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Section F Forest Protection

Analysis of Forest and Land Fires in Riau Province Based on The Use of Land for Mitigation of Smoke Disaster

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ABSTRACT

Forest and land fires engulfing large parts of regency and city in Riau Province at dry season since 1997, with huge of losses. It has been a lot of funds of local and central Government are spended for fire suppression activities every year. Not to mention the health impacts and the transportation of millions of people of Riau affected by smoke generated. This study aim to make another approach that can rapidly monitor the incidence of fire by using NOAA satellites using an overlay on the Digital Thematic Maps (administrative boundaries, forest region, Forest licenses, right to cultivate, distribution of peatland , and landsat imagery coverage of the 2010) so that the policies undertaken by governments can be more efficient and targeted. This study did in Riau Province which dominated by peat fire. This study showed us that *Hotspot overlay* 46.85% fire occurred in northern of Riau Province (Rokan Hilir Regency and Bengkalis, Dumai City). 63,87% of the area burned is in the forest are, 40.25% on deep peatlands in fire-prone. Thicket vegetation dominating the area of forest fires (70.03%), so that can be concluded that abandoned area is the source forest and land fires in Riau Province. The paper is expected to be input for the Ministry of Forestry and Riau Provincial Government to draw up a strategy for disaster mitigation smoke.

Keywords: Hot spots, overlays, forest, peat, forest plantations industry, vegetation, mitigation

1. INTRODUCTION

Forest and land fires engulfing most of the district/city in Riau Province in the dry season since 1997 with a number of very large losses. Considerable funds are depleted state and local budgets for fire fighting. Not to mention the impact of health and transportation for millions of people of Riau Province are affected by the smoke generated.

The biggest environmental impact occurs in peat ecosystems due to approximately four million hectares or approximately 46.5% of the land area of peatlands in Riau Province. Fire allegedly as a result of land clearing activities in both small and large scale that directly using fire for land clearing activities and indirectly resulted in the peat becomes more vulnerable to fire because of changes in physical properties of peat becomes dry and no longer able to absorb water (Muslim and Kurniawan, 2008).

Fires in peatlands causing a huge release of carbon into the atmosphere and become a contributor to greenhouse gas emissions are very large and the effect on the degradation of environmental quality. Peat fires covering an area of one hectare can produce 25 to 50 tons of carbon (Prabowo *in* Hadi, 2006).

To support efforts to control forest fires and land necessary technological support that is able to provide prompt, precise and accurate information and can cover large areas. Use of Geographic Information Systems (GIS) has been quite able to make it easy for stakeholders to monitor and estimate the incidence of fires that have been or are currently happening and the estimated incidence of fires in the future and can know the environmental changes caused by fire

during a certain period. Provincial Government of Riau utilize NOAA image data to monitor the distribution of hot spots that occurred in the district/city.

Hot spot data from NOAA imagery can be used as an indication of forest fires / land, both crown fires, fire surface and ground fire. The area around the location of the hot spot is an area that is prone to fire, therefore it is in the area should not be carried out burning activities (Sari *in* Siddik, 2008).

GIS is a tool can used to manage (input, management, and output) data spatial or geographically referenced data. Any data that refer to locations on the earth's surface can be referred to as a geographically referenced spatial data. For example an area population density data, data network or lines, and so on. (Prahasta, 2004). Handling fire problem have focused on the outage was not able to stop the fires that come every year. It required another approach that is an inventory of land use on hot spots that occur.

2. MATERIALS AND METHODS

Inventory of forest and land fires vulnerability started from the collection of digital data in the form of thematic maps of Riau Province such as Administrative Map of District/City, Map of Forest Land Use Agreement (TGHK), Map of Indonesian Topography (RBI), Licensing Forestry Map, Map of Business Right (HGU) of Riau Province, Map Distribution of Peat, Map Landsat Coverage of 2010 and satellite data from NOAA hot spot coverage of 2010. Furthermore, the data do hot spots overlap stacking (overlay) with Riau Province thematic maps using Software ArcView 3.3.

Step-by-step analysis of hot spot data, namely:

1. Downloading data from a web site hot spots Directorate General of Forest Protection and Nature Conservation in http://ditpkh-phka.dephut.go.id address or web site at the address www.groups.yahoo sipongi group/group/sipongi (registration) in the format text (*. txt).
2. Opening a hot spot data with ArcView software by clicking the add button on the Project page like Figure 1.

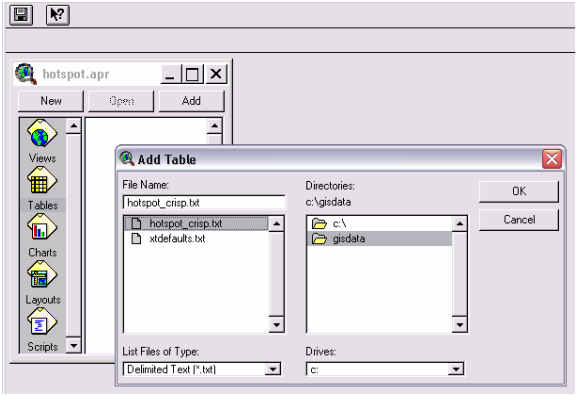

Figure 1: Opening a hot spot data

3. Click the View>Add Event Theme to see the location of hot spots on the map.
4. Change the text data into Shapefile with the click Theme> Convert to Shapefile.
5. Open the Administrative Map of District / City, Map of Forest Land Use Agreement (TGHK), Map of Indonesian Topography (RBI), Licensing Forest, Map of Business Right (HGU) and Landsat coverage 2010 by clicking View> Add Theme.
6. Combining hot spot table columns with of each map with a "Spatial Join" by clicking View> Geoprocessing Wizard, select Assign data by location and select Hotspot 2010 for

the column above and border administration for the below column as Figure 2. Perform the same steps to the data table map to another.

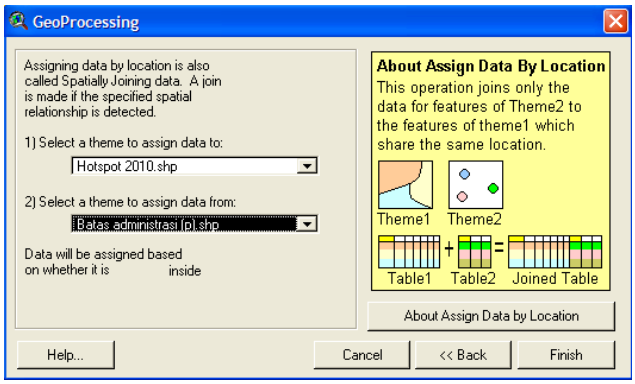

Figure 2: Merging columns between tables

7. Open the data table hotspot 2010 DBF format (*. dbf) with Microsoft Excel2003. Then click the Pivot Table to calculate the hot spot on Administrative Map of District / City, Map of Forest Land Use Agreement (TGHK), Map of Indonesian Topography (RBI), Licensing Forest, Map of Business Right (HGU) and Landsat Coverage 2010 as Figure 3.

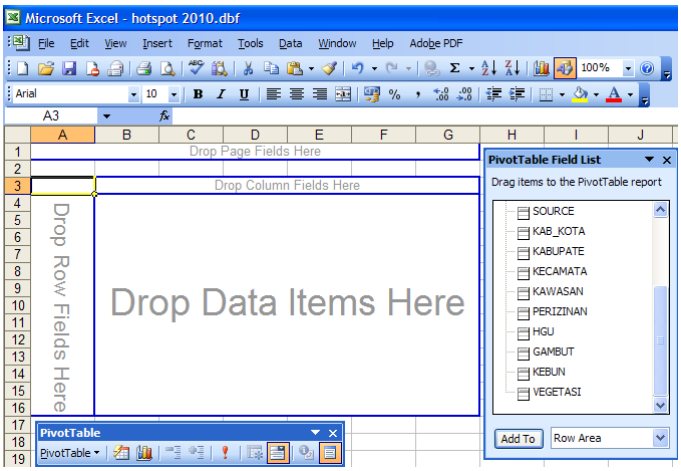

Figure 3: Counting the hot spots based on a theme

3. RESULTS AND DISCUSSION

3.1 Region Condition

Riau provincial government administration consists of 10 (ten) districts namely regency, Kampar, Rokan Hulu, Rokan Hilir, Siak, Bengkalis, Regency Kuantan Singingi, Indragiri Hilir, Indragiri Hulu, Meranti archipelago, and 2 (two) city they are Pekanbaru and Dumai. The total area of each regency/city can be seen in Table 1 (Annual Report of the Forestry Service of Riau Province Year 2010).

Table 1. Total area of each regency/city in Riau Province

District	Capital	Area (Ha)	% Area
Regency			
Kampar	Bangkinang	1.047.277,14	12,18
Pelalawan	Pangkalan Kerinci	1.203.276,80	13,99
Kuantan Singingi	Taluk Kuantan	507.313,56	5,90
Rokan Hulu	Pasir Pangarayan	703.707,77	8,18
Rokan Hilir	Bagan Siapi-Api	868.505,57	10,10
Indragiri Hulu	Rengat	766.420,21	8,91
Indragiri Hilir	Tembilahan	1.301.892,94	15,14
Siak	Siak Sri Indrapura	789.707,77	9,18
Bengkalis	Bengkalis	800.472,70	9,13
Meranti	Selat Panjang	345.442,42	4,20
City			
Dumai	Dumai	197.320,27	2,29
Pekanbaru	Pekanbaru	67.789,86	0,79
Provinsi Riau	Pekanbaru	8.598.757,00	100,00

3.2 Portrait of fires in 2010

3.2.1 Based on the Regency/City 2010

Incidence of forest fires and land based on administration area regency/cities can be seen in Table 2.

Table 2. Occurrence Percentage of fires based on Regency/City

Regency/City	Occurrence	Percentage (%)
Rokan Hilir	373	23.68
Bengkalis	253	16.06
Pelalawan	208	13.21
Kampar	145	9.21
Rokan Hulu	114	7.24
Dumai	112	7.11
Siak	102	6.48
Inhu	100	6.35
Inhil	94	5.97
Kuansing	52	3.30
Meranti	18	1.14
Pekanbaru	4	0.25
Number	1,575	100.00

Rokan Hilir is the region most frequently burned each year followed by Bengkalis. But when taking into account the area of densest hot spots occur in the City of Dumai. This occurs

because the three northern areas of Riau Province is a major destination of forest encroachers from North Sumatra, exacerbated by the dominance of ground conditions in peatlands.

3.2.2 Based on the licensing of forestry

Most areas of Riau Province by the Ministry of Forestry has been given permission to the plantation and Utilization License Timber Forest Products in Industrial Forest Plantation (IUPHHK-HTI). For the plantation area has been given to plantation forests release as many as 163 units covering an area of 1,767,862 hectares, the area of Business Right (HGU) for the plantation is an area of 1,107,737 ha, but the total area of plantations based on data from the Riau Province Plantation Service in 2010 is an area 2,775,617 ha, it is estimated that there are more than 1 million hectares of plantation in forest areas without permission.

While the area of IUPHHK-HTI in the province of Riau on the basis of data Riau Provincial Forestry Service is as much as 61 units covering an area of 1,697,897 ha, but the realization of plantation just reached 899,153 ha. These are becaused there are many encroachment IUPHHK-HTI area especially the northern region of Riau Province, even the PT. Arara Abadi northern district of Riau realization of the plant only reaches 50%. Generally, the origin of the fire on IUPHHK-HTI burning is the burning of land by the community around that carried by the wind like Figure 4.

Figure 4: IUPHHK-HTI burning

Based on the Licensing of the Department of Forestry for the occurrence of hot spots IUPHHK-HTI Permit for 437 events (27.75%) and the Plantation of 310 events (19.68%) so that the area accounted for 47.43% licensed occurrence of hot spots. HGU area hot spots accounted for 96 events (6.1%) due to the condition of this area in Riau Province nearly all of HGU area already planted with palm oil so that the fire risk to be small.

3.2.3 Based on The Functions of Forests

Permanent Forest Area in the province of Riau on TGHK Map according to the decree of the Forestry Minister Number 173/KPTS-II/1986 can be seen in Table 3.

Table 3. Permanent Forest Area of Riau based on TGHK

Function Area	Area	(%)
Protected	228.793,82	5.3
Nature Reserve & Tourism Forest	531.852,65	12.3
Production	1.605.762,78	37.16
Production Limited	1.954.383,36	45.23
Number	4.320.792,61	

Data analysis of hot spots there are 1006 events (63.87%) in the forest area remains, but when viewed the existing permissions are 317 events (20.13%) in IUPHHK-HTI. It Shows 2/3 hot spots occur in the production forest area that has not been burdened with licensing. Forests are not burdened with concession is an area of open acces owned by local community leaders so freely traded to the immigrants from North Sumatra with the legalization of the local village chief and sub-district.Occurrence of hot spots based on the functions of the forest can be seen in Table 4

Table 4. Occurrence of hot spots based on the functions of forests

Forest Function	Occurence	(%)
Protected	39	2,48
Nature Reserve & Tourism Forest	103	6,54
Production	407	25,84
Production Limited	457	29,02
Number	1.006	63,87

IUPHHK-HTI, although still considered open acces by local community leaders, but more keep because there was an attempt of IUPHHK-HTI permit holders in the form of patrols and the legal process in court, so that land buyers to be more careful when buying land that already have a license IUPHHK –HTI.

3.2.4 Based on The Depth of Peat

There are 840 (53.33%) occurrence of hot spots in peatlands in 2010, the interesting thing is the 3/4 hot spots as many as 634 (40.25%) occurred in the peat into more than 4 m. Fires in peatlands are always repeated every year at the same location. This proves not yet mastered the technology of agricultural land, especially on deep peat. Occurrence of hot spots based on the depth of peat can be seen in Table 5.

Table 5. Occurrence of hot spots based on the depth of peat

Peat Depth	Occurence	(%)
Lebih dari 4 m	634	40,25
0,5 - 1 m	13	0,83
1 - 2 m	185	11,75
2 - 4 m	8	0,51
Number	840	53,33

Insecurity in the area of peat fires generally increased due to the burned area has been drained with canals like Figure 5.

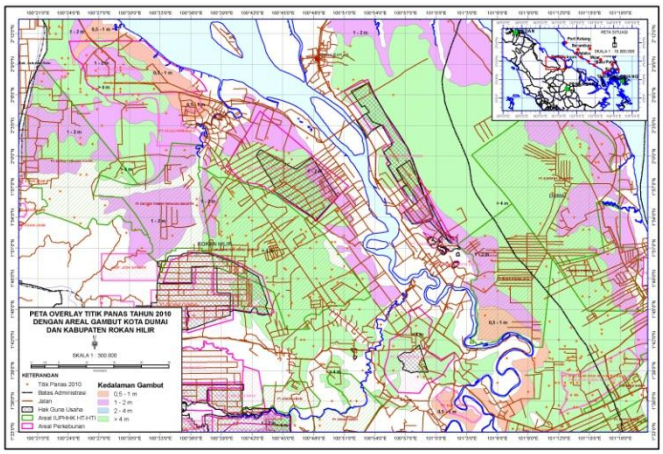

Figure 5: The results of the hot spot overlay in 2010 and peat

3.2.5 Based on The Vegetation Cover

In contrast to the news media and writing non-governmental organizations (NGO) which tend to blame the company as a source of fire, from the analysis of hot spots known source comes from bush fires 70.03% incidence of hot spots. Bush is an area that has been encroached upon by the public but has not been successfully used as palm oil. Barriers, especially on peat soils prone to fires and planting that is not in unison like Figure 6.

Figure 6: Peat in the Pelintung, Dumai City

For example in the area there Dumai City Pelintung peat areas that have been planted since 2000, but until now has not been successful. This caused some landowners are still clearing land by burning, so existing plants on land next to the border they are always on fire. Occurrence of hot spots based on vegetation cover can be seen in Table 6.

Table 6. Occurrence of hot spots based on vegetation cover

Forest Fuction	Occurence	(%)
Acacia	110	6,98
Shrub	1.103	70,03
Forest	204	12,95
Palm Oil	158	10,03
Number	1.575	

From Table 6 above, it is clear that the plant acacia and palm oil has a low risk of fire by 6.98% and 10.03%. This is understandable because most companies have implemented rules on Zero Burning of land clearing. Moreover, to the plants that would have been so well guarded because it is an asset and source of life for the company.

Generally, a burning permit area is the area that encroached upon by the public and there is a variable amount of the entire area encroached upon, but there are also areas which have very little encroached upon by society. This permits the intake area has always emerged as the area burned by the mass media and NGOs so that the data submitted to be biased.

The results of the hot spot overlay in 2010 with Licensing around City Dumai can be seen in Figure 7.

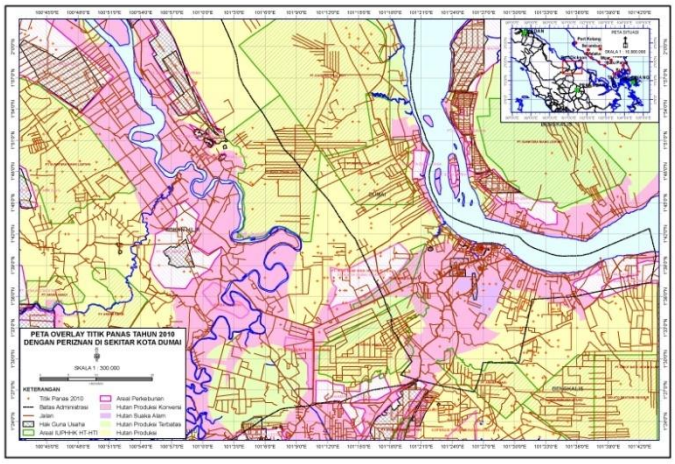

Figure 7: Results overlay of hot spots in 2010

3.3 Mitigation of Forest and Land Fires

3.3.1 Permanent Forest Area

In the forest areas that have not been burdened with licensing needs to be done immediately inventory on field conditions include vegetation cover, forest encroachment, infrastructure and socio-economic conditions of society. Furthermore do utilization of forest area in the form of People's Forest Plantation (HTR), this can be done considering the forest encroachers are generally the immigrant communities. Local communities can be empowered to change the area of encroachment is to be used as acacia plants in cooperation with PT. Arara Abadi or PT. Riau Andalan Pulp and Paper. The success of HTR will reduce 50% of fire, given the region accounted for 63.87% of forest fires.

3.3.2 Non-forest Areas

Source of fires in the area of non-forest area is largely a areas that can not be controlled by the release of forest license holder. In this case the necessary cooperation with the company's palm-held areas in order to transform communities area into oil palm plantations, financing can be obtained through the provision of credit by banks. Furthermore, if there are people who still burn the land then the National Land Agency can immediately categorize the area as land abandoned in accordance Government Regulation Number 11 of 2010 on Control and Utilization of Abandoned Land.

3.3.3 Infrastructure

Generally encroachment activities through the company area or industrial forest plantations. For it is necessary for the Government co-operation with the company to shut down access to the forest encroachers. Against the canal that has been made on peat in the immediate closure due to dangerous conditions of peat hydrology.

3.3.4 Aspects of Stewardship lands

For areas that are in the area of encroachment of forest land to do revocation letter to give a deterrent effect against perpetrators of forest encroachers. While in areas outside the forest area conducted enforcement abandoned land that are the source of fire.

4. CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

1. Encroachment of forest and abandoned land in the form of scrubland was the main source of fires in peat and not peat. Followed by the development of land management that do not pay attention to the principles of conservation and boost the economy also exacerbates the occurrence of land and forest fires.
2. Nearly half of the hot spots occur in the northern province of Riau which is an area of forest encroachers purposes with the condition of peatlands.
3. Production forests are not burdened with licensing (open acces) accounted for 2/3 the incidence of hot spots in forest areas.
4. Half of the hot spots occur on peatlands, mostly from deep peatlands.
5. From observations of Landsat imagery looks peatland conversion activity continues although there has been a moratorium on Presidential Instruction on peat.

4.2 Recommendations

1. The problem of forest fires and land is a multi-sectoral issues that need to be implemented in a comprehensive treatment.
2. Inventory of public land ownership, state, and the company to be known so that the abandoned land can be utilized for the benefit of the community and country through agrarian reform and state strategic programs.
3. Development of sustainable alternative livelihoods for the community, thereby reducing the use of fire, such as diversion of agricultural crops a year into plantations/agroforestry (in partnership with the company).
4. Law enforcement strongly and consistently against the perpetrators and those who cause fires, including prevention of transaction costs which can cause further burning freely by certain parties.

5. Keep in mind the economic-based policy instruments such as, (a) provide incentives to a group or someone who is able to keep the region from the fire and provide a disincentive to those who are not able to keep the region from the fire, (b) create programs that can inhibit the burning of forests and lands do and disseminate it to society, such as fires prevention efforts to confront the credit farming or food credit.

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INTERNATIONAL CONFERENCE OF INDONESIAN FORESTRY RESEARCHERS (INAFOR)

Section F Forest Protection

Pest and Diseases Attacking Cadamba (*Anthocephalus cadamba* Miq.) Plantation at Riau Province

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ABSTRACT

Cadamba (*Anthocephalus cadamba* Miq). is an alternative tree species for raw pulp and paper material. As homogeny ecosystem, cadamba plantation has many problems in pests and diseases attack. The aim of this research was to identify and evaluate the severity level that caused many pest and diseases attacking cadamba. Average incidence percentage of pest attack at CF pantai cermin showed the highest pests attacking cadamba plantation is *A. hilaralis* (31%) and *C. sumatranus* (16.4%). While at IPF Baserah, *A. hilaralis* (73%) and *C. sumatranus* (13.2%) became the dominant species. Further while *A. hilaralis* (18.65%) and *Coptotermes* sp. (6.3%) became two dominant species at IPF Pelalawan. The defoliator damage showing the highest level was happened at HTI Baserah sector (92.88%) and the lowest was happened at HTI Pelalawan sector (40.5%). The diseases observation showed that leaf spot that was caused by *Cercospora* sp., *Pestalotia* sp., *Curvularia* sp. and *Colletotricum* sp. had highest attack percentage in 4 location (98%-100%), second dominant diseases were black mildew that were caused by *Meliola* sp. (2.3%-6%), third dominant diseases were stem and root rot that were caused by *Fomes* sp., *Schizophyllum* sp., *Pleurotus* sp. and *Auricularia* sp. (3%-6.8%), and the fourth dominant diseases were stem cancer (0,4%) that caused by *Corticium salmonicolor* and *Lasiodiplodia* sp. The highest severity level caused by leaf spot showed highest level at industrial plantation forest of Pelalawan sector (96.88%), industrial plantation forest of Baserah sector (90.88%), Pantai cermin community forest (64.45%) and Rumbai community forest (65.37%).

Keywords: Cadamba, plantation, pest, diseases, forest

1. INTRODUCTION

Ministry of Forestry of Republic of Indonesia had made a regulation about the plantation forest industry by Government Regulation No. 7 years 1980 for anticipating the raw wood demand to pulp and paper industry that annually increases. Due to this rule, there were many plantation forest industries started to establish their own plantation forest by using advanced species (i.e. *Acacia mangium* and *Eucalyptus* sp. that are planted at mineral land and *Acacia crassicarpa* that are planted at peat land). The advanced species had been chosen based on their ability to survive at underprivileged land, fast growth, and qualification as a raw wood at pulp and paper industry.

The usage of the advance species in every rotation had given negative impact to many aspects, i.e. soil nutrition decreased at every rotation changing. It made cost of fertilizer increase in every rotation changing, and gave direct effect to more operational cost (Sudarmalik *et al.*, 2008). Pest and diseases attack also showed an increased trend at every rotation. For example, root rot attack increased in every rotation changing on *A. mangium* at mineral land (Budi Cahyono, *personal communication 2009*).

Forestry Research and Development (FORDA) of Republic of Indonesia had stated many alternatives for pulp and paper species plantation for substituting the advance species that had many problems in its management. Cadamba (*A. cadamba*) is one of the species that were

stated by FORDA for raw wood in pulp and paper industry. The characteristic of this species had been suitable for pulp and paper industry requirement, i.e fast growth, fiber length 1,561 μm, fiber diameter 23.95 μm, and fiber wall thickness 2.78 μm (Aprianis, 2007).

Cadamba plantation as homogeny ecosystem was effortlessly attacked by pest, disease, and interfered by weed. Inventory and identification are needed before pests, diseases, and weed management will be done. Failure in pest, disease, and weed identification will make the other problem and will not complete the problem. Due to that problem, the research aims were to identify and evaluate many pests and diseases attacking cadamba plantation in mineral and peat land at Riau province.

2. METHODOLOGY

2.1 Time and Location

This research was conducted at January 2009 to December 2010. The research was conducted at mineral land in Riau, mineral land (plantation forest industry RAPP co. ltd consented/PFI at Baserah sector, community forest/CF at Rumbai, CF Pantai Cermin) and peatland (PFI at Pelalawan sector). The locations description is:

1. CF of Pantai cermin is located about 7 km from Pekanbaru. Based on Simpang Tiga Meteorology station, the daily average temperature are 27.4°C, maximum temperature 32.5°C and minimum temperature 23.2°C. The soil type is Podsolik yellow-red (PMK), sandy textured, and flat area in topology. Based on Schmidt and Ferguson, the climate type is A. The location was previously used to *Hevea brasiliensis* plantation.
2. PFI of RAPP co. ltd. at Baserah sector administratively located at Kab. Kuantan Singingi. The soil type is Podsolik yellow-red (PMK), sandy textured, and flat area in topology. Based on Schmidt and Ferguson, the climate type is A. The location was previously used to *A. mangium* plantation.
3. CF of Rumbai is located about 10 km from Pekanbaru. This plantation is near to Siak river (about 200 m). Based on Simpang Tiga Meteorology station, the daily average temperature are 27.4°C, maximum temperature 32.5 °C and minimum temperature 23.2°C. The soil type is Podsolik yellow-red (PMK), sandy textured, and flat area in topology. Based on Schmidt and Ferguson, the climate type is A. The location was previously used to damp of plywood waste and seasonally flooded by Siak River.
4. PFI RAPP co. ltd atPelalawan sector administratively located at Kab. Pelalawan. The soil type is organosol (hemik to fibrik). Based on Schmidt and Ferguson, the climate type is A. The location was previously used to *A. crassicarpa* plantation.

2.2 Identification of Pests and Diseases of Cadamba Plantation

Sample of pest insect was preserved in alcohol 70% and formaldehyde 4 % (v/v) and identified at Zoology Museum (LIPI) in Cibinong. The other reference was also used to found the effect of the pest to another crop or plant (Kalshoven, 1981). Meanwhile, sample of microorganism caused the diseases was identify based on Alexopoulus *et al.* (1996).

2.3 Evaluation of Pest and Diseases Incidence and Severity Level

2.3.1 Equation of pest and diseases incidence

$$I = (n / N) \times 100\% \quad (1)$$

Where: I : Incedence level of pest and diseases attacked
n : Total stands attacked by certain species of pest and diseases
N : Total of observed stands

2.3.2 Equation of pest and diseases severity level (Kilmaskossu dan Nerokouw, 1993)

$$S = [(ni \times vi) \times (N \times V)] \times 100\% \quad (2)$$

Where: I : Severity level
ni : Total stands that have certain score
vi : Value of score
N : Total of observed stands
V : Highest score.

3. RESULTS AND DISCUSSION

3.1 Pests and Predators at Cadamba Plantation

3.1.1 Pests at Cadamba Plantation

Based on observation at 4 locations, there were many major and minor pests found in 4 locations. The major pest had been classified based on their attack severity when the observation was done and it was based on their history on other stands like *Acacia* and *Eucallyptus* sp. There were defoliator (*Arthrochista hilaralis* and *Daphnis hypothous*) (Figure 1 and 2) and plant sucker (*Cosmoleptrus sumatranus*) (Figure 3), termite *Coptotermes* sp. (Figure 4), and stem borer *Zeuzera* sp. (Figure 4) (Table 1). The minor pest was classified based on their attack in low severity level. There were Bag worm (Psychidae)**,** *Melanura pterolophia*, *Hypomeces squamossus*, *Lawana* sp., *Cicadulina* sp., and *Dysdercus cingulatus.*

Figure 1: Imago (left) and larvae (right) of *A.hilaralis*

Figure 2: Imago (left) and larva (right) of *D. hypothous*

Figure 3: Imago of *C. sumatranu*s

Figure 4: *Coptotermes* sp.

Figure 5: Larvae of *Zeuzera* sp.

Table 1. Major and minor pests of *Anthocephalus cadamba*

No	Major pest species	Location that pest founded
1.	*Cosmoleptrus sumatranus* (hemiptera).	(Plantation Forest Industry/IPF Baserah and Pelalawan sector and Community Forest/CF Pantai Cermin).
2.	*Arthroschista hilaralis* (lepidoptera).	(IPF Baserah and Pelalawan sector and CF Pantai Cermin).
3.	*Zeuzera* sp. (lepidoptera).	CF Pantai Cermin.
4.	*Coptotermes* sp. (isoptera).	IPF Pelalawan.
5.	*Daphnis hypothous* (lepidoptera).	IPF Baserah.

No	Minor pest species	Location that pest founded
1.	*Melanura pterolophia* (coleoptera).	IPF Baserah.
2.	*Hypomeces squamossus* (coleoptera).	IPF Baserah.
3.	*Lawana* sp. (homoptera).	IPF Baserah, CF Pantai Cermin.
4.	*Cicadulina* sp. (homoptera).	CF Pantai Cermin.
5.	*Dysdercus cingulatus* (hemiptera).	IPF Baserah, CF Pantai Cermin.
6.	Bag worm (*Physidae*)	IPF Baserah, CF Pantai Cermin.

Average incident percentages of pest attack at CF pantai cermin that showed the highest pests attacking cadamba plantation were *A. hilaralis* (31%) and *C. sumatranus* (16.4%). While at IPF Baserah, *A. hilaralis* (73%) and *C. sumatranus* (13.2%) became the dominant species. Furthermore *A. hilaralis* (18.65%) and *Coptotermes* sp. (6.3%) became two dominant species at IPF Pelalawan (Table 2.)

Table 2. Average of Incidence percentage of pest attacked cadamba plantation at 4 observed location

Location	Species of pest						
	A. hilaralis	*C. sumatranus*	*Daphnis hypothous*	*Coptotemes* sp.	*Zeuzera* sp.	Bag worm (Psychidae)	*Dysdercus cingulatus*
CF Pantai cermin	31	16.4	0	0	0.2	0	5
IPF Baserah	73	13.2	0.2	0	0	5	1.2
IPF Pelalawan	18.65	0	0	6.3	0	2.2	0

Remark: Data was processed from Pribadi *et al.* (2010)

Based on Table 2., the dominant species attacking cadamba when observation was done at 3 locations was *A. hilaralis* (18.65% - 73%). This pest attacked cadamba leaves and made high defoliated by rolling up the leaves and eating the leaves. The highest defoliated level was happened at IPF Baserah (92.88%), and followed by CF Pantai cermin (55.67%), and IPF Pelalawan (40.5%) (Table 3).

Table 3. Percentage of defoliator damage level at 3 locations of jabon plantation)

Location	IPF Baserah	IPF Pelalawan	CF Pantai cermin
Average of percentage of defoliated level caused by defoliator	92.88	40.5	55.67

Remark: Data was processed from Pribadi *et al.* (2010).

IPF Pelalawan was classified as the lowest severity category. This probably happened because the temperature (40^{o}C) and humidity at this location were very improper for defoliator (*A. hilararis*) metabolism and gave direct effect to decrease of eating activity. Gogoi *et al.*, (2000), stated that there were many meteorology parameter effects to pest insect development. Another possibility was the appearance of the vegetation under cadamba plantation that shifted and turned the *A. hilararis* attack. At IPF Baserah, after weeding was done by chemical sprayed, the severity level of defoliator attack had highest severity level (92.88%) (Figure 6). It was probably caused by the alternative host (vegetation under cadamba plantation) which was disappeared and the defoliator attacked the cadamba leaves. Second possibility why the CF Pantai cermin showed lowest severity level than PF Baserah was the spacing plant. The plant spacing used at CF Pantai cermin was about 4x5 m and it was different at IPF Baserah that used 2 x 3 m and 3 x 3 m. Arief *et al.* (2006) stated that pest population would decrease equivalently with plant spacing added.

Figure 6: Defoliator severity level in jabon caused by *Arthochista hilaralis* at IPF Baserah

3.1.2 Potential Predator and Parasitoid Insect at Cadamba Plantation

Evagoras surdidulus (Figure 7), *Insyndrus* sp. (Figure 8), and red ant *Oecophylla saragillina* are the potential predator for pest attack at cadamba plantation. *Evagoras surdidulus* and *Insyndrus* sp. use their inhalator needles to get the pest liquid. These predators usually prefer the larvae phase than imago phase because their chitins are not as much as when they are at imago phase. Slow moving is also one factor why the larvae are easier caught by the predator.

Figure 7: *Evagoras* sp.

Figure 8: *Insyndrus* sp.

The other potential predator is an ant *Oecophylla saragillina*. This predator resided at cadamba tree by creasing the leaves in such manner using their silk web (Figure 9). This ant has different way to eat and attack the pest. It attacks the pest in a group and does not suck its food but just eats the food.

Figure 9: *Oecophylla saragillina* resided at cadamba tree by creaseing the leaves

The other type, there were parasitoid insects that was found in cadamba plantation. This parasitoid attacked defoliator by laid their egg into the defoliator larvae body. After hacthing, the parasitoid larvae began to eat the defoliator larvae from inside. In several days, the larvae would pupae at the outside of the dead body of defoliator larvae (Figure 10).

Figure 10: Parasitoid insect attacked defoliator at cadamba plantation

3.2 Diseases at Cadamba Plantation

There were many diseases attacking cadamba at plantation area such as leaf spot, black milder, stem cancer, rotten stem and rot. But the dominant diseases happened at plantation was leaf spot.

3.2.1 Leaf Spot Diseases

The fungi that caused leaf spot diseases are associated by (1) *Cercospora* sp., (2) *Pestalotia* sp., (3) *Curvularia* sp., and (4) *Colletotricum* sp. The symptoms of leaf spot which attacked cadamba leafs are an appearance of irregular yellowish to brownish round (1-5 mm in diameter) at first attacked stage and then the round became more extended (Figure 11). This caused the reducing the area of photosynthesis and the infected leaf was falling down faster than uninfected leaf (senescence).

Figure 11: Leaf attacked by leaf spot at the first stage/left picture showed yellow halo spot and became showed extensively chlorosis in the latest stage/right picture.

The leaf spot diseases widely spread by insect, wind, and rain. After finding the suitable place, the conidia will germinate and penetrate through the stomata. The conidia will start to

infect the leaf tissue until the new conidia is formed. The chlorosis appearance is caused by the fungi toxin (Yulistyarini and Wawaningrum, 2007).

3.2.2 Black Mildew Disease

The other disease which attacked cadamba leaf is black mildew that is caused by fungi *Meliola* sp. Based on observation, there is no heavy severity that is caused by this fungi attacks. Leaf attacked by black mildew showed a covering by sticky black smooth web (Figure 12.) The leaf covered (only covering the leaf dorsal sides) by this web will reduce their photosynthesis area. The existence of these fungi is also predicted by the appearance of *Cicadulina* sp. that is often found at cadamba leafs. This insect produced excessive honey dew at the upper of cadamba leafs and if the environment factors are suitable, the *Meliola* sp. is easy to grow and to develop.

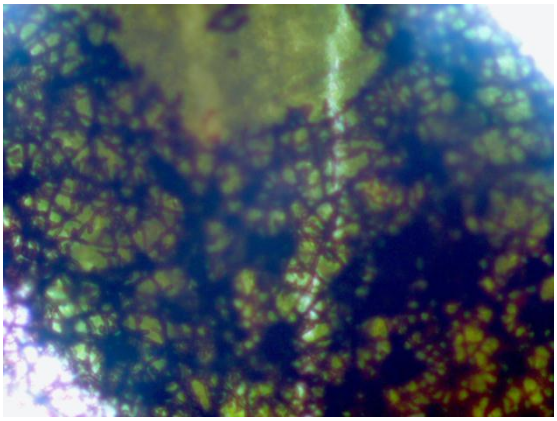

Figure 12: Microphotosgraph of *Meliola* sp. hifae/mycelium covering on cadamba leafs)

3.2.3 Stem Cancer

The diseases attacking cadamba stem and root at plantation area are stem cancer, rotten root and stem. The fungi which caused stem cancer are associated by *Corticium salmonicolor* and *Lasiodiplodia* sp. These fungi have many trees as their host, i.e *A. crassicarpa* (Hadi and Nuhamara, 1997), *Hevea brasiliensis* (Hilton, 1958) and *Eucalyptus* sp. (Sharma *et al.*, 1984). Stem attacked by these diseases will show abnormal form. The bark is seen fold up and the endodermis of the stem appears. The existence of decomposer will make high risk rottenness (Figure 13).

Figure 13: Stem cancer causing the secondary rotten damage by decomposer organism

Crist and Schoeneweiss (1975) stated that the stands planted at unfavorable environment and low in rainfall intensity will easily be infected by stem cancer diseases. Smith *et al.* (1996) even stated that the stem cancer disease in low level is also caused by defoliator, stem borer attack and bad silviculture tehique. These fungi did not cause the rottenness but would made the entrance for decomposed fungi and organism.

3.2.4 Stem and Root Rot

The fungi causing the rotten stem and root are *Fomes* sp. and *Schizophyllum* sp. These fungi commonly attack the root of many woody plants. In addition, *Pleurotus* sp. and *Auricularia* sp. were also found at healthy cadamba bark especially at area that had high humidity. Based on the field observation, this fungi will cause the decomposition of wood rapidly. Rajaput dan Rao (2006) had reported that the *Pleurotus* sp. and *Auricularia* sp. had attacked mango plantation at India on winter season.

Unlike the *Ganoderma* attack that caused the leaf and the bark died, these fungi do not show that symtomp. The other difference is that the starting point of the fungi attacks do not start from the root, but at the bark. The sign of this fungi can be seen by their fruiting body appearance at the bark and root (Figure 14).

Figure 8: Appearance of fruiting body of fungi that caused stem and root rot on cadamba tree

3.2.5 Diseases Incidence and Severity Level at Cadamba Plantation

Based on field observation, the highest percentage of diseases was leaf spot (100%, except at CF Pantai cermin), black mildew (2.3% - 6%), stem/root rot (3% - 6.8%, at IPF Baserah sector and Pelalawan), and stem cancer (0.4%, at IPF Baserah sector) (Table 4).

Table 4. Percentage of many diseases attacking cadamba plantation in 4 locations

Location	Diseases (%)			
	Leaf spot	Black mildew	Stem cancer	Stem/root rot
Community forest at Pantai Cermin	98	6	-	-
Community forest at Rumbai	100	2	-	-
Industrial plantation forest at Baserah sector	100	5.2	0.4	3
Industrial plantation forest at Pelalawan sector	100	2.3	-	6.8

Based on severity level observation at 4 locations, the highest leaf spot severity level was happened at IPF Pelalawan sector (96.88%) and IPF Baserah sector (90.88%). Furthermore, CF Pantai cermin (64.45%) and CF (65.73%) were categorized as high severity level (Table 5).

Table 5. Leaf spot severity level at 4 cadamba plantation locations

Location	Leaf spot severity level %	Add	Abiotic parameter	
			Temperature ^{o}C	Humidity %
Community forest at Pantai Cermin	64.45	High severity	33.75	71.75
Community forest at Rumbai	65.37	High seveirty	29.32	77.5
Industrial plantation forest at Baserah sector	90.88	Very high severity	31.25	83.25
Industrial plantation forest at Pelalawan sector	96.88	Very high severity	32.25	80.5

There are many suspected factors causing the high leaf spot severity level at IPF Pelalawan and Baserah sector, such as the effect of environment factor (air and soil factor) (Purnomo, 2007). Eventhough Anonim (2003) *in* Wawaningrum and Yulistriani (2007) stated that the increasing of attack percentage and intensity of *Cercospora* sp. (fungi that caused leaf spot disease) equivalent with temperature increase and long wet day. Optimum condition for *Cercospora* sp. growth is between 25^{o}C to 35^{o}C and the attack intensity will decrease when temperature is below 15 ^{o}C. In addition, Yulistyarini and Wawaningrum (2007) stated that low humidity (65%-67%) and long dry season will decrease the attack of severe intensity. Based on many statements above and Table 5, it was informed that temperature and humidity at 4 locations were suitable for leaf spot growth.

The difference of silviculture tehnique was also suspected factor to leaf spot growth. Silviculture management at cadamba plantation in IPF Pelalawan and Baserah use SOP for *Acacia mangium* planting, one of which is weeding only done in first year (3 times in a year). Unlike cadamba plantation at IPF Baserah and Pelalawan, CF Pantai cermin and CF Rumbai do weeding routinely using chemical spray and manual cutting every 3 month. Based on field observation, vegetation condition under cadamba plantation at IPF Baserah and Pelalawan was more dense (closed to 100%) than at CF Pantai cermin and Rumbai (30%-40%). Almost 60% of the cadamba plantation at IPF Baserah and Pelalawan was tied and covered by *Mikania micrantha*, *Smilax* sp., and *Piper* sp. that was infected by leaf spot. The high density of vegetation under cadamba plantation may effect to leaf spot severe intensity. Agrios (1997) stated that weed can became host of pathogen fungi both at plantation area and nursery.

4. CONCLUSION

1. There are many pests attacking cadamba plantation, i.e *Arthrochista hilaralis*, *Daphnis hypothous*, *Cosmoleptrus sumatranus*, *Coptotermes* sp., *Zeuzera* sp., bag worm (Psychidae), *Melanura pterolophia*, *Hypomeces squamossus*, *Lawana* sp., *Cicadulina* sp. and *Dysdercus cingulatus*.
2. There are potencial predators and parasitoids available at cadamba plantation such as *Evagoras surdidulus*, *Insyndrus* sp. and *Oecophylla saragillina*.
3. The diseases attacking cadamba plantation i.e leaf spot, black mildew, stem cancer, and stem/root rot.

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Section F Forest Protection

Nest Characteristic and Density of Orangutan (*Pongo pygmaeus morio*) in Buffer Zone of Kutai National Park, East Kalimantan

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ABSTRACT

Nest can be used as indicator of orangutan presence. The difference of habitat condition has impact on nest characteristic. Orangutan density in buffer zone of Kutai National Park give information that this area is important for orangutan habitat and has implication on buffer zone management for orangutan habitat. Research was done to obtain information about nest characteristic and orangutan density. This research was conducted on June 2011 in buffer zone of Kutai National Park within Surya Hutani Jaya consession, Sebulu, East Kalimantan. We made seven transects with total length was 6000 m. The distance of each transect was ±200 m and we investigated all nest along 50 m from transect. The observation of nest characteristic were nest position, nest age, and number of nest. We recorded 67 nests in buffer zone Kutai National Park with density 338,692 nest/km^2. Nest in main stem was more common than in top of tree crown and the end of branch. Overall, we didn't find new nest (A or B) of orangutan.

Keywords: *Pongo pygmaeus morio*, nest density, nest characteristic, buffer zone, Kutai National Park

1. INTRODUCTION

Orangutans (*Pongo* spp.), the only great ape outside Africa, are found in Sumatera and Kalimantan island in Indonesia, and Sabah and Serawak in Malaysia. Almost 90% their habitat within Indonesia border (Johnson *et al*., 2005; Meijaard *et al*, 2001). The population of orangutans in South East Asia tend to decline due to hunting, habitat loss, and forest fragmentation and degradation (Marshall *et al*., 2009). The IUCN classes the Sumatran orangutan as critically endangered and the Kalimantan orangutan as endangered (IUCN, 2006).

Pongo pygmaeus morio, the subspecies of orangutan in Kalimantan, distributes in eastern part of Kalimantan including several districts in East Kalimantan and Sabah, Malaysia. This species can survive on poor habitat with low food availability and separated on small habitat called mosaic (Russon, 2010). The plausible reason for it that orangutan may not spend a higher percentage of their feeding time on high quality foods (fruit, insect). They can shift their feeding time on low quality food (bark, vegetation) during food scarcities (Meijaard *et al*., 2001). One of their habitat covers Kutai landscape including Kutai National Park and an adjascent area such as mining concession (PT Kaltim Prima Coal, PT Indominco, PT Tambang Damai), forest industries concession (PT Surya Hutani Jaya and PT Sumalindo Lestari Jaya II), palm oil plantation, also forest community. In Kutai National Park, orangutan population estimated 1779 individu (range from 1109 to 3003) in sanctuary zone and 298,4 individu (range from 196,5 to 453) in wilderness zone (Rayadin, 2010).

Based on regulation, the area around national park regarded as buffer zone which has main function to support national park ecosystem (Bismark and Sawitri, 2007). The nest presence of orangutan is an indicator that orangutan ever used buffer zone for their activities and give

information that there area is important for orangutan habitat. The implication for these statements is a buffer zone management especially for orangutan habitat is needed. Buffer zone management as orangutan habitat is integration between orangutan conservation and development mission around Kutai National Park. Furthermore, to create the comprehensive guide we need the basis information about nest characteristic and density, and orangutan density in buffer zone. Knowledge of a species distribution, density and populatin size is essential for conservation, because collecting this information is the only adequate method of assessing a species risk of extinction (Husson *et al.*, 2009). With these aims in our mind, we conducted research in buffer zone of Kutai National Park within PT Surya Hutani Jaya consession. We did this research to obtain information about nest characteristic and density of orangutan. We expected that our research can contribute an alternative of buffer zone management as orangutan habitat and can be guide to arrange the conservation model of orangutan in East Kalimantan, especially in Kutai National Park.

2. MATERIAL AND METHODS

2.1 Study Site

The study was conducted in buffer zone of Kutai National Park within PT Surya Hutani Jaya consession ($00^0$20,897'N, $116^0$57,936'E and $00^0$20,896'N, $116^0$57,934'E) East Kalimantan on June 2011. PT Surya Hutani Jaya belongs to Sinar Mas East Kalimantan region which is one of the world's leading pulp and paper companies. This consession encompasses approximately 157.070 ha which 98.000 ha planted with *Acacia mangium*.

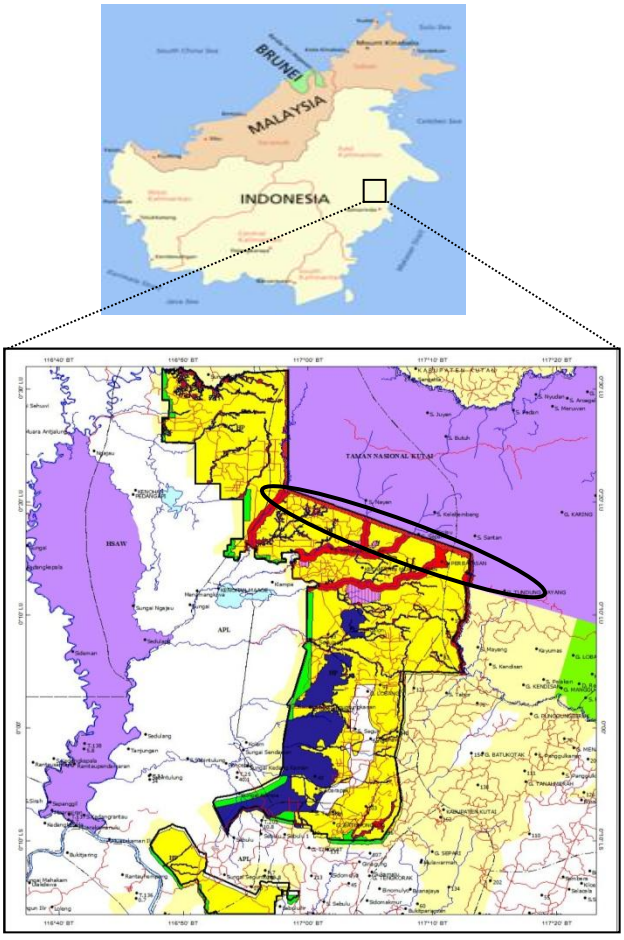

Figure 1: Study site

2.2 Nest Survey

The method that we used to count orangutan nest was transect line (Johnson *et al.*, 2005; Russon *et al.*, 2001). Line transect sampling methods rely on four basic assumptions that must be met to ensure validity of results. They are: (1) objects are detected at their initial location, (2) all objects located exactly on (or above) the transect line are detected, (3) distances are measured accurately and (4) transects are located randomly in the habitat (Morrogh-Bernard *et al.*, 2003). We placed midlines along existing trails to minimize disturbance. Transect lines have length 500 m or 1000 m and placed perpendicular to midline. The standard length that we used was 1000 m, but when the habitat was too degraded the transect was stopped before 1000 m. To avoid double counting, two transect on the same side of midline are placed at least 200 m from each other. Each transect was walked twice based on hypothesized that the double count would: (1) minimize the chance that nests were missed, especially directly above the transect, in violation of a key assumption; (2) minimize error due to inter-observer variation (Johnson *et al.*, 2005). During survey we stopped every 5 m and search 360^0 for nest occurring within 50 m of either side of the transect (Felton *et al.*, 2003). Finally, a total of 7 transect had been built with total length was 6 km.

2.3 Data Collection

We recorded all nest along transect line. For each orangutan nest, we measured perpendicular distance from directly below the nest to the transect and recorded nest characteristic (nest position, nest age, trees used for nest sites and number of nest). We classified nest position in tree following Rayadin and Saitoh (2009) and Prasetyo *et al.*, (2009).

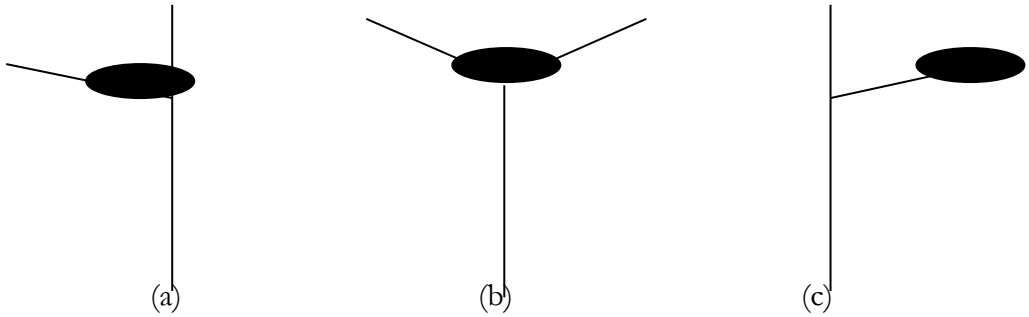

Figure 2: Orangutan nest position (a) main stem, (b) top of tree, (c) top of branch

Nest age was classified in five stage as follow: A= nest is new, still entirely green, B = nest is relatively new, mixture of gree and dried leaves, C = nest is brown, but shape remains intake, D = nest has begun to fall apart; there are holes or chunck of leaves missing, E = nest is old; leaves are gone and only the skeletal branch and twig structure remains (Johnson *et al.*, 2005).

2.4 Data Analyses

Estimating nest density per km^2 using equation (van Schaik *et al.*, 1995 *on* Russon, *et al.*, 2001) as described below:

$$D\ (N) = \frac{\mathrm{N}}{\mathrm{l\ x\ 2w}} \qquad (1)$$

Where:
D (N) = nest density
N = total nest count
l = total length of transect surveyed

w = the effective width of the strip

Nest density was used into orangutan density using equation:

$$D\ (OU) = \frac{\mathrm{D(N)}}{\mathrm{p\ x\ r\ x\ t}} \quad (2)$$

Where:
D (OU) = orangutan density
D (N) = nest density
p = proportion of nest builders in the population
r = the number of nest produced per orangutan per day
t = the estimated length of time (total days) that nests are still detectable (decay rate)
For value of *p, r, t,* we adopted from several publication as follow:

Table 1.The values of *p,r,t* parameters

Parameter	Value	Remarks
p (proportion of nest builders in the population)	0,9	van Schaik *et al.*, 1995 *on* Russon *et al.*, 2001, Johnson *et al.*, 2004
r (the number of nest produced per orangutan per day)	1,08	Rayadin, 2010
t (the estimated length of time (total days) that nests are still detectable (decay rate)	602	Rayadin, 2010

3. RESULT AND DISCUSSION

3.1 Nest Position

Nests are generally built near the top of tree (Ancrenaz *et al.*, 2004), but mean height of the nests varies from site to site, from 11 m at Tuanan to 20 m at Ketambe (Prasetyo *et al.*, 2009). In buffer zone of Kutai National Park, we calculated that mean heigth of the nests is 15 m. Proportion of nest position in main stem is higher than other location, we found 42 nests on main stem (62.69%), 13 nests on top of branch (19.40%) and 12 nests on top of tree (17.91%). Nest position can be indicator to know population structure of orangutan. Adult orangutan tend to build nest on stable position (main stem), and young orangutan common build nest on top of branch. We thought that orangutan in buffer zone have good structure population shown by distribution of age class (Rayadin and Saitoh, 2009; Rayadin, 2010). Proportion of nest position on study site was shown on Figure 3.

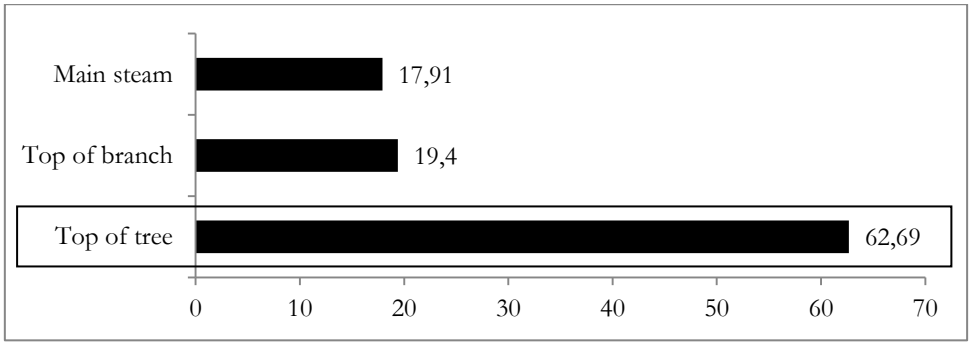

Figure 3: Proportion of nest position in buffer zone of Kutai NP

The basic pattern of nest position in the tree can be distinguished on four categories, which differ with respect to how the main platform is created. Type 1 refers to a nest built near the main stem by bending the horizontal branches springing from it to form the platform. Type 2 uses the horizontal branch as its main foundation and uses side-branches to build the platform. This can be done near the main stem or quite a distance away from it. Type 3 nests are in tree forks, i.e. where there is no main stem above the nesting site. Type 4 deviates fundamentally from the other three in that several, usually rather small, tree are connected, by bending and locking branches from each tree together (Prasetyo *et al*., 2009).

3.2 Nest Age

Data of nest age can be translated to predict how far orangutans using the buffer zone as their habitat. As information, we didn't find new nests in buffer zone of Kutai National Park. Proportion of nest age in class C is higher than D or E. We try to give reason for this. In buffer zone, orangutans were frequent user of ulin (*Eusideroxylon zwageri*), as we know ulin has high quality of wood. It caused nest age in stage C is more abundant. Nest age was related to nest decay rate that used to calculate orangutan density. Overall, nest decay rate is influenced by forest type, altitude, and other biological parameters (van Schaik *et al*., 1995 *on* Kabangnga, 2010; Ancrenaz *et al*., 2004). Although new nests were not found, it is predicted that orangutan still use buffer zone as their habitat. The implication for this that buffer zone is an important habitat for orangutan. Figure 4 show the proportion of nest age in buffer zone of Kutai National Park.

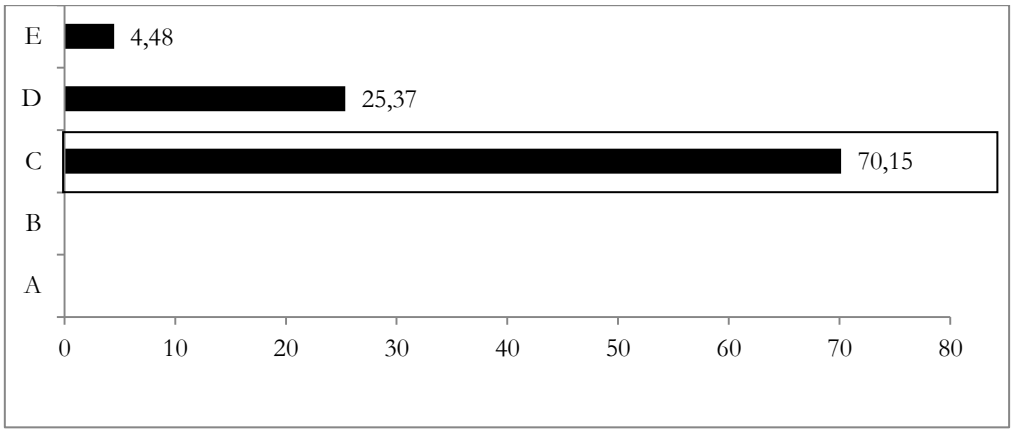

Figure 4: Proportion of nest age in buffer zone of Kutai NP

When we compared this result with Rayadin's research (2010) in sanctuary zone and wilderness zone of Kutai National Park (he found new nests in the two location). The result of our research strengthen statement if one of the main function of buffer zone is to support national park ecosystem and extend wildlife habitat (Bismark and Sawitri, 2007).

3.3 Number of Nests

We found 67 nests in buffer zone of Kutai National Park. Generally orangutans built one nest on one tree (the proportion is 45,19%). This result was same with Ancrenaz's result research conducted in Sabah, Malaysia (Ancrenaz *et al*., 2004). They found 86% case of one nest on one tree. The information about reusing nest tree can be extended for habitat quality assessment (Ancrenaz *et al*., 2004). Resource limitation may lead to a higher proportion of nest tree reuse in orangutan (Rayadin and Saitoh, 2009; Prasetyo *et al*., 2009).

3.4 Nest and Orangutan Density

The parameter values of *w* shown in Table 2.

Table 2. The parameter values of *w*

Site	Transect lenght	Number of nest	w/Strip width (m)		
			w	***w* 95%U**	***w* 95%L**
Buffer zone	6000 m	67	16,485	18,945	14,344

Remark:
w = the effective width of the strip
U = upper
L = lower
ND = nest density

Furthermore, we estimated orangutan nest density as follow (Table 3).

Table 3. Orangutan nest density in buffer zone of Kutai NP

Site	Transect lenght	Number of nest	*w (m)*			Nest density		
			w	***w* 95% U**	***w* 95% L**	**ND /Km²**	**ND 95%U /Km²**	**ND 95%L /Km²**
Buffer zone	6000 m	67	16,485	18,945	14,344	338,692	389,245	294,713

Remark:
w = the effective width of the strip
U = upper
L = lower
ND = nest density

Using p,r,t values, we estimated orangutan density in buffer zone of Kutai NP (Table 4).

Table 4. Orangutan density in buffer zone of Kutai NP

Site	ND			DO		
	ND	**ND95%L**	**ND95%U**	**DO/km²**	**DO95%L/km²**	**DO95%U/km²**
Buffer zone 6000 m	338,692	294,713	389,245	0,579	0,504	0,665

Remark:
w = the effective width of the strip
U = upper
L = lower
ND = nest density
DO = density of orangutan

From Table 4, we know that orangutan density in buffer zone of Kutai NP is 0.579 individu/km^2. When we compared with orangutan density in buffer zone of Gunung Palung National Park, the orangutan density in buffer zone of Kutai National Park is lower than orangutan density in buffer zone of Gunung Palung National Park (2.5 individu/km^2) (Johnson *et al.*, 2004). Regardless the result of orangutan density, we can conclude that buffer zone of Kutai National Park is the one of important habitat for orangutan in East Kalimantan.

3.5 Buffer Zone Management as Orangutan Habitat

Habitat orangutan in buffer zone of Kutai National Park consists of secondary forest that characterized by the abundance of *Macaranga gigantea*, open area that occupied by bushes, bamboo, and less canopy covers. Trees have low stem density (300,71 trees/ha), small basal area (14,41 m^2/ha) and were dominated by 15-19 m long with proportion 45,13%. Trees that reach ≥ 35 m belongs to Dipterocarpaceae, Burseraceae and Lecythidaceae.

Based on the data of orangutan density, it is clear that orangutan use buffer zone outside the park for their habitat. This results of our survey have implication for buffer zone management as orangutan habitat. Because of buffer zone within PT Surya Hutani Jaya consession, we need commitment from this concession to support orangutan conservation on their area. The act first can be done for orangutan conservation is work in collaboration between Kutai National Park and PT Surya Hutani Jaya i.e. arrange regulation for orangutan conservation, create or improve law enforcement in the consession, and identify of remaining population. Work in collaboration is not only limited by the two of them, but also including experts, universities, and research agencies.

Less canopy covers means more gaps in buffer zone and makes orangutans have to travel so far. It will expend amount energy travelling. Buffer zone management as orangutan habitat should focus on enrichment planting that has function as food sources and nest for orangutan. The guide that we can refer for enrichment planting arranged by Kuswanda *et al.* (2008) as describe below:

- The plants proportion that have function for food resources of orangutan were 60-80%.
- The plants proportion that have function for orangutan nest were 40-50%.
- The proportion of medicinal plants for orangutan is 20-30%.

We also need doing test to find the effective way to protect Acacia plantations by planting for buffer zone might focus on species that do not interest orangutan and/or create visual barriers so that orangutans cannot easily see plantation crops beyond. Presumably, fast growing species would be the most helpful (Marshall *et al.*, 2009). Future conservation planning must acknowledge the increasing importance of these areas, and work to prevent these areas from becoming more seriously disturbed and monitoring on orangutan ranging, behavior, reproduction and carrying capacity should be given higher priority (Johnson *et al.*, 2005).

The majority of orangutans occur outside national parks, and unfortunately many of their habitats will be used for commercial timber extraction, and converted to timber plantations. Although Indonesia has announced a two year moratorium on new forest clearance, which may represent a trend towards less forest conversion in the future, all concessions granted before this agreement will likely be allowed to proceed with extractive activities. We need to know wether and which species use, and can survive in, degraged habitats that make up the matrix outside forest reserves and how their survival could be supported through better management of the entire landscape (Meijaard *et al.*, 2010).

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INTERNATIONAL CONFERENCE OF INDONESIAN FORESTRY RESEARCHERS (INAFOR)

Section F Forest Protection

Use of Neem Extract to Control *Eurema blanda* Boisd., A Major Pest of *Falcataria moluccana* (Miquel) Barneby & Grimes, on Laboratory Scale

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Use of Neem Extract to Control *Eurema blanda* Boisd., A Major Pest of *Falcataria moluccana* (Miquel) Barneby & Grimes, on Laboratory Scale

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ABSTRACT

Sengon (*Falcataria moluccana* (Miquel) Barneby & Grimes is one of plant that currently dominates the community forest in Indonesia, especially Java Island. One obstacle on sengon development is *Eurema blanda* Boisd. pest infestation. These pests can inhibit plant growth even lead to death. Currently, most of *E.blanda* controls use chemical pesticides that have negative impact to the environment. For that reason, we need another alternative that is more environmentally friendly, such as the use of botanical pesticides. The objective of this study was to know the effectiveness of neem extract to control *E. blanda* larva on laboratory scale. Neem extract in five different concentrations sprayed on *E. blanda* larvae. Each treatment used ten larvae and three replications. The results showed that extracts of neem was effective in controlling *E. blanda* larvae. At a concentration of 1%, this insecticide caused 92.31% larva mortality after three days treatment. This value is not statistically different from 2% and 3% concentration at $P<0.05$. LC_{50} value of neem extracts against *E. blanda* larvae after three days treatment was 0.802%.

Keywords: *Eurema blanda* Boisd., *Falcataria moluccana* (Miquel) Barneby & Grimes, neem extract, mortality

1. INTRODUCTION

Sengon (*Falcataria moluccana* (Miq.) Barneby & JW Grimes)) is one of the dominant plants in the plantation forests area. In Indonesia, this plant already cultivated in 13 provinces with the largest area is on the Java Island. Sengon population on Java reached 50.08 million trees or 83.69% of the total population of sengon in Indonesia with a total area more than 1.2 million hectares and the number of households who cultivate it reached 1.98 million hectares (Ministry of Forestry and Central Bureau of Statistics, 2004; DG RLPS, 2005).

Sengon have some superiority, e.g. including fast growing tree, can grow on a wide range of climate conditions, and wide range of growth site condition. In addition, its wood can also be utilized for various purposes, such as building materials, particle board, raw material of pulp, and container. Concession sengon expected to overcome the deficit of timber caused by reduced supply from natural forests. Currently, the exploitation of sengon has successfully supplied the wood for the existing industry or new wood processing industry and has a lot to create jobs and increase foreign exchange through exports.

The existence of pest and disease in sengon become one of the obstacles in the sengon development. The importance one is the caterpillar of the yellow butterfly (*Eurema blanda* Boisd.). This caterpillar often builds up in large numbers and cause locally widespread defoliation in nurseries and young plantation (Nair and Sumardi, 2000). Pest control is still dominated by the use of synthetic chemical insecticides. The chemical control indeed can control pests quickly, but if it done unwise, it potentially increase insect resurgence and resistance, kill non targets insects or

other animals and have a negative impact on human health. Utilization of a variety of natural ingredients extracted from plants as pest control agents is an alternative that is more environmentally friendly. Several studies have shown that various types of plant extracts have reported to have anti-insect and antimicrobial activity (Dharmagadda *et al.*, 2005; Tzortzakis and Economakis, 2007; Nguefack *et al.*, 2008; Ayvaz *et al.*, 2010), so that it can be used as a botanical pesticide.

One of the plants that have been applied widely as a botanical insecticide is neem (*Azadirachta indica* A. Juss). This plant is known to be toxic to more than 200 insects. This plant contained several active ingredients, such as azadirachtin, meliantriol, salanin and nimbi (Anonymous, 1992). Almost all parts of the neem plant contain these ingredients, but the highest content is in the seed (Stoll, 1986). The objective of this study was to know the effectiveness of neem extract to control *E. blanda* larva on laboratory scale.

2. MATERIAL AND METHOD

The research was conducted at the Laboratory of Forest Protection, Center for Forest Productivity Improvement Research and Development, Bogor. An insecticide used in this study is neem seed extracts obtained from the Research Institute for Medicinal and Aromatic Plants (Balitro) Bogor. *E. blanda* larvae were collected directly from sengon plantation located in Bogor. The third instars of *E. blanda* then selected to be used in this experiment. Research conducted using completely randomized design with five treatment concentrations (0.25%, 0.5%, 1%, 2% and 3%) and three replications. The treatment was carried out by using spraying method. Ten of third instars larvae sprayed with neem extract as much as five times for each concentration. The larvae then put into petridisk and fed with sengon leaves. Observations of larva feeding activity and mortality conducted every day until day 3. Mortality data corrected with the larvae mortality on the control using the Abbott formula (1925) in Trisyono and Whalon (1999).

3. RESULT AND DISCUSSION

Mortality of larvae after three days of treatment was shown in Table 1. At concentrations of 0.25 and 0.5%, the mortality of larvae was still under 40% after three days of treatment. Meanwhile, at a concentration of 1% and 3%, mortality of larvae increased significantly, i.e. 92.31% and 100% respectively. LC_{50} value of neem extract after three days of treatment was 0.802. Figure 1 showed mortality achieved in the concentration of 3% was higher than the concentration of 1% and 2%, either on one day after treatment and three days after treatment. However, mortality at these concentration is not statistically significantly different at 5% level (P <5%).

Mortality associated with the efficacy of insecticides in controlling insects. The higher the percentage of insect mortality, the higher the toxicity of these insecticides. Based on these results, extracts of neem was effective against larvae *E. blanda*, so it need to proceed on field tests. E. *blanda* mortality occurred due to the active ingredients contained in neem seeds, namely azadirachtin, meliantriol, salanin and nimbi. These materials do not kill the larvae directly, but it cause death slowly through several mechanisms, such as reduces feeding activity, inhibit growth, interfere the process of mating and inhibit reproduction (Saxena, 1989).

Table 1. Mortality of larvae of *E. blanda* after three days of treatment

Concentration (%)	Mortality (%)	LC_{50}
0.25	38.46	
0.5	11.54	
1	92.31	0.802
2	92.31	
3	100	

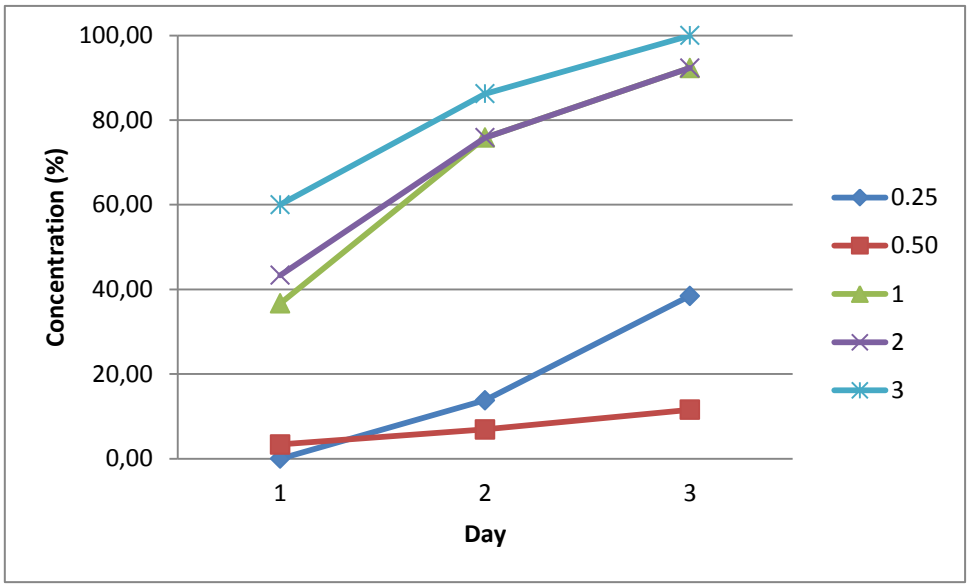

Figure 1: The average mortality of larvae of *E. blanda*

An observation on the feeding activity of yellow butterfly larvae was shown in Table 2. On the first day of treatment, feeding activity of larvae of *E. blanda* seen begins to decline and on day-2 activity has begun to lose. It can be seen in the conditions of sengon leaves are used as food. In the treatment, the condition of sengon leaves still looked intact, while at the controls, sengon leave was eaten.

Table 2. Feeding activity of yellow butterflies larva

Treatment	Day-1	Day-2	day-3
Control	+++	+++	+++
Consentration 0.25%	+	-	-
Consentration 0.5%	+	-	-
Consentration 1%	+	-	-
Consentration 2%	+	-	-
Consentration 3%	+	-	-

In insects, physical endurance and physiology of each instars tended to differ. Older instars tend to be more resistant from external factors changes that happened, because the skin has undergone some changes (Chapman, 1969; Gullan and Cranston, 2005). Tests in this research using third instars larva, so that the effectiveness of neem extracts against yellow butterfly larvae instar I and II probably higher.

4. CONCLUSION

Neem extract at a concentration of 1% can cause mortality of *E. blanda* larvae about 92.31% after a three days treatment. At higher concentrations, the resulting mortality was not significantly different. Meanwhile feeding activity of larvae on day-1 observations have shown begin disturbed.

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Section F Forest Protection

Conservation of Proboscis Monkey and Their Isolated Habitat in Kuala Samboja, East Kalimantan

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Conservation of Proboscis Monkey and Their Isolated Habitat in Kuala Samboja, East Kalimantan

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ABSTRACT

Proboscis Monkey *(Nasalis larvatus)* is one of a protected endemic primates of Borneo. Recently, their habitat was damage and their population was decline. Forty percent their habitat have changed the function and only 4.1% are located in conservation areas. Kuala Samboja River is one of proboscis monkey habitat outside the conservation area in East Kalimantan. The area was narrow i.e. only on the right side and left side of the river and a length of 5 kilometers. Besides their area isolated by a variety of land use and community activities, such as settlements, gardens, fish ponds, farms and road. The population of proboscis monkey increased in this area. In 1989, 90 proboscis monkeys were present and 22 years later population increased more than 143 individual and probably divided into 3 all-male groups (AMG) and more than 7 one-male groups (OMG). The narrowness of the habitat did not rule out proboscis monkey of habitat and into the community land. This condition is extremely vulnerable to conflict with the surrounding community. As area proboscis monkey habitat outside conservation areas, local community involvement in conservation and habitat proboscis monkey very decisive. Yet surely there must be a direct benefit can be obtained proboscis monkey preservation society by doing such. One of the possible is by ecotourism activities with proboscis monkey as its main object. With this system, the local community to actively protect and preserve the proboscis monkey and in return the community to obtain additional income from ecotourism activities.

Keywords: Proboscis monkey, isolated habitat, population, ecotourism

1. INTRODUCTION

Proboscis monkeys (*Nasalis larvatus*) are endemic to the island of Borneo and inhabit mangroves, riverine forest (Boonratana, 2000; Matsuda *et al.,* 2010), freshwater peat swamp (Yeager, 1989), also been found in upstream dipterocarp forest, galam swamp forest, limestone hill forest and in rubber forest (Soendjoto, 2004). They are large, sexually dimorphic, and primarily arboreal colobine primates (Napier and Napier, 1985). The weight of female is 7-11 kg and the weight of males is 16-22.5 kg (Nowak, 1999).

One-male group is basically typical social unit of proboscis monkey, consisting of an adult male and several females with their offspring, as well as all-male groups consisting only of young males (Bennett and Sebastian, 1988; Yeager, 1991a), also found Non-breeding group (Bennet and Sebastian, 1988; Muarai *et al.,* 2007), and adult male solitary (Boonratana, 2000). The species is considered *Endangered* according to the IUCN threat criteria (Meijaard *et al.,* 2008) and is listed on Appendix 1 of the CITES convention (Soehartono and Mardiastuti, 2002). In Indonesia protected species by government regulation number 7/2009. In 1990 proboscis monkey was chosen as the fauna mascot of South Kalimantan Province (Saidah *et al.,* 2002).

Distribution of the proboscis monkey covering three countries, namely Indonesia (all four provinces), Brunei Darusalam and Malaysia (Sabah and Serawak). Within East Kalimantan, bekantan occurs in Tanjung Redeb, Kutai National Park, Kayan river, Sesayap river, Sebuku River, Sebakung River, Sangkulirang, Sepaku River, Balikpapan Bay, Tenggarong, Sanga-Sanga,

Mariam River, Mahakam Delta, and Kuala Samboja River (Yasuma, 1994; Bismark, 1995; Alikodra, 1997; Meijaard and Nijman, 2000).

Threat of proboscis monkeys and their habitats outside protected areas is very high. Origin of proboscis monkey habitat is 29.500 km^2, however 40% has been los and only 4.1% of this habitat in protected area (Mc Neely *et al.* 1990). Meijaard and Nijman (2000) reported the main factors contributing to proboscis monkey habitat destruction are logging (both legal and illegal), forest fire, gold mining, swamp reclamation and shrimp farming.

Kuala Samboja River is one of proboscis monkey habitat outside the conservation area in East Kalimantan. The area was narrow and isolated by several community activities. So that the required conservation strategy by involving local communities.

2. METHOD

2.1 Site Description

Kuala Samboja River is part of the Watershed Seluang. This river more commonly known as the Hitam (black) River. Hitam River is a tributary which empties into the river estuary Samboja. Called the Hitam River because the water looks black when meeting with the water from Kuala Samboja River. The area is belonging to Kuala Samboja village, Samboja district, Kutai Kartanegara Regency, East Kalimantan and geographically this area is located between 01°00'22.0"- 01°00'44.5"S and 117°05'18.0" - 117°06'32.9"E.

The total area of Kuala Samboja Village is 15,750 hectares. North bordered by Senipah Village, the south by Tanjung Harapan Village and Sungai Merdeka Village, west by Sungai Seluang Village, and east by the Strait of Makassar. Base on monograph of Kuala Samboja village in 2004, number of inhabitants is 6,162 people. Livelihoods are fishermen, farmers, ranchers, civil servants, and self-employed (Pemkab Kukar, 2004).

2.2 Census

The survey was conducted in September 2011 along the Kuala Samboja River. Boat survey method was used to census the proboscis monkey populations. Searches for proboscis monkeys groups were made in the morning (06.00-10.00) and the evening (16.00-18.00). Number of animals was recorded and the location sightings of their groups were marked by GPS Garmin CSx60. All proboscis monkey groups records were given a latitude/longitude coordinate and entered in a computerized geographic information system (GIS), using ArcView 3.3 software. Other data layers contain information on map data base.

2.3 Vegetation and land use

Both common vegetation and land use were identified by USGS map and checking ground. Additional information was obtained from local people. Habitat was classified according to personnal observation.

3. RESULT AND DISCUSSION

3.1 Habitat

Proboscis monkey habitat in Kuala Samboja River is only one remaining of fours habitats in the Samboja District based on Yasuma (1994). Formerly proboscis monkey reported in Merdeka River and Beras River. Isolated habitat by a variety of land use and community activities, such as settlements, gardens, fish ponds, farms and road. Settlements are distributed in along Balikpapan-Handil II road nearby proboscis monkey's habitat. People density in the downstream was greater than that in upstream. Isolation also occurs by the canal. Canals up to 1 km long and 5 m wide in Handil Jamur and Lempahung have been dug to drain the swamp areas

in to the river, then area is used to Agricultural. Habitat isolation may have resulted in considerable genetic drift (Munshi-South and Bernard, 2011), and inbreeding may increase. Map of Proboscis monkey habitat at Figure 1.

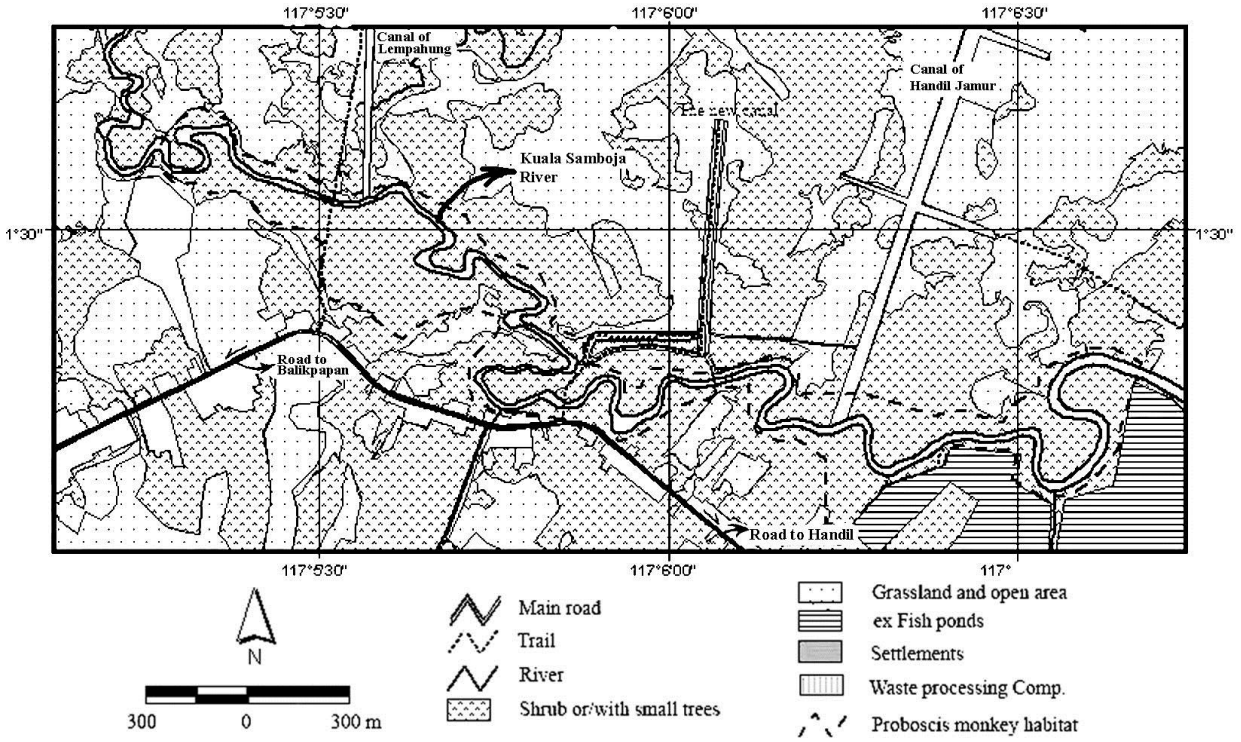

Figure 1: Map of Proboscis monkey habitat at Kuala Samboja River

Almost all the Proboscis monkey habitat is overlap by public land. This area divided into three, namely upstream, middle and downstream. In the upper stream not only farm land and cattle farm land but also ex sand mining and waste treatment company. Various commodities of farm land are kecapi (*Sandoricum koetjape*), manggis (*Garcinia* sp.), durian (*Durio* sp.), mangga (*Mangifera* sp.), and karet (*Hevea brasiliensis*). In the other hand native plant species in the upstream is more varied, such as *Hibiscus tilliaceus*, *Ficus* sp., *Dillenia* sp., *Vitex pinnata*, *Syzygium* sp., *Elaeocarpus stipularis*, *Sonneratia caseolaris, Oxyceros longiflora, Teijsmanniodendron* sp., *Flagellaria* sp., *Buchanania arborescens*, *Derris* sp., and *Rapidophora* sp.

In the middle stream adjacent to road and residential. Vegetation in this area are the shrubs with S. caseolaris and *N*ipa fruticans. Although still found Sonneratia caseolaris trees with large-diameter, but both pole and sapling stage are rare. Whereas in the downstream close to ex fish pond, dominated by *N*. fruticans and *S. caseolaris* with *Acrostycum aureum* and fern in the ground.

Proboscis monkey consumes the leaves and fruit of *S. caseolaris* as its main diet. Other food plant are *Vitex pinnata*, *H. littoralis, Hevea brasiliensis, A. aureum, Buchanania* sp., *Ficus* sp., and *Syzygium* sp. The proboscis monkey food plant in mangrove habitat in Serawak are *Sonneratia alba, Avicennia alba, Bruguiera gymnorrhiza* (Saltar *et al.,* 1985), *Rhizophora apiculata*, *Avicennia officinalis,* and *B. parviflora* (Soerianegara *et al.,* 1994), in the Mahakam Delta are *S. caseolaris, Syzygium* sp*., Uncaria* sp*., Premna corymbosa, Vitex pinnata, Heritiera littoralis, Caesalpinia* sp*., Derris* sp*., Barringtonia* sp. (Atmoko and Sidiyasa, 2008), *Nothaphoebe umbellifora, Ficus* sp*., Eugenia reinwardtiana, Hibiscus tiliaceus, Eugenia zollingeriana, Excoecaria indica, Ilex cymosa,* and *Gluta renghas* (Alikodra and Mustari, 1994), whereas in the peat swamp forest are *Eugenia* sp., *Ganua montleyana,* and *Lophopetalum javanicum* (Yeager, 1989). Soendjoto (2004) reported proboscis monkey food in galam forest,

limestone hill and rubber forest are *Melaleuca cajuputi*, *Acrostycum aureum*, *Stenochlaena palustris*, *Ficus* sp., *Hevea brasiliensis*, *Artocarpus integer*, *A. teysmanii, Vitex pubescens* [*pinnata*] and fruit of rattan.

The sympatric non-human primate in this area is long-tailed macaque (*Macaca fascicularis*). Agonistic behavior among this primates not observed, in spite of long-tailed macaque also eat some of the same type with the proboscis monkey. Yeager (1989) mention long-tailed macaques were potential competitors for the same resources.

The potencial predator in this area are monitor lizard (*Varanus salvator*) and raptors. Yeager (1991), Galdikas (1985) and Matsuda *et al.* (2008) reported proboscis monkey predator by false gavials (*Tomistoma schlegeli*), crocodilians, and clouded leopards (*Neofelis diardi*). Other potencial predator area include raptors, such as black eagle (*Ictinaetus malayensis*) (Fam and Nijman, 2011), crested serpent-eagle (*Spilornis cheela*), bat hawk (*Macheiramphus alcinus*), and reptiles, such as python (*Python curtus*) (Matsuda *et al.,* 2008), cobra *(Ophiophagus hannah)*, and *Boiga dendrophila* (Bismark, 1986; 1994).

3.2 Population

Base on formerly study showed population of proboscis monkey was increased. In 1989 reported 90 proboscis monkey in Kuala Samboja (Yasuma, 1994), in 1991 increased to 98 individuals (Alikodra *et al.,* 1997) then two years later rise to 103 individuals (Alikodra *et al.,* 1995). Recently, from preliminary study showed the number of proboscis monkey more than 143 monkeys, consist to more than 10 groups. More than seven groups are one-male group (OMG), and three groups are All-male group (AMG). As the habitat condition, the spread of proboscis monkeys were divided into three groups, i.e. upstream, midstream and downstream. Four OMG in the midlestream was habituated to observer and their homerange overlapped each other with ranging 5-15 individual per group. Researchers reported are varied of group size by location, ranging from 5-16 individuals (Bennet and Sebastian 1988), 3-23 individuals (Yeager, 1989), 8–34 individuals (Murai *et al.,* 2007) and 17-25 individuals (Bismark, 2009) whereas all-male group reach 30 individuals (Murai *et al.,* 2007). No territorial in proboscis monkey (Napier and Napier, 1967; Boonratana, 2000; Matsuda, 2008), overlapped groups of an average of 95.9% (Yeager, 1989) and often share of sleeping tree (Boonratana, 2000; Matsuda *et al.,* 2010).

The proboscis monkey population in this location is relatively increased, unlike in other locations. Unknown how the strategy of proboscis monkeys adapting to a narrow and isolated habitat. Soendjoto (2005) reported proboscis monkey adapt in the rubber forest through the efficient use of food and learning.

3.3 Threat

a. Local people decision leaves of *Nipa fruticans* as raw material for roofing. Taking in large amounts can be deadly *N. fruticans* as a protection of the river mouth.
b. Kuala Samboja River is estuary of several tributaries in the upstream, i.e. Merdeka River, Petai river and Muarawali river. Upstream region there are many coal mines, so that on rainy season the flow of water increases in downstream. The condition caused streambank erosion, which undermines vegetation and falling tree in the riverbank. Trees in the riverside are importance as a sleeping site of proboscis monkey.
c. During the dry season fish poisoning often occurs in the upstream (Samboja Dua Village), which resulted in the death of water organisms. Although yet unknown effect on proboscis monkeys

3.4 Conservation Efforts

As area proboscis monkey habitat outside conservation areas, local community involvement in conservation and habitat proboscis monkey very decisive. Yet surely there must be a direct benefit can be obtained proboscis monkey preservation society by doing such. One of the possible is by ecotourism activities with proboscis monkey as its main object. With this

system, the local community to actively protect and preserve the proboscis monkey and in return the community to obtain additional income from ecotourism activities.

Atmoko (2010) reported the result of SWOT analysis in this location showed matrix position lie on conservative position which is WO (weaknesses-opportunities). There were five strategies should be conducted, namely: bulding of management board, package of integrative turism, package of scientific adventure, increasing public awareness and promotions.

Habitat rehabilitation carried out with plant enrichment of food resources, riverbank protected tree and provide to economic value for local peoples. Wherever possible the plants are native species i.e. *Sonneratia caseolaris*, *Hevea brasiliensis*, *Vitex pinnata*, *Sandoricum koetjapi*, *Garcinia* sp., *Durio* sp., and *Mangifera* sp. The first two species are more recommended because *S. caseolaris* is the main diet while *H. brasiliensis* not only as proboscis monkey's diet but also has economic value. Schematic process of Proboscis monkey conservation in Kuala Samboja present at Figure 2.

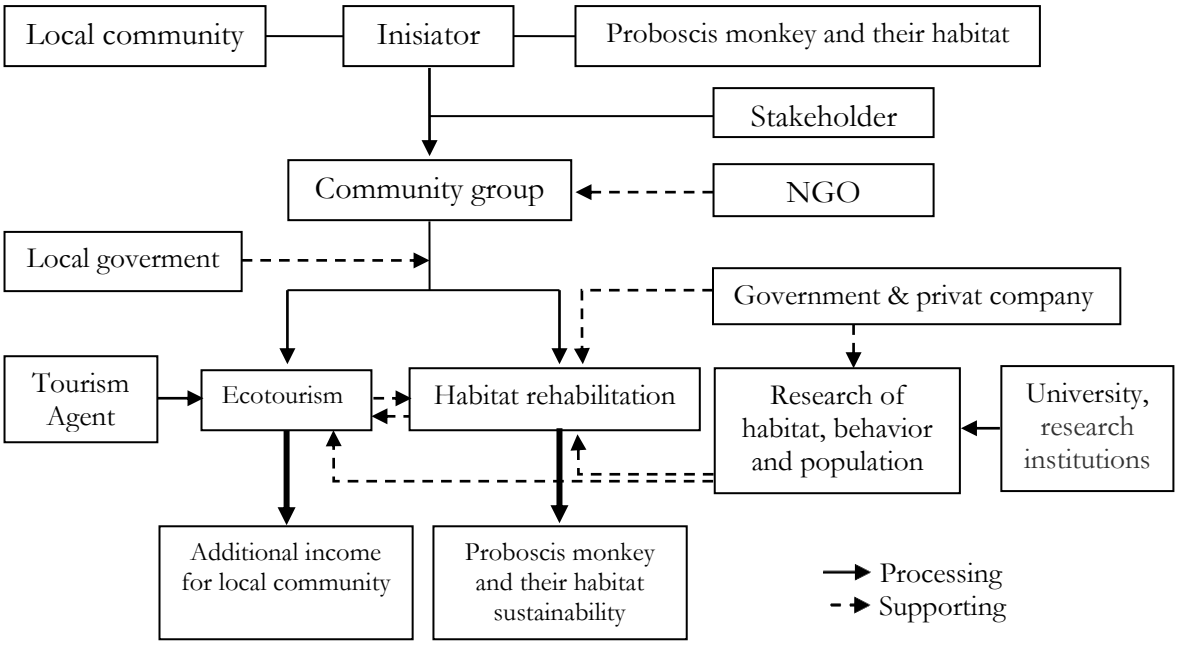

Figure 2: Schematic of Proboscis monkey conservation in Kuala Samboja

Currently, the stage of conservation activities are formated of community groups, identification of area, survey of proboscis monkey population and their behavioral. Community groups assistance conducted by Research Institute of Nature Resources Conservation Technology (Balitek KSDA) and Alas Taka foundation. While the visit of foreign tourists has been since 2006, especially guests from BOS-Samboja Lestari's ecolodge and travel agent from Balikpapan.

4. CONCLUSION

Proboscis monkey's habitat in Kuala Samboja is narrow and isolated, but the population increases, so study the adaptation of proboscis monkeys in this location is need. Ecotourism activities with proboscis monkey as its main object provide additional income for local community and in return the community to actively protect and preserve the proboscis monkey and their habitat.

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Section F Forest Protection

Response of Stem Borer Growth on Artificial Diet

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ABSTRACT

Sengon (*Paraserianthes falcataria* (L.) Nielsen) is one type of fast growing species which has high economic value due to the wood. It is used for pulp, packing cases and furniture. The biggest problem in sengon plantation is stem borer (*Xystrocera festiva* Pascoe) attack. The stem borer (boktor) larvae consume sap wood (*xylem*) and borrowing the wood. Mostly activity of larvae was inside the stem, therefore it is difficult to study about the boktor larvae. The objective of this sudy was to determine the growth of stem borer in artificial diet. Artificial diet can used to several purposes such as study on life cycle, bioassay of pesticide, selection of plant resistant. The aim of this study is to investigate the growth of boktor larvae in artificial diet. Parameters that observed were head diameter, body length, body weight and food consumption. Big size of boktor larvae (± 3 cm) was used in this study. The main component of artificial diet is powder from bark and stem of sengon tree. The results show that boktor larvae could growth optimally in artificial diet that compose from bark powder of sengon, compare to stem ones. Stem of sengon might contain inhibitor compound that could inhibit the growth of boktor larvae.

Keywords: *Paraserianthes falcataria*, artificial diet, stem borer

1. INTRODUCTION

Sengon (*Paraserianthes falcataria* (L) Nielsen) is one type of fast growing species which has hight economic value due to the wood. It is used for pulp, packing cases and furniture. This species is a fast-growing tree species that can be harvested within a relatively short period and can grow everywhere. The biggest problem in sengon plantation is stem borer (*Xystrocera festiva* Pascoe) attack. The stem borer X. *festiva* start attacks the stems sengon when they are 3-4 years old. *X. festiva* distributed in Indonesia (Java, Sumatra and Borneo), Malaysia, Philippines and Thailand (Husaeni, 2001).

The larvae feed gregariously on the inner part of the bark (phloem) and the outer part of sapwood (xylem) (Anonymous, 2011). Mostly activity of larvae was inside the stem, therefore it is difficult to study about the boktor larvae. Until now, some techniques used for controlling stem borer have not shown the maximum results. They were culture technique, biological and chemical technique. Chances to reduce these pests by planting resistant trees have promising technique. Therefore, knowledge about the biology and physiology and behavior of boktor larvae is needed. However, information about biological aspect of boktor is very limited. This is because of feeding activity occurs inside the stem. So, it is difficult to observe. Then, artificial diet needed to facilitate the observations. Artificial diet is a media consisting of natural materials and chemicals with a certain dose. This study will provide information about the possibility of larvae boktor to growth in artificial diet. This information is very useful in plant breeding purposes. The aim of this study was to determine the growth of boktor larvae in artificial diet.

2. MATERIAL DAN METHOD

Artificial diet composes of sengon powder from stem and bark that has been freeze dry processed. Others chemical were yeast extract (0.75 g), streptomycin (0.5 g), Ascorbic acid (0.5

g), sodium benzoate (0.5 g), sucrose (5 g) and aquades (50 ml), gel powder (1.75 g) and aquades (50 ml). The sengon powder was taken from two different conditions of tree, e.i. healthy (uninfected) and infected by boktor.

Material I in artificial diet begins with enter the sucrose into a beaker with aquades and stir until its dissolved. Then put yeast extract, and stirring it while added streptomycin, sodium benzoate and ascorbic acid and stir until its dissolved. Next, mix the stem and bark of sengon powder (five g) accordance with the conditions and stir again until until all ingredients are thoroughly mixed. Material II made by pouring powder gel into a beaker of aquades, stirred and heated it with an electric stove. After the two materials are ready, then mixed it (material II) into the material I (mixture of powders and other chemicals).

The experiments were conducted with putting big size of *X. festiva* larvae (± 1.5 to 3 cm) one by one into a test tube that filled with artificial diet, then covered with gauze and tied with rubber bands. Kept the tubes on the shelf with room temperature and get enough air. The observed parameters consist of larvae weight, larvae head diameter, the length of larvae and feed consumption. The measurement and replacement of food every two weeks for 6 times observations.

3. RESULT AND DISCUSSION

The results showed that four parameters: larvae weight, larvae head diameter, the length of larvae and feed consumption showed a difference response between the treatments in stem and bark of sengon. In Figure 1 shows four parameters of larva growth development on the stem of sengon generally negative effect, it's seen from the number of parameters that described the negative numbers. Negative influence meant, the low number of growth developmental parameters of larvae on artificial diet affected un-optimal of larvae growth.

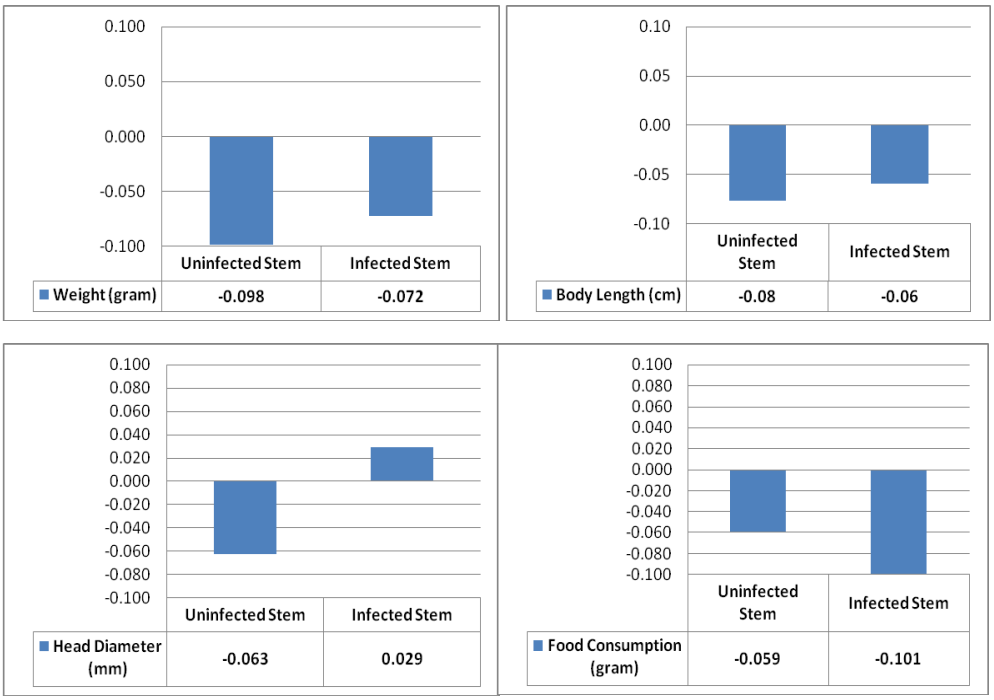

Figure 1: Parameters of the larvae growth on the stem of sengon for 12 weeks

Based on the trees condition, artificial diet by using uninfected-stem and infected-stem powder showed generally negative response (not good) to larvae growth, only the parameters of larvae head diameter give a positive response on infected-stem. This possibility happen because the inhibitor content on infected-stem lower than uninfected-stems. Djati (2009) and Saimima

(2010) mentions that sengon consist of α-amylase inhibitor and the trypsin inhibitor content in infected-stem was lower than uninfected-stems.

Prasetya (2007) mentions that in the larvae boktor digestive contained trypsin enzime and α-amylase enzyme. The highest activity of the α-amylase enzyme present in larvae boktor in size ± 3.5 cm, when the larvae move from the bark layer of sengon tree into the stem of trees that contain lots of starch.

This pest is most damaging pests in sengon tree. Pests attack the bark and the cambium of tree also damage the outer timber of sapwood. If the damage attacked until a heart wood, it disturbed the flow of nutrients from leaves to roots and causes dead (Listyorini, 2007). Sengon tree damage as a borer result of larvae and effected holes. The existence of drill holes on the stem causing the tree become weak and broken easily broken by winds (Hawiati, 1994).

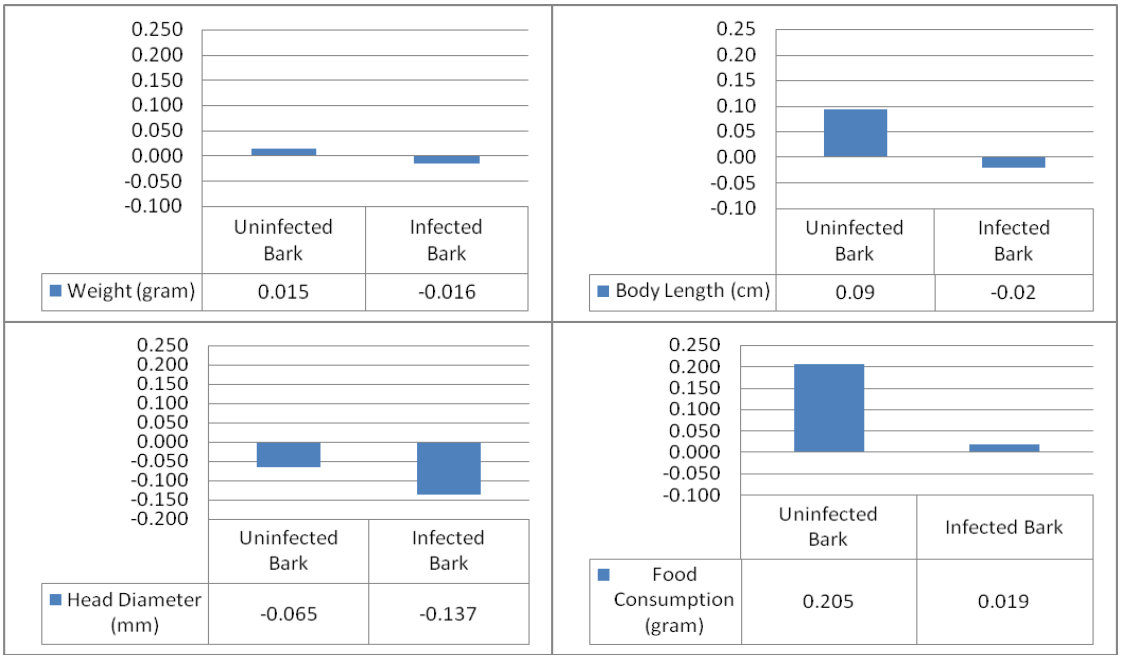

Figure 2: Parameters of the larvae growth on the bark of sengon for 12 weeks

In the parameters weight (Figure 2), the length and feed consumption, larvae growth uninfected-bark of sengon better than infected-bark of sengon. However, from the four parameters shows that positive effect of larvae growth by using bark powder of sengon, which each parameter influence larvae grwoth better.

Based on sengon's bark conditions, the response of larvae growth on the infected-bark better than uninfected-bark, it's accordance with Barbosa and Wagner (1989) stressed trees may affect the sensitivity of trees attacked by pests, more susceptible attack by pest compared with uninfected trees. Stress on the tree caused by biotic factors (pests, diseases, and competition between trees) and abiotic factors (temperature, humidity and fire).

Based on the data (Figure 1 and Figure 2) shows that the growth of the larvae boktor provides a better response by using the bark of sengon compared stem of sengon. In summary, artificial diet with the stem powder of sengon as main ingredient were appropriate for larvae growth.

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INTERNATIONAL CONFERENCE OF INDONESIAN FORESTRY RESEARCHERS (INAFOR)

Section F Forest Protection

Biodiversity Conservation: Do We Really Need to Introduce an Exotic Species?

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ABSTRACT

The presence of exotic or alien species has been common in all forest habitats around the world including the tropical rain forest of Indonesia, particularly in the disturbed forest ecosystem. Non-native plant species is introduced through various ways and for various purposes such as agriculture, silviculture, soil improvement, ornamental, medicinal, and others. In many cases, an introduced species has becoming dominant in its new habitat and is likely to be invasive out competing the native plant species and causing damage to the environment. A number of case studies on the negative effects as well as benefits provided by these exotic species are described in this paper. For example, *A. nilotica* was first introduced to the savanna habitat of Baluran NP in 1969 for fire breaks and later on the plant became dominant and suppressed the growth of native grasses in the savanna. Aside from its negative effect to the environment, *A. nilotica* also provides alternative of livelihood to local community. Result of study showed that local community generates income from selling *Acacia* seed to be further processed for coffee mixture, bean sprout and milk products. This economic value may be changed as the density of *Acacia* also fluctuated since the Park's management has launched an *Acacia* eradication to promote the growth of native grass for wild buffalo forages. In some ways, exotic species could provide both negative and positive impacts to the environment depending on how we could wisely manage them for the economic use of plant resources.

Keywords: Exotic, habitat, ecosystem, environment, community and economic

1. INTRODUCTION

High richness of plant species or plant diversity has been much discussed in almost all scientific papers, especially across the tropical rain forest country region including Indonesia. Most of paper presented either in scientific journal and articles or during international conference has exposed the high richness of plant species in particular areas and some of them afford to make comparison on the plant richness and diversity across the different sites within the tropical areas. Yet, only few discusses on the presence of non-native species that, for some people, is considered to enrich the diversity of native plant species. Since the 17th century, invasive alien species have contributed to nearly 40% of all animal extinctions for which the cause is known (CBD, 2006). 80% of the threatened species in the Fynbos biome of South Africa are endangered because of invading alien species (Chozin and Guntoro, 2010).

Non-native species existence, especially those perennial plants in particular areas, is often negligible as people are likely to focus more on their performances rather than the reason behind their presence. Most local community in Java island have limited knowledge on the most common tree planted in their garden and along the main road such as White Lead tree (*Leucaena leucocephala*) that originally comes from Mexico and Central America. It was firstly spread in Asia

Pasific for various purposes since Spain occupation in the Phillippine at the end of 16th century and it further spreads to all parts of the worlds including Indonesian region. This fast growing species has been planted widely in Java and Bali since 1986 by the government of Indonesia mainly for shade trees, fuel wood and forage for cattle. It has a local name of *Lamtoro* and is also grown by private plantation and small farmers for commercial purposes. Some people still considered this tree as local species until it massively spread across the island and the outbreaks of insect pest namely psyllid (*Heteropsylla cubana*) causing severe damages to all *Lamtoro* trees of which it can only be remedied by its biological predator (*Curinus coeruleus* Mulsant) introduced from Mexico. This species has been reported as the most invasive one by some countries (Tjitrosemidjo, 2010).

Similar to the case of white lead tree, teak (*Tectona grandis*), mahagony (*Swietenia mahagony*), rubber (*Hevea brasiliensis*) and other non-native tree species are planted in the forestry sector for commercial purposes and mainly for timber, except rubber trees that is extracted for its latex. Only few people have recognized that those commercial tree species are introduced from overseas since ages because they are commonly seen in plantation forest areas in Indonesia. Unlike white lead tree, these species have not been reported to be invasive and even preferred over the native species due to various benefits they can provides such as high values of timber and latex.

In Indonesia, the number of exotic species is approaching around 2,000 species. One of the most legendary one is water hyacinth (*Eichornnia crassipes)* or called as "*eceng gondok* " that has been flourishing since 1990 in some areas throughout Indonesian islands. People also grow them in their garden due to its attractive performance and the bright velvet color of its flower. Lately, this fast growing species has turned into a disturbing and invasive plant. Their massive distribution is not only disturbing water transportation, but also causing to sedimentation and killing of plankton in the water body such as pond, lake and areas along the riverine.

Exotic species can and cannot be invasive in their new habitat depending on several internal and external factors. There are a number of pros and con with regard to the presence of exotic species. Some of the invasive one has spread massively outside their natural habitat and compete out the native one because they do not have the natural enemies. Later on, these plant species turn out into weed or an unwanted species due to its negative impact to the environment. At large scale, it has high potency to jeopardize the natural ecosystem. This paper discusses the pro and contra of the presence of exotic species and how we could wisely adjust to their presence.

2. PATHWAY OF EXOTIC SPECIES IN FORESTRY

Biodiversity Convention that was ratified by Indonesian government through Act No.5 1994, in particular under article 8(h), mandates to all countries to avoid introduction of IAS, to control and eradicate IAS that potentially cause negative impact to the environment and causing damage to the original biological diversity.

Biodiversity Convention (COP IV CBD) held in Bratislava in 1998 has mandated to the Parties to develop education, training and community awareness effectively as well as to develop campaign program and dissemination of information regarding to various aspects or issues related to IAS control, including review and impact management towards negative impact due to this IAS introduction.

According to *International Union for Conservation of Natural Resources*/IUCN, introduction is movement induced by human in form of species, sub-species or organism at lower taxon level, out of their original habitat. Movement or dispersal may occur within country or across countries. This movement is possible due to the dispersal agents such as human or animals. What is invasive alien species? IAS are plants, animals, pathogens and other organisms that are non-native to an ecosystem, and which may cause economic or environmental harm or adversely

affect human health. In particular, they adverse impact upon biodiversity, includes decline or elimination of native species - through competition, predation, or transmission of pathogens - and the disruption of local ecosystems and ecosystem functions (Based on Convention of Biological Diversity (CBD)). Invasive alien species, introduced and/or spread outside their natural habitats, have affected native biodiversity in almost every ecosystem type on earth and are one of the greatest threats to biodiversity. There are several reasons on why people kept introducing exotic species:

- ***Economical aspects (business).*** The introduction o animal and ornamental plants has become big business lately. The current trend of people to collect something that different from other common thing or unique causing them to introduce plant or animal that people have never seen before.

- ***Food***. Various poultry or livestock, including fish that is commonly introduced by human from one country to the other for food. From a number of animal and plant species, only those species that has characters of fast growing and easily adapted to the new environment will be selected. In addition, they must be easy to be allocated or moved from one place to the other as well as highly nutritious.

- ***Ecosystem manipulation***. This has been done in the case of the introduction of natural enemy to mitigate disturbing organism.

Most exotic species has been introduced to Indonesia mainly for agriculture or food improvement (peanuts, corns, soybeans, and others). To open the agriculture land, people may open forest areas that mainly dominated by trees. This area has been heavily logged, with most logging occurring in the last thirty years to create not only timber business but also large cultivation. Commercial logging destroyed the forests while providing access to local people to open land for agriculture. In the bigger scale, massive agricultural projects, such as oil palm, rubber, and industrial timber for pulp and plywood, soon followed. Smaller agricultural shareholders also filled in these areas by cutting and burning patches of forests. By the late 1980s Indonesia was the world's largest plywood producer. Private and state-owned forestry companies have stripped the land clear for pulp and palm oil plantations, destroying vast tracts of forest. They are replanting with a limited number of fast-growing exotic species (Galdikas and Briggs, 1999; Barber and Schweithelm, 2000).

The above three reasons may not all be applicable to forestry sector because field fact shows that most of the presence of the exotic species in the forested areas has their own pathways. For example, the presence of *Acacia mangium* in Kalimantan was due to the old policy of the government to plant fast growing species in order to cover the areas along the logging road. However, these species has been massively spread in areas that is relatively open and started to suppress local tree species. Other evidence was the presence of tree bearing fruit of exotic species such as guava, annona and others that is commonly grown by the logging company staff to enrich their base camp. These plants are easy to be transported as most of them can be reproduced easily through their seeds. In fact most of these exotic fruit bearing tree species are highly adaptable to most tropical forest land.

3. ECOLOGICAL IMPACT OF EXOTIC SPECIES

Technically, economically, socially and ecologically, a number of species and new variety are needed and they have been significantly and positively contribute to the prosperity of the community. However, some of them are negatively impacted to the native ecosystem. Pest, weed and disease outbreaks due to the introduced new exotic species and especially the invasive one

has reduced crop's yield, competing out local livestock and commodities and causing damage to the environment (agriculture and plantation).

There are also several ecological impacts causing by the introduction of some exotic species, although some of them may not be damaging to the local species. These impacts are :

- Reduction of biodiversity
- Loss or encroachment upon endangered and threatened species and their habitats
- Loss of habitat for native insects, birds, and other wildlife
- Loss of food sources for wildlife
- Changes to natural ecological processes such as plant community succession
- Alterations to the frequency and intensity of natural fires
- Disruptions of native plant–animal associations such as pollination, seed dispersal, and host–plant relationships

Below diagram (Figure 1) shows possibility of population growth of IAS and the corresponding way of actions to overcome the problems (Tjitrosoedirdjo, 2010). It needs some time for exotic species to adapt with their new environment and once they have adapted they started to occupy places that suitable for them to proliferate and sustain their population. Without biological enemy, some of these species may spread easily to other places through various media (dispersal agents). Some survivor may compete for resources with local or native species and it is too often that local species losing out.

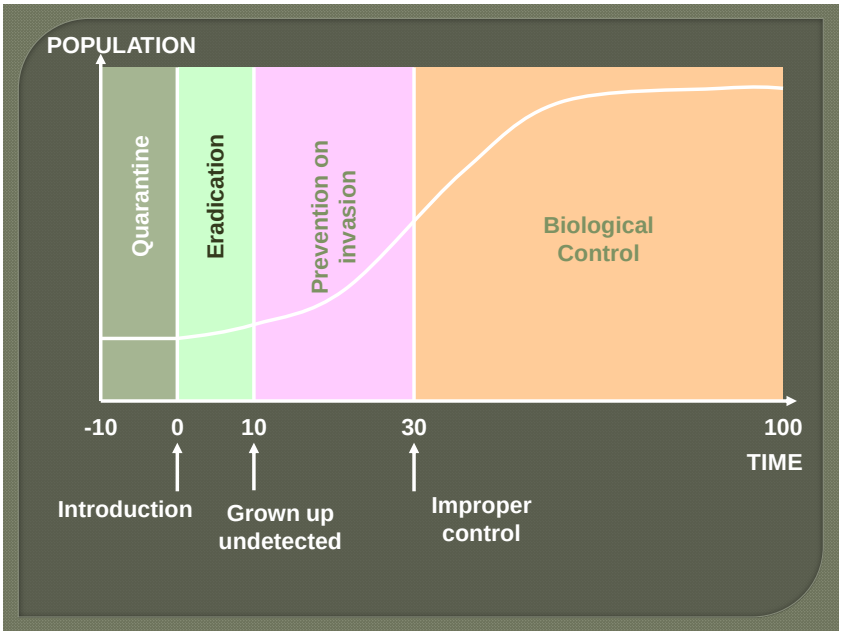

Figure 1: Diagram of possibility of population growth of IAS and the corresponding way of actions

4. CASE STUDY OF INVASIVE EXOTIC/ALIEN SPECIES IN INDONESIA

4.1 Acacia (*Acacia nilotica*) in Baluran National Park, East Java

Acacia nilotica was firstly introduced to Baluran National Park (BNP) in 1969. This species was planted in savanna Bekol as fire breakers so that it would not cause damage to teak plantation situated close to the national park. *A.nilotica* is a dry resistant plants and it could well adapted to any climate condition. It was imported from India Botanical Garden in Calcuta (Tjitrosoedirdjo *et al.,* 2011). At the beginning, this species is introduced as source of gum but

later it was found that it will not economically worth then it was decided to throw away the plant. Later on, it was found that the seeds was planted in Bali, Timor and Poso. Schuurmans (1993) reported that this legume species can produce pod as much as 61 pod/m^2. The mature pod of *A.nilotica* that fallen down to the ground was consumed by herbivores such as wild cow, water buffalo, deer and the seeds can survive passing though these herbivores digestive system. Some of the seeds remains viable when defecated by these herbivores. With extremely wide home range and defecating in any places, these herbivores are further simbiozed with *A.nilotica* and dispersed the seeds rapidly and massively throughout their home range. Seed regenerated more faster from the faecal and it will grow very well under suitable condition. The distribution at early stage is relatively slow because at that stage the plant is only grow as fence along 2 km in distance. Nonetheless, with incredibly rapid expansion thorugh the simbiosis with these herbivore, the invasion of *A.nilotica* run very fast. Based on the monitoring program developed by the National Park, it is predicted that during year 2011, almost all savanna will be invaded by *A.nilotica*.

High adaptability of *A. nilotica,* by no means, also invited other exotic species to appear such as those belonging to weeds. The invasive weed species suppressed the growth of local species and eradication of acacia was done half-heartedly as there was no after-treatment maintenance being regularly done. In addition, funding limitation make the situation becomes worst beside the occurrence of illegal cattle inside the park. There is also other problem of lacking information regarding to technique and methodology to control these invasive species. Some of disturbing plants that are detected in Baluran NP among of those are: *Acacia nilotica, Thespesia lampas, Flemingea lanneata, Indigofera sumatrana, Vernonea sp., Mimosa invisa, Croton hyrtus, Jathropa gossypifolia, Azadirachta indica, Acacia tomentosa, Zysypus rotundifolia, Callotropis sp., Achyranthes aspera, Cosmos caudatus, Cleome sp., Merremia emarginata, Datura methel, Ochimum sp., Villanthus sp., Sida acuta,* and *Sida cordifolia*. There is no record what so ever on how these exotic species firstly came and appeared in this savanna. Once the area was taken over by *A. nilotica* that suppressed the growth of local or native species, these weed species was spread very rapidly and almost cover all the areas. Report from Baluran NP management showed that effort to eradicate these weed has failed due to various reasons, and among of those are uncertain weather condition such as longer rainy season that makes application of herbicide is not efficient and wide areas of savanna that was not possible to be managed without a well-designed eradication planning.

4.2 Aster (*Eupatorium sordidum*) in Gede Pangrango National Park

This Mexican species is firstly introduced to the Gunung Gede Pangrango National Park, in West Java and became invasive in this area since after. This species is competing out some potential medicinal plants as well as other animals. The park manager and researcher from LIPI, Sunaryo (April, 2009) stated that the condition is now getting worse as it is difficult to control their massive spread. There are at least eight species of invasive exotic/alien species recorded in this park.

4.3 Chromolaena (*Chromolaena odorata)* in Java and Sumatra

This species is native to South and Central America. Aggressively, it invades cattle farm, plantation, garden and other cultivated land. This species is considered as the primary weed towards environment and it is commonly suppressed other vegetation. In Indonesia, it was firstly reported to be found in Lubuk Pakam, North Sumatra during 1934. This species spread across the region very rapidly from Aceh to Papua. This species also invades Pananjang, Pangandaran, and Ujung Kulon National Park as well as savanna in Nusa Tenggara.

4.4 Bittervine or Chinesse creeper (*Mikania micrantha)* in Java

It is imported firstly in 1949 from Paraguay and planted in Bogor Botanical Garden. In 1956, this species was introduced as non-legume cover crops to the rubber plantation. It grows

very quickly and covers all other vegetation grown nearby. In 1976, it occupies almost all areas of the rubber plantation and widely spread to other cultivated or agriculture land in East and West Java as well as South Sumatra. This species is also potential to be allelopathy to other plant species that grown nearby. Extracts from *M. micrantha* slow the germination and growth of a variety of plant species (Shao et all, 2005)

4.5 Sweet granadilla (*Passiflora ligularis)* in Gunung Gede National Park, West Java

This species is native to South America. First naturalized in West and Central Java and grows very fast. It is a common fruit plants planted by local community mainly in Sumatra and Java at altitude from 800 to 1500 m above sea level. Flowering during a year and has a peak tome during long dry season. Local people also use this species from medicine such as fruits from anti-inflammatory and reduce fever, and the leaves for curing worms and for anti-depressant. The leave and fruit have chemical content such as saponin, the leave contains alkaloid and polyphenol while the fruits contains flavonoid and ascorbic acid. The fruit is also edible.

In Gede Pangrango National Park, this species causes problem and it crawl and strangle to other forest trees and suppresses their growth. The occurrence of this species as competitor to other endemic plants and invades the ecosystem in relatively wide areas has become great concern for the national park management. Slow but sure, this species is potentially damaging to the existing habitat. However, local community in this area also harvests the fruits (local name as *konyal*) for consumption and herbal treatments.

5. WHAT WE SHOULD DO?

Introduction, distribution and use of various exotic species either intentionally or unintentionally that is latter become invasive in their new habitat has caused to massive ecological and economically loss. Loss in form of environmental damage due to this invasive exotic species is commonly difficult to restore. This is due to the character of the species where some are highly adaptable, easily grows and proliferate in their new habitat. Extinction of a local organism species is a non-renewable damage.

Exotic flora and fauna species that become invasive as it is mentioned above are only a few example of thousand of IAS species that is currently existed in Indonesia. None of them was introduced for bad purposes but in fact it posses a number of weakness while knowledge and information regarding to their ecological and biological character are lacking. Certainly, this causes to a great danger or threats to local plants. No one knows, what will happen with the wide market of Brazilian turtles that people traded because of their cuteness and attractive performances. Is this going to lengthen the suffering of our native ecosystem by the appearance of these non-weapon invader species?

Considering the ecological impacts of the invasion of exotic species in our ecosystem, there are a number of alternative options that need to be done such as follows:

a) Conduct inventory of all exotic species
b) Review on positive and negative impact
c) Develop method for risk analysis
d) Set up national strategy to manage IAS
e) Establish collaborative action and international network to avoid exotic species movement across countries

In term of policy and regulation, the government of Indonesia has so far provided policy that only serves as formal media and it is written down only as law instrument. Although these policy instrument have discuss on several problems and threats of introducing exotic flora and fauna species.

Under Government Regulation No 27 year 1999 regarding Environmental Impact Analysis (EIA), Section 3 article (1) with regard to species, business and/or activity that

potentially causing wide and significant damage to the environment including point 1.f., which is introduction of plant, animal species and microorganism. All introduction activities has obligation to conduct EIA. However, guideline for risk and management analysis in relation to species introduction has yet to be developed.

Considering the pros and cons of the presence of the exotic species in Indonesia as well as problems arouse towards environment and community, there are many options that people could choose for the sake of biodiversity conservation. One things that we must remember is that nowadays Indonesian forestry sector, particularly plantation sector, has become overwhelmingly dominated by non-native species such as teak, pines, mahagony, rubber (Hevea), Acacia (for pulp and paper). These species have been domesticated and become well adapted to their new environment. As most of them are slow growing species, except for Acacia, there have been no reports on their invasiveness. Under special case, Acacia may need special attention as some of the species such as *Acacia nilotica* which is firstly planted for its fire breaks in Baluran National Parks has created problems by suppressing the growth of local grass and forage and *Acacia mangium* that has also been reported to spread extensively inside the forest concession in Kalimantan and Sumatran region.

6. CONCLUSION AND RECOMMENDATION

Based on the above discussion, we have not sure yet whether the advantages of introducing exotic species has exceeded its negative impact caused by the their massive spread. This can only be answered by thorough and in-depth study on the presence and distribution of these exotic species in Indonesia. Therefore, a number of recommendations are suggested as the following:

1. Spread of IAS has become international issues and it shall only be resolved by collaborative action among the country ranges
2. Set up strategy to manage IAS but prevention is the most priority to be taken.
3. Collaborative works to reduce the negative impact that has been exposed to particular habitat and conduct habitat restoration
4. Review on current regulation on IAS prevention in forestry and agriculture.
5. Introduction of exotic species is prohibited unless risk analysis has been done.

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INTERNATIONAL CONFERENCE OF INDONESIAN FORESTRY RESEARCHERS (INAFOR)

Section F Forest Protection

Daily Activities of Released Silvery-Javan Gibbon Pair at Patiwel Forest, Gunung Gede-Pangrango National Park: A Preliminary Study

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Daily Activities of Released Silvery-Javan Gibbon Pair at Patiwel Forest, Gunung Gede-Pangrango National Park: A Preliminary Study

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ABSTRACT

Research on a pair of released-silvery-javan gibbon (*Hylobates moloch*) conducted at Patiwel Forest Gunung Gede-Pangrango National Park, West Java on July-August 2010 to a pair of released silvery-javan gibbon, namely Achi and Septa. Those pair was released on October 2009. The objective of this research was to analyze the daily activities of released group of javan gibbon in their natural habitat. The study included, daily activities, such as feeding, traveling, resting and social behavior. The habitat study also conducted to know habitat preference of the gibbon. Data collected by using scan sampling and ad-liebetum sampling. The result showed that the pair of gibbon has used 11 hours for daily activity with time budget for feeding 25.6%, moving 38.9%, resting 29.3% and social activity 6.02%. Feeding activity started from the morning after woke up and make a morning calls. The most high frequency feeding time was from 08.00-09.00 in the morning. The composition of food that fed by the gibbon are fruit 85.22%, leaves 7.95%, flower 0.28% and insect 6.55%. During the study, we recorded 17 species food trees that consumed by the gibbon, e.g. afrika (*Maesopsis emonii*), beunying (*Ficus fistulosa*) and kokosan monyet (*Dysoxylum aleaceum*). When ate the food, the gibbon preferred to use the upper canopy (63.1%). The gibbon use 35.6% from their total activity time budget to do moving activity. When moving they preferred to use upper canopy (60.53%). The average of the daily length of the gibbon was 1,500 m, which the shortest range was 1000 m and the longest ranger was 1950 m. The resting time consumed 29.36% from total daily time budget. When resting, they preferred use the upper tree canopy (59.09%) and the position when resting was sitting. Social activity was only 6.2% from total time budget. Kind of social activity recorded were call (70.7%), agonistic (25.3%) and grooming (4%).

Keywords: Silvery-javan gibbon, daily activity, behaviour, Patiwel forest

1. INTRODUCTION

Silvery-javan gibbon (*Hylobates moloch*) is an endemic to Java Island and protected by Indonesian Law since The Dutch Colonial Government by Wild Animal Protected Regulation No. 256/1931 and also The Government Decree No. 7/1999. In The Red Data Book of IUCN (2006), this animal was categorized as an Endangered Species. In their natural habitat, the population was decreased from time to time. The resent population estimation of the wild gibbon was 1000-1500 individual (Wedana, 2010).

The habitat of silvery-javan gibbon was decreased and fragmented because of illegal activities and utilization of the forest. The resent distribution of gibbon lying from the west part of Java to the central of Java. Some important habitat were Gunung Gede Pangrango National Park (NP), Gunung Halimun Salak NP, Ujung Kulon NP, Gunung Simpang Nature Reserve,

Leuweng Sancang Wildlife Sanctuary, Gunung Papandayan, Gunung Wayang dan Gunung Porang (Wedana, 2010).

The rehabilitation of silvery-javan gibbon was one of the efforts to conserve and preserve the gibbon by release them to their natural habitat. After passed a long time rehabilitation process in 2009, the first pair of silvery-javan gibbon named Septa and Echi Javan was released by Gibbon Foundation and Directorate General of Forest Protection and Nature Conservation at the Patiwel forest block, within the Gunung Gede Pangrango NP.

Descriptions of Javan gibbon social organization usually emphasize the small group size, territoriality, and monogamous mating pattern. However, there are relatively few data on the distribution, behavior, or socioecology of this species (Kappeler, 1984; Nijman, 2001). This data is very important to the conservation of the silvery-javan gibbon, especially for rehabilitation and release program in the future. The objectives of this research were to identify the adaptability of the rehabilitant pair of gibbon after released and the daily activity pattern of the pair.

2. MATERIAL AND METHODS

2.1 Study Site

This research was conduct at Patiwel forest block, Gunung Gede-Pangrango National Park West Java on October to November 2009. Patiwel forest formerly was a production forest planted by puspa (*Schima walichii*) and rasamala (*Altingia excels*) mixed with wild plant species. Now the forest is a part of the Gunung Gede Pangrango NP (Figure 1). This site was located at a hill of the Pangrango Mountain (06°46'52.98" S and 106°49'44.19" E) with altitude of 800 meters above sea level.

Figure 1: Situation map of Patiwel forest, Gunung Gede-Pangrango NP

2.2 Data Collection

The daily activity and behavioral data were collected by followed the pair of released gibbon, named Septa and echi (Figure 2), full day using the Focal scan sampling Method (Altmann, 1974). At five minute interval we determined and recorded for each individual in the focal group all daily activity categories i.e. feeding, moving, and resting. All-occurrences of social behaviors such as grooming, copulations, or inter-group encounters were recorded using ad liebetum sampling method. All food items that consumed by the gibbon were also recorded. We

also identified the use of canopy strata when conduct the activities, i.e. Strata 1 (S1) for lower canopy, S2 for middle canopy and S3 for upper canopy.

Figure 2: Septa and echi in their new habitat

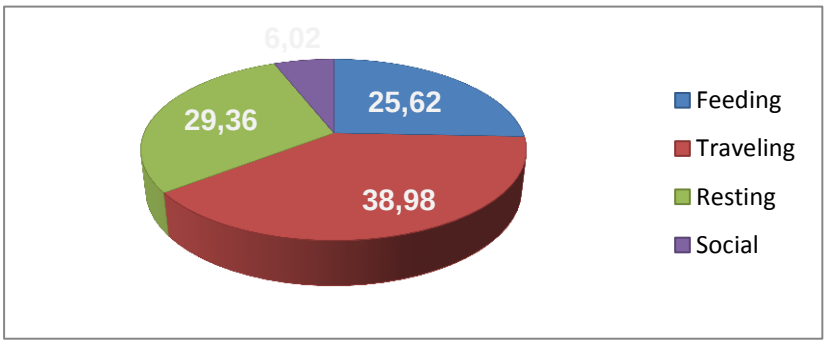
2.3 Data Analysis

All data recorded were analyzed descriptively by compared with some other behavioral research result.

3. RESULT AND DISCUSSION

3.1 Time Budget of Daily Activity

Total of 85 hours of the behavioral observation showed that the average of daily activity of released-pair of gibbon was 11 hour. The pair was started their activity at 6 o'clock. The time budget of each activity were feeding 25.6%, traveling 38.9%, resting 29.3%, and social activity 6.02% (Figure 3). Otherwise, between echi and septa showed the slightly different proportion of time budget. Whereas septa has higher frequency of feeding, traveling and resting than echi, but lower in social activity. (Figure 4).



Figur 3: Time budget of daily activity of the released-pair of gibbon

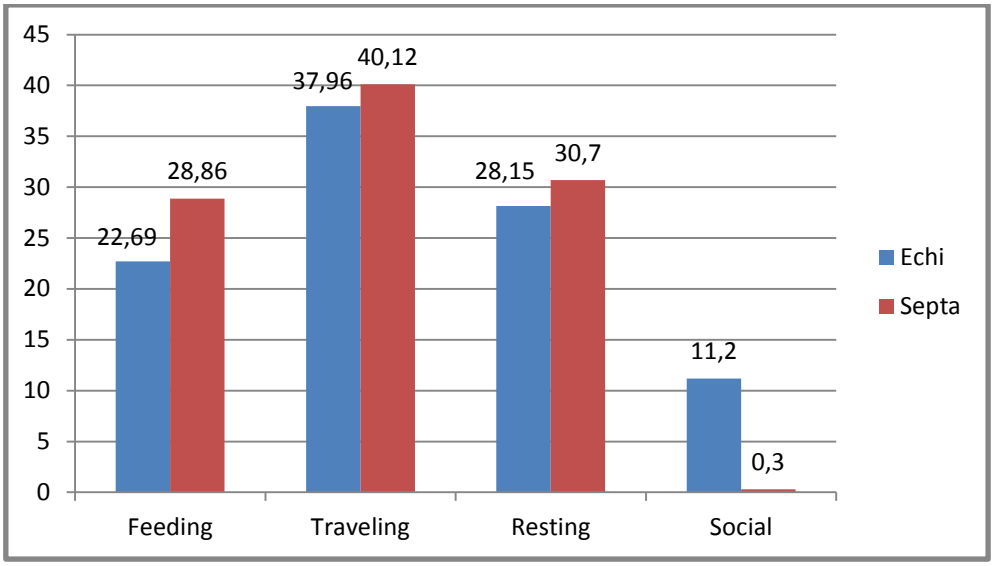


Figure 4: Different proportion of daily activity between echi and septa

A study conducted by Iskandar (2007) to a group of gibbon at rasamala (*Altingia excels*) forest block showed different result, i.e. feeding 41.2%, traveling 13.9%, resting 37.1%, social 1.9% and calling 5.9% (Iskandar, 2007), while another study showed that two groups in Gunung Halimun-Salak NP have 30.7% for feeding, 35.4% for traveling, 33.3% resting, 0.6% social and 0.31% calling (Ladjar, 1996), and 30.25% feeding, 24.11% traveling, 39.14% resting and 6.47% social activity (Prastyono, 1999).

3.2 Feeding Activity

The pair spent 25.6% of their total daily activity for feeding. This activity mostly started at 7.00 and the optimum time for feeding activity was occurred between 8.00 – 10.00 am (Figure 5). Septa has higher frequency of feeding activity (28.86%) than echi (22.69%). When conduct the activity, both of individuals Septa and echi mostly used the 3rd canopy strata (Figure 6).

During the observation period, we record 18 species of food sources were consumed by the gibbon, e.g. afrika (*Maesopsis emanii*), beunying (*Ficus fistulosa*), kondang (*Ficus variegate*), cangcaratan (*Nauclea orientalis*), rasamala (*Altingia excelsa*) and kisireum (*Syzygium rostratum*) (Table 1). The composition of food that consumed by the gibbon were leaf 7.95%, flower 0.28%, fruit 85.22% and insect 6.53% (Figure 7). Iskandar (2007) reported that the composition of food item consumed by the gibbon were leaf 48.52%, flower 43.15% and fruit 8.33% (Iskandar, 2007), while Ladjar (1996) showed that the composition of food item consumed by the gibbon at Cikaniki forest block, Gunung Halimun-Salak NP were fruit 85.45%, leaf 9.86%, epiphyte 2.86%, stand 1.5% and insect 0.43%.

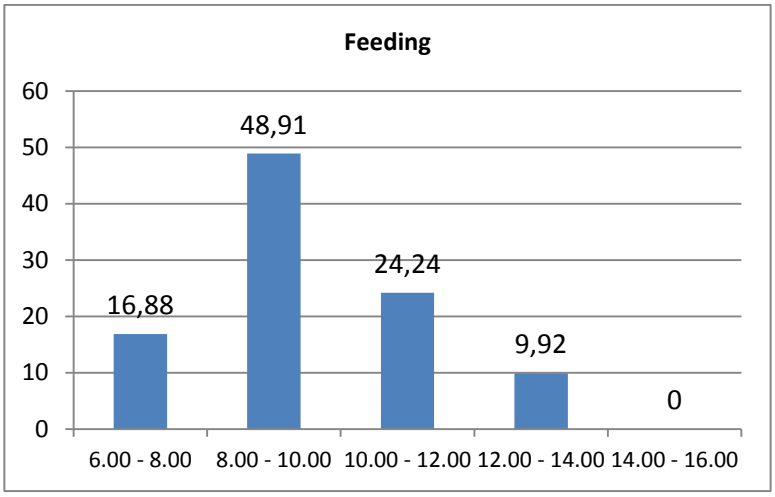


Figure 5: Time usage of daily feeding activity

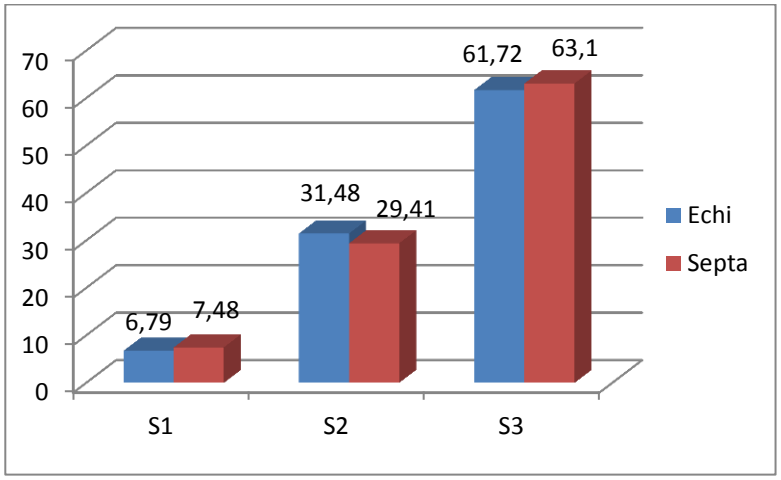


Figure 6: Frequency of canopy strata used by the gibbons during feeding activity

Table 1. Food plant species which consumed by the gibbon

No	Local Name	Scientific Name	Family
1	Afrika	*Maesopsis emanii*	*Rhamaceae*
2	Beunying	*Ficus fistulosa*	*Moraceae*
3	Cangcaratan	*Nauclea orientalis*	*Rubiceae*
4	Kihujan	*Engelhardia spicata*	*Junglandaceae*
5	Kisieur	*Antidesma tentradum*	*Euporbiaceae*
6	Kisampang	*Evodia sarmentosa*	*Rutaceae*
7	Kiseureum	*Syzygium rostratum*	*Myrtaceae*
8	Kondang	*Ficus variegate*	*Moraceae*
9	Kokosan monyet	*Dyxocylum aleaceum*	*Meliaceae*
10	Leungsir	*Pometia pinnata*	*Sapidaceae*
11	Manglid	*Magnolia blumei*	*Magnoliaceae*
12	Nangsi	*Villebrunea rubescens*	*Urticaceae*
13	Pasang		
14	Puspa	*Castanopsis argentea*	*Theaceae*
15	Rasamala	*Schima wallichii*	*Hammamelidaceae*
16	Saninten	*Altingia excelsa*	*Fagaceae*
17	Teurep	*Artocarpus elastic*	*Moraceae*
18	Walen	*Ficus ribes*	*Moraceae*

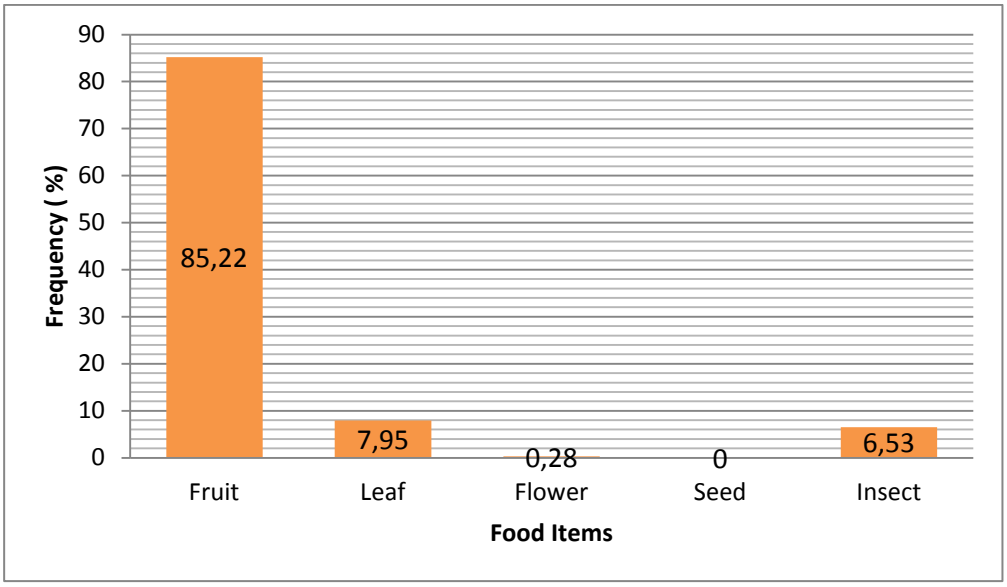


Figure 7: A part of Food items consumed by the gibbon

3.3 Traveling

The released-pair gibbon was spent 35.6% of total activity time budget for traveling. It was similar with a gibbon group at Cikaniki forest, Gunung Halimun-Salak NP, which spent of 35.6% of their time budget of daily activity (Ladjar, 1996). Both individual used 3rd strata when traveling (Figure 8). Most of the movement conducted by brachiating, and also bipedal and leaping.

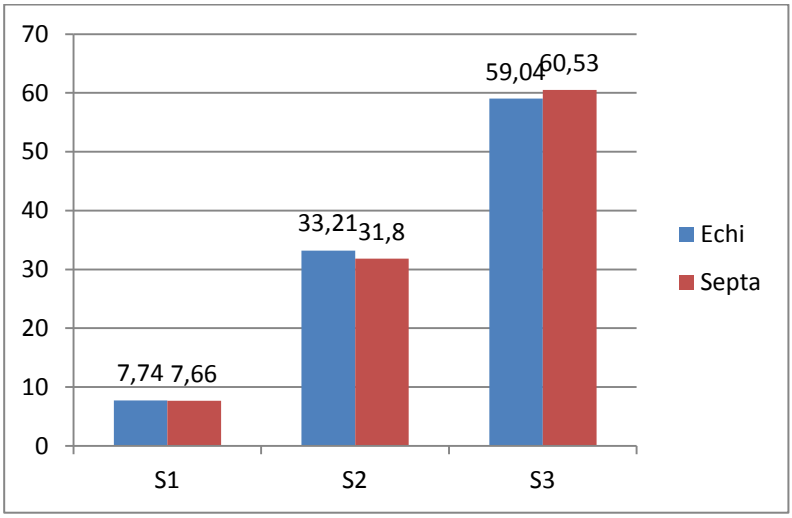


Figure 8: Percentage of canopy strata used by echi and septa

Base of mapping of group day range, showed that the average of day range was 1500 meter, with the shortest range was 1000 meter and the longest range was 1950 meter. Chivers (2001) reported that the average of day range length of each Hylobates group were varied, e.g. *H. lar* 1.5 km; *H. Agilis* 1.3 km, and *H. agilis* 0.9 km. The distance between the sleeping trees (Night position shift) was ± 55 meter. The home range of the released-pair gibbon at Patiwel forest was 5 hectares.

3.4 Resting

The observed gibbon used 29.36% of their total time budget for resting, while Iskandar (2007) noted that the gibbon in rasamala forst block spent 37.1% for resting and at Cikaniki forest block spent 33.3% their total daily time for resting. Kakati (2004) reported that in a hoolock group (*Hylobates hoolock*) which lived at tiny and fragmented habitat has spent 52% time proportion for resting. When resting, the group usually used 3rd canopy strata (Figure 9).

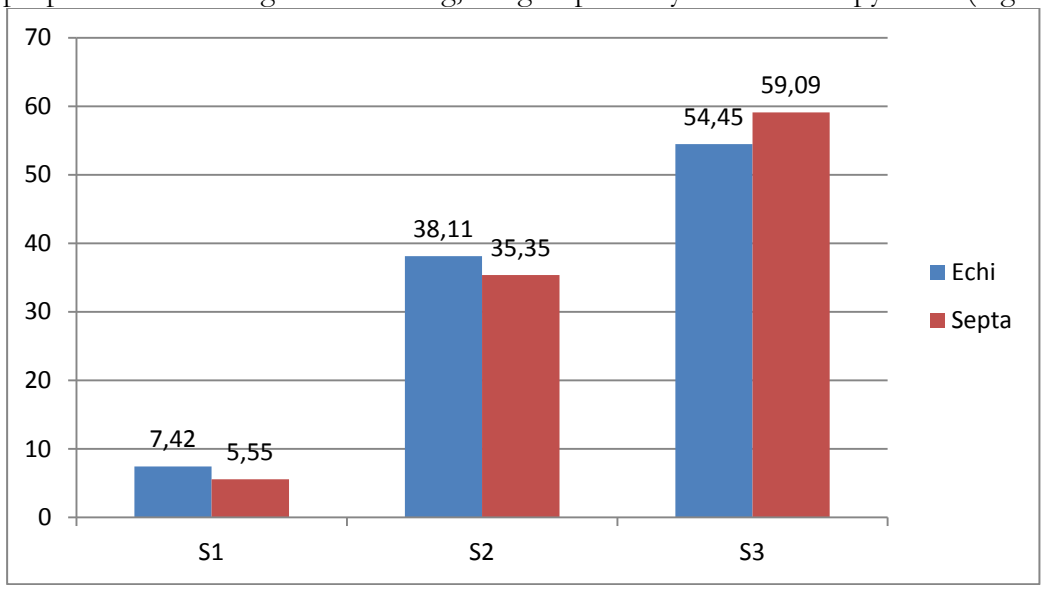


Figure 9: The percentage of canopy strata used by the gibbon when they resting

3.5 Social Activity

The released-gibbon pair spent only 6.02% of their total time budget for social activity. This time portion was lower if we compare with another primate species. The family group system (monogamous system) should be influence their social interaction between individuals, especially this group was a new couple that just paired since in rehabilitation period. It also showed by the group in rasamala forest block, which only spent 1.9% of total daily time budget (Iskandar, 2007). When conduct their social activity, the group usually used the 3rd canopy (Figure 10).

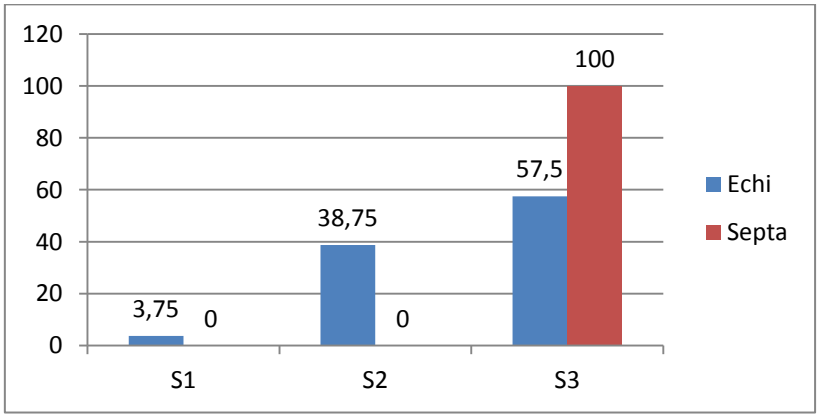


Figure 10: The percentage of canopy utilization by the gibbon

Some social activities that record during observation time were calling, playing, agonistic, grooming and mating. Calling was spent 70.7% of total social activity time, while agonistic spent of 25.25% (Figure 11). During observation time, only once grooming recorded. The agonistic behavior was shown by the adult female echi.

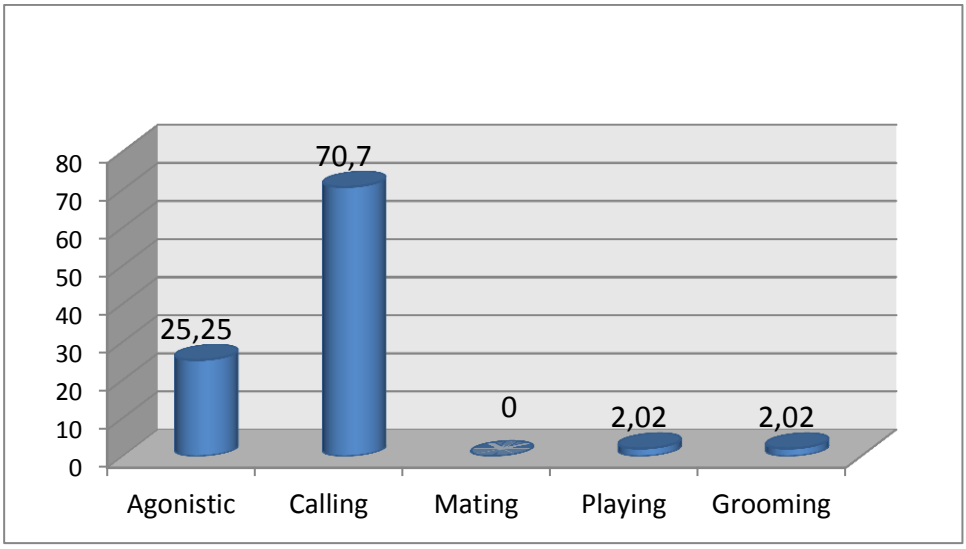


Figure 11: Percentage of social activity recorded during the observation

4. CONCLUSION

- Generally the pattern of daily activity of the released-gibbon pair was similar with wild gibbon groups. Both individual has a same proportion of time budget, even though the data showed slightly different each other.
- Almost in all activities, both individual used an upper canopy, except when social activity, whereas echi only used 57.5% at the upper canopy, and the rest at middle canopy.
- This study was very general and conducts in a short period. So we suggest conducting the long term study, with more detail aspect, both in ecology and behavior.

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