grotte de la partie supérieure de cette couche qui est constitué de matériel in situ, de même que les traces d’activité humaine représentant l’occupation la plus ancienne du site ; (2) les dépôts alluviaux de la partie inférieure de la couche, se traduisant par des ossements roulés et d’autres caractéristiques taphonomiques indiquant le transport des matériaux.
INTRODUCTION

This studies focused on the faunal assemblages in Terus Layer as the primary data. The last excavation have yield a more ancient layer with faunal remains consist of macromamals and microfauna. Recent studies about Terus layer has suggest the possibilities of occupation layer appeared at the upper part of Terus layer. Distribution of fresh bones, stalagmites and microfauna in this layer indicates cave sedimentation, supporting the occupation of the cave by human (Fauzi, 2008). Terus layer cover a very long time periods. Based on the certain absolute dating, the age of this layer ranged from +/-300-80 ka (Hameau, 2006; Sémah et al., 2004; Simanjuntak, 2004). ESR/U-series dating taken from two teeth associated with the lithic artifact provide consistent ages of 254 ± 38 and 341 ± 51 ka. These results confirm the Middle Pleistocene age for the oldest Terus archaeological assemblage. The major concentration of animal remains at the upper part of the Terus layer (primary data for this study) lies between 80-120ka (Falguères et al, unpublish). The animal remains collected from this layer presumably close to those reported by Badoux as the Punung Fauna. The importance of Song Terus cave also related to the possibility of understanding the periods during the transitional from the late middle Pleistocene (MIS6) to the Late Pleistocene (MIS5). The most ancient layer already excavated present more scarce faunal remains with difference fossilisation. This assemblage could be associated to the intermediate level of Terus complex described in the KI and KII test pit (Gallet, Sémah, 2000). The question for this level is can we report this faunal assemblages to Punung fauna or to the late middle Pleistocene fauna as Ngandong fauna.

Archeozoological approach including the taxonomic and taphonomic analysis are the main work of the study. The expected result of this study can be pointed into three main objectives:

- Variety of species including the big mammals and micro fauna which reflect the environmental condition during this particular period and its significance to the Punung Faunal assemblage.

- Distribution of animal remains within this layer associated with the taphonomical aspect.
-Trace of human activities based on the taphonomical observation.

Studies of caves and rock shelters sites in Southeast Asia are the main important resource for the studies of human occupation, specifically in understanding of the modern human dispersal and their behavior. Evidence of human occupation in marked by the remains of human activities which were found in situ inside the cave. Caves and rockshelter studies in southeast Asia so far has provide evidence of permanent occupation by modern human, based on the abundance of anthropic remains during the late Pleistocene approaching the early Holocene (Simanjuntak, 2005).

Until 2000 we have few evidence about the cave occupation by Homo erectus at the early and middle Pleistocene in Southeast Asia. Finds from south China give the evidence of cave occupation by the Homo, they are three teeth which found in a karst cave in Hubei. The age is considered early because they were found in association with Gigantopithecus. In northern Thailand, by example, rockshelter in Kao Pah Nam yielded archaeological evidence of early hominin in mainland Southeast Asia based on the artifacts and hearth in association with faunal assemblage. There are still no absolute dating for this site, but faunal assemblage identical to middle Pleistocene age. The early human fossils in correlation to the cave occupation in Vietnam are the very few isolated teeth from Tham Khuyen and Tham Hai, also at Tan Hang cave in northern Laos which two teeth and cranial fragments are comparable to those of Chinese Homo erectus from the late early and early middle Pleistocene context. Probably the most well known evidence about the cave occupation by Homo erectus during the middle pleistocene came from the eastern Asia, in Zhoukoudian cave southwest Beijing, China. This cave yielded more than 40 individuals of Homo erectus, and provide confidant estimation that Homo erectus occupied the cave intermittently between 06 and 0.25 Ma (Delson, 2000).

Concerning the early cave occupation in the late middle Pleistocene. Tongzy cave, northern Guizhou Province in South China, is one of the important site since this site has yielded six hominid teeth together with artifact and faunal assemblage dated from 192 - 172 ka (U-series) (Bekken, 2004). In Thum Phra Khai Phet and Thum Wiman Nakin cave, Thailand, large quantity of mammals is dated to 169 ka (Tougard, 1998).
In most part of southeast Asia, the beginning of more intensive cave occupation can be dated back to the late Pleistocene period. Cave investigation concerning the earliest human occupation in many part of southeast Asia has been studied and has give important contribution especially to the chronology of early modern human dispersal and cultural successions of the Upper Pleistocene and Holocene. In Duoi U’Oi cave Northern Vietnam, two worn teeth assigned to the genus Homo found and dated at 66 ± 3 Ka. These specimens doubtfully considered as Homo sapiens since no evidence of Homo erectus was still present on the continent around that period (Bacon et al., 2008). The earliest human remains together with their lithic industries in the Philippines have been found at Tabon cave on Palawan Island in the Southeast and recently dated to c. 47 Ka (Dizon, 2003; Fox, 1970). In Niah cave, Malaysia, the oldest modern human so-called Deep Skull dated to 45 – 43 Ka (Barker et al. 2001).

In Indonesia, study about early hominids dispersal has yield a big contribution of data, especially in Java Island, known to be the riches place of pre-sapiens fossils. This island also produce undisputed evidences for human occupation prior to the late Pleistocene (Bellwood, 1987). The questions about the earliest appearance of hominids in this island has been discussed by Sémah (2000) based on the study of the volcanic sediment layer in Sangiran dome. He suggest that the emergence of dry land in this area happened at c. 1,7 ma, marked by the “lower lahar” (volcanic sediment layer) at the base of deposits in Sangiran dome (Sémah, 2000). Numerous individual of Homo erectus have been found within this periods but none of them associated with the cave occupation.

In Flores, the arrival of Homo, based on the stone tools found at central Flores, can be estimated around ~840 ka (Morwood, 2001). This dating cannot be attributed to the earliest cave occupation by Homo floresiensis until later, the studies on the Liang Bua cave in Flores has indicate the earliest occupation layer based on the conglomerate deposit associated with lithic artifacts fall within 190 – 135 ka (Westaway et al., 2006).

In later periods, evidence of cave occupation in Indonesia covered a vast area, those found at Leang Burung 2 in South Sulawesi, Leang Sarru in Talaud Island, Golo cave in Maluku, Lemdubu cave in Aru Islands, Toe cave in Papua, and a numerous caves at Gunung Sewu locality. The 14C dating given from these sites are around 40-30 Ka (Simanjuntak, 2005).
As mentioned above, early cave occupation in Indonesia and in many part of southeast Asia mostly associated with the emergence of *Homo sapiens*. Theoretically there was changing in occupational orientation from *Homo erectus* with open landscape occupation and *Homo sapiens* who has used natural caves and rock shelter as a place to perform various activities (Simanjuntak, 2005). Environmental change hold an important role on the migration of modern human in the regions. The Pleistocene geological events indicate that there have been important glacio-eustatic sea level fluctuations especially during the Middle and Late Pleistocene, and the sea level lowering could have occurred several times causing the emersion of a huge continental shelf of Sundaland. During this periods, faunal turnover happened in Indonesia, mainly in java marked by the arrival of new immigrants fauna from the Asian mainland. The late middle Pleistocene cooling also believed as the cause of southwards migration of Southeast Asian fauna (Tougard, 2001).

Presumably, the migration of hominin into Southeast Asia may have been part of the overall faunal turnover. The Important faunal exchanges in relation with the modern human migration occurred between the Sundaic and Indochinese provinces during the Late Middle Pleistocene and Late Pleistocene. The paleontological record of Java is one of the best known in the region and has detailed evidence of these exchanges. This event also gives possibility that the middle Pleistocene faunal turnover documented on Java also marked the replacement of *Homo erectus* by *Homo sapiens* (Marwick, 2009).

The most important paleontological record in Java which represents the most significant faunal turnover on the island is Punung fauna. This site marked the replacement of earlier faunal stages to a fully modern fauna (Westaway, 2007). The question about Punung fauna has been discussed by Badoux (1959) based from the fossil which were collected by G.H.R Von Koenigswald. The fossils which found in fissure deposits at two areas in Punung locality somehow shows the character of recent fauna, meanwhile the more ancient fauna no longer found in this area (Badoux, 1959). The assumption about this assemblage shows that the faunas are new immigrant that occupies the more humid area. The large quantity of *Primata* indicates the tropical forest environment (Vos, 1994), with wetter and warmer conditions than in earlier or later stages of the faunal sequence (Westaway et al., 2007). The age for this assemblage has been decided in range of 60 – 125 ka (Bergh, 2001), while recent studies place this site on the early last interglacial age between 128 ± 15 and 118 ± 3 Ka (Westaway, 2007), represent the
late Pleistocene periods (Vos, 1994). This site documents the first known appearance of several extant Southeast Asian fauna in Java including *Elephas maximus*, *Helarctos malayanus*, and the rainforest-dependent species, *Pongo* and *Hylobates syndactylus*. There is also a tooth of *Homo sapiens* claimed to belong to the Punung fauna (Storm, 2005) this discovery follows the earlier report by von Koeningswald (1939) about the presence of five hominin remains that later being lost. Unfortunately the presence of *Homo sapiens* not fully accepted, since the material are missing and the date are too old in compare with the earliest known *Homo sapiens* from the Niah and Tabon.

The problem of correlating the punung fauna and early modern human emergence is the lack of archaeological material among the assemblages. It is important to have a comparative well recorded archaeological data that can be associated with this faunal assemblages.

Not far from the locality where punung fauna have been discovered, Song Terus cave is known to be the most representative site in order to give comparative data to the Punung fauna. This site have been intensively studied by the *Museum National d'Histoire Naturelle* in collaboration with Archaeological Research center of Indonesia. This site has a long span sequence cover the Middle Pleistocene up to the Holocene periods. The oldest cultural layer in this site contain numerous lithic tool as well as faunal assemblages dated to middle until the late Pleistocene (Sémah et al., 2004).

Terus layer is a name refer to the oldest cultural layer in the Song Terus cave. This layer lay at around four meters deep from the surface, covered by 10-20 cm thick blackish volcanic ashes which appears to be the boundary that clearly separate Terus layer from the cultural layer above (Tabuhan layer). This layer characterized by the alluvial sediment consist of clays, gravels, and sands which deposited when a river ran in the cave (Sémah et al, 2004). The materials found within this layer mainly dominated by the lithic assemblage. According to the test pit materials, lithics are found through the 7m depth in this layer while the faunal remains mainly discovered within the first meter on the top of Terus layer, and very scarce at the deeper level. All the lithic artifacts associated with animal remains presumed as the trace of human activities who occupied the river bank (Sémah et al, 2004)
CHAPTER 1. Gunung Sewu and Song Terus site

1.1 Gunung Sewu

The name Gunung Sewu (translated: Thousand Hills) derives from the landscape which dominated with the conical limestone hills. The density of hills is being estimated around ± 30 per km square, consist of around 40,000 hills with most of them contains cave that often rich in prehistoric remains (Bastra, 1976). The estimated height of the hills are ranging from 80 m to 500 m above the sea level.

This area located in the eastern part of the Southern Mountains, this area lays adjacent to the south coast of Central Java and covers over 1000 km² (fig.1). This area situated between 6° and 9° South latitude and 105° and 114° East latitude, around 80 km from Pacitan gulf in the east to Oyo River in the west.

Gunung Sewu is an important region for the prehistoric research due to the richness in prehistoric artifacts. The discoveries of Paleolithic and Neolithic industries marking the long sequence of lithic traditions in this area (Sémah, et al. 2004). Recent study have suggested that the beginning of cave occupation in Gunung Sewu began around 120 ka (Sémah, 2007; Fauzi, 2008).

1.1.1. Geology

The Gunung Sewu area is supported by the massive Miocene reef limestones, which document shallow marine sedimentation (Waltham A. C. et al 1983; Sémah 2004). This sediment sometimes underwent heavy silicification like chert, silex, silicified tuffs and breccias, chalcedony, jasper and silicified wood (Sémah, 2004). The silicified rocks which particularly abundant in the fluvialite deposit, provide raw material for lithic artifacts as seen as in the Pacitanian industry (Sémah, 2004).
Figure 1. Location of Gunung Sewu; top: The geological map of Java (Sémah et al., 2004); Bottom: Gunung Sewu area (Puslitbang Arkenas) (after Budiman, 2009).
The Gunung Sewu area consists of different stratigraphic formations (Bemmelen, 1949). The formations are: Besole, Djaten, Wuni, Nampol, Punung, Terra rossa and Holocene alluvial (fig. 2).

![Image: The geological formation of Gunung Sewu](image)

*Figure 2. The geological formation of Gunung Sewu (Sartono, 1964; Samodra et al., 1992)*

1.1.2. Research History

The unique landscape of Gunung Sewu have attracted many researcher since the early of 19th century, especially on the geological point of view. The first geological description are the area full with the conic hills, given by F. W Junghun (1836). Many other researcher also gives contribution about the studies of Karst formation, they are Van Dijk, Verbeek, Fennema, Niermeyer (Bastra, 1976).
The beginning of archaeological researches in this area was conducted in 1927 by Van Stein Callenfels. He discovered more than 100 open air sites with finding of the Neolithic culture. This area is also a place where the “Pacitanian” culture was first discovered by Ralph von Koenigswald in 1935. This discovery records the oldest human activities in the Gunung Sewu by the abundance of chopper and chopping tools from the riverbed of Baksoka River.

The first archaeological study of cave and rock shelter in this area done by Ralph von Koenigswald in 1936, who discovered the “Sampungian bone Industry” in Song Agung cave, Punung. Archaeological study continued in 1990 when Simanjuntak (2004) excavated Braholo cave and Keplek cave and found numerous artifacts which associated with the human occupation. The sedimentary filling in Braholo caves dated from 33.000 to 300 BP and in Keplek cave from 24.000 to 800 BP.

The paleontological record have been reported by Badoux (1959) as the Punung fauna is also found in this region. This discovery makes the Gunung Sewu not only important for the archaeological studies, but also Paleontological.

Until now, This area still being intensively studied. One of the most important site in this area is Song Terus cave (the site of this study), which since 1994 up to now, this site still continuously being explored by the National Research Centre of Archaeology (Puslitbang Arkeologi nasional-Indonesia) in collaboration with Muséum national d’Histoire Naturelle (MNHN-Paris)

1.2. Song terus site

Song Terus cave is located in Weru village, Pacitan, East Java. This site is one of the caves that formed in the limestone karstic hills in Gunung Sewu Area. The location of the cave is about 3 km from Keplek cave, and around 300 m from Tabuhan cave (fig.3).

1.2.1. Geomorphology

The orientation of Song Terus is west-east, with dimension 20 m wide and 100 m long with altitude of ± 330 m above the sea level at the entrance of the cave (Sémah et al.,
2004). The cross section profile of the cave is forms a long tunnel for 60-70 m long with a smaller opening at the opposite direction of the main entrance (fig. 3). The cave mouth has a semicircular shape with 15.5 m wide and 5-6 m height from the ground. The elevation slightly sloped at the central of the cave. Inner chamber of the cave is large with numerous of stalactites and stalamites. Below the cave surface an underground river (Kali Banjar) is passing through the cave from the west to the east. The mouth of the underground cave is located on the west, around 50 m from the cave entrance.

Figure 3. Topography map of Song Terus site (MQPI)

1.2.2 Research history
The first archeological excavation was conducted by R.P. Soejono and Basoeki in 1953. They reported the Neolithic artifacts together with animal remains of *Elephas maximus* and *Primata* (Soejono, 1993:93). The more intensive research in this site first conducted in 1992 by collaboration between the Center of Archaeological research, Indonesia with
Museum National d’Histoire Naturelle, Paris. In 1994 two tes square were excavated, KI consist of two squares of 4 m² each and KII consist of three square. The two tes pit were dug deeper in 1995. In 1996 the new square were opened, consist of M10, M11, K9, and L9. Until 2000 four other squares (M9, N11, K9B and L11B) were opened.

1.2.3 Stratigraphy and Chronology of the site

In K1 stratigraphy at the lowermost level it contains massive thickness of clay deposit accounting to 5 meters which strongly suggests a depositional character of low energy. At the depth of 4-10 meters fluviaite actions and high energy of deposition of sediments comprising sand, gravels and pebbles are noticeable. They are also characterized by the presence of ferruginous concretion which gives a red color to the deposit. An appreciable deposition of volcanic deposits comprise of ash mixed with fine silts and sand lie at the depth 4m below the surface. There are two layers that consist volcanic sediments the lower one is called layer «J» with black and grey color with 30 to 40 cm thickness and the upper layer «G» with grey color and which is consistently powdery (Galet, 2004; Hameau, 2004; Sémah et al, 2004) (fig.4). The thick and dense dark grey layer of ashes «J» represents the last fluvialite action in the cave and considered as the boundary between the Terus and Tabuhan layers.
1.1.3.1. Terus layer

The lowest cultural layer in Song Terus cave named. The dating with U-series and ESR methods at c. 341 and 254 ka have put this layer into a Middle Pleistocene period (Hameau S., 2004; Sémah F. *et al*., 2004). The recent dating have put the uppermost of the layer into the Late Pleistocene periods. This layer consists of alluvial deposit (Gallet, 2004) and contains abundant lithic artifacts (nuclei, flakes and flake tools such as scrapers and denticulates) made of chert. This assemblage mixes quite fresh artefacts (most probably made very near the cave) and also patinated, rounded, and transformed lithic tools. According to the sedimentological study, during this period the cave was crossed by a river. As mentioned previously, the uppermost part of the Terus layers contain old cave occupation floors dated around the Middle to Upper Pleistocene boundary. The content of these very ancient cave occupation layers has been characterized from the archaeological point of view (Ruly, 2008) and the mammal fauna, tough consisting of few species (Cervidae, Bovidae, Tapiridae and *Rhinoceros*) can be correlated with the “Punung” fauna (Badoux, 1959). Those layers end around 4 m below the surface and are overlaid by a thick layer of black volcanic ashes (±30 cm thick) which covered the whole surface of the cave during a flood.
1.1.3.2. Tabuhan layer
Late Pleistocene occupation layers inside the cave are dated around 60 – 30 ka (Hameau S., 2004; Sémah F. et al., 2004), and document an exploitation of large mammals (such as Cervidae, Bovidae, and Suidae). Lithic industries are very scarce compared to those found in the previous level from quality (mainly hard limestones) or quantity. As mentioned previously the pollen content of the Upper Tabuhan layer reflects dry conditions. Many burnt stones are found including several zones which can be interpreted as fire places. The detailed stratigraphical interpretation of the “Tabuhan” layers is quite complex. The recent study have divide this layer into three subdivision based on the characteristic of the accumulation of archaeological filling (Kusno, 2009).

1.1.3.3. Keplek layer
A carbonate lamination filling in between the Tabuhan and Keplek layer seems to be the boundary that reflect the transition between Pleistocene into a Holocene periods. The $^{14}$C dating has give the absolute for the Keplek layer to 5700 and 9400 BP. This layer constitute of rich flake industry, abundance of *Cercopithecidae*, consist of Trachypithecus and Macaca, together with the big mammals like *Bovidae*, *Cervidae*, *Bovidae*, *Rhinocerotidae* and *Elephas*. The layer also contain the aquatic fauna which are mollusk and turtle.

One individu of human was found in this layer (fig.5), which recent study has suggest the indication of burial activity related to this remains (Budiman, 2008)
Figure 5. human burial in Keplek layer (MQPI: Détroit, 2002)
CHAPTER 2. Materials and Methods of Study

The sampling strategy for the Terus assemblages are divided into two different method. According to Connor (2000) there are four different strategy in choosing the material for study:

1. Full recovery
   This method is taking 100% of all sample from all contexts.

2. Some recovery of bones from all contexts
   This method suggests a sample strategy where a smaller sample from every single feature is sampled.

3. Full recovery from some contexts
   As this method suggests, the archaeologist identifies which features are best for sampling.

4. Some recovery from some contexts
   The same principles apply to this method as the one above and may be used with some consideration. A number of features in this method may be selected subjectively or objectively for recovery. Furthermore the recovery from each feature would only be partial. (Connor, 2000).

For the Terus assemblage two different strategy were applied. For the materials that collected by hand during the excavation, all the materials are used as the samples. For the sheaving materials, only some representative are chosen for the sample.

2.1 Material used for this study
Most of the large specimens collected by hand during the excavation, while the small specimens collected from the sieving process. Total number of specimens collected by hand from the excavation is 410 specimens and the number of identified animal remains from five excavation squares is small: only 170 specimens. Those collected by hand are well recorded materials which each has its own coordinates including the x, y, and z. This allows us to reconstruct the distribution and visualize them digitally. Microfaunal
assemblage such as Rodentia, Reptilia, Insectivora, and Chiroptera are mostly came from the sieving. These materials are separated quantitatively from those collected by hand. Only small number of rodents are recorded during the excavation.

With an exception for microfaunas, the preservation condition of animal remains is generally highly fragmented, fragile and some are rounded. Long bones are mostly represented by the fragments of diaphysis, and the cranium part mostly represented by the isolated teeth and some jaws. Animal remains from the upper part of the Terus layer showed the best preservation, and in most cases, any traces of butchery or gnawing could be observed.

So far three families have been identified as the most dominant big-fauna discovered in the site. Those are Cervidae, Bovidae, and Suidae. Others taxa like Carnivora, also found but not significant in number. Specimens of Rodentia, and Insectivora which are mostly came from the sheaving, seems to be the most abundant remains in the site.

In total of 125 specimens of Cervidae can be identified, consist of three genera based on the morphology and size of the teeth (fig.6). Those are Muntiacus, the small sized Cervidae; Axis, the medium sized; and Cervus, the big sized Cervidae. Muntiacus teeth are the smallest in size the morphological feature of this genus is distinct with the other genus in this site. Axis teeth somehow shows more hyposodont than Cervus and Muntiacus. Only size that can distinguish the Axis and Cervus, while the morphological feature is similar.

665 teeth and jaws specimen of Microfauna are classified into Rodentia, Insectivora, Chiroptera, and Reptilia. The most representative materials are used to make a taxonomical classification.
Only 29 specimens identified as *Bovidae*, 19 of them are teeth specimens (fig.7)
Sus seems to be the only one genera present in the site, the number of identified specimens is 38 with 15 of teeth specimens (fig. 8)

![Figure 8. number of identified specimens of Suidae](image)

2.2. Methods

2.2.1. Taxonomy

General taxonomic determination of the Terus assemblage done by the paleontological team from Museum National d'Histoire Naturelle, Paris and Indonesian team together with the author. Some of the specimens can be identified until level of genera or more general taxa, depending on the element examined and comparative materials that available for comparison. Identification made by the comparing of the specimens with the anatomical references, including the complete skeleton of various species, bibliographical reference, and bone collection from the excavation which have been identified. There are several bibliographical references used for the basic classification of the assemblage, they are works of R. Barone (1976), L. Pales and M. A. Gracia (1981), Schmidt (1972), and Hilson (2005). Further identification to Terus assemblage
are its comparison with other faunal records especially Punung fauna which represent the late Pleistocene fauna. The determinations are recorded following the database codification established in the *Lexique du laboratoire du Muséum National d'Histoire Naturelle*, Paris.

Some problems encountered during the identification of animal remains. Certain skeletal elements such as costae and vertebrae are mostly could not be identified into a specific taxon due to the low preservation of the specimens. The classification between genera among the *Cervidae* can only be made for the certain skeletal elements, teeth are the most ideal elements for this, while by bones can only be observed by variation of size but most of the case can be very speculative since the materials are not very well preserved.

Problems for the microfaunal assemblages are the lack of anatomical references which refer to a specific species. For the rodents, a complete skeleton of *Muridae* and *Hystrix* appear to be the only references available for comparison, but unfortunately they belong to the unknown species. Since these materials are very important for reconstructing the environment condition, a different approach necessarily applied. Further identification for the rodent can only done by size, by measuring the incisors teeth. Akersten (1981) and Weintraub and Shockley (1980) described methods for rodent identification by measuring the arc diameter of isolated incisors. Incisor teeth of rodent are long and curved, if the curve line consistently extended it will form a perfect circle, which permit us to measure the diameter of the tooth. Generally, incisor size is species-specific and shows a liner relationship between the arc of the tooth and size of the rodent. For Terus assemblage, this method can only gives insight about size variety of rodent that presence in the layer. Several paleontological reports are also used to have more specific determination to the microfaunal assemblage in Terus layer in order to give a preposition of taxonomical classification.

For the purpose of giving clear descriptions about the complex anatomy of teeth, some terminologies need to be cited.
Figure 9 Terminology of teeth used in this paper: a. Bovidae; b. Suidae; c. Muridae; d. chiroptera (adapted from Tougard, 1998; Musser, 1982; Freeman, 1998; Hilson, 1992)
Since the total number of animal remains is mainly as a result of the post-depositional process, a zooarchaeological approaches of quantification need to be applied. This method gives an interpretative number rather than absolute, which mainly based on the proportion of the bones. For Terus assemblage the main goal for the quantification methods is to know the minimum number of individual, and the skeletal completeness by measuring the fragmentation level of the assemblages.

NISP is related to the number of identified specimens which correspond to specific elements of anatomical part (Reitz & Wing, 2008:203). NISP can be used as one category or combined with other methods (e.g. MNE). NISP cannot be used to infer the number of animal individuals in a site because of the fragmentation condition of the remains. Fragmentation makes bias because some elements are more likely than others to be fossilized. The fragmentation of bones can be caused either by natural or anthropic processes and practices, or even both. Human intervention in bone fragmentation is related to the transportation, butchering, distribution of meat, cooking, disposal, and also non subsistence uses.

MNE is derived by determining how many elements are represented by the fragmentary remains, based on the presence of overlapping landmarks features, and hence is not the same as NISP (Reitz & Wing, 2008:226). The elements can be represented for each skeletal element, for example by separating the proximal and distal part of the long bones. The MNE result may be in absolute value or standardized in percentage with respect to the highest MNE.

MNI is defined as the minimum number of individuals which account for all of the skeletal elements (specimens) within a particular species found in a site. High MNI estimates are related to the number of identifiable symmetrical or singular axial elements (Reitz & Wing, 2008:207).

2.2.2. Taphonomy
The Terus assemblage clearly has shown the reduction of the anatomical representation. The Taphonomic studies for this assemblage mainly aimed to evaluate the factors that
responsible for this reduction. The studies of differential diagenesis that caused the alteration of the bones is also the main works of this study.

Identification of taphonomical process involving human and non-human agent, such as butchery and animal gnawing done by direct observation to the animal remains. Fresh and non-fresh bones are separated and calculated in order to give indication about non-transported and transported bones, also gives possibilities concerning human activities. Another taphonomical observation is related to the pedogenic processes which could be traced on the bone surface. The main goal is to know the soil condition during the depositional process especially the dry-wet dynamics of the soils. It is important for Terus layer to know the possibilities of certain dry area during the deposition of animal remains, since this layer contain the alluvial deposits.

2.2.2.1. Bone alteration

Bone alteration is influenced by physical and chemical agents that can lead to the formation of fissures within the bones and that the internal components both microscopic and inorganic are separated or damaged. This occurs either during their burial state or when they are exposed at the surface level (Behrensmeyer, 1978). In large mammal bones there are several stages of surface modification noticeable when they are subjected to weathering ranging from stage zero (absent), slightly cracking to splitting (stage 5) and extremely fragile and eventually may completely destroyed when the bone structure and consistency is lost (Fernandez-Jalvo et al., 2002:357). In applying weathering stages to fossils, Behrensmeyer made three broad categories: 1) fresh (stage 0), 2) slightly weathered (stage 1-2), 3) weathered (stage 3-5) (Behrensmeyer, 1978:159). To distinguish the weathering and modification of faunal assemblage in the Tabuhan layer, the manual of *Lexique du Laboratoire de Prehistoire du Museum National d'Histoire Naturelle*, France was used as guide in determinignthe four stages of fissures present on bone surface.

Physico-chemical agents produce important changes on bones that correspond on the mineral and organic structure and in their chemical composition (Denys, 2002:479). Inside the cave, aside from the anthropic impact e.g., burning activity that is manifested on the presence of black color on the bone assemblage, there are other source of color
alteration such as the presence of carbonaceous material (soot from torches, lanterns and guano fires; humate; tar; coal-derived organic material and surface vegetation-derived material). Above all, manganese oxides are the most persistent agent of discoloration operating on caves (Hill 1982). Thus, presence of manganese is a good marker in understanding formation and the post-depositional issues affecting the archaeological and paleontological deposits (Lopez-Gonzales et al., 2006:707)

### 2.2.2.2. Bone Modification

There are three kinds of observation to the Terus assemblage regarding the bone modification. The bone modification that caused by natural agent and bone modification that possibly caused by human.

### 2.2.3. Archaeostratigraphical preposition

Before further discussion about animal remains in Terus layer, archaeo-stratigraphical approach needs to be established in order to prevent contextual mixture among the specimens. The objective is to determine subdivision level within the Terus layer, characterize the deposition, and to have clear boundaries between each level. The preliminary taphonomical analysis is used to characterize the difference of preservation within the Terus layer.

Comparison between rounded bones and fresh fractured bones are used to see their distribution pattern in the deposition. Two different level are recognized. Level B at the lower part shows a different preservation of bone assemblage in this layer the fresh fractured bones are almost absent. The rounded bones marks the division between them.

In the Level A, high consentration of fresh bones are present in two different areas: in M11 square at the 400 m depth, and in L9 – L8 border at the 430 m depth. The rounded bones in Level A are scattered and not significant. In contrast with the Level B, the fresh bones are almost absent, while the percentage of the rounded bones is high.
It is important to note that the rounded bones distribution can be also an intersection between two separated levels, which give possibility of the third level is present in Terus layer. Unfortunately the scarce material the level B complicate the separation between them, so the division only separate the two different level: A and B.
CHAPTER 3. Analysis

There are two main discussions in this chapter, taxonomical characteristic and taphonomical analysis. The taxonomical analysis consist in the description of materials which strictly based on the samples of teeth, and its comparison with the recorded materials from other localities. The taxonomical classification which proposed in this chapter is based on morphological similarities and bivariate analysis of teeth dimensions with the comparative materials. The comparative material and measurements mostly came from the several paleontological reports about the corresponding materials which each will be discussed in this chapter.

Taphonomical analysis are presented to give insight of different preservation between the two levels.

3.1. Taxonomical characteristic of Terus assemblage

3.1.1. Artiodactyla
All the teeth material that examined for the Artiodactyla came from the level A. Some teeth also are found in the level B but the materials are mostly fragmented and not supporting for the measurement and taxonomical identification.

3.1.1.1. Cervidae
Based on the teeth measurement, Cervidae in terus assemblages can be classified into three groups. The big sized Cervidae assigned as Cervus, the middle sized assigned as Axis, and the small sized assigned as Muntiacus. The problem in determining the specimens for Terus assemblages is the lack of antler element which are very specified for each species of Cervidae. However, we still can compare and discuss the teeth materials from the assemblage.
3.1.1.1. Cervus

*Cervus* in the Terus layer are the two isolated teeth of lower M2 and Lower P2. The morphological feature of the teeth is similar to *Axis*, with some slight difference. Dimension probably the only variable that can separate this genus from *Axis*. Badoux (1959) reported *Cervus sp.* from Punung fauna, unfortunately there is not enough comparable material for the comparison between the *Cervus* in Terus layer and *Cervus* sp from Punung fauna. However, there is one lower M2 from Punung collection with bl 13 mm and md 18 which probably close to the *Cervus* from Terus layer which has bl 12 mm and md 17 mm. Further identification is needed for this specimen, until now we only can put this specimen as *Cervus sp.*

3.1.1.2. Axis

Apart from the dimension, general feature that separate *Axis* and *Cervus* is the crown height. The *Axis* somehow show more hypsodontic shape than the *Cervus*. This feature can only be observed for the young individual, while is difficult to distinguish them on the worn teeth.

Lower M2 and M1 has an identical feature. Without measurement, It is difficult to distinguish them for the isolated teeth. For the M2 specimen the hypoconid is more developed and sharp toward the buccal side than the protoconid. Either entostylid or metastylid are small and not developed but more developed in compare with the *Cervus*. At the buccal side on the gap between the hypoconid the presence of prominent interlabial column can be observed.

Badoux did not mention about the presence of *Axis* in the Punung collection. *Axis* in Terus layer somehow smaller than *Axis* in Tabuhan and Keplek, but bigger than the *Muntiacus*. The comparison can be made with the *Axis* from other localities including the *muntiacus* from Thum Phra Khai Phet and Thum Wiman Nakin cave, Thailand that reported by Tougard (1998).
Further analysis need to be done for this specimen since the size is not correspond to Axis from Tabuhan and From Keplek layer. Until now we can only put Axis sp. for the medium sized Cervidae in Terus layer

3.1.1.3. Muntiacus

A significant difference between this genus with the others is the dimension. The morphological characters of this genus also distinct in compare with Cervus and Axis. In the lower molar the parastylde and entostylde are very developed, forms the very prominent pillar in the lingual side of the teeth.

The dimension of upper M2 for this specimen is corresponds to the Muntiacus muntjak from Punung, and Muntiacus muntjak from Keplek layer.
Figure 12. Bivariate analysis on upper M2 of Muntiacus sp.

Figure 13. 1. Muntiacus sp.; 2. Axis sp.; 3. Cervus sp.; a. occlusal view; b. buccal view; c. lingual view.
3.1.1.2. Bovidae

Only isolated teeth that represent the *Bovidae* in Terus assemblage. The difficulties in classifying the isolated teeth of Bovidae has been discussed by Badoux (1959). The only material that could distinguish *Bibos* from *Bubalus* is P2 which is lack in Terus assemblage. Therefore the classification for this material only can reach the level of *Family*.

Figure 14. bovidae from terus layer.

3.1.1.3. Suidae

*Sus* specimens from Terus layer can be assigned into one single species from the three different individual based on measurement of the teeth. The specimen number L913J37214 is an adult individual represented by upper jaws with series P2 – M2 still intact. On the occlusal view, Upper P3 has a rectangular outline, with clear division between two rows of cups. The first row is shorter bucco-lingually than the second. It has distinctive size between the paracone, metacone, protocone and hypocone. The paracone is almost twice bigger than the metacone, while protocone is bigger than the
hypocone. The upper P4 has a triangular outline merging the paracone, metacone and protocone together, but somehow the median margin on buccal side still clearly dividing paracone and metacone. The M1 is highly worn. The enamel surface is almost completely abraded, leaving only dentine with some isolated islands on it. The tooth has rectangular outline divided into two rows consist of paracone, metacone, protocone and hypocone at approximately the same size. At the margin between rows on the buccal surface, an interlabial column is present and prominent. M2 of this specimen is elongated. The very developed hypoconulid at the posterior part form pentagonal outline of the tooth.

Badoux have clearly described the anatomical difference of three species of *Sus* based on the morphological character of Lower M3, which are lack in Terus assemblage. There are no distinct characteristic from the Upper molars that can be used to separate the species of *Sus*, only measurement appear to be the difference between them (Badoux, 1959).

Archaic fossil of Suidae is classified into two species: *S. brachygnathus* and *S. macrognathus* with one subspecies: *S. macrognathus terhaari*. During the Late Pleistocene, the archaic form appears to be replaced by the new immigrant including the *Sus barbatus*, *Sus verrucosus*, and *Sus vittatus* (Badoux, 1959; Hardjasasmita, 1983). Comparison of teeth for *Sus* from Terus assemblage include the recent *Sus* reference that recorded by Badoux (1959). To give clearer dimension differentiation, measurement of *S. brachygnatus* and *S. macrognathus* (Hardjasasmita, 1983) is also included in this comparison.

The most representative element chosen for this comparison is Upper M2 due to the lack of lower M3 in the assemblage, which according to Badoux, are more distinctive in separating the three species of *Sus* based on the isolated teeth. The more elongated dimension of the upper M2 in Terus assemblages, presumably indicate the more elongated the snout of the species. In comparison with the body size, *S. verrucosus* has a more elongated and narrow snout than those in *S. Vittatus* and *S. barbatus* (Groves, 1981). This feature may reflected by the elongated M2 specimens from Terus assemblage which used for the comparison.
The bivariate analysis has shown the close dimension of specimens from Terus assemblages with the specimens of *S. verrucosus* recent that mentioned by Badoux. The taxonomical classification for these specimens can be proposed as the *S. verrucosus*. 

**Figure 15.** comparison of upper M2 Sus

**Figure 16.** suidae from Terus layer
3.1.2. Carnivora

Only one specimen is identified as the *Carnivora* among all Terus assemblage. The specimen number M1013JY3C1 is identified as lower right premolar of small sized *Carnivora*. The md length 5.2 mm and bl 3 mm. The tooth is consist of one main pointed cusp with the height of the crown 3.5 mm. Small anterior cingulum can be observed, with the tip started equal to posterior limit of anterior root on the buccal side and ended nearly at the center of the lingual side. On the posterior side a small and thin posterior cingulum is present also a small interlobe is present vertically from the base of the enamel to the tip of main cusp. The dimension of this specimen close to the lower P2 of the two families: *Viveridae*, and *Mustelidae*.

These two families of small *Carnivora* present in Keplek and Tabuhan layer, which represented by *Paradoxurus hermaphrodites* and *Martes sp*. The *Martes* lower P2 shows a different morphology with the specimen. The tooth of *Martes* somehow more elongated and narrower with the more developed posterior cingulum. In the other hand, the *Carnivora* specimen from Terus layer shows a similar morphology to the lower P2 of *Paradoxurus hermaphrodites*. 
Further investigation and more comparative materials are needed for this specimen, since the determination only made based on the morphological similarities without any comparative measurement to the population of small *Carnivora* that presence in this locality. We only can report that the small *Carnivora* is present in the Terus layer which the morphological feature of lower P3 close to the *Paradoxurus hermaphrodites*.

### 3.1.3. Insectivora

Insectivora specimens are abundance among the microfauna. Unfortunately almost all the material are isolated teeth, mostly represented by the lower molar and only few upper teeth were found. The important element to identify the species among this order is by identifying the present or absent of incisor, canine, and premolar teeth, and for some genera the morphological character of P4 also can be distinctive (Hilson, 1992). Only two specimens of upper P4 in this assemblage and one of them are still intact in the maxilla. The specimen number M1013JO3I1 consist of series P4-M2. The P4 md is 2,1 mm and bl 2,4 mm with the paracone that very developed and extended to the
posterior side and located slightly higher than the parastyle of M1. The protocone and hypoconal basin are developed and forms two separated cusps. On the occlusal view of the upper M1 and M2, the paracone-metacone and protocone-hypoconal basin form a double “W” shape. The metastyle in M1 is large located equal to the parastyle of M2.

The morphology of the upper P4 is close to the *Echinosorex* (moon rat), with a very developed hypoconal basin among all the *Insectivora*.

Figure 18. *Echinosorex* from Terus layer ; 1 upper jaw ; 2 lower jaw

Badoux (1959) mentioned the presence of *echinosorex* in the collection of Punung fauna which later the material being lost.

The moon rat inhabit lowlands, including primary and secondary forest, mangroves, rubber plantations, and cultivated areas. It is terrestrial and nocturnal, resting during the day in hollow logs, under the roots of trees. In empty holes, in crevices, or in nipa palms. It prefers wet areas and it usually found near streams. A nest is constructed of leaves or other available material. There is some controversy regarding the food habit. Davis discounted reports that the moon rat was mainly a hunter of aquatic vertebrates and indicated that it fed almost exclusively on earthworms and arthropods found on the forest floor. (walkers, 83)
3.1.4. Rodentia

3.1.4.1. Muridae

85 specimens consist of teeth and jaws have been identified as *Muridae*. Based on the measurement to 37 elements of Lower M1, we can classified the assemblage into three different groups by size. The Group A is the small sized teeth, consist of 33 elements with three of them are came from the level B. The first group presents the same morphology with around 1 mm of md and bl size range from the smallest to the largest. They shows a various wear stages, but the outline still gives a consistent feature. There is no observed morphological difference between the Group A of the level A with those in level B, thus we can put them all as the same population of *Muridae*. The second group consist only one specimen of isolated lower M1 which has different morphological feature relative to the group A and C. The last group (C) consists of three specimens that show the different wear stages.
The comparison of *Muridae* assemblages from Terus layer made following the report of Musser (1982) about the *Muridae* specimens from Trinil, and his discussion about the different origin of *Muridae* that present in Java Island. The measurements and illustrations that described by Musser (1982) are used to classified the *Muridae* from Terus layer.

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<th>ALM1-2</th>
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Table 1. Measurement of 17 species of *Muridae* from Java, Sumatera, and Malaya that taken by Musser on material collection of American Museum Of National History (AMNH), Rijksmuseum van Natuurlijke Historie (RMNH), and Dubois collection (DC); molar Breadth or BL (BM); molar length or MD (LM); length of alveolus molar (ALM); and number of roots (Musser, 1982).

Dimension ranges and number of roots of lower M1 for each group in Terus assemblage are used to limit the number of species that needed to be compared with the groups. In all groups, the lower M1 elements that have been examined supported by four roots, so the comparison will exclude the two-rooted M1 references.
<table>
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Table 2. Measurements to the lower M1 of the three different groups of Muridae.

Considering the measurement of lower M1 of the group A that gives the idea of size variations within the same population, the reference for comparison that used for the assemblages are taken based on the mean of lower M1 BL size with range of possible variation of ±0.5 mm. The references which used for the group A are Niviventer bukit, Niviventer cremoriventer, Niviventer lepturus, Kadarsanomys sodyi, Rattus rattus, Rattus Tiomanicus, Rattus argentiventer, Rattus norvegicus, Rattus exulans, and Rattus trinilensis. The references which used for the group B are Niviventer lepturus, Leopaldamys sabanus, Pithecheir parvus, Kadarsanomys sodyi, and Rattus tiomanicus. The references which used for the group C are Leopaldamys sabanus and Rattus maxi.

A. Group A

Two most well preserved samples of mandibles from Level A are taken as the representatives for the comparison. The specimens number M11NON77-85M1 and L912II3M10 are specimens of mandible with complete series of molar teeth. The outline of M1 is almost forms a rectangular shape. The anterolingual and anterobasal cusps are large and very well developed. The anterobasal cusp is smaller and oriented perpendicular to the anterolingual cusp with its tip located in the middle half of the anterolingual cusp. The laminae of the second row forms a chevron shape, while in the third row is most likely arcuate (less sharp than the second row). A posterior labial cusplet is present while the anterior labial cusplet is absent. The posterior cingulum is small and triangular, located right in the middle of M1 plane.
The M2 has a similar configuration with the second and third rows of M1. One striking difference is the presence of both anterior and posterior labial cusplet with the anterior one is the biggest among all the cusplet in the series of teeth. Orientation of the laminae somehow slightly inclined to the labial.

The M3 has triangular outline. Posterior labial cusplet is small and the arch of the laminae in the first row is weak and nearly straight. The second row forms a half moon shape with a deep hollow which separating it with the first row.

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Table 3. Measurement to the Terus Specimen of Group A

The combination features that shown in the dentary of two samples correspond to what have described by Musser as genus of *Rattus*. According to Musser, the combination features of *Rattus* are: (1) small body size; (2) large anterolingual and anterolabial cusps on the first molar; and (3) slightly arcuate laminae on the second molar, especially the posterior lamina (Musser, 1982). For *Niviventer and Leopoldamys*, the sample shows a consistence feature of small anterolingual and anterobasal cusps.
The more developed anterolingual and anterobasal cusps with the corresponding outline shape with the sample from Terus layer can also be seen in the three reference materials: *Rattus exulans*, *Rattus trinilensis* and *rattus argentiventer*.

In comparison with the *Rattus exulans*, the teeth from Terus layer is clearly have a bigger dimension, but the anterolingual and anterobasal somehow shows a similar characteristic. Some morphological similarities also can be seen in the shape of the lamina in the second row of M1, the lamina in the first row of M2, and the over all morphology of M3.

Apart from the similarities, some striking differences also observable between these specimens. In the *Rattus exulans*, two cusplets are present, in the anterior and posterior labial of M1, while in Terus specimen only posterior labial cusplet which is present. The lamina of the third row of M1 and second row of M2 forms a very strong angled chevron shape, while in the Terus sample is more arcuate. Another difference also can be seen in the orientation of the lamina in the M2 of *Rattus exulans* which are nearly straight to the M1 plane. Based on the several morphological differences described above, we can consider that the specimen from Terus layer is differs from the reference of *Rattus exulans*.

The *Rattus trinilensis* shows some corresponding features with the sample from Terus layer. Unfortunately the reference of *Rattus trinilensis* is highly worn, and the M3 is missing. However the outline is still clearly shows the morphological characteristic of the teeth.

The M1 of *Rattus trinilensis* is more elongated than M1 of sample from Terus. The anterolingual and anterobasal cusps are well developed and have the same orientation with the sample from Terus. The lamina in the second row of M1 and overall features of M2 are similar.

The very striking difference between *Rattus trinilensis* and sample form Terus layer is the presence of anterior labial cusplet in the *Rattus trinilensis* specimen. Even though the teeth are highly abraded, the outline of anterior labial cusplet and posterior labial cusplet are still visible, merged with the primary cusps of the second and third rows. The posterior cingulum of Rattus trinilensis is much smaller than those in sample from
Terus layer. We consider that the sample from Terus layer is not corresponds to the reference of Rattus trinilensis.

The *Rattus argentiventer* is probably the most corresponding reference to the sample from Terus layer. The dimension of Rattus argentiventer is close to the sample number M11NON77-85M1. Almost all teeth configuration is similar to the sample of Terus layer. The orientation of anterobasal cusp is perpendicular to the anterolingual. The anterior labial cusplet is absent and the posterior cingulum is triangular and located right in the center plane of M1.

Some slight differences need to be noted between the Terus sample with the *Rattus argentiventer*: (1) the orientation of the anterolabial and anterolingual cusp of M1 in *Rattus argentiventer* is inclined to the labial while in Terus samples are straight; (2) the arcuate laminae of the second and third rows of M1 are sharper than those in Terus sample.

*Figure 22. 1. Specimen number L912II3M10 2. Rattus exulans; 3. Rattus trinilensis; 4. Rattus argentiventer; 7. Specimen number M11NONM1*
*Rattus argentiventer* known mainly for their depredations on the rice fields and garden in Southeast Asia, this raises questions to the presence of this species in the Terus layer. The slight morphological difference could mean the variation of adaptation for this species in Terus layer.

Based on the comparison between the first group of Muridae from Terus Layer and the material collection, we can conclude that the teeth configuration of Terus sample is close to the *Rattus argentiventer.*

**B. Group B**

Only one specimen of lower M1 in the Group B. The tooth is still unworn, anterobasal and anterolingual cusps are small relative to the other cusp in the tooth row, so the Muridae specimen form group B is not belong to the genus of *Rattus.* In between the anterobasal and anterolingual cusp, there is a large anterocentral cusp located in the anterior of the tooth. The lamina of second and third rows are chevron. Three labial cusplets are located each in every margin between the cusps. One small ellipse posterior cingulum is nested far from the second row lamina. The very similar morphology can be seen in the *Pithecheir parvus.*
One striking difference however can be seen in the anterocentral cusp, that in the *Pithecheir parvus* is divided, while in Terus sample is unite. This difference maybe related to the different wear stage of the tooth. We can consider the group B muridae from Terus layer belong to the species of *Pithecheir parvus*.

The monkey footed rat is found in dense forests up to about 1600 meters elevation. It builds globular nests of leaves or moss in the branches or hollows of trees. Two nests found in java were about 150mm in diameter and located about 2 and 3.5 meters above the ground (Walkers, 83).

### C. Group C

The Muridae from group C has a small anterolingual and anterobasal cusp. This feature make this specimen distinct from the genus of *Rattus*. 
The lamina of second and third rows are arcuate, with a wide posterior cingulum. The configuration of the tooth is close to the *Leopoldamys sabanus*.

Figure 24. (top) 1 specimen from Terus layer; 2 *Leopoldamys* reference; 3. *Rattus maxil*; (below) 1. *Leopoldamys* from Ma U’Oi cave, Vietnam; 2&3 specimens from Terus layer.

*L. sabanus* occurs in evergreen forest, generally below 750 meters. The latter species is usually found at ground level. But is able to climb freely.
3.1.4.2. Hystricidae

There are only two specimens of Hystricidae from the level B. Both are fragment molar that cannot be measured. Comparison to the corresponding material in the Punung fauna cannot be obtain.

![Figure 25. hystricidae](image)

3.1.5. Reptilia

There are three kind of Reptilia that present in the Terus layer (level A and level B) belong to suborder Lacertilia. The first reptile represent the family *Agamidae*. With characteristic of acrodont teeth (the teeth fused with the bone), tricuspid and have a triangular profile (Bailon, personal communication).

The second and the third are represent the family of *Gekkonidae*, with plurodont, isodont with one single pointed cusp (Bailon, personal communication).
3.1.6. Chiroptera

*Chiroptera* from Terus layer are belong to the unknown species. We were not able to study this material more intensively due to the high diversity within this taxa and lack of material comparison. We only can suggest that the teeth resemble the insectivorous or carnivorous type of bat.
3.1.7. Primata

One isolated tooth number M1113KC2P1 is identified as a *Primata*. The tooth bears one highly worn cusp supported by a narrow root at the lingual and expanded to the buccal. The md size is 4.5 mm and bl 5.5 mm. The occlusal profile is asymmetrical but nearly forms an ellipse shape. The teeth can be recognized as an element of incisivus. The present of strong marked cutting edge on the lateral surface of the oclussal, indicates the teeth was in contact with a developed canine that giving the precise identification for this element as the upper left I2. The dimension is clearly bigger in compare with the upper I2 of *Trachypithecus* and *Macaca* which are found in the Keplek layer and the upper most of Tabuhan layer. Comparison with other *Primata* needs to be done for this specimen, especially to those from the collection of Punung fauna.

Badoux (1959) reported the presence of *Pongo pygmaeus* and *Symphalangus syndactylus* in the collection of Punung fauna, unfortunately no upper I2 of *Symphalangus syndactylus* in the collection while the dimension of *Pongo pygmaeus*...
upper I2 are too big in compare with the Terus primate. Hooijer (1960) reported the collection of gibbon teeth from the prehistoric caves of Sumatera in the Dubois collection. Therefore the comparison for Terus Primata made following the report of Hooijer on the Symphalangus syndactylus and Hylobates agilis specimens with reference of Pongo pygmaeus that reported by Badoux.

In His report, Hooijer mention about the present of Upper I2 within the collection and He stated that the incisivus and canine are not a significant element to made separation between the Symphalangus syndactylus and Hylobates agilis, but he also conclude that the size of incisivus of Hylobates agilis is smaller than those of Symphalangus syndactylus with some overlapping size between the biggest range of Hylobates and the smallest range of Symphalagus.

Based on the bivariate analysis, dimension of upper I2 specimen from Terus is bigger than the highest range of Hylobates I2 in Hooijer’s collection, and falls within the range of the Symphalagus syndactylus.

Figure 28. Upper I2 primate

Based on the bivariate analysis, dimension of upper I2 specimen from Terus is bigger than the highest range of Hylobates I2 in Hooijer’s collection, and falls within the range of the Symphalagus syndactylus.
3.2. Quantification

Quantification to the anatomical representation of the *Cervidae*, *Suidae*, and *Bovidae* are given in the table below to give the different of preservation between the Level A and Level B. Unfortunately the number of identified specimens are not very significant especially for the Level B.

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Table 4. Anatomical representation of Cervidae

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Figure 30. Anatomical representation of Cervidae.

table 5. Anatomical representation of Cervidae.
Figure 31. Anatomical representation of Bovidae

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Table 6. Anatomical representation of Suidae

Figure 32. Anatomical representation of Suidae.
The similarities of anatomical representation between the three Families, probably can be seen in the ratio of anterior extremities and posterior extremities which shows the posterior extremities are more represented than the anterior.

3.3. Bone modification.
Traces of bone modification by human are present in both levels. The concentration of modified bones in Level A can be seen in M11 square, while in the M9 are more scattered.

Figure 33. Distribution of bones with modification by human
Three specimens from Level B shows the mark of gnawing by rodents. In the level A only one observed with this mark.
3.4. Taphonomy

A. Bone aspect
Quantification of bone aspect (D0-D5) for the Terus assemblage can be associated with the presence of transported bones. All the stages are present but the D4 stage. The quantification of this taphonomic aspect has clearly shows the different preservation of the bones between the Level A and Level B. More than 50% of bones in the Level B are showing the surface alteration while it gradually increased in number to the highest stage of bone alteration. In contrast for the level A the percentage of highest stage alteration (D5) is the fewest in compare with all other stages. The high percentage of D5 in the level B gives a strong indication of transported deposition.

![Figure 36. Percentage and distribution of bone aspect.](image)

B. Fissure
From the quantification of the fissure, we can conclude that the weathering is not the significant cause of the bones alteration in the Terus assemblage. The highest stage of fissure (F3) is absent either in level A or B. The low stage of fissure can be
C. Manganese

Manganese oxides are the most common coloring agents in caves (Hill, 1982:15-19). Further studies for this taphonomical factor need to be done. The micro analysis to the specimens probably can characterize the manganese from the two levels.
D. Iron oxide

The presence of the iron oxide in bones collection of the Terus layer is probably associated with the dynamic of the dry and wet deposition. The high number of bone with iron oxide in the Terus layer clearly seen in the Level B, while in the Level A the iron oxide is almost absent. The iron oxide also can be clearly seen in the sediment of the Level B, together with the sand and pebble stone, marking the alluvial deposits.
E. Stalagmite and animal remains distribution

The stalagmites distributions showing the correlation with the animal remains concentrations. This correlation can clearly be seen on the Level A of M11 and L8 square. The concentration of stalagmite in the both square accompanied by the concentration of the animal remains.
The distributions of animal remains between the Level A and B showing the linear orientation. Need to be noted that the M9 square is not reach the Level B depth. In the Level A the animal remains are more distributed in all the square, while in the Level B the distribution seems to be more oriented diagonally marked by the empty spaces in the left wall area of M11 and in L8.
4. CONCLUSION AND PERSPECTIVES

CONCLUSION

The taxonomical classification to the Terus assemblage which basically done by the paleontological analysis have shown the high diversity of the faunal composition that present in both Level A and B. As much as 17 taxa were identified from this layer consist of Cervus sp., Axis sp., Muntiacus muntjak, Sus verrucosus, Bos sp. Paradoxurus sp., Echinosorex sp. Sympalagus syndactylus, Rattus argentiventer?, Pithecheir parvus, Leopoldamys sabanus, Sciuridae gen., Hystrix sp., Gekkonidae gen., Agamidae gen., Selachimorpha indet., and Chiroptera indet.

Among the Artiodactyle, Cervidae seems to be the most represented animal in the site. Three different genera (Muntiacus, Cervus, and Axis) has been identified. Muntiacus muntjak, probably the most successful species among this family. The comparison between the teeth specimen from the Punung Fauna collection Terus Layer with those from the Keplek layer not showing any difference. Sus verrucosus is the only representative from the family of Suidae in this sites. The scattered find of isolated teeth of Bovidae are not supporting for the more specific taxonomical classification.

Only one specimen of lower P3 that represent the carnivore, which its morphological features close to the Paradoxurus hermaphrodites. One representative species of the insectivora (Echinosorex sp.) also identified. Other fauna such as Selachimorpha (shark) also present.

Some of the identified taxa from the microfaunal and macrofaunal assemblages are useful in reconstructing the paleo-environmental condition of the site. Three species from the collection known as the marker of forested environment: Sympalagus syndactylus (siamang), Pithecheir parvus (monkey rat), and Leopoldamys sabanus (long-tailed giant rat). These species could link the Terus assemblage to what have been reported by Badoux as the Punung fauna. The presence of S. syndactylus, Muntiacus muntjak, Echinosorex sp, and Hystrix sp also correspond to the species that presence in the Punung Fauna collection.
The archaeostratigraphical study to this assemblage have characterize the two different deposition within the Terus layer. The Level B in the lower part of the Terus layer characterized by the higher stage of bone alteration together with trace of iron oxide, marking the alluvial deposition. The Level A constitute of numerous fresh fractured bones, the low stage of bone alteration and almost absent of iron oxide, marking the cave deposition.

Based on the distribution of fresh bones and bone modification by human, we able to confirm the presence of occupational layer in the level A.

PERSPECTIVES

The presence of *Rattus argentiventer* in the Terus collection rises a question about the origin of this species, since it always being correlated with the earliest human agriculture and never been found in the wild. The more intensive studies about *Muridae* distribution in Southeast Asian region need to be done in order to compare with this species from Terus assemblage.

The more comparative materials for the *Carnivora, Reptilia* and *Chiroptera* also needed to have better taxonomical classification for this assemblages.

The more advance taphonomical analysis including the microscopic analysis to the animal remains between the two level are needed to have better characterization between the different preservations. The taphonomic studies also need to account the microfaunal assemblages which in this studies, only teeth were being collected for the purpose of taxonomical classifications.

Sedimentological analysis to the Upper Layer are needed to confirm the difference between two different deposition within the Terus layer.

The lithic tools are abundance in the Terus layer, the difference of bones preservation which are clear between the two layers also can be seen in the lithic assemblages. Therefore the lithic analysis based on the two different layer need to done.
BIBLIOGRAPHY


O’Connor. (2000). The archaeology of animal bones. Sutton publishing


TABLE OF FIGURES

Figure 1. Location of Gunung Sewu; top: The geological map of Java (Sémah et al., 2004); Bottom: Gunung Sewu area (Puslitbang Arkenas) (after Budiman, 2009). ................................ 13
Figure 2. The geological formation of Gunung Sewu (Sartono, 1964; Samodra et al., 1992) ... 14
Figure 3. Topography map of Song Terus site (MQPI) ............................................................. 16
Figure 4. Song Terus Chronostratigraphy (MQPI) ................................................................. 18
Figure 5. Human burial in Keplek layer (MQPI: Détroit, 2002)) ............................................ 20
Figure 6 number of identified specimens of Cervidae .......................................................... 23
Figure 7 number of identified specimen of Bovidae ............................................................. 23
Figure 8. number of identified specimens of Suidae .............................................................. 24
Figure 9 Terminology of teeth used in this paper: a. Bovidae; b. Suidae; c. Muridae; d. chiroptera (adapted from Tougaard, 1998; Musser, 1982; Freeman, 1998; Hilson, 1992) .... 26
Figure 10. archaeostratigraphical preposition for the Terus assemblage ......................... 30
Figure 11. comparison of Upper M3 axis. ............................................................................ 33
Figure 12 Bivariate analysis on upper M2 of Muntiacus sp. .................................................. 34
Figure 13. 1. Muntiacus sp.; 2. Axis sp.; 3. Cervus sp.; a occlusal view; b. buccal view; c. lingual view ................................................................. 34
Figure 14. bovidae from terus layer ....................................................................................... 35
Figure 15. comparison of upper M2 Sus ............................................................................... 37
Figure 16. suidae from Terus layer ....................................................................................... 37
Figure 17. comparison between the Paradoxurus hermaphrodites recent with the material form Terus layer. ......................................................................................... 39
Figure 18. Echinosorex from Terus layer; 1 upper jaw; 2 lower jaw ...................................... 40
Figure 19. reference comparison of showing the similarities between the Terus insectivore with the specimen of Echinosorex. ................................................................. 41
Figure 20. Group classification of Muridae based on the lower M1 dimension .................... 42
Figure 22. 1. Specimen number L912II3M10 2. Rattus exulans ; 3. Rattus trinilensis ; 4. Rattus argentiventer; 7.Specimen number M11NONM1 ............................................ 47
Figure 23 : 1. Niviventer lepturus; 2. Rattus tioianicus 3. Pithecheir parvus 4. Specimen number M1013JA4M15; 5.Kadarsanomys sodyi ................................................................. 49
Figure 24. (top) 1 specimen from Terus layer; 2 Leopoldamys reference; 3. Rattus maxi; (below) 1. Leopoldamys from Ma U’Oi cave, Vietnam; 2&3 specimens from Terus layer........ 50
Figure 25. hystricidae .......................................................................................................... 51
Figure 26. 1. Agamidae 2. Gekkonidae 3. Gekkonidae (different species than number 2) ..... 52
Figure 27. Left mandibule of Chiroptera; a. occlusal view; b. buccal view; c. lingual view ...... 53
Figure 28. Upper I2 primate ............................................................................................... 54
Figure 29. Upper left I2 of Primata from Terus layer; a. Buccal view; b. Distal view; c. Lingual view; d. mesial view (MQPI, 2009) ................................................................. 55
Figure 30. Anatomical representation of Cervidae. ............................................................. 56
Figure 31. Anatomical representation of Bovidae ............................................................... 57
Figure 32. Anatomical representation of Suidae. .............................................................. 57
Figure 33. Distribution of bones with modification by human ........................................... 58
Figure 34. Fragment of distal radius Cervidae, showing the cut mark (arrow) and fresh
fracturation (MQPI, 2009; drawing by Dayat) .................................................................. 59
Figure 35. Bone fragment showing an intensive rodent gnawing (MQPI, 2009; drawing by
Dayat) .................................................................................................................................... 59
Figure 36. Percentage and distribution of bone aspect ...................................................... 60
Figure 37 Percentage and distribution of Fissure ............................................................... 61
Figure 38 percentage and distribution of manganese ....................................................... 62
Figure 39. Distribution and percentage of bones with iron oxide ....................................... 63
Figure 40. concentration of faunal remains in association with distribution of the stalagmite 63
Figure 41. orientation of faunal distribution ...................................................................... 64

TABELS

Table 1. Measurement of 17 species of Muridae from Java, Sumatera, and Malaya that taken
by Musser on material collection of American Museum Of National History (AMNH),
Rijksmuseum van Natuurlijke Historie (RMNH), and Dubois collection (DC) ; molar Breadth or
BL (BM); molar length or MD (LM); length of alveolus molar (ALM); and number of roots
(Musser, 1982). ...................................................................................................................... 42
Table 2. Measurements to the lower M1 of the three different groups of Muridae. .......... 43
Table 3. Measurement to the Terus Spesimen of Group A ................................................ 44
Table 4. Anatomical representation of Cervidae ............................................................... 56
Table 5. Anatomical representation of Cervidae ............................................................... 56
Table 6. anatomical representation of Suidae ................................................................... 57