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Original research article

Diversity and Abundance of Cerambycid Beetles in the Four Major Land-use Types Found in Jambi Province, Indonesia

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ABSTRACT

Longhorn beetles (Coleoptera: Cerambycidae) have an important function in the ecosystem, i.e. bio-indicators, saproxylic, pollinators, and as food of other organisms. Land cover changes due to land use can disrupt the natural balance of the ecosystem, which can result in a decrease of cerambycid diversity. Cerambycid species diversity was evaluated in four land types, i.e. jungle-rubber, rubber plantations, oil palm plantations, and felled jungle-rubber. Collections of cerambycid beetles were conducted by using artocarpus trap, made by freshly cut *Artocarpus heterophyllus* branches. Collections of beetles were made on day 4th, 7th, 10th, 13th, and 16th after the traps were set up. In the four land-use types in Jambi province, we collected 72 species including 34 morphospecies of cerambycids, consisting of 42 species from the jungle-rubber, 39 species from rubber plantations, 16 species from oil palm plantations, and 28 species from felled jungle-rubber. Cerambycid diversity was highest in jungle-rubber (H' = 3.23), followed by rubber plantation (H' = 2.67), felled jungle-rubber (H' = 2.38), and oil palm plantations (H' = 2.01). Highest similarities of cerambycid communities occurred in the rubber plantation–felled jungle-rubber (51.2), followed by jungle-rubber–rubber plantation (50.0), rubber plantations–oil palm plantations (43.5), oil palm plantation–felled jungle-rubber (42.4), jungle-rubber–oil palm plantations (35.3), and jungle-rubber–felled jungle rubber (34.8). The number of cerambycid species and individuals collected was highest on day 7th.

1. Introduction

Terrestrial insects are an integral component of tropical forests with high species diversity. However, the function of the insects is rarely considered in the forest management (Janzen 1987). Beetles have a high diversity, representing about 30% of all insects (Lawrence & Britton 1991) and play important roles, such as herbivore, predator, fungivore, and as food sources for other organisms (Janzen 1987). Beetles also play roles in decomposition and nutrient cycling in forest ecosystems (Siitonen 2001; Grove 2002) and as indicators of environmental change (Forsythe 1987).

Cerambycids (Coleoptera: Cerambycidae) are insects that play roles in decaying wood (Fellin 1980). Diversity of cerambycid beetle is affected by many factors, such as composition of tree species, canopy cover, litter, and decayed trees. Beetle diversity and distribution may change due to the influence of land use change (Kra *et al.* 2009). Logging and timber extraction in the forest can affect the distribution and abundance of cerambycid beetles (Ponpinij *et al.* 2011). Forest conversion causes biodiversity loss and a threat to ecosystem function and sustainable land use (Hoekstra *et al.* 2005; Cardillo 2006).

Various land cover changes due to the differences in land use can disrupt the natural balance of ecosystem which may cause a decrease in cerambycid diversity. Jambi is one of the provinces in Indonesia with a high deforestation rate (Achard *et al.* 2002). Not many reports are available on the effects of forest conversion on cerambycid beetle communities in the Jambi province. Our research was aimed to understand how different habitat types may affect the composition of cerambycid beetles. This research focused on diversity and abundance of cerambycid beetles in four land-use types, i.e. jungle-rubber (HJ), rubber plantation (HR), oil palm plantation (HO), and felled jungle-rubber (HF) in Jambi province, Sumatera, Indonesia.

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2. Materials and Methods

2.1. Collection and identification of beetles

Cerambycid beetles were collected from November to December 2012 in four land-use types located at Bungku, Pompa Air, Sungkai, and Singkawang villages, Bajubang Sub-district, Batanghari Regency, Jambi province, Indonesia (Figure 1). HJ, HR, and HO used in this research were 10 year old after planting in Bungku, Pompa Air, Sungkai and Singkawang villages, whereas HF was 1 year old after logging in Bungku and Singkawang villages (Figure 2). The HJ is polyculture with a broad canopy cover forest floor and has a lot of twigs and bark. At this area, human activities were intensive. HR is monoculture plants with a narrow canopy cover and has branches and decayed wood on the forest floor. Human activity in this area is high. HOs are monoculture plants with narrow canopy cover and the floor is covered by palm stem trimming. HF has a canopy cover and twigs and bark are commonly found on the forest floor. This area is disturbed by human activities. Total area used in this study was 5.6 ha in four land-use types. In each land-use type, we used 1.4 ha as a plot and divided into four sub-plots and distance between each sub-plot is 500 m.

Cerambycid beetles were collected using artocarpus trap, made by jackfruit fresh leafy branches (Noerdjito 2008). Twenty branches of artocarpus (80 cm in length) were tied together and mounted in the tree about 150 cm height from the soil surface (Figure 3A). A total 48 traps were set up in each land-use type (12 traps in each sub-plot). Collections of beetles were done by shaking or hitting the traps. A white screen (100 cm × 100 cm) was placed under the each trap to collect the beetles (Figure 3B). Collection of beetles was conducted on day 4th, 7th, 10th, 13th, and 16th after the traps were set up. Collected beetles were put into a bottle with ethyl acetate. Beetle specimens were processed and identified in the Laboratory of Entomology, Indonesian Institute of Sciences and identified based on Makihara (1999), Makihara & Noerdjito (2002, 2004), Samuelson (1965). Specimens were deposited in the Museum Zoologicum Bogoriense, Cibinong.

2.2. Data analysis

Collected cerambycid beetles were counted for the number of individuals (N) and species (S). Diversity of cerambycid was analyzed using Shannon–Wiener diversity index (H') and evenness (E) (Magurran 2004). The composition of cerambycid between habitat types was analyzed by Bray–Curtis similarity index (Bray & Curtis1957). Similarity of cerambycid between habitats is shown in the dendrogram.

3. Results

A total of 1274 individuals of cerambycid beetles were collected in four land-use types, consisting of 24 genera, 72 species, and 34 morphospecies (Figure 4, Table 1). The species richness of cerambycids was highest in the HJ (42 species, 35%) and the lowest in HO (16 species, 13%; Figure 5A). Meanwhile, the highest number of

Figure 1. Location of cerambycid study in Jambi province: Jungle rubber (HJ), Jungle-rubber (HR), oil palm plantation (HO), and felled jungle-rubber (HF).

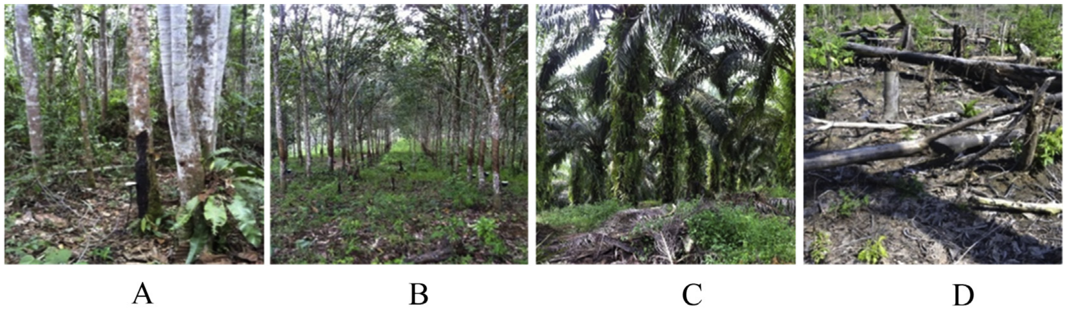

Figure 2. Four land-use types used to study cerambycid beetle in Jambi province: jungle-rubber (A), rubber plantation (B), oil palm plantations (C), and felled jungle-rubber (D).

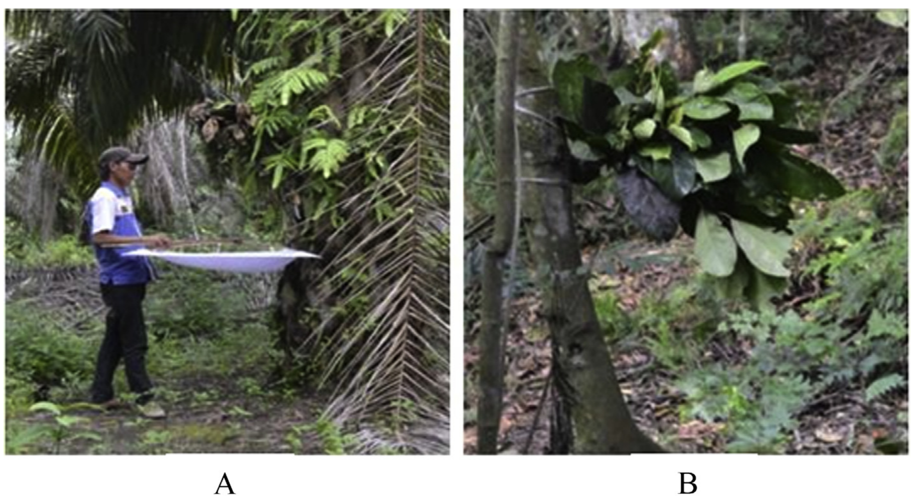

Figure 3. Artocarpus trap used to collect cerambycid beetle in Jambi province: a white screen (100 cm × 100 cm) to collect beetles (A), artocarpus traps tied in the tree (B).

individuals (481 individuals, 38%) was found in HF and the lowest in HJ (227 individuals, 18%; Figure 5B).

The species composition of cerambycid beetles in the four land-use types varied considerably (Table 1). Of the 72 species collected, 16 species (*Trachelophora cervicollis, Metopides occipitalis, Gnoma sticticollis, Apomecyna longicollis, Ropica* sp1., *R.* sp2., *R.* sp3., *R.* sp8., *Sybra* sp3., *S.* sp4., *S.* sp7., *Egesina* sp2., *Eg.* sp3., *Eg.* sp4., *Exocentrus rufohumeralis*, and *Ex.* sp1.) were found only in HJ. Eleven species (*Acalolepta bicolor, A.* sp1., *Batocera* sp., *Cacia* sp1., *S.* sp5., *Moechotypa thoracica*, *Eg.* sp1., *Pterolophia secuta*, *P.* sp5., *P.* sp7., and *Glena* sp1.) were found only in HR. Two species (*S.* sp.5 and *Obera denominata*) were found only in HOs. Nine species (*Clyzomedus annularis, Ropica honesta, R.* sp7., *Sybra borneotica, Sybra pseudalternans, S.* sp6., *S.* sp9, *Pterolophia propinqua, Rendinbilis spinosus*) were found only in the HF (Figure 4, Table 1).

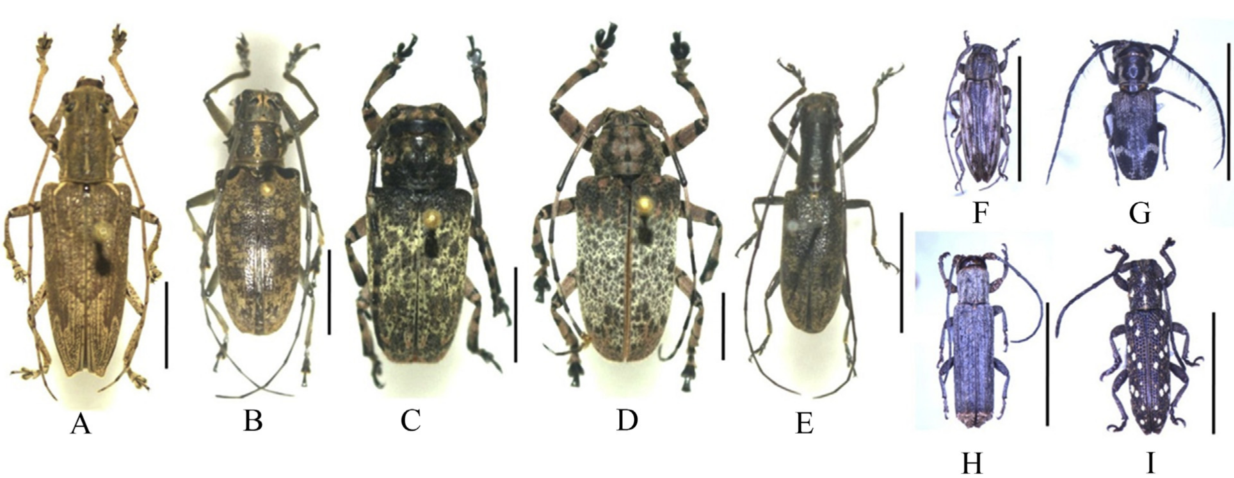

Figure 4. Diversity of cerambycid beetles collected in Jambi province: *Trachelophora cervicollis* (A), *Epepeotes luscus* (B), *Coptops undulata* (C), *Moechotypa thoracica* (D), *Gnoma sticticollis* (E), *Sybra pseudalternans* (F), *Egesina albolineata* (G), *Atimura bacillina* (G) and *Apomecina longicollis* (H). Scale bar = 1 cm.

Table 1. Species and individuals of cerambycid beetle collected from four land-use types in Jambi province

Subfamily; Tribe; *Genus (Species)*	Number of individual				
	HJ	HR	HO	HF	∑
Lamiinae					
Homonoeini					
Trachelophora curvicollis	1	0	0	0	1
Monochamini					
Acalolepta rusticatrix	9	11	1	0	21
Acalolepta unicolor	7	0	0	1	8
Acalolepta bicolor	0	1	0	0	1
Acalolepta dispar	3	1	0	0	4
Acalolepta sp1.	0	1	0	0	1
Epepeotes spinosus	15	3	1	0	19
Epepeotes luscus	13	6	0	1	20
Metopides occipitalis	10	0	0	0	10
Batocerini					
Batocera sp.	0	1	0	0	1
Mesosini					
Caciapicticornis	5	12	0	0	17
Cacia sp1.	0	2	0	0	2
Clyzomedusannularis	0	0	0	1	1
Coptopslichenea	1	6	0	0	7
Gnomini					
Gnoma sticticollis	14	0	0	0	14
Imantocera plumosa	2	6	0	1	9
Apomecynini					
Apomecyna longicollis	2	0	0	0	2
Atimura bacillina	1	5	0	26	32
Ropica marmorata	15	47	45	76	183
Ropica borneotica	0	0	2	30	32
Ropica honesta	0	0	0	29	29
Ropica illiterata	1	1	0	0	2
Ropica sp1.	2	0	0	0	2

Subfamily; Tribe; *Genus (Species)*	Number of individual				
	HJ	HF	HO	HR	∑
Apomecynini					
Ropica sp2.	2	0	0	0	2
Ropica sp3.	2	0	0	0	2
Ropica sp5.	1	2	2	0	5
Ropica sp6.	0	1	0	1	2
Ropica sp7.	0	0	0	4	4
Ropica sp8.	5	0	0	0	5
Sybra vitticollis	4	5	0	0	9
Sybra lateralis	2	1	0	0	3
Sybra propinqua	0	3	0	2	5
Sybra fervida	0	1	0	5	6
Sybra borneotica	0	0	0	15	15
Sybra pseudalternans	0	0	0	2	2
Sybra sp1.	1	4	0	1	6
Sybra sp2.	0	0	1	0	1
Sybra sp3.	1	0	0	0	1
Sybra sp4.	1	0	0	0	1
Sybra sp5.	0	1	0	0	1
Sybra sp6.	0	0	0	2	2
Sybra sp7.	1	0	0	0	1
Sybra sp8.	1	1	0	0	2
Sybra sp9.	0	0	0	1	1
Sybra sp10.	0	2	0	10	12
Zorilispe seriepunctata	1	2	0	0	3
Xenoleini					
Xenolea tomentosa	10	10	19	53	92
Hecyrini					
Moechotypa thoracica	0	2	0	0	2
Nyctimeniini					
Nyctimenius varicornis	12	0	0	2	14

Subfamily; Tribe; *Genus (Species)*	Number of individual				
	HJ	HF	HO	HR	∑
Pteropliini					
Egesina albolineata	0	5	30	0	35
Egesina sp1.	0	3	0	0	3
Egesina sp2.	1	0	0	0	1
Egesina sp3.	6	0	0	0	6
Egesina sp4.	1	0	0	0	1
Egesina sp5.	1	0	2	0	3
Pterolophia melanura	20	100	30	128	138
Pterolophia crassipes	24	30	18	55	127
Pterolophia fractilinea	10	0	1	0	11
Pterolophia secuta	0	4	0	0	4
Pterolophia propinqua	0	0	0	3	3
Pterolophia sp1.	10	8	0	22	40
Pterolophia sp2.	0	2	80	3	85
Pterolophia sp3.	2	9	17	2	30
Pterolophia sp4.	0	3	0	3	6
Pterolophia sp5.	0	5	0	0	5
Pterolophia sp6.	4	0	3	0	7
Pterolophia sp7.	0	2	0	0	2
Acanthocinini					
Exocentrus rufohumeralis	1	0	0	0	1
Exocentrus sp1.	2	0	0	0	2
Rondibilis spinosus	0	0	0	2	2
Saperdini					
Glena sp1.	0	2	0	0	4
Obera denominata	0	0	1	0	1
Number of species	42	39	16	28	72
Number of individual	227	313	253	481	1274
H'	3.23	2.67	2.01	2.38	
E	0.87	0.72	0.72	0.71	

E = evenness; HF = felled jungle-rubber; HJ = jungle-rubber; HO = oil palm plantation; HR = rubber plantation; H' = Shannon-Wiener diversity index.

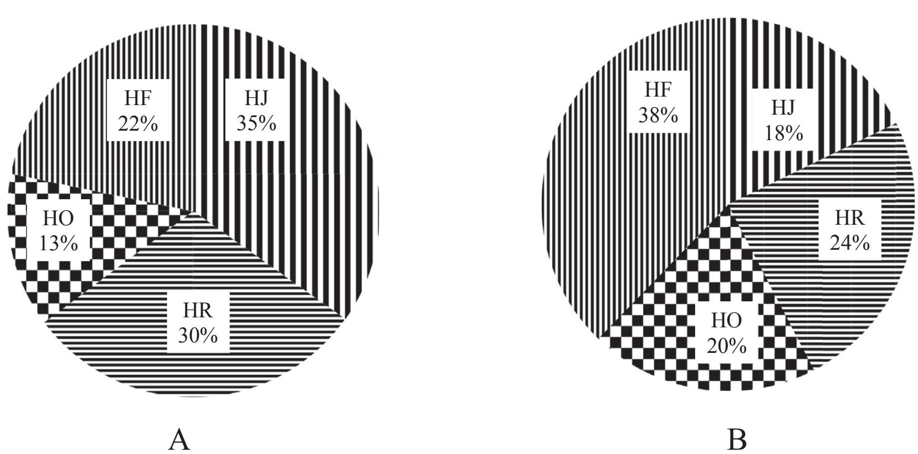

Figure 5. Percentage of the number of cerambycid species (A) and individuals (B) collected in the four land-use types in Jambi: jungle-rubber (HJ), rubber plantation (HR), oil palm plantation (HO), and felled jungle-rubber (HF).

The highest diversity of cerambycid beetles was in HJ (H' = 3.23, E = 0.87), followed by HF (H' = 2.67, E = 0.72), HR (H' = 2.38, E = 0.71), and HO (H' = 2.01, E = 0.72; Figure 6). Based on Bray–Curtis similarity index, community of cerambycid was grouped in three, i.e. HJ, HO, and HR-HF. Similarity index of cerambycids between habitats ranged from 34.8 to 51.2. The highest similarity occurred between HJ and HF (51.2%), followed by HJ and HR (50.0%), HJ and the HO (35.3%), and HJ and HF (34.8%; Figure 7). The highest number of individuals and species of cerambycids found was on day 7th after the traps were set up (Figure 8).

4. Discussion

All species of cerambycid beetles collected belong to the subfamily Lamiinae, consisting of 24 genera and 12 tribes (Table 1). Lamiinae is characterized by a flat face (Ponpinij *et al.* 2011). Ten species collected (*Trachelophora curvicollis, Acalolepta unicolor, Cacia picticornis, Ropica marmorata, Ropica borneotica, S. fervida, S. borneotica, P. fractilinea, P. propinqua,* and *O. denominata*) were also reported in Borneo (Heffern 2013). Three species (*Atimura bacillina, R. illiterata, Ex. rufohumeralis*) have been reported in Borneo and Sumatera. Species *A. bicolor* has been

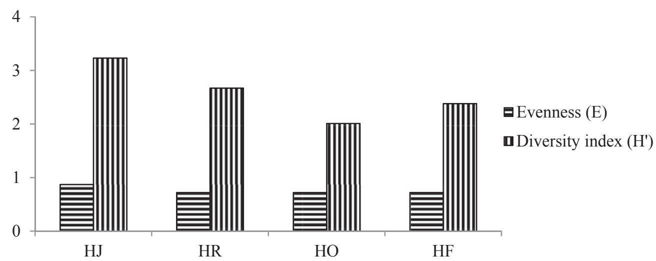

Figure 6. The evenness (E) and diversity index (H') of cerambycid beetles in jungle-rubber (HJ), rubber plantation (HR), oil palm plantation (HO), and felled jungle-rubber (HF).

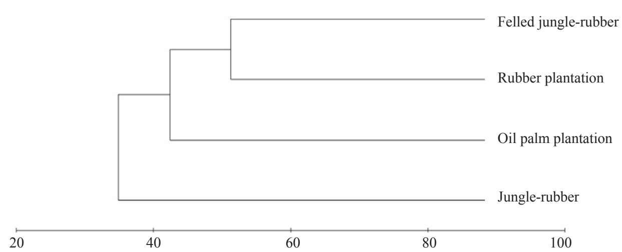

Figure 7. Dendrogram showed cerambycid beetle community in Jambi province based on Bray-Curtis similarity index.

reported in Borneo and Malaysia and *S. pseudalternans* has been reported in Borneo and Sulawesi. Three species have a wide distribution, i.e. *A. rusticatrix* (distributed in Borneo, Sumatra, Java, Sulawesi, Philippines, Taiwan, and India), *R. honesta* (distributed in Borneo, Sumatra, Java, Papua New Guinea, Philippines, Taiwan, and China), *Xenolea tomentosa* (distributed in Borneo, Sumatra, Malaysia, Andaman, Japan, Taiwan, and China) (Samuelson 1965; Heffern 2013).

Three genera were dominant in this study, i.e. *Ropica* (11 species), *Sybra* (16 species), and *Pterolophia* (12 species). All dominant species found have small size (8–18 mm in length) and their larvae are able to live on small branches and twigs. Small sized cerambycid, *Stenostola ferrea* (8–14 mm in length) preferred *Tilia* spp. that has diameter of branch and twig ranging 1–20 cm as a host plant (Kvamme & Wallin 2011).

Diversity of cerambycid beetles was highest in HJ compared with other land-use types. The highest diversity of cerambycid in this area may be related with availability of twigs and bark as a major habitat of beetle larvae. This result supported Fellin (1980) that larvae of longhorn beetles eat plants dying or dead wood and play an important role in wood decay.

The characteristics of HJ are availability of branches, decayed wood and dense canopy cover that support the high cerambycid diversity. Vegetation in HJ was relatively polyculture with fairly low intensity of disturbance. Twigs or branches and rotten trees were available to make suitable habitat for cerambycid beetles. The number of species found in HF was lower than that in HJ. It related with conditions of canopy cover. Formerly, this area is a HJ, but logging activity done about 1 year before the research made level of disturbance was high. HOs are often dominated by decayed palm fronds which typically do not support many cerambycid beetles. Similar characteristics were found in HF and HRs, they were decayed branches or twigs, decaying fallen trees, and narrow or no canopy cover. The twigs and branches were enriched by rotten wood on the floor. Unlike the HJ and HF, the number of species found in the HR was low. This was probably due to the area being dominated by rubber stands (*Havea braziliensis*) with high intensity of disturbance. High similarity of cerambycids between HJ and HR was probably due to the similarity of stand dominance and forest floor characters in the two habitats.

Different number of species and individuals of cerambycids found in each land-use type indicates the tolerance limits and species needs for habitat conditions. It has been shown that lower diversity of cerambycids in HO was caused by availability of twigs and branches in HO. Cerambycid bettles also can be used as a biological indicator of a forest area because the beetles depend on availability of dead wood and are sensitive to forest condition (Yanega 1996).

Variation of cerambycids collected in day collection was closely related with the process of decaying traps. Artocarpus trap is a good and effective trap for the collection of cerambycid beetles. On the day 7th after traps were set up, leaves had withered and the number of species and individuals trapped were highest compared to the previous and after the day. On day 10th, 13th, and 16th, leaves of the trap had withered and were slowly falling and only the twigs remained. These conditions did not support cerambycid beetles.

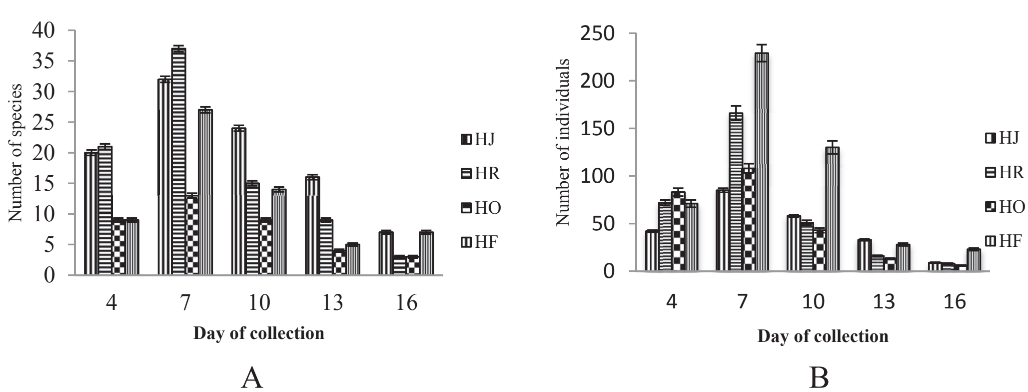

Figure 8. The number of species (A) and individuals (B) of cerambycid beetle in Jambi province collected by artocarpus traps in jungle-rubber (HJ), rubber plantation (HR), oil palm plantation (HO), and felled jungle-rubber (HF).

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