

Behavior Ecology of the Javan Green Peafowl (*Pavo muticus muticus* Linnaeus 1758) in Baluran and Alas Purwo National Park, East Java

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The javan green peafowl (*Pavo muticus muticus*) is an endangered bird species. They have big pressure to the population and the habitat. The fact that the birds are still exist on their local distribution. Behavior ecology of javan green peafowl is dealing with activities, mechanism and strategies of the birds in relation to their environment. The aimed of the study is to obtain data and information of ecological adaptation strategies through the behavior activities, mechanism and strategies of javan green peafowl in-relation to their habitat types. Ad libitum sampling method was used on continuous recording every peafowl activities in relation with duration, frequencies mechanism and strategy were influenced by habitat type's condition. Chi-square test was used for statistical analysis to know different behavior has influenced by habitat types. The result shown that the javan green peafowl habitat type has significant influenced on duration of the activities but not at the activities pattern. The walking during the feeding, select shading places or luxuriant trees close to feeding site, choosing tall trees or emergent trees close to open area as roost site, open area also road as display or dancing area, open area which grow shrubs as nesting site are javan green peafowl ecological behavior strategies. The mechanism and strategies of javan green peafowl behavior ecology are related to avoid from disturbance and to adapt their habitat type's conditions.

Key words: ecological behavior, strategy, javan green peafowl

INTRODUCTION

The javan green peafowl (*Pavo muticus muticus*) is a protected bird species in Indonesia and in the newest ICBP check-list has nominated as globally threatened (Collar & Andrew 1988). Former distribution of javan green peafowl was spread out from Malaysia to Java except Sumatra and Borneo were not present. But now, javan green peafowl at Malaysia was extinct, and only in Java the birds still present. The green peafowl distributed at several habitat types in Java such as; tropical low land forest, monsoon forest, savanna and teak forest. The range of green peafowl has become patchily and locally restricted (Hernowo 1995). Alas Purwo and Baluran national park are as distribution sites of the bird. Baluran national park have typically savanna and monsoon forest habitat, but Alas Purwo have habitat more varies like; low land tropical rain forest, grazing area, and teak plantation with intercropping.

Behavior ecology of javan green peafowl is dealing with activities, mechanism and strategy of the birds in relation to their environment. The high pressure to the

bird caused by declined population sharply. Problems to the peafowl are poaching (eggs, chicks, peacock, peahen, and their train feathers), and disturbed on their habitat. This ecological behavior studies dealing with strategy of the green peafowl to again disturbances both to the population and their habitat.

Although, pressure to java green peafowl population is high, but it is the fact that the birds still exist on their local distribution. This reason, it became hypothesis that birds have good strategy to adaptation from disturbance. Those field realities are interesting to be analyzed to get more information of ecological adaptation strategy on javan green peafowl through their behavior.

This study was aimed to obtain data and information on ecological adaptation strategy through the behavior activities, mechanism and strategy of javan green peafowl in-relation to their habitat types.

MATERIALS AND METHODS

Site of Study. Baluran national park (BNP) is located at the tip of Northeastern Java Island (7°29'10" - 7°55'55" latitude South and 114°29'10" - 114°39'10" longitude East), cover an area of about 25,000 ha. The national park is

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bordered by Madura Strait to the North and by the Bali Strait to East. At Southern West of the park was bordered with Bajulmati and Klokoran River. Baluran has a typical monsoon climate with a long dry season. This climate is heavily influenced by the southeast wind during the period of April to October, with less precipitation. The average dry period covers about 7-8 month of the year. The annual precipitation ranges from 900 to 1,600 mm per year. Due to the dry period being quite longer, water is most limiting factor in BNP. The local distribution of wild animal is influenced by availability of water. The vegetation types have developed in BNP Park, like Savanna grassland, beach forest, mangrove, deciduous forest or monsoon forest, evergreen forest, swampy area and sub mountain forest (Forestry Department 2008).

Alas Purwo national park (APNP) is cover an area of about 43,420 ha. The national park is located at tip of southeastern of Java island (8°26'45" - 8°47'00" latitude South and 114°20'16" - 114°36'00" longitude East). At Eastern of the national park was bordered with Bali Strait and in the South also West direction were boundaries by India Ocean. The annual precipitation ranges from 1,079 to 1,554 mm per year with 79-112 rainfall days. Five vegetations type have been developed in Alas Purwo national park such as beach forest, mangrove, low land tropical forest, bamboo forest and teak plantation. Besides those vegetation types, man made grazing area occur at Sadengan (Forestry Department 2008).

Research was conducted in Baluran and Alas Purwo national park, around 10 month from June to October 2006 and August to December 2007. The study focused at the local distribution of javan green peafowl in Baluran national park at Bekol resort (savanna, beach forest, and monsoon forest) and in Alas Purwo national park at Rowobendo resort (Sadengan grazing area, intercropping area, and teak plantation).

The sample area for observation on behavior ecology of javan green peafowl in BNP, were focused at three main type of habitat such as savanna, beach forest and monsoon forest. Meanwhile, in APNP, sample area was focused at five places such as Sadengan grazing area, Rowobendo intercropping area, Guntungan intercropping area, Sumbergedang teak plantation forest, and Ngagelan teak plantation forest.

Sampling and Data Analysis. Purposive sampling was used to record the behavior with number observation varies between 30 to 120 times (N = 30 to 120) at feeding site, water hole, roosting site, sheltering and resting site,

dusting site, and display area to know the activities, mechanism and strategy of behavior of the bird in relation to the habitat type. Main parameters to be study on ecological behavior are peafowl activities, duration and frequencies in relation to the habitat types. *Ad libitum sampling* method was used on continuous recording every peafowl activities in relation with duration, frequencies mechanism and strategies was influenced by habitat types.

The activities duration of the javan green peafowl counted by

$$P = X \pm \frac{SE}{\sqrt{Sx^2}}$$

$$SE = \frac{\sum x^2 - (\sum x)^2/n}{n - 1}$$

P = Average duration activities, X = Duration activities, SE = standart error, Sx^2 = variance duration of the activities, T = table t - student, $\alpha = 0.01$, $\alpha = 0.05$.

Each main behavior in relation to habitat type were analyzed by χ^2

Test criteria

$$\chi^2_{\text{calculation}} > \chi^2_{\text{table}} \rightarrow \text{refuge Ho}$$

$$\chi^2_{\text{calculation}} < \chi^2_{\text{table}} \rightarrow \text{excepted Ho}$$

Refuge Ho = except H1, it mean the habitat types have influence to the behavior, but if except Ho, habitat types do not impact to the behavior.

Several types of javan green peafowl calling were recorded used tape recorder. Raven Lite (Spectrogram and Wavegram) programs to analysis the call and described and interpret in-relation to the green peafowl activities.

RESULTS

Feeding Behavior. Feeding behavior is activities which are done by the peafowl beginning with pick up food by their bill and enter to their mouth. Feeding site for green peafowl is open areas which are growth by shrubs and grasses. Grasses were preferred by the javan green peafowl such as *Brachiaria mutica*, *Eleusine indica*, *Paspalum conjugatum*, *Cyperus rotundus*, and *Panicum stignicum*. In APNP, there are two concentration places for feeding site such as Sadengan grazing area and intercropping area at teak plantation. But for BNP, the birds feed at savanna and open area at beach forest, monsoon forest and evergreen forest.

Table 1. Feeding duration of javan green peafowl at several types of habitat in Alas Purwo national park (APNP) and Baluran national park (BNP) in 2006 and 2007

Location	Average duration (second)		Variance (second) ²		Duration min (second)		Duration max (second)	
	2006	2007	2006	2007	2006	2007	2006	2007
APNP								
Sadengan grazing area	31995	32525	122991	93578	31864	32411	32126	32639
Intercropping area	32931	33015	145543	284508	32789	32816	33073	33214
Teak plantation	18430	19392	361352	293541	18206	19190	18654	19594
BNP								
Savanna	28535	29460	608474	625759	28244	29165	28825	29755
Beach forest	14580	15450	409069	392759	14342	15216	14818	15684
Monsoon forest	21465	21750	475371	223276	21208	21574	21722	21926
Evergreen	15620	16350	740103	514310	15299	16083	15941	16617

Observing on feeding activities of the javan green peafowl no less than 120 times ($n = 120$). The feeding activities and mechanism of the bird are influenced by kind of food. If the bird feed of grasses (leaf), or fruit which are fallen at the ground, they direct pick up it by their bill, then it is swallow. If the peafowl feed on flower or seed of grasses where position more higher than the birds,

they will jump and pick up it by their bill. Search food like grasshopper, the birds running around or run while jump to get it. Usually if feeding fruit on the tree, peafowl direct flying to the tree and choosing ripe fruit.

In general the green peafowl in APNP and BNP have two main times for feeding are morning feeding and afternoon feeding. The morning feeding begins at early morning approximately 5.30 until 9.30 AM and afternoon feeding at 13.30 PM and lasted at around 17.30 PM in 2006, but in 2007, it started earlier 5.00-9.30 AM and second feeding at 13.55-17.40 PM. The feeding mechanism is begin after the peafowl come down from roosting site, and the birds walk direct to feeding site. After 3 to 4 hours they morning feeding, the peafowl forward to shelter site to get rest, and they will done afternoon feeding around 4 to 5 hours.

Table 2. Number of sucking and duration of drinking water of the javan green peafowl at water hole Alas Purwo national park (APNP) and Baluran national park (BNP) in 2006 and 2007

Drinking activities	APNP 2006	APNP 2007	BNP 2006	BNP 2007
Number of sucking water	7-42	11-47	13-132	16-120
Duration (minute)	1 - 8	2 - 9	2 - 18	2 - 8

Table 3. Sheltering and resting duration of the javan green peafowl at several types of habitat in Alas Purwo national park (APNP) and Baluran national park (BNP) in 2006 and 2007

Location	Average duration (second)		Variance (second) ²		Duration min (second)		Duration max (second)	
	2006	2007	2006	2007	2006	2007	2006	2007
APNP								
Sadengan grazing area	14575	14565	115475	107784	14448	14443	14702	14687
Intercropping area	14115	13940	203647	209379	13947	13769	14283	14111
Teak plantation	14030	13995	99759	157474	13912	13847	14148	14143
BNP								
Savanna	16115	15785	351922	213474	15894	15613	16336	15957
Beach forest	13620	13925	389414	183578	13387	13765	13853	14085
Monsoon forest	13800	13765	249482	199509	13614	13599	13986	13931
Evergreen	13900	13815	282931	219853	13702	13640	14098	13990

Table 4. Trees that are used for sheltering and resting by the green peafowl in Alas Purwo national park (APNP) and Baluran national park (BNP) in 2006 and 2007

Trees	Local name	Frequency		Document
		2006	2007	
APNP				
<i>Ficus infectoria</i>	Apak	7	9	At tress
<i>Dalbelgia latifolia</i>	Sonokeling	7	17	Under trees
<i>Vitex pubescens</i>	Laban	4	3	Under trees
<i>Lagerstroemia speciosa</i>	Ketangi	9	28	At tress
<i>Strepblus asper</i>	Serut	4	4	At tress
<i>Schoutenia ovata</i>	Walikukun	4	30	Under and at tress
<i>Nuclea siamea</i>	Gempol	3	3	At trees
<i>Swietenia macrophylla</i>	Mahoni	5	8	At trees
<i>Tectona grandis</i>	Jati	8	6	At trees
<i>Eupatorium</i>				
BNP				
<i>Zyzyphus rotundifolius</i>	Widoro bukol	15	30	Under trees
<i>Azadirachta indica</i>	Mimba	5	7	Under and at trees
<i>Tamarindus indica</i>	Asem	3	1	Under trees
<i>Strepblus asper</i>	Serut	3	2	Under trees
<i>Ficus superbus</i>	Krasak	2	2	Under trees
<i>Acacia leucophloea</i>	Pilang	8	7	Under trees
<i>Schleichera oleosa</i>	Kesambi	6	8	Under trees
<i>Morinda ticntoria</i>	Mengkudu hutan	8	12	At tress

Table 5. Covering duration of the javan green peafowl at several habitat types in Alas Purwo national park (APNP) and Baluran national park (BNP) in 2006 and 2007

Location	Average duration (second)		Variance (second) ²		Duration min (second)		Duration max (second)	
	2006	2007	2006	2007	2006	2007	2006	2007
APNP								
Sadengan grazing area	2450	2180	59483	55103	2359	2093	2541	2267
Intercropping area	1610	1410	26621	41448	1549	1334	1671	1486
Teak plantation Ngagelan	1370	1345	25966	24026	1310	1287	1430	1403
BNP								
Savanna	3240	2890	71448	84379	3140	2782	3340	2998
Beach forest	2160	2290	39552	26966	2086	2242	2234	2351
Monsoon forest	2905	2245	98164	16784	2788	2197	3022	2293
Evergreen	1390	1565	61621	19336	1298	1513	1483	1617

The green peafowl feeding while walking is behavior of foraging strategy. The peahen leader leads bare of feeding. The leader walk in front of members of the groups. Several reasons for the activities done by walk of the birds (i) the birds' get more quantity and quality of food (ii) prevent from predator attack (iii) close to sheltering site or drinking site or roosting site. If feeding site became hot; the birds walk forward to sheltering site, or if afternoon feeding they walk forward to roosting site.

The behavior during exploring food at open area, usually the peafowl stop feeding for a moment with erected their neck and turn left and right of their head, see and inspect surrounding from disturbance, and then continuous the feeding activities. Those activities are also mechanism and strategy of feeding behavior for green peafowl on prevent from predator attack.

The average duration feeding activities has different at each habitat types in APNP or BNP. The longest feeding activities in APNP is at intercropping teak plantation habitat types in 2006 and 2007. Meanwhile in BNP, the green peafowl more span time for feeding activities at savanna habitat.

Based on chi-square test the result showed that the duration feeding activities of the javan green peafowl has significantly influenced by habitat type in APNP and BNP year 2006 and 2007, APNP year 2006 ($\chi^2 = 4740.68$, $P < 0.01$), and year 2007 ($\chi^2 = 4218.69$, $P < 0.01$), or BNP year 2006 ($\chi^2 = 6161.76$, $P < 0.01$) and year 2007 ($\chi^2 = 5990.32$, $P < 0.01$).

Drinking Behavior. Drinking behavior is activities in order to get water. Observation on drinking activities of the javan green peafowl no less than 120 times ($n = 120$). The green peafowl drinking activities is started from stand up the body, and then the head come down to the water and the bill implanted, and then sucking water in few second. After that, the head stand up and the neck shaped

form S letter and water is gulped, and stop for moment to watch and inspect surrounding, then continued drinking activities and it is repeated several times if they are secure. These activities are mechanism of drinking behavior of javan green peafowl.

In general, drinking activities will be held by the green peafowl in the morning or afternoon. Morning drink is around 06.00-11.00 AM, and afternoon drink 13.00-17.00 PM. The higherst frequencies of drinking activities in APNP year 2006 was afternoon drink 14.00-15.00 PM, but in 2007 was morning drink 07.00-08.00 AM. Meanwhile the higherst frequencies of drinking activities in BNP year 2006 was morning drink 5.00-6.00 PM, but in 2007 was afternoon drink 14.00-15.00 PM.

The drinking durations or number of suck water varied depend on individual of green peafowl and season (Table 2).

The green peafowl will drink at places where water are available. During dry season water available at certain places, in BNP water available at Bekol water hole and waterhole surrounding Bama beach. In APNP water available at Sadengan grazing area and breachis water present at the back of mangrove close to Gunting and Gedangan teak plantation area.

Drinking mechanism can be done by individual or group of the green peafowl. If drinking group, usually the peahen leader lead on direction to water hole which will be choosen. The leader will walk in front of members groups toward drinking site.

Chi-square test for duration of drinking activities of the green peafowl at several habitat types in APNP and BNP year 2006 and 2007 showed that duration of drinking in APNP year 2006 ($\chi^2 = 8.97$, $P < 0.05$), and year 2007 ($\chi^2 = 47.00$, $P < 0.01$) and in BNP year 2006 ($\chi^2 = 57.55$, $P < 0.01$), and year 2007 ($\chi^2 = 62.77$, $P < 0.01$) were influenced significantly by habitat types at both national park.

Table 6. Display duration of javan green peafowl at several habitat types in Alas Purwo national park (APNP) and Baluran national park (BNP) in 2006 and 2007

Location	Average duration (second)		Variance (second) ²		Duration min (second)		Duration max (second)	
	2006	2007	2006	2007	2006	2007	2006	2007
APNP								
Sadengan grazing area	5205	5565	30233	59336	5140	5474	5270	5656
Intercropping area	4985	5120	36750	32517	4914	5043	5056	5197
Teak plantation	3695	3500	104371	87069	3575	3390	3815	3610
BNP								
Savanna	5475	5350	60991	46207	5383	5270	5567	5430
Beach forest	3875	3695	60991	104371	3783	3575	3967	3815
Monsoon forest	4770	4685	28034	99681	4708	4567	4832	4803
Evergreen	3610	3745	66621	153681	3524	3599	3706	3891

Table 7. Roosting duration of the javan green peafowl at several habitat types of in Alas Purwo national park (APNP) and Baluran national park (BNP) in 2006 and 2007

Location	Average duration (second)		Variance (second) ²		Duration min (second)		Duration max (second)	
	2006	2007	2006	2007	2006	2007	2006	2007
APNP								
Sadengan grazing area	42790	42030	905759	884931	42435	41679	43145	42380
Intercropping area	42010	41445	972655	760820	41643	41119	42378	41770
Teak plantation	41860	40820	863000	748552	41513	40498	42206	41142
BNP								
Savanna	42810	42665	495069	237784	42548	42483	43072	42847
Beach forest	41535	41935	709853	626405	41221	41640	41849	42230
Monsoon forest	41760	41860	749624	863000	41437	41514	42083	42206
Evergreen	42020	41895	1006483	894193	41646	41543	42394	42247

Tabel 8. Fight duration of javan green peafowl at several habitat types in Alas Purwo national park (APNP) and Baluran national park (BNP) in 2006 and 2007

Location	Average duration (second)		Variance (second) ²		Duration min (second)		Duration max (second)	
	2006	2007	2006	2007	2006	2007	2006	2007
APNP								
Sadengan grazing area	615	620	21233	20103	561	567	669	673
Intercropping area	815	725	22655	13952	759	681	871	769
Teak plantation Ngagelan	0	0	0	0	0	0	0	0
BNP								
Savanna	1100	1055	20690	19267	1046	1003	1154	1107
Beach forest	0	0	0	0	0	0	0	0
Monsoon forest	950	945	17046	11235	901	906	999	985
Evergreen	0	0	0	0	0	0	0	0

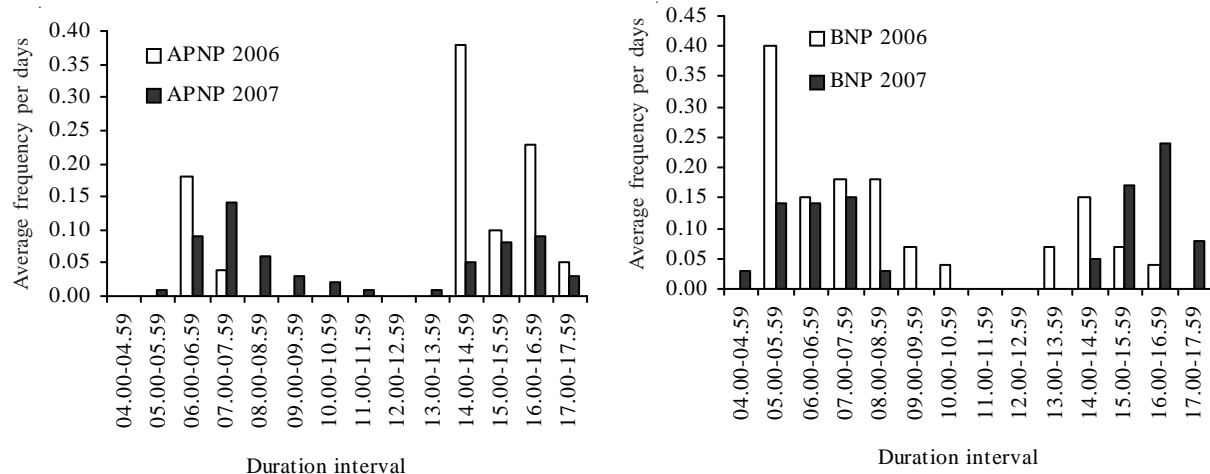


Figure 1. The drinking frequency of javan green peafowl in Alas Purwo national park (APNP) and Baluran national park (BNP) 2006 and 2007.

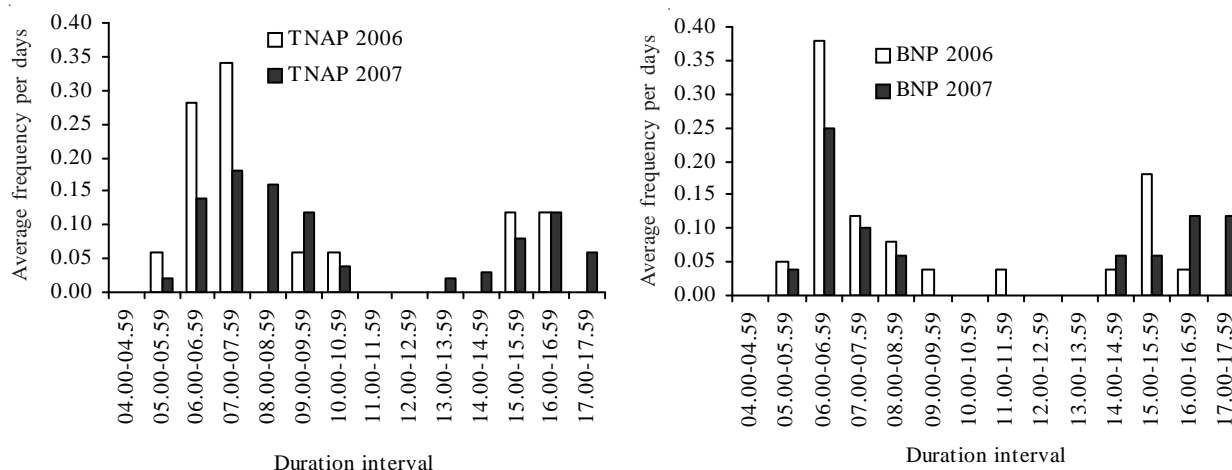


Figure 2. Covering frequencies of the javan green peafowl in Alas Purwo national park (APNP) and Baluran national park (BNP) 2006 and 2007.

Sheltering and Resting Behavior. Sheltering and resting behavior done by the green peafowl to avoid from over exposed sun light during day time. Observing on sheltering and resting activities of the javan green peafowl around 60 times ($n = 60$). These activities are done by the birds after the bird morning feeding or drinking before they afternoon feeding. Several manners the birds sheltering and resting. The birds will sheltered under luxuriant trees, where the trees closed to feeding area or the birds perch in the trees. On the other way, peafowl will shelter under shrub. Strategy for sheltering and resting,

the green peafowl will select places which are comfort, close to feeding area and save from any disturbance. Those behavior activities are mechanism of sheltering and resting of the birds.

The javan green peafowl in APNP will start sheltering and resting, if the feeding site getting hot (the temperature more than 28 °C), the birds started sheltered and rest 10.00 AM-14.00 PM in APNP; meanwhile in BNP green peafowl started sheltered and rest 9.00 AM-14.30 PM, in 2006 and 2007.

The mechanism of sheltering and resting of the green peafowl, if they sheltering at tree, the peafowl walk to close the tree and direct fly to branch and select the branch which comfort for sheltering and resting. They stand up at the branch for a moment, after the birds secure they lay at the branch. If the peafowl sheltered bellow luxuriant tree, the birds walk forward under the tree and stand up there or they will lay up the body at the ground. The height of sheltered and rest at the trees varies 4-9 m. During the peafowl sheltering or resting, they are also preening.

Trees used for sheltering and resting in APNP and BNP in 2006 and 2007 are presented at Table 4. The trees are preffered as sheltered and rested in APNP such as *Ficus infectoria*, *Lagerstroemia speciosa*, *Schoutenia ovata*, *Dalbergia latifolia*, *Swietenia macrophylla*, and *Tectona grandis*. But in BNP the trees are such as *Zyzyphus rotundifolia*, *Azadirachta indica*, *Acacia leucophloea*, *Schleichera oleosa*, and *Morinda tomentosa*.

Besides the green peafowl sheltered and rested under or at trees, they are also used shrubs area as sheltering and resting site. The shrubs were used by the birds such

as *Eupatorium odoratum*, *Lantana camara*, and *Melastoma malabatricum*.

Chi-square test for the duration of sheltering and resting activities of the green peafowl in 2006 and 2007, showed that duration of the bird in APNP and BNP have significantly influenced by habitat types at both national park (APNP in 2006 ($\chi^2 = 12.08$, $P < 0.01$), and in 2007 ($\chi^2 = 16.91$, $P < 0.01$) and in BNP in 2006 ($\chi^2 = 289.22$, $P < 0.01$), and in 2007 ($\chi^2 = 200.05$, $P < 0.01$).

Covering Behavior. Covering behavior is behavior done by javan green peafowl related to disturbance from many factors e.g from predators and human. Observation on covering activities of the birds approximately 60 times ($n = 60$). The mechanism of covering behavior with principle the birds will get away from disturbance by fast walking, running, or flying. If the peafowl flying they will calls “kokokokoko.....”. They got away, fly to the tree or came bushes far from disturbances. If the birds still suspect from human disturbance and informed to the others they will call tk.tk tk kroow, tk.tk tk kroow, tk.tk tk kroow, The call will repeat many times until the peafowl feel secure. The position of the birds will stand up while suspect with situation in the surrounding.

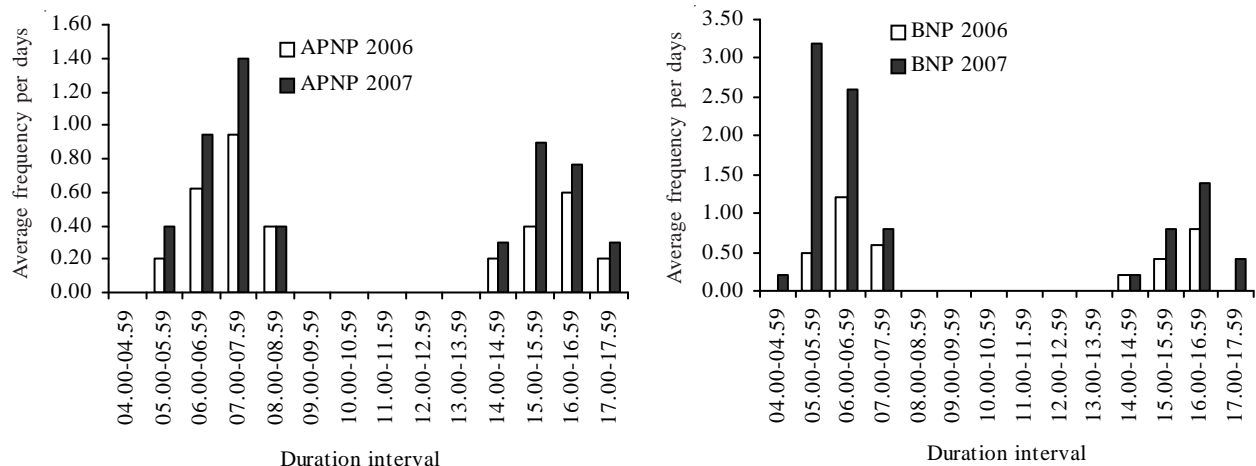


Figure 3. The display frequencies of the javan green peafowl in Alas Purwo national park (APNP) and Baluran national park (BNP) 2006 and 2007.

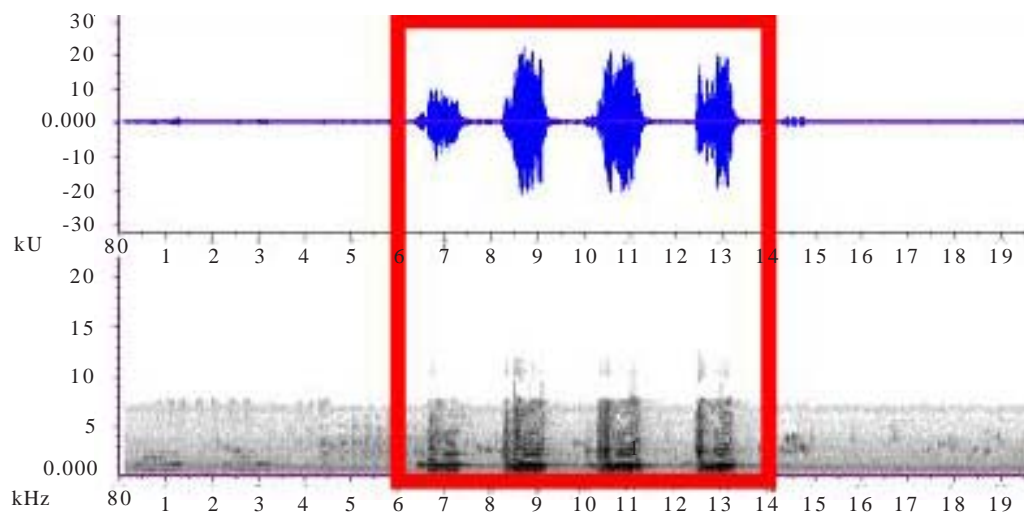


Figure 4. Sound analysis of “auwo” call by wavegram and spectrogram.

During the birds covering or hiding, they always in suspect condition. The birds stand at branch or shrubs and bushes and they will inspect the surrounding. If the birds feel un-secure from disturbance they will continuously call and move to other places.

Sources of disturbance came from several kind such as human, predator and others. In APNP the disturbance are visitors, intercropper, raptors white-bellied sea-eagle (*Haliaeetus leucogaster*), crested serpent-eagle (*Spilornis cheela*), changeable hawk-eagle (*Spizaetus cirrhatus*), and feral dog. Meanwhile in BNP the disturbance are visitors, red dog (*Cuon alpinus*), changeable hawk-eagle, crested serpent-eagle, long tailed macaque (*Macaca fascicularis*), javan mongoose (*Herpestes javanica*), leopard cat (*Felis bengalensis*), civet (*Viverra malacensis*, *Paradoxurus hermaprodithus*), and common monitor (*Varanus salvator*). During the observation do not found the green peafowl dead by any disturbance in APNP, but 3 individual dead by predator in BNP.

Covering places are used by the green peafowl such as trees which have dense crown, or shrubs with dense condition. Choosing on trees or shrubs which give security from the disturbances is strategy to avoid from disturber or predator. Many covering activities held at morning at APNP from 05.00-11.00 AM and afternoon 13.00-17.00 in 2006 and 2007, also same phenomenon at BNP. The highest frequencies of disturbance is happen at morning 06.00-08.00 AM.

The strategy of covering is select places which give secure from disturbances, by fast walk, running or flying. The main strategy from disturbance is avoid or away from disturbance.

Chi-square test shown that duration of covering activities of the javan green peafowl at several habitat types in APNP and BNP, 2006 and 2007 has significantly influenced by habitat types in both the national park ($\chi^2 = 355.36$, $P < 0.01$), ($\chi^2 = 262.28$, $P < 0.01$) and ($\chi^2 = 840.05$, $P < 0.01$), ($\chi^2 = 391.74$, $P < 0.01$).

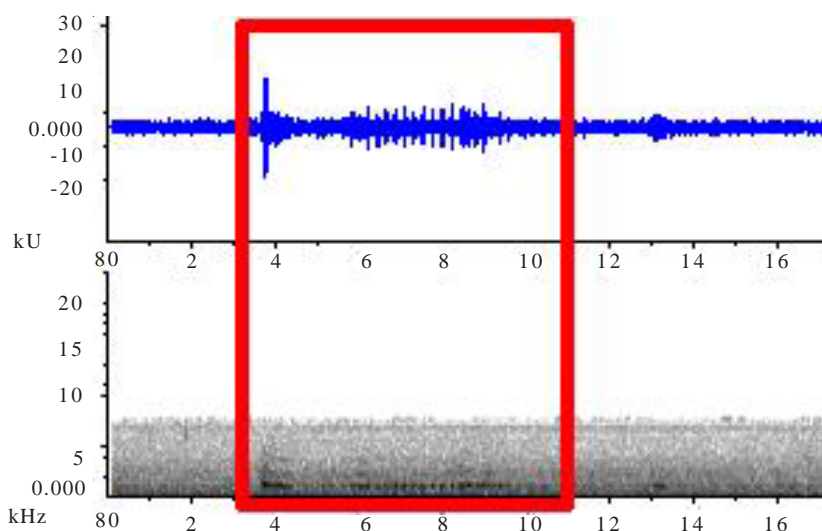


Figure 5. Sound analysis of "kokoko" call by wavegram and spectrogram.

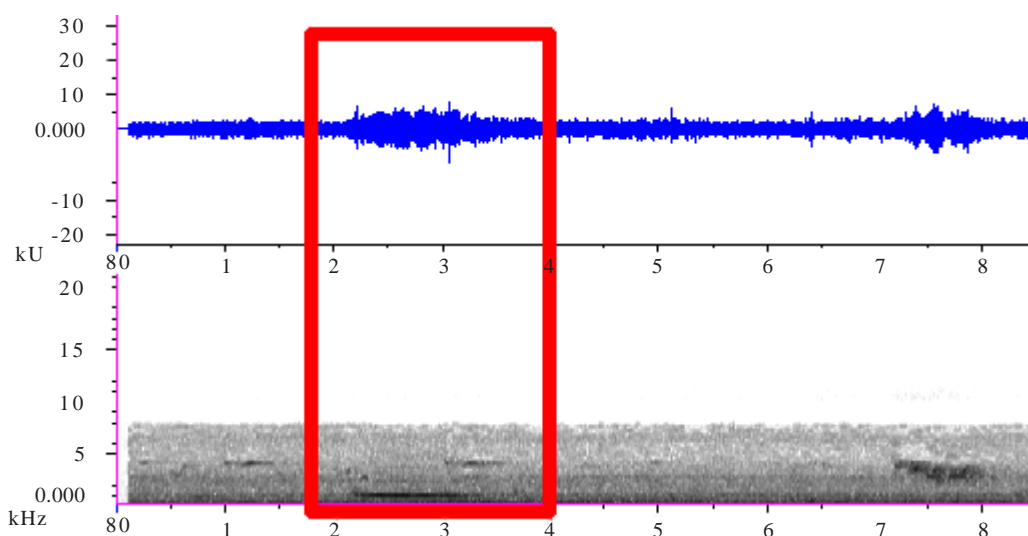


Figure 6. Sound analysis of "kroooooow" call by wavegram and spectrogram.

Display Behavior. Display activities are done by peacock to attract peahen. Usually, dance activities held by peacock at open area. The sub adult male birds also did, but different purpose more to learn dance. Observing on display activities of the javan green peafowl around 30 times ($n = 30$). The mechanism of display behavior is if the female birds come closed to male, after that the peacock with complete train feather will open the feathers frontally. The whole trains is lifted up and spread, supported by tail feather, it form a huge fan, metallic green and purple, the

ocelli with blue 'eye' and fringed with green. The wings are dropped and sometimes the peacock walking close to peahen.

If the peahen is close in front of the peacock the train feathers will be vibrated in few minute and it will be repeated several times. The vibrating train feather will heard like rattle sound such as ...ssseerrr, ...ssseerrr, ...ssseerrr.... If the female give attention to the dance while watch the peacock, they will circling the peacock many times to get signal agreed or disagree to mating. To

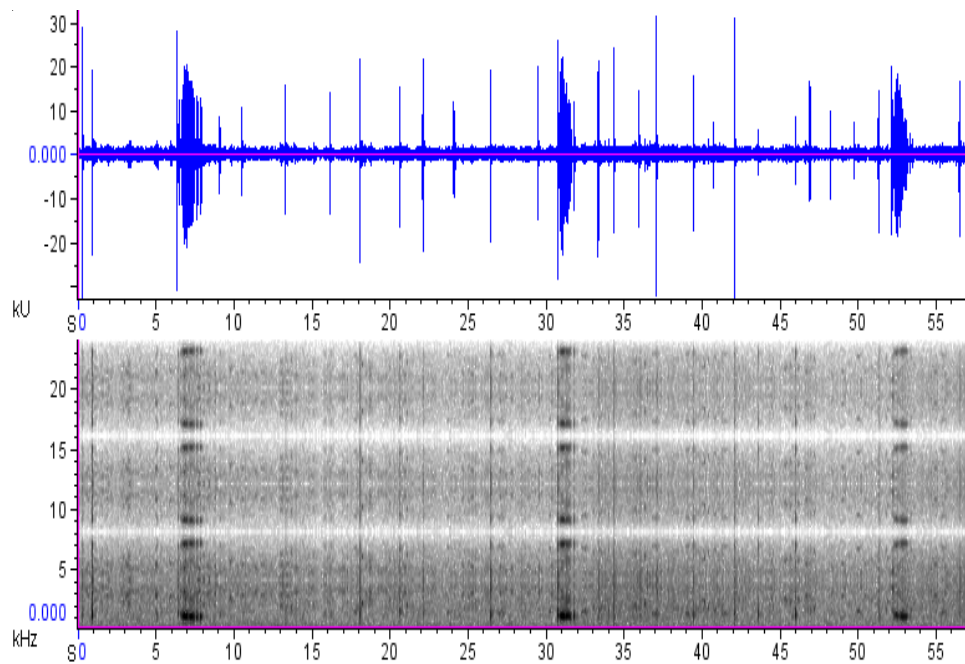


Figure 7. Sound analysis of "tek,tek,tek kroooooow, kokoko" call by wavegram and spectrogram.

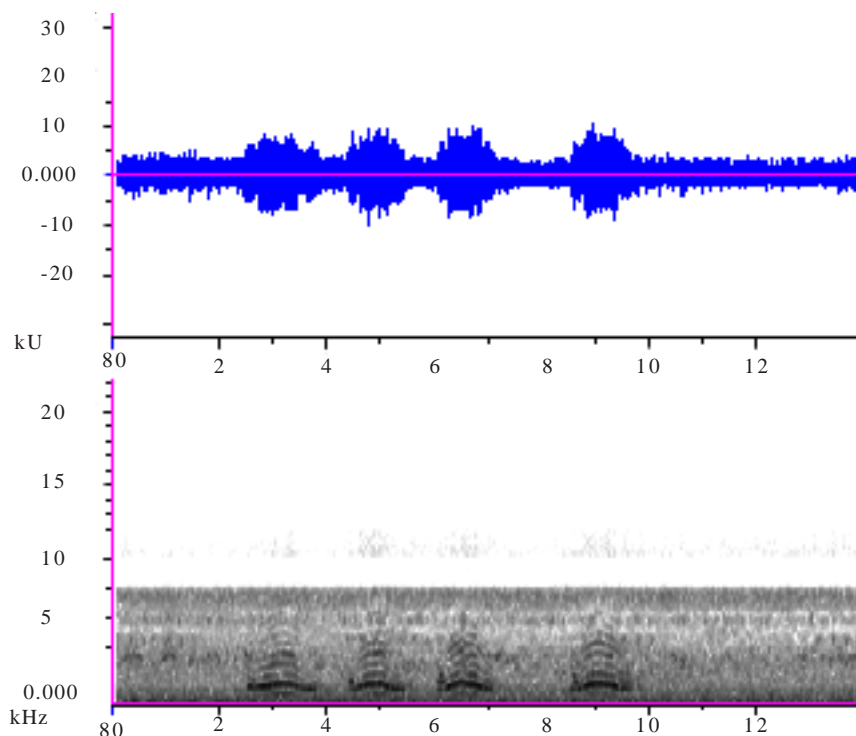


Figure 8. Sound analysis of "eewoooooo" or "eewaaaaooo" call by Wavegram and spectrogram.

attract the female, sometimes the peacock suddenly turn back the body and show the back of tail to peahen while stolen gland to female, afterward return back again and face to face with the female and vibrating the huge train feather until the fan feather such as bowing.

If agreed the female crouch the body and male raid on back body of female and make copulation. If the peahens have not attracted to dance of the peacock, the female birds will continued the activities like feeding, drinking or move to other places and the male bird will stopped dance.

Display held in the morning 06.00-09.00 AM and afternoon 14.00-18.00 PM in 2006 and 2007 in both national park (APNP and BNP). The highers frequency for display in the morning 07.00-09.00 AM in APNP, but 05.00-07.00 AM in BNP and afternoon 15.00-16.00 at both national park.

Display is held at open area, it is behavior strategy of green peafoyl. Open area is easily to find the peacock, to get more space for dance, the female can catch bright color of the train feather and easily to detect disturbance.

Chi-square test shown that duration of display activities has significantly influenced by habitat types in APNP and BNP year 2006 and 2007 ($\chi^2 = 287.55$, $P < 0.01$), ($\chi^2 = 499.59$, $P < 0.01$) and ($\chi^2 = 493.63$, $P < 0.01$), ($\chi^2 = 436.35$, $P < 0.01$).

Roosting Behavior. Roosting behavior is behavior started by activities of the green peafoyl on selected trees for the roost. Observing on roosting activities of the javan green peafoyl around 90 times ($n = 90$) at late afternoon approximately 18.00 PM, the green peafoyl walk to roost tree. After they found roost trees the birds will fly directly to the roost trees or gradually fly to trees, below the roost

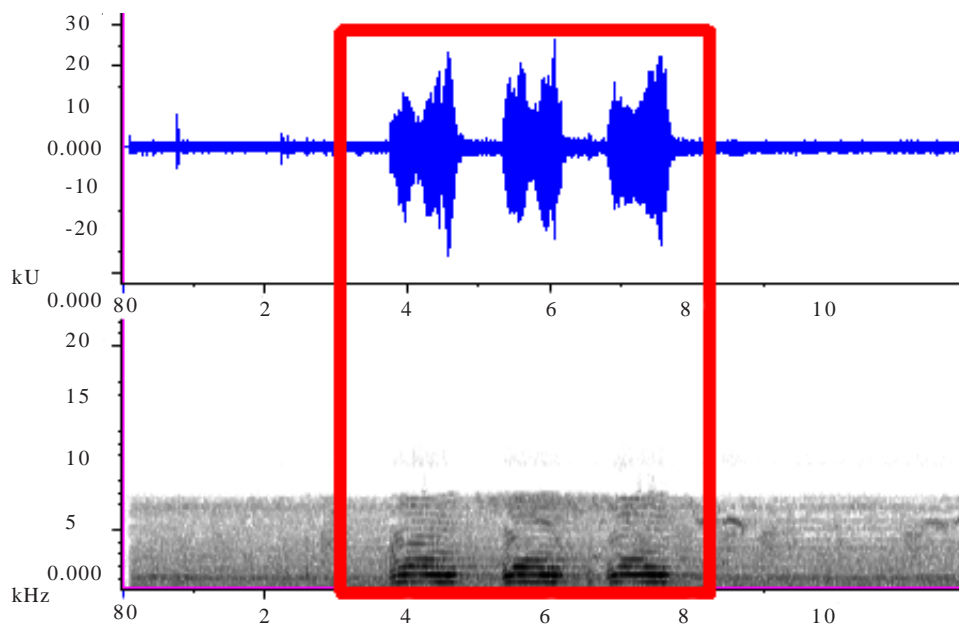


Figure 9. Sound analysis of "ngeeeeyooo" call by wavegram and spectrogram.

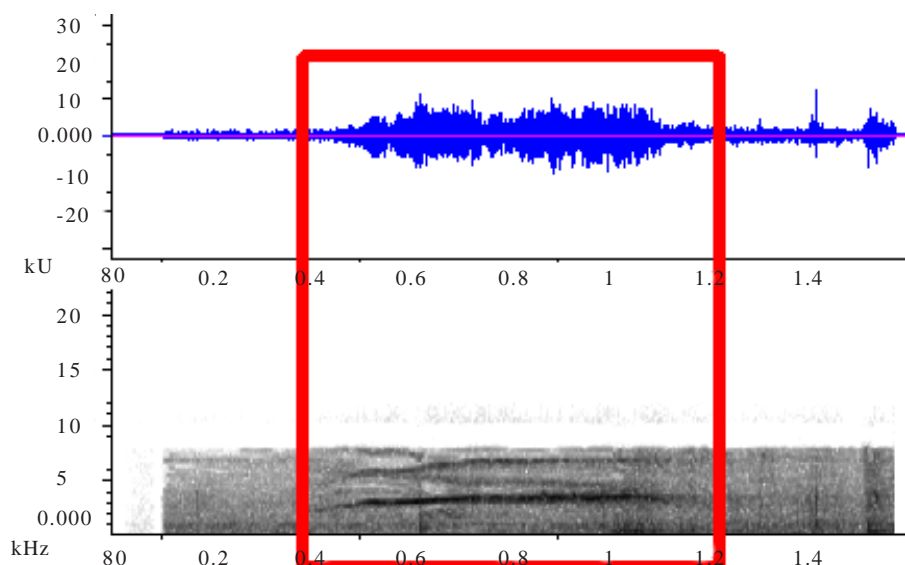


Figure 10. Sound analysis of "sheeiiks" call by wavegram and spectrogram.

tree and lasted to the roost tree. The green peafowl will choose certain tree for roost. Characteristic roost trees are (i) Tall trees or emergent trees (high more 10 m) (ii) Not so dense leave (iii) the braching system up right angle to the stem (iv) Besides the trees, present open are close to the roost tree.

The roost trees have been used in APNP such as *Bombax valetoni*, *Ficus inspectoria*, *Vitex pubescens*, *Ficus elastica*, *Nuclaea siamea*, *Swietenia macrophylla*, *Tectona grandis*, and in BNP, *Acacia leucophloea*, *Azadirachta indica*, *Tamarindus indica*, and *Corypha utan*.

Base on result of chi-square test for duration of roosting activities of the javan green peafowl at several habitat types in APNP and BNP year 2006 and 2007 shown that habitat types has significantly influenced the duration ($\chi^2 = 11.81$, $P < 0.01$), ($\chi^2 = 17.68$, $P < 0.01$) and ($\chi^2 = 22.04$, $P < 0.01$), ($\chi^2 = 10.59$, $P < 0.05$).

The strategy of roosting behavior is at trees and select the tall/emergent tree, to get secure from predator or any disturbance. The green peafowl select on rather tip of branch which will be use for roost strategy to avoid predator attack.

Calling Behavior. The call of javan green peafowl is behavior as tool sign for communication to each other. This behavior expressed by the birds through their sound from throat or mouth. The calling activities will do by the neck and head right up or straight, the body and tail position rather come down. The birds can quite or they while move, event flying. Seven types call of the green peafowl were registered during the observation. In general calling activities will increase during breeding season.

Type I: "auwo". The *auwo* call is the commonest call at communication system in the javan green peafowl population. The *auwo* call have three variation, they sounded of *auwo* 1 times, *auwo* 2 times, or *auwo* 3 times. This calling can be done by males or females bird. These frequent were recorded in BNP and APNP.

Type II: "kokoko.....". The call type II: "kokoko....." is expressed by the green peafowl while flying. This call is sounded because the birds have disturbances and starlet. This type of call will do every where and every time if the green peafowl feel starlet. The call is frequent heart at morning and afternoon both in APNP and BNP. The duration of the call is less than 20 second. Two variation of this calls are "*kroooooow.....kokokoko.*" and "*auwo...kokokoko....*". The first variation will be called if the bird startled and inform to the other there any disturbance. Call of "*auwo...kokokoko.*". The sound of "*kroooooow.....kokokoko....*", was sounded in short duration, but it can be repeated several times, so total call can be long times. The call of: "*kokokoko.....*" and their variation were recorded both in BNP and APNP.

Type III: "Kroooooooow". The call of type III: "*Kroooooooow*" will sound by the green peafowl if they are suspect some think and looking for their friend or their chick. The call frequent repeated many times, while the bird walking.

Type IV: "Tek, Tek, Tek....." Tek, Tek, Tek.....Kroooooooow . or Tek, Tek, Tek.....Kroooooow kokoko. This call will sound if the peafowl feel suspect something. Usually the call sounded by female birds. The activities during suspect something, they can quiet or alert also while move forward to object caused the bird suspected. If they get clear what subject, the bird will be silent or move or continued the activities. Besides call *tek,tek,tek...*, the call can be combined *tek,tek,tek kroooooooow* or *tek,tek,tek kroooooooow kokoko*. The first sound is *tek, tek, tekkroooooow*, a sign that the female bird looks for their group, or a sign that other peafowl should pay attention to something to be suspected. But for second variation is *tek,tek,tek ... kroooooow kokoko* that the birds away from something disturbance, while inform to the other.

Type V: "eewoooo" 'eewwaaaa'. This call only sounded by adult male birds and the call will be sound during mating season. The call is a sign that male of bird has already mate during mating system.

Type VI: "ngeeeeeeyooo". This Ngeeeeeeyooo call only sounded by adult male birds during mating season. These call is a sign that male of bird has already mate at breeding season and attracted for female birds.

Type VI: "Sheeiiks". This call only sounded by adult male birds during copulation, when the male ride on the female bird.

Combat Behavior. Combat behavior in general done by adult peacock of green peafowl, but very rare by peahen, mainly during breeding season. The peacock, if close to the others, they will combat. The distance can be varies 1-100 m. Combat seems have relation to defence area at breeding season.

Usually combat started with adult males take position closed to each other. The birds erect position with tail push up horizontal with the body. The peacock strength to each other and come get closed while circling to each others. Then they fight while jumping. The combat will stop if one of the peacock become winner. Sometimes during combat activities they also done running activities chees away to the lost.

Combat activities might be happen at 05.00-10.00 AM or at afternoon 14.00-17.00 PM. Fighting activities are frequent happen at morning than afternoon in APNP year 2006 and 2007.

Combat activities were found at Sadengan grazing area, Gunting intercropping area, savanna Bekol and beach forest of Manting. Combat is strategy to defend of the area.

Chi-square test shown that duration of combat activities has significantly influenced by habitat types in APNP and BNP year 2006 and 2007 ($\chi^2 = 27.97$, $P < 0.01$), ($\chi^2 = 8.20$, $P < 0.05$) and ($\chi^2 = 10.98$, $P < 0.01$), ($\chi^2 = 6.05$, $P < 0.05$).

Territorial Behavior. The javan green peafowl territorial is area which defend by the bird. The territories are signed by combat or chased away. The females seem to have no territories. It is not clear the males occupy territories or not, but adult males keep quite a clear distance from each other. The distance mechanism

between adult male could be seen relatively clear during the breeding season.

DISCUSSION

The habitat types of the green peafowl in Java are monsoon forests, low land dry forests with patches of grassland and even teak plantation forests. Nowadays, possible habitats to support these birds are forest reserves (National Park, Game Reserve, Nature Reserve, and Forest Protected Area) and teak forest plantations. The range of green peafowl has become patchily and locally restricted in every site of their local distribution (Hernowo 1995; Balen *et al.* 1995). Habitat are selected by the javan green peafowl forested area or plantation (teak, coffee, rubber, cacao etc) which occurred open area at east java (Hernowo 1999; Hernowo & Palita 2004; Hernowo 2011). In Baluran national park, the javan green peafowl are more abundant at habitat type of savanna and bordered savanna and monsoon forest (Hernowo 1997). Meanwhile in Alas Purwo national park the birds are distributed at Sadengan grazing area and intercropping teak plantation (Hernowo & Wasono 2006; Hernowo 2011).

In general the javan green peafowl in BNP and APNP have two feeding times, morning feeding and afternoon feeding (Maryanti 2007; Ramadhan 2009; Hernowo 2011). The morning feeding approximately 3.5-4 hours and afternoon feeding around 4 hours (Hernowo 2011). The javan green peafowl feeding at open area while walking at bekol savanna of BNP (Sativaningsih 2005; Maryanti 2007; Ramadhan 2009; Hernowo 2011). The walking activities of javan green peafowl during they are feeding is strategy of the bird to have various kind of their food and also to avoid predator attack (Maryanti 2007; Ramadhan 2009; Hernowo 2011). Because the size of the peafowl relatively big, they need quantity and quality of food quite much in relation to the size of the birds (Rini 2005; Septania 2009). The green peafowl feed on leaf, flower and seeds of the grasses and shrubs. The javan green peafowl feed on quite wide range species of grasses and shrubs (Rini 2005). The birds are belonging to *polyphagus* species, because they use quite wide range of kind food and the bird also quite demanding on food as omnivorous bird (Septania 2009). The green peafowl feeding explore many kind of their food but main diet are leaf, seed, flower of grasses and shrubs. This is strategy for the birds get enough food in simply of the habitat (Hernowo 2011).

During dry season, the javan green peafowl come to water resources take water to drink at stream, water hole etc every day in BNP and APNP (Hernowo & Wasono 2006; Hernowo 2011). On drinking activities, the birds are frequently stop for moment and looking right and left to inspect the surround from disturbance (Maryanti 2007; Ramadhan 2009; Hernowo 2011). In Huai Kha Kaeng Sanctuary Thailand and Dak Lak Province Vietnam, distribution of green peafowl closed to water resources (Ponsena 1988; Brickle 2002). Number sucking water varied on individually of the javan green peafowl (Hernowo 1995; Hernowo 2011). The availability of continued water

resources is important for living of the green peafowl (Hernowo 2011).

The javan green peafowl sheltered and take rest at trees or under luxuriant tree as characteristic resting site and the selected trees do not far from feeding site (Hernowo 2011). The resting trees at Baluran were widoro bukol, pilang, asem, kesambi and mimba (Hernowo 1999; Hernowo 2011). Meanwhile in TNAP the birds used walikukun, laban, sonokeling, apak and jati as sheltered trees (Hernowo & Wasono 2006; Hernowo 2011). The javan green peafowl take rest and sheltered close to feeding sites are the strategy of the bird in order to efficiency energy (Hernowo 2011).

The green peafowl slept on tree (Ponsena 1988; Hernowo 1999). Subramanian and John (2001) reported that the Indian blue peafowl (*Pavo cristatus*) at Reserve forest of Deer Park, Tirunelveli Tamil Nadu preferred roosted on tamarind (*Tamarindus indicus*), vagai (*Albizia lebbek*), neem (*Azadirachta indica*), usilai (*Albizia amara*), and palmyra (*Borassus flabellifer*) also less frequently on manjanathi (*Morinda tectoria*), and velvelam (*Acacia leucophloea*). According to Hernowo 1999, the green peafowl select certain tree for roosting site. The characteristic of roosting tree is tall tree (emergent tree), not dense leaf, branching system up right angle to the stem and present open area closing to roosting tree. Most preferred roosting trees at BNP were pilang and dead of gebang (Hernowo 1995; Hernowo 1999; Hernowo 2011), meanwhile at APNP preferred trees as roosting site was Apak (Hernowo & Wasono 2006; Hernowo 2011). The birds select tall or emergent tree closed open area is strategy to avoid predator attack and efficiency of energy because closed to feeding site (Hernowo 2011).

Displays will held by the male of green peafowl at open area as grazing area, intercropping area, savanna and gaps (Hernowo 1999; Hernowo & Hernawan 2003; Sativaningsih 2005; Dwisatya 2007; Maryanti 2007; Ramadhan 2009; Hernowo 2011). Those preferred places are selected because easily for the female bird found the male and for male bird can dance more easily is effective and efficiency strategy (Hernowo 2011). Dakin 2008, stated that blue peafowl dance at open area in relation to appearance of their train feather.

The green peafowl live in group, polygamous mating system (Hoyo *et al.* 1994; Hernowo 1995). The polygamous system in the javan green peafowl is that male of the bird can mate with several females or the female bird can mate with several males. Hoyo *et al.* 1994, mentioned that peafowl live in group with harem polygyny system. The harem means that male dispersion on several female group and lead in the group. Hernowo 2011, found that the javan green peafowl live in small group with polygyny system, but male has no harem, because the male bird is not lead the female bird, the male can not set the female and female choose the male. The same phenomenon has reported by several observers of blue peafowl, that peahen of the bird choose a peacock (Manning 1989; Petrie *et al.* 1991; Gadagkar 2003; Takahashi *et al.* 2007; Loyau *et al.* 2008).

There are three stages of courtship of mating system of the javan green peafowl, first is courting (pre copulation), the second is copulation and the after their copulation (Dwisatya 2007). The mate choosing at the javan green peafowl having by female bird. The observation to the male birds have been done far before courtship process (Hernowo 2011). Those observation can be done by roost together with the male, or roost at the closed tree with the male, visited and observed the male dance or visited lek. Petrie *et al.* 1991, recorded that female of blue peafowl visited and observed to mate choose the male at least 4 times before copulation. Several observer of the blue peafowl (*Pavo cristatus*), stated that factors for attracted mate choose and mate success were trains feather (Occelli), symmetric and length of the trains (Manning 1989; Petrie *et al.* 1991; Gadagkar 2003; Loyau *et al.* 2008). But Takahashi *et al.* 2008 stated that the copulation success at the blue peafowl were influenced not only the factors mentioned above, but total function of the male. Loyau *et al.* 2007, reported that non defendable factors such as lek closed to the feeding site has influenced for mating success. Besides those factors, the shivering of the trains feather during the male of blue peafowl dance was as attracten factor for the female to mate choosing the male (Gadagkar 2003; Dakin 2008). Hernowo 1995 stated that the male of the javan green peafowl in BNP dance while fibrating the trains feather. Dakin 2008, stated that visual signalling for mating behavior at blue peafowl has influnced on succeeded of mating.

Nesting site of green peafowl is open area which is growth by shrubs and the nest is not so hidden, but it is indistinct (Hernowo 1999; Hernowo & Hernawan 2003; Hernowo 2011). Sometimes the nest direct get sun when do not occupied by female birds (Hernowo 1999; Hernowo & Hernawan 2003). The nest performance is very simple and the egg direct contact with ground. Direct contacts with soil or sun are helping on hatching of the eggs. Open area were selected by the bird as nesting site is a strategy to help hatching eggs and camouflages to avoid from disturbances.

Calling is a tool of communication between individual or group of the javan green peafowl in BNP (Hernowo 2011). Hernowo 2011, found 7 types of the javan green peafowl calling at BNP and APNP. Ponsena 1988, reported that 5 types of calling of green peafowl were recorded from Huai Kha Khaeng Wildlife Sanctuary. Those call type depend on the purpose such as alarm, attention, mating and territorial. Hernowo 2011, found that calling of the male of the javan green peafowl *ngeeyaouw* and *eeewaouw* were made during mating season as signal that the male already copulate the female bird. Meanwhile Takahashi *et al.* 2008 found 8 type calling of blue peafowl, between those call types, *keow*, *ka*, and *hoot call* were the male call which are called only at mating season.

Combat are behavior activities of many bird species in order to defend their territory (Perrins & Birkhead 1983). The blue peafowl observer, stated that the blue peafowl have territory during mating season (Petrie *et al.* 1991; Hoyo *et al.* 1994; Gadagkar 2003; Takahashi 2008; Dakin 2008). Ponsena 1988, stated that green peafowl in Huai

Kha Khaeng Wildlife Sanctuary savered from other to have territory. But Hernowo 1995, stated that between the adult male of the javan green peafowl in BNP having distance (distance mechanism), whether the male of the javan green peafowl have territory or not. Bird territory is defend by calling, chase away event fighting (Perrins & Birkhead 1983).

Fighting between adult peacock of the javan green peafowl happen in BNP and APNP at breeding season. The combat has observed at Sadengan grazing area twice at west corner which is as a male having area. The male at that area chase away and combat to the other which came at that area, but did not every male, but any male come there did not cheesed away, but each other male have distance between them. In APNP did not found lek, but in BNP have lek at Batangan-Bekol road Hm 120–70, between the male can closed each other but the distance around 25-75 m each other (Hernowo 2011). Keep on distance between the adult male of the javan green peafowl not only happen at breeding season also outside the breeding season (almost year). Although the adult male feeding together at open area, but between them still keep on distance (Hernowo 2011). Also during drinking at drinking site, between them can not to closed each other (not less than 1 m). Never found at one roosting tree stay together two or more adult peacock of the javan green peafowl.

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