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Species diversity of cerambycid beetles at reclamation area of coal mining in Berau District, East Kalimantan, Indonesia

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Abstract. *Sugiarto, Boer C, Mardji D. 2016. Species diversity of cerambycid beetles at reclamation area of coal mining in Berau District, East Kalimantan, Indonesia. Biodiversitas 17: 200-207.* Longhorn beetles (Cerambycidae) are amongst the most popular beetle families and hence lots of research has been carried out on the family. However, the presence of this beetle in the reclamation area of PT Berau Coal has not been investigated yet. PT Berau Coal is a coal company that has long been operated. In the former mining areas have been planted with reclamation plants. The study was carried out to determine the cerambycid beetle species diversity in three sites of the reclamation area, mainly Lati (L), Sambarata (S) and Binungan (B). This is the first report of cerambycid beetles diversity at a reclamation area of PT Berau Coal. This study reveals a total of 16, 19 and 22 species with 100, 140 and 192 individuals respectively. Calculation with Simpson's diversity index (1-D) resulted in highly index of biodiversity, namely 0.90, 0.89 and 0.89 respectively. These highly index of diversity is likely due to varied types of vegetation and distance from natural forest to study sites is relatively close. There were seven species respectively dominant at Lati and Sambarata reclamation areas, while at Binungan were six species. Simpson's evenness index of Lati was the highest, followed by Sambarata and Binungan, that were 0.64, 0.53 and 0.41, respectively. This differences might be influenced by the ability of each beetle species to move to other habitats. Jaccard's similarity indices at the three sites were relatively same; they were L with S = 0.45, L with B = 0.46 and S with B = 0.46. The similarity index reflects similar environmental conditions of the three study sites. From the viewpoint of nature conservation, it is concluded that post-mining areas can play a key role in the conservation of beetle diversity since they are as new habitat for beetles species whose original habitats are now in critical condition due to human impact. An important task for future management of post-mining areas is to maintain successional processes and to prevent loss of habitat diversity through revegetation.

Keywords: Cerambycidae, Berau Coal, reclamation, species diversity

INTRODUCTION

Cerambycidae is the second largest family in order of Coleoptera with thousands of them are found almost worldwide, consisting of more than 35,000 species (Lawrence, 1982). Beetles in the family Cerambycidae are often called longhorned beetles because many species possess extremely long antennae, which may be as long or longer than the entire body. However, some species have short antennae, and may be confused with other families of beetles. Many longhorns are large and colorful, which has lead to the group being very popular among collectors. (Schiefer 2015).

Forest in East Kalimantan, the majority of natural forest is a habitat for many species of fauna including beetles of family Cerambycidae. The forest has been changed. Among others for the coal mining which is then planted with reclamation vegetation. The change in habitat resulted in conditions that are not suitable for insect life because of reduced food and changed in the microclimate, so that certain species that are not resistant to these conditions will be away to another place that is found to be appropriate.

This study was undertaken in the reclaimed area of post-mining of PT Berau Coal, where the company has been operated since 1983. The mining system made by this company is an open pit mine. Before the mining begins, land clearing needs to be done to remove vegetation. The soil is excavated to a certain depth to take coal while the woods of economic value are used by PT Inhutani. The site that has been completed mined, are back filled with soil originating from the next site which is being excavated. After mining at a site has been finished, the land is reclaimed around one year after the end of mining.

The species composition of cerambycids fauna depends on the geographical location, climate peculiarities and the vegetation of the region (Georgiev 2013). Establishment of forest plantation often has a negative impact on biodiversity of various types of organisms in many parts of the world because of its structure and function has changed between the natural forest and the plantation (Palik and Engstrom 1999). In Japan, one of the greatest consequence of habitat destruction is the conversion of natural and secondary forests to broadleaf plantations needles especially *Cryptomeria japonica* and *Chamaecyparis obstusa* (Hartley 2002). Disappearance of forested habitat and replacement of old forests with younger forests may have played a role in the decline; nine species were first collected after 1950, resulting in a net loss of 11 species (Mccorquodalel et al. 2007). Other studies revealed that beetles species diversity and their distributions are influenced by the change of habitat, such as habitat destruction and degradation (Baur et al. 2002), habitat fragmentation (Collinge et al. 2001), change of environment (Baselga 2008).

This study was conducted to determine the cerambycid beetles species diversity in the reclamation area, where such study was not conducted before.

MATERIALS AND METHODS

This study was undertaken in the reclamation area of PT Berau Coal, Berau District, East Kalimantan Province, Indonesia from March to August 2013. The study sites were located at Lati (117°35'25.17" E-2°16'49.88" N), Sambarata (117°24'29.34" E-2°10'2.13" N) and Binungan (117°25'58.93" E-2°2'51.86" N) (Figure 1).

The size of the reclaimed area up to the end of 2012 was 91.29 ha, 76.21 ha, and 48.30 ha, respectively. Based on the classification of Köppen, climate type in the study area is wet tropical (Af), while according to the classification of Schmidt and Fergusson the climate included to type A (very wet). The forest types are mainly classified as old secondary forest and plantation forest as reclamation plantation. There are more than 30 floral species of the lands available in the area including *Acacia mangium*, *Agathis*, *Anthocepallus cadamba*, *Areca catechu* (pinang), *Artocarpus integer* (cempedak), bamboo (bambu china), *Caliandra calothyrsus* (kaliandra), *Canna indica* (bunga kana), *Cassia siamea* (johar), *Citrus* sp. (jeruk), *Cupressus sempervirens* (cemara lilin), *Dimocarpus longan* (kelengkeng), *Dryobalanops* sp. (kapur), *Durio zibethinus* (durian), *Enterolobium cyclocarpum* (sengon buto), *Eugenia aquea* (jambu air), *Gliricidia sepium* (gamal), *Gmelina arborea*, *Hevea brasiliensis* (karet), *Hyophorbe lagenicaulis* (palem botol), *Lansium domesticum* (langsat), *Lavandula afficinalis* (lavender), *Macaranga hypoleuca* (mahang), *Mallotus paniculatus*, *Melaleuca leucadendron* (kayu putih), *Nephelium lappaceum* (rambutan), *Palaquium rostratum* (nyatoh), *Paraserianthes falcataria* (sengon laut), *Parkia speciosa* (petai), *Pterocarpus indicus* (angsana), *Salacca zalacca* (salak), *Shorea laevis* (bangkirai), *Shorea* sp. (meranti), *Spondias pinnata* (kedondong), *Swietenia macrophylla* (mahoni), *Terminalia catappa* (ketapang), *Theobroma cacao* (kakao) and *Vitex pubescens* (laban) (Berau Coal 2013).

To record the species of beetles, a plot measuring 20 m ò 100 m (0.2 ha) had been established in each site with the transect pattern (Figure 2).

Three malaise traps (Figure 3.A) at each site were set as described by MEM (2006) and three artocarpus (jackfruit) traps (Figure 3.B-C) were set as described by Makihara et al. (2011). They were used for capturing the beetles. Artocarpus trap was made by using bait consisted of

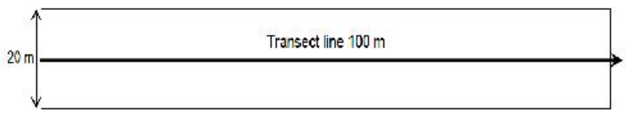

Figure 2. Beetles and vegetation monitoring plot

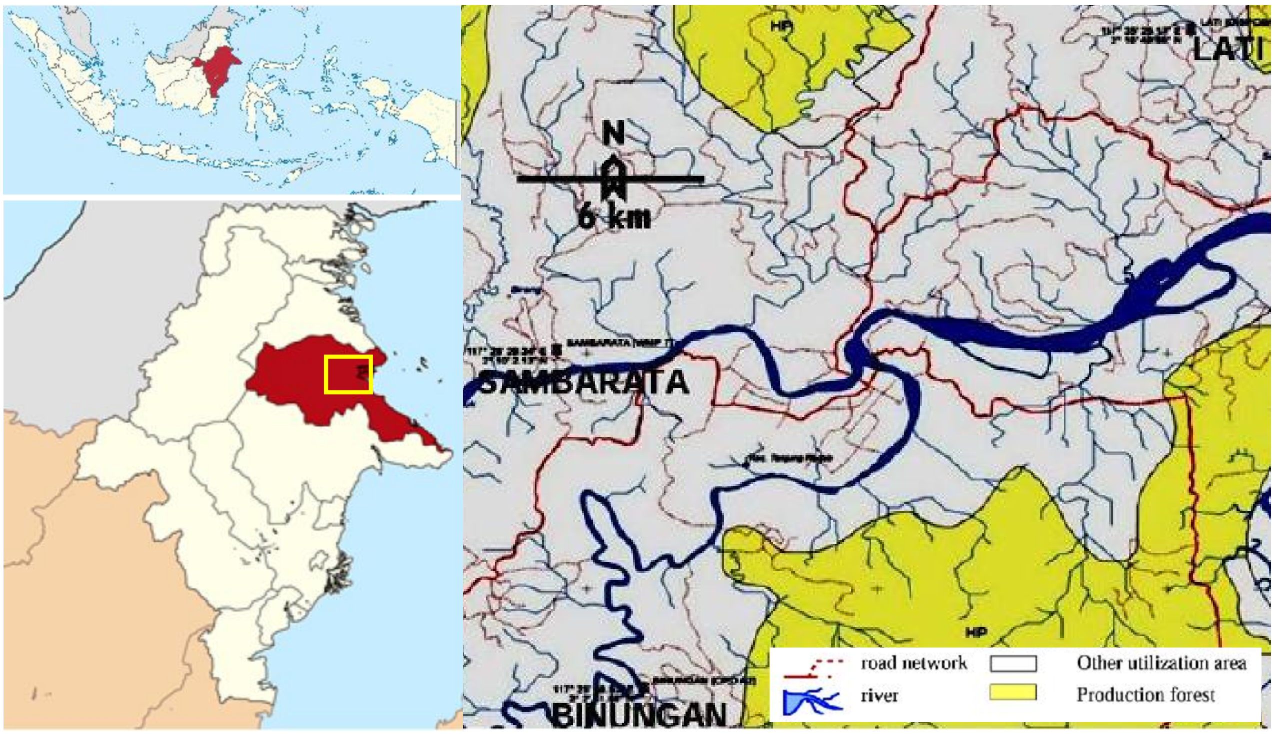

Figure 1. Study site at PT Berau Coal (Lati, Sambarata and Binungan) in Berau District, East Kalimantan, Indonesia

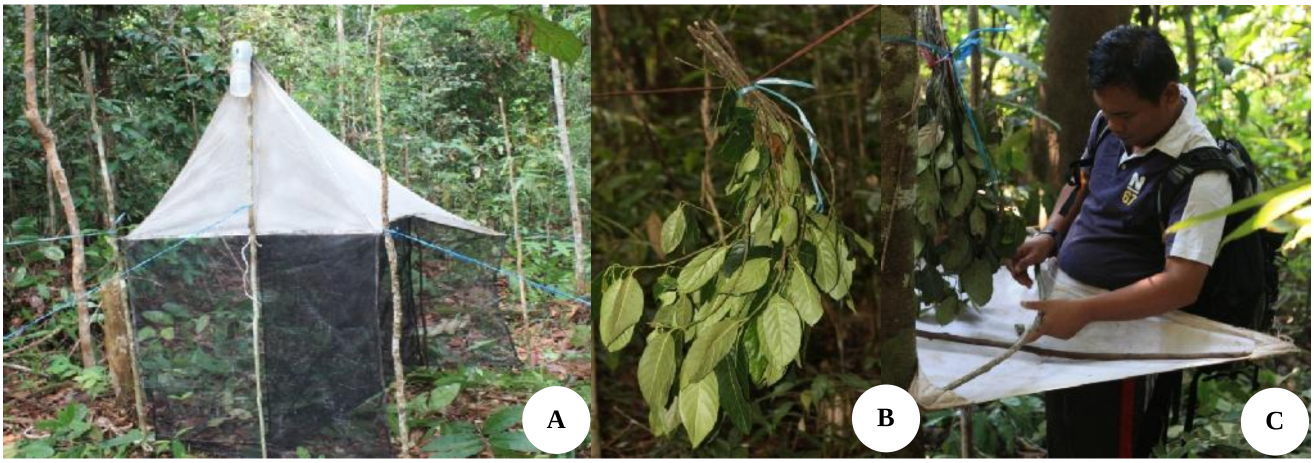

Figure 3. A. Malaise trap set under a light canopy. B. Artocarpus trap where the leafy twigs of jackfruit are tied together and hanged on a tree. C. Artocarpus trap is beaten on a sheet of cloth (beating method) for collecting beetles

several parts of the leafy twigs of jackfruit (*Artocarpus heterophyllus*), then tied into a single clump (Figure 3.B). After three days, artocarpus trap was pounded on a piece of cloth (beating method) for collecting beetles (Figure 3.C). Beetles entered in malaise trap were taken once a week and every time retrieval, old propylene glycol was replaced with a new one, while the beetles trapped in the artocarpus trap were taken every 3 days and when the leaves had withered, then replaced with a new one.

The gathered data were characteristics of beetles, namely: color of body, the size of the antennae, the size of the body and limbs. The primary source for identifications was Makihara (1999) and Makihara et al. (2000).

The Simpson's diversity index was applied to estimate beetle diversity with the following formula: $1 - D$. $D = \{\sum n(n-1)\}/\{N(N-1)\}$, where n = the total number of beetles of a particular species while N = the total number of beetles for all species (Doherty et al. 2011). The index values range between 0.0, which represents no diversity, and 1.0, which represents infinite diversity.

Dominant species of beetles are the most abundant of individuals of each species in a community and were calculated as a percentage. Dominant species were calculated according to Mühlenberg (1993) as follows: Dominant species = (number of individuals of certain species) / (sum of individuals of all species) × 100%. To determine the level of dominant of each species, a formula according to Jorgensen (1974) was used, where >5% is dominant, 2-5% is subdominant and 0-<2% is not dominant.

Simpson's evenness index was calculated according to Krebs (2014) as follows: $E = (1/D) / D_{max}$, where $D = \{\sum n(n-1)\} / \{N(N-1)\}$, where E = evenness index, D = Simpson's index, D_{max} = total species in the community. This index ranges from 0 (unequal distribution of all habitats) to 1 (equal distribution of all habitats).

Jaccard's similarity index was calculated according to Thada and Jaglan (2013) as follows: $S_J = |X \cap Y| / |X| + |Y| - |X \cap Y|$, where S_J is Jaccard index of similarity, *X* is the number of species found in the first site, *Y* is the number of species found in second site and $X \cap Y$ is the number of species shared by the two sites. The range of Jaccard index is 0 to 1, where larger values than 0 mean more similar.

RESULTS AND DISCUSSION

Species diversity

Species richness and individuals at the three sites were somewhat different, at Lati were 16 species with 100 individuals, at Sambarata 19 species with 140 individuals and at Binungan 22 species with 192 individuals (Table 1). There were total of 31 species captured at the three sites (Figure 4). Species diversity index at those three sites was almost same, at Lati 0.90, at Sambarata and Binungan were same, i.e 0.89.

The diversity index was relatively high. This indicated that those three sites were same appropriate for development of the beetles. The main factor that influenced the development was a diversity of vegetation. As above mentioned that there were more than 30 floral species of the lands available in the area at the end of 2012 and the size of revegetated area were 91.29 ha, 48.30 ha, and 76.21 ha, respectively. It is a good development of the area condition that revegetated area is providing diverse habitat that can support a large variety of beetles. The positive relationships between the numbers of longhorn beetle species and individuals with the number of tree species and individuals were reported by Meng et al. (2013) in a region of southern Yunnan, China.

Those species richness and individuals were included slightly when compared to natural forests. For example in the Education Forest of Mulawarman University at Bukit Soeharto were found 555 species of Cerambycidae beetle included in 6 subfamilies in after burned primary and secondary forests (Makihara 1999), at Bukit Bangkirai found 437 species (Makihara et al. 2000), while in the education forest of Unmul at Lempake there were found 45 species with 1744 individuals (Djatmiko 2005). Reclamation land is an area that has been converted from natural forest to artificial (plantation forest) so that the conditions have changed dramatically both physical and biological condition. Conversion of natural forests to other land use may result in loss of insect populations. However, so far there is no study about population of cerambycids beetle in the natural forest near the reclamation land. In this study, the species diversity index of Cerambycidae at the three study sites was high. This indicated that the sites conditions were appropriate for the development of Cerambycidae beetles, where the successive process of vegetation is going on.

There were 10 same species (32.3%) of 31 species present at three sites, that were *Acalolepta rusticatrix*, *Atimura bacillima*, *Epepeotes luscus*, *Nyctimenius ochraceovittata*, *Pterolophia annulitarsis*, *P. crassipes*, *P. melanura*, *Ropica marmorata sarawakiana*, *Sybra* (*Sybra*) *borneotica* and *Xenolea tomentosa*. This means that species were able to adapt at the three sites. The ability to adapt at the sites probably due to the structural similarity of the environment and availability of food, so might represent a suitable habitat, or the ability to fly and migration from one site to another is high.

The movement abilities of longhorn beetles vary greatly, from flightless species that may move 100 m in 10 days (Baur et al. 2002). *Nyctimenius ochraceovittata* was considered to be indicators for less disturbed forest, while *Atimura bacillima*, *Ropica marmorata* and *Xenolea tomentosa* were indicators for degraded forest (Noerdjito et al. 2010). Buchori et al. (2013) studied the importance of insect as bioindicator of reclamation success at Binungan reclamation area, and the result showed that insect diversity collected from reclamation area differed depends on age of reclamation area; the environmental factors such as change of pioneer plant age, vegetation diversity (tree and shrub) and soil chemistry (N total) affect insect diversity in reclamation area. They determined that ants can be potential bioindicator to assess reclamation success in the coal-mining area. More than 200 species of insects including moths, dragonflies, locust, flies and beetles are known to migrate over long distances by air (Meyer 2007). The distance from Lati to Sambarata is 22 km, Lati to Binungan 26 km and Sambarata to Binungan 11 km. The distance from natural forest to Lati reclaimed area is 2 km, to Sambarata 6 km, and to Binungan 3 km. Furthermore, these distances are relatively easy to achieve by the beetles within some days.

Table 1. Diversity, evenness, similarity indices and criteria of dominant of Cerambycidae beetle at reclamation area of PT Berau Coal, East Kalimantan, Indonesia

Species	Lati (L)		Sambarata (S)		Binungan (B)	
	n	Criteria	n	Criteria	n	Criteria
Acalolepta opposita (Pascoe)	2	SD	0		0	
Acalolepta rusticatrix (Fabricius)	20	D	4	SD	2	ND
Amechana nobilis Thomson	0		1	ND	0	
Astathes japonica (Thomson)	0		0		4	SD
Atimura bacillima Pascoe	8	D	15	D	14	D
Cereopsius sexnotatus Thomson	1	ND	1	ND	0	
Cleptometopus grossepunctatus Breuning	3	SD	0		1	ND
Epepeotes luscus (Fabricius)	10	D	3	SD	2	ND
Menesia vittata Pascoe	0		1	ND	0	
Mutatocoptops diversa (Pascoe)	0		0		1	ND
Myagrus vinosus (Pascoe)	2	SD	0		0	
Nyctimenius ochraceovittata (Auriv)	14	D	4	SD	7	SD
Pterolophia annulitarsis (Pascoe)	2	SD	24	D	31	D
Pterolophia crassipes (Wiedeman)	4	SD	12	D	34	D
Pterolophia melanura (Pascoe)	10	D	28	D	37	D
Rhaphipodus hopei (Waterhouse)	2	SD	0		0	
Rondibilis spinosula (Pascoe)	0		0		1	ND
Ropica angusticollis (Pascoe)	0		0		4	SD
Ropica marmorata sarawakiana Hayashi	3	SD	9	D	4	SD
Ropica nigrovittata (Breuning)	0		0		10	D
Ropica piperata Pascoe	0		2	ND	0	
Ropica sp. (Atlas: sp.2)	0		0		1	ND
Sybra (*Sybra*) *arator* Pascoe	0		1	ND	2	ND
Sybra (*Sybra*) *borneotica* Breuning	7	D	1	ND	4	SD
Sybra (*Sybra*) *lineolata* Breuning	2	SD	0		2	ND
Sybra (*Sybra*) *pulla* Breuning	0		4	SD	19	D
Sybra (*Sybra*) *umbratica* Pascoe	0		4	SD	0	
Sybra (*Sybra*) *cretifera* Pascoe	0		14	D	2	ND
Sybra (*Sybra*) *vitticolis* Breuning et de Jong	0		2	ND	0	
Xenolea tomentosa (Pascoe)	10	D	10	D	8	SD
Xystrocera globosa (Olivier)	0		0		2	ND
Sum (N)	100		140		192	
Diversity index		0.90		0.89		0.89
Evenness index		0.64		0.53		0.41

Note: D = dominant. SD = subdominant. ND = not dominant. Jaccard similarity index (S_J) L with S = 0.45. S_J L with B = 0.46. S_J S with B = 0.46

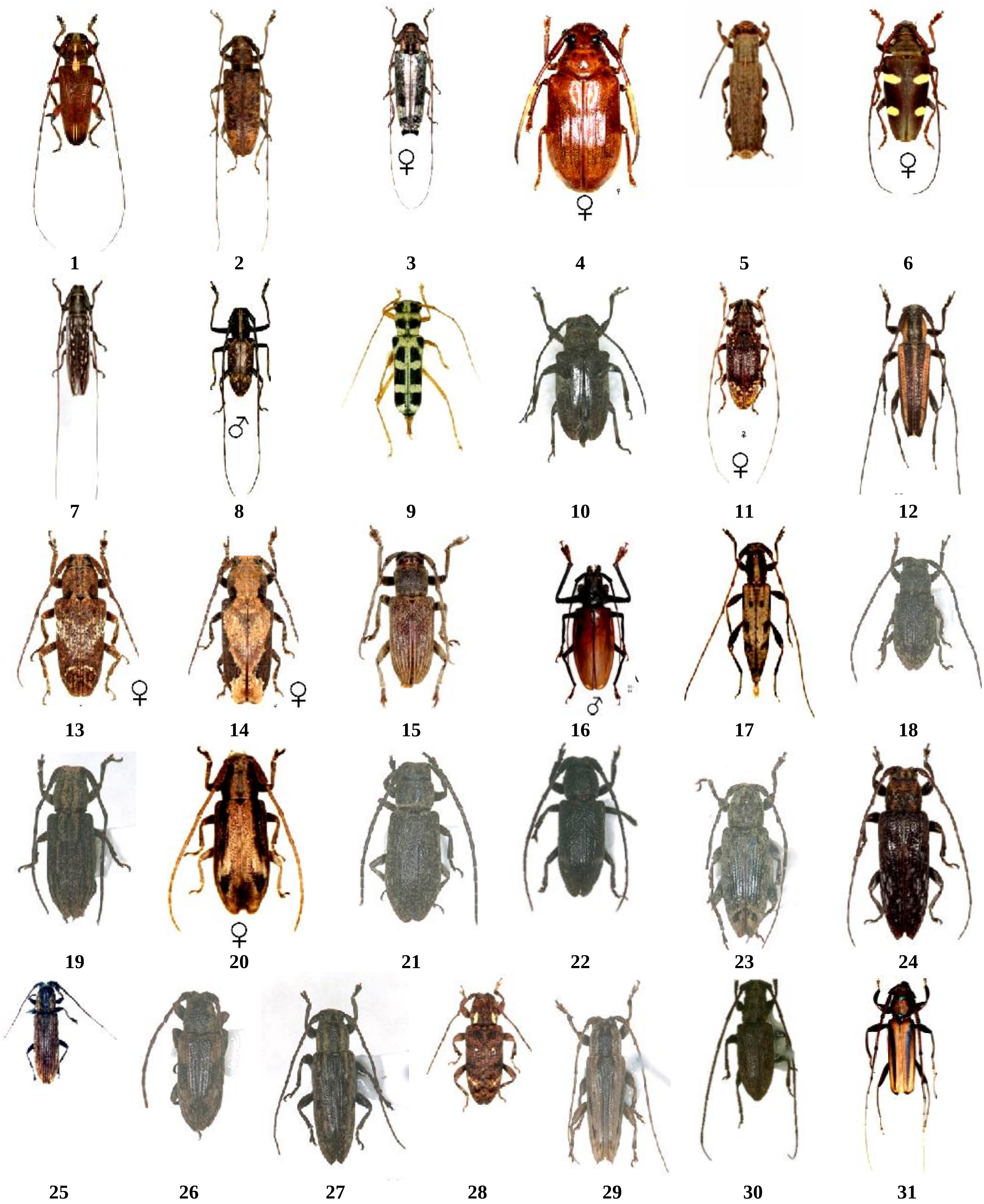

Figure 4. Cerambycidae beetles found in reclamation area of PT Berau Coal. Note: 1. *Acalolepta opposita* (Pascoe); 2. *Acalolepta rusticatrix* (Fabricius); 3. *Amaechana nobilis* Thomson; 4. *Astathes japonica* (Thomson). 5. *Atimura bacillima* Pascoe; 6. *Cereopsius sexnotatus* Thomson; 7. *Cleptmetopus grossepunctatus* Breuning; 8. *Epepeotes luscus* (Fabricius); 9. *Menesia vittata* Pascoe. 10. *Mutatocoptops alboapicalis* Pic; 11. *Myagrus vinosus* (Pascoe); 12. *Nyctimenius ochraceovittata* (Auriv.); 13. *Pterolophia annulitarsis* (Pascoe); 14. *Pterolophia crassipes* (Wiedeman); 15. *Pterolophia melanura* (Pascoe); 16 *Rhaphipodus hopei* (Waterhouse); 17. *Rondibilis spinosula* (Pascoe); 18. *Ropica angusticollis* (Pascoe); 19. *Ropica marmorata sarawakiana* Hayashi; 20. *Ropica nigravittata* (Breuning); 21. *Ropica piperata* Pascoe. 22. *Ropica* sp.; 23. *Sybra* (*Sybra*) *arator* Pascoe; 24. *Sybra* (*Sybra*) *borneotica* Breuning; 25.

Sybra (*Sybra*) *lineolata* Breuning; 26. *Sybra* (*Sybra*) *pulla* Breuning; 27. *Sybra* (*Sybra*) *umbratica* Pascoe; 28. *Sybra* (*Sybra*) *cretifera* Pascoe; 29. *Sybra* (*Sybra*) *vitticolis* Breuning et de Jong; 30. *Xenolea tomentosa* (Pascoe); 31. *Xystrococera globosa* (Olivier).

The company has successfully conducted reclamation and revegetation, as it can see now in Lati and Binungan various fauna species such as monkeys, deer, and Enggang birds have returned to nest just two years after the reclamation began (Berau Coal 2013). Smith et al. (2004) studied dispersal and spatiotemporal dynamics of the Asian longhorned beetle, *Anoplophora glabripennis* in Gansu Province of northern central China and resulted that 98% of beetles were recaptured within 920 m from a release point, whereas the median dispersal rate for all recaptured adults was 30 m/d; dispersal potential within the course of a season for males and gravid females was 2,394 and 2,644 m, respectively. Yarrow (2009) stated that habitat for any wild animal must provide cover (shelter) from weather and predators, food and water for nourishment, and space to obtain food, water, and to attract a mate. This criterion is met the conditions in the natural tropical rainforests such as in the study site. Many species in the rainforest, especially insects and fungi, have not yet been discovered by scientists; every year new species of mammals, birds, frogs, and reptiles are found in rainforests (Butler 2015). Forest actually contains most of the living species, particularly in the case of tropical forests where up to 90% of the planet's species live; tropical forests possess the highest level of biodiversity and therefore provide the biggest genes reservoir (EfB 2016). More than half of the world's estimated 10 million species of plants, animals and insects are living in the tropical rainforests. A 25-acre plot of rainforest in Borneo may contain more than 700 species of trees-a number equal to the total tree diversity of North America (PNF 2016).

Hence natural tropical rainforest is a species source and essential habitat for many living organisms. In contrast, the coal mining area is arid land with no vegetation. But, by reclaiming various species of vegetation, the area that was originally barren slowly turned into a nice area, thus attracting the animals to come in search of food, shelter and breeding. The animals came from a nice habitat (tropical rain forests) around the reclamation area. So here going on source-sink dynamics, where tropical rain forests as a source and reclamation area is a sink. The cause of the high diversity species index of longhorn beetle in three sites of reclamation areas likely due to environmental conditions suited for their lives, because the age of the reclamation plant at the time this study was conducted (the year 2013) was range from 2 to 11 years with an area of reclaimed quite extensive as those mentioned in materials and methods. Appropriate environmental conditions attract beetles from natural forests (source sites) to migrate to the reclamation area (sink sites). Migration in insects serves not only for escape from old habitats but also for reproduction and colonization in new ones (Dingle 1978). Weather seems to be an important factor for the majority of insect migrations. Insect migrations are usually completely confined to the lowest 2 km of the atmosphere, the planetary boundary layer (Drake and Farrow 1988). Williams et al. (2004) stated that adult beetles are prompted to move when the density of beetles in a given area reaches high levels. Individual beetles typically attack a single host tree but migrate to nearby host trees when beetle populations become too dense. Although Asian longhaired beetles can fly distances greater than 400 yards (0.37 km), migration often depends on the abundance of suitable host materials (USDA 2001). According to Bancroft and Smith (2005), the Asian longhorned beetle *Anoplophora glabrescent* move to another habitat when they are in search of a mate.

Foley and Holland (2010) predicted that the best cost surfaces for each species of beetle would reflect aspects of their ecology: *Neoclytus acuminatus acuminatus* would respond positively to urban areas as they provide additional wood resources such as stressed trees; *Neandra brunnea* would respond to urban and field areas, as they may contain damaged or stressed trees and utility poles; *Typocerus velutinus velutinus* would respond to agriculture areas as they contain both large areas of flowers that serve as adult feeding sites and some decaying wood for larval habitat; and *Urographis despectus* would respond to habitat only as it is a specialized larval feeder. Flight is one of the primary reasons that insects have been successful in nature; flight assists insects in the following ways: escaping from danger, finding food, locating mates and exploring for new places to live (Smithsonian 1999). Some common species of longhorn beetles can be categorized as open habitat species that prefer to live in open areas and bore into small branch while others as forest dwellers species or mature forest species living only in primary or very mature secondary forest depending on specific host plants (Noerdjito et al. 2010).

Species dominance

There were seven species respectively dominant at Lati and Sambarata reclamation area while at Binungan were six species. *Atimura bacillima* and *Pterolophia melanura* were dominant at the three sites while *P. annulitarsis* and *P. crassipes* were dominant at both sites Sambarata and Binungan, *Xenolea tomentosa* were dominant at both sites Lati and Sambarata. The dominant value comprises >5% of total individuals. The dominance of these species probably due to their high adaptability to revegetated area and the environment is suitable for breeding, resulting in a lot of the number of individuals. High numbers of ground beetles species and individuals had been captured directly after revegetation at Lusatian mining region (Germany); the dominant beetles were xerophilic species, known to prefer open sandy sites; catches in different plots were positively correlated with the amount of vegetation cover (Kielhorn et al. 1999). The number of herbivorous beetle species was positively correlated with the number of plant species present on the sites at reclaimed strip mines in Southwestern Wyoming. The trophic structure on reclaimed mine sites was dominated by omnivores, insect-carrion feeders, predators and fungivores, whereas the undisturbed site's beetle fauna was dominated by omnivores, herbivores and predators (Parmenter and Macmahon 1987). *P. melanura* and *P. anulitarsis* are common in all habitat types and thought to be habitat generalists (Noerdjito et al. 2010). A generalist species is able to thrive in a wide variety of environmental conditions and can make use of a variety of different resources and are thus often urban adapters (Douglas and James 2015).

There were eight subdominants (2-5%) and only one not dominant species (0-<2%) at Lati reclamation area; at Sambarata five subdominant and seven not dominant; at Binungan six subdominant and ten not dominant species. The criteria of dominance depend on the abundance of individuals of each species. The number of individuals in a population has never fixed the whole time. Births and immigration will increase the number of individual while the death and emigration reduced the number of individual.

Species evenness

The evenness index at Lati was 0.64, Sambarata 0.53 and Binungan 0.41. This shows that the number of individuals of each species of beetles at each site were distributed unevenly. The abundance of individuals each species at Lati were more evenly distributed than at Sambarata and at Sambarata were more evenly distributed than at Binungan. The uneven distribution of the study sites indicated there were some dominant species at the three sites, as above mentioned, there were seven species respectively dominant at Lati and Sambarata reclamation area while at Binungan were six species.

Species similarity

The similarity indices between Lati and Sambarata, Lati and Binungan, Sambarata and Binungan were relatively same, that were 0.45, 0.46 and 0.46, respectively. This means that the species of beetles at the three sites were similar, but the values of similarity index were low. These studies concluded that the low degree of similarity in the reclaimed areas were most likely due to the slow colonization by beetles, where this colonization depended on the succession of planted vegetation. In the Lusatian mining region (Germany), ground beetles species and individuals numbers were high directly after revegetation, while in control plots (not revegetated) were the lowest (Kielhorn et al. 1999). Species richness and diversity on reclaimed strip mines in Southwestern Wyoming showed an increase during the first 3 yr following revegetation, but then declined over the next 3 yr; the magnitude of the observed species richness and diversity trends may have been influenced by the presence or absence of topsoil on the sites (Parmenter and Macmahon 1987). At study sites, the mining process begins with land clearing, followed by topsoil removal, drilling and blasting for overburden removal, transporting overburden, extraction, and hauling of coal. Post-mining activities are backfilling, final disposal and after mining activities are completed, the revegetation of pits (Berau Coal 2013).

This study revealed that the species diversity of beetles at the three study sites (Lati, Sambarata and Binungan) was high, although the species richness in each of these sites is lower than in natural forests in other locations. However, the results of this study demonstrate the success of post-mining land reclamation by PT Berau Coal, in which the longer the diversity of the vegetation will be more and more, so the beetle species richness will also increase. Among the species of beetles, there are dominant, subdominant and not dominant. The spread of the number of individuals of each species of beetles is also uneven. This is related to differences in the nature of each species of beetles, good ability to adapt to their habitat as well as the ability to reproduce. Although the species richness, dominant species and the distribution of individuals number of each species are not the same, but the similarity of species of beetle is relatively the same at the three locations. This relates to the similarity of vegetation planted in three reclamation area. Replanting of post-mining areas is the company's obligation to restore damaged land to be returned to its original condition.

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