

**SOME ECOLOGICAL ASPECTS OF BORNEAN SAMBAR DEER
(*Cervus unicolor brookei*) IN THE WILDS:
LESSONS LEARNED FROM LOCAL HUNTERS' EXPERIENCE**

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Abstract

Some ecological features of sambar deer are known to be used by hunters in purpose of hunting. Although in some cases, the ecological knowledge about this species is not used in proper manner in the context of conservation, this study has tried to dig such knowledge from local hunters' experience. Pellet piles and tracks which are common and recognizable are good indicators to represent the existence of sambar deer in a certain habitat. Other secondary features such as signposting, stamping ground and wallows also appear to complement their habitats functionally. Some ecological characteristics found in the study area can give an insight into sambar deer ecology and distribution in wild habitats. Since observations of sambar deer in East Kalimantan rainforests are extremely rare, this research could be a preliminary to study further this cryptic and elusive herbivore.

Mapping the distribution of sambar deer is the first possible step in monitoring their population in East Kalimantan. Owing to their shyness and naturally low densities, the presence of sambar deer in certain habitat types can be expected where hunting and bush-meat market are still prevalent. Local knowledge of sambar deer ecology owned by hunters can be used to get better understanding in the ecology of this species.

Key words: *ecological features, pellet piles, tracks, signposting, stamping ground, wallow*

1. Introduction

The Bornean sambar deer (*Cervus unicolor brookei*) is one of the important game species. Although this species has been cultivated in the breeding farm of East Kalimantan, little is known about their ecology in wilds because observations of sambar deer in their natural habitats are extremely rare. In addition to the inherent difficulty of observing this cryptic and elusive mammal, presently at low densities and the nature of Bornean tropical forests itself hamper field research on this species.

In the past, natural resource extraction, including hunting, was aimed only to fulfil peoples' basic needs in subsistence economy. To do that, they still

had mechanisms to prevent over-exploitation of wild animal resources (Primack, 2004); for example, the hunting rights to specific harvesting territories; hunters were not allowed taking females and juveniles; there were certain seasons of the year and times of the day when harvesting was prohibited; there were prohibitions for certain efficient types or methods of harvesting. These kinds of restrictions should allow traditional communities to harvest communal resources on a long-term and sustainable basis. However, population pressure, process of commercialization (as consequence of economic growth) and political-economic conditions have changed the way people managing their

natural resource including hunting. It can be said that hunting by local people is no longer sustainable.

In the current situation where traditional laws in hunting have been lost, local hunters actually have some basic knowledge about ecology of game species including sambar deer. Such knowledge have been learned by process and passed from their ancestors to next generations. However, they have been only developed in relation to hunting. For that reason, this study has tried to dig the ecology of sambar deer from local hunters' experience, although in some cases, it is not used in proper manner in the context

of conservation. Karanth *et al* (2002) mentioned that interviews of local informants like hunters can be useful, if they are truly knowledgeable. Hunters' information are then completed with results from direct sightings, signs encountering and camera trapping in order to describe some ecological characteristics found in the study area. Perhaps, it would give an insight into the ecology and distribution of sambar deer in wild habitats. Since observations of sambar deer in East Kalimantan rainforests are extremely rare, this research could be a preliminary to study further this cryptic and elusive herbivore.

2. Description of Study Area

This study was carried out in Suanslutung village, one of the villages in the Paser District, where the hunting pressure is still relatively high and local people still depend on hunting for bushmeat, sambar deer in particular. This

village is surrounded by the abandoned forest plantation, at the western part of the Gunung Lumut Protection Forest, Muara Komam Sub-district, Paser District, East Kalimantan Province (Fig. 1). The sample area was about 80 km².

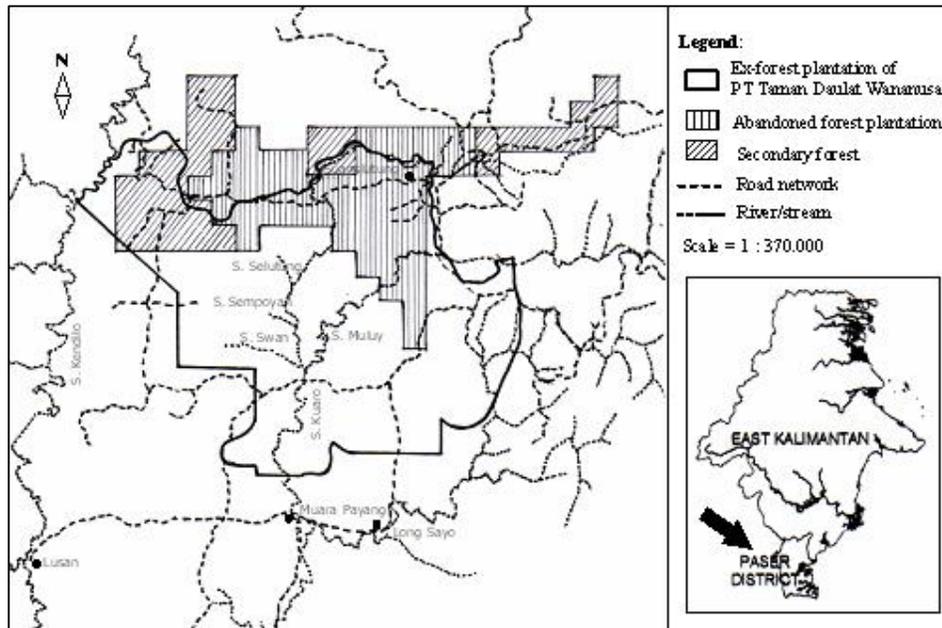


Figure 1. The research area and habitat quadrates

The study area receives about 1,990 mm of rainfall annually (data from Meteorology and Geophysics Bureau in

Balikpapan), most of it between October and April (Fig. 2). The dry season lasts about five months from May to September.

The data on the number of rainy days which is obtained from monthly data averages between 1996 to 2005 shows that

the lowest rainfall occurs in August (only about 5 days). About 13 rain-days occur on January and November.

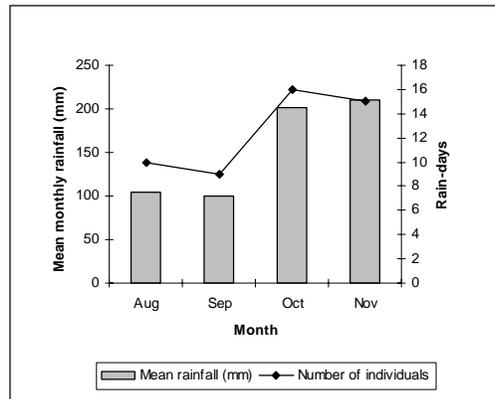


Figure 2. The mean monthly rainfall 1996 – 2005 and number of rainy days per month (rain-days) were taken at the station in Muara Komam Sub-District (Source: Meteorology and Geophysics Bureau in Balikpapan, East Kalimantan, 2006)

The study area used to be the forest plantation area of PT Taman Daulat Wananusa. This company worked in the Paser District since 1992 with a legal basis of Minister of Forestry Decree Nr. 254/Kpts-V/1992 which was a shared-company of PT Telaga Mas and PT Inhutani I. The total area agreed upon was 13,400 ha. This company collaborated with the Ministry of Transmigration in managing forest plantations through the transmigration program. At the beginning of the transmigration project and the forest plantation in 1993, about 300 families were settled in Suanslutung village. With this program, some workers who are mostly from outside East Kalimantan were introduced to the plantation site. They came from Central Java, West Java, South Kalimantan and Timor. Along with Paser people as indigenous people inhabited that area, Suanslutung village developed as a village with a variety of people used as labour by the company.

Gmelina arborea were planted in the area starting at 1994. The plantation actually has been invaded by wildlife since

the forest was cleared to grow *Gmelina arborea* in that area. These were mainly sambar deer (*Cervus unicolor*), bearded pig (*Sus barbatus*) and smaller mammals like muncak (*Muntiacus* spp.), lesser mouse deer (*Tragulus javanicus*), greater mouse deer (*Tragulus napu*), pangolin (*Manis javanica*) and porcupine (*Hystrix* spp.). They sometimes intruded agricultural areas and even entered into the village. At that time, people in Suanslutung village have actually started hunting as a secondary job besides working in the plantation. Initially, they could still easily hunt sambar deer.

After the company was bankrupt in 1999, the *Gmelina arborea* plantation has been abandoned and is no more managed. The age of the stands is almost up to 10 years old now, which means that they were ready to be harvested in 2006 if the company was still active. Because *Gmelina arborea* has grown without any management (like thinning) for up to 10 years, the stands of *Gmelina arborea* have grown mixed with alang-alang (*Imperata cylindrica*) and pioneer vegetation which

are dominated by *Macaranga* spp. and *Melastoma* spp.

Because there was no job in plantations anymore, almost half of the inhabitants went back to their old villages (especially those who came from Java) or found a better job in town. Suanslutung village consists presently of about 168 families, of which approximately 30% consists of Paser Dayak, 30% of East Javanese transmigrants and the remaining a mix of Sundanese and Buginese and other origins. The rest of the inhabitants then tried to survive and focused more on

their agriculture area (called "ladang") where they grow paddy and other commodities to get food for their daily needs. Besides, they also depend on hunting to get cash. The main targets of hunting for meat are sambar deer (*Cervus unicolor*) or "payau" (local name) and barking deer (*Muntiacus* sp.) or "kijang" (local name). Hunters do not hunt wild pig (*Sus barbatus*) since they are mostly Moslem

3. Methodology

We used indirect surveys in recording signs (tracks and pellet piles) whenever encountered along transects. The information about tracks' and pellet piles' ages was obtained from hunters who accompanied the research team during the observation. Tracks and pellet piles were searched as many as possible during research period. Information obtained from hunters were dig as much as possible in knowing the best sites for finding tracks and pellets, recognizing ecological features and studying more detail about ecology of sambar deer in their wild habitat. More attention were given on sites which had great probability in finding tracks such as stream-banks, wallows or waterholes ("sopan": Paser; "jilatan": Java), stamping ground and food sources.

For additional information, results from sambar deer surveys using camera traps were used to obtain some related ecological aspects. With data packs that register each photograph with time and date of the event, activity pattern of capture sambar deer could also be explained. Choice of optimal locations was mostly based on information from hunters who usually knew animal trails with signs of recent activity, especially trails next to wallows and stream-banks. Those locations were chosen mostly after

judging the frequency of use by sambar deer which can be detected through tracks.

Semi-structured interviews with active hunters and wildlife dealers were conducted in Suanslutung village in order to get information about the presence of sambar deer yearly in the study site. Informants should not be randomly drawn individuals from the local population (Karanth *et al.*, 2002). For that reason, respondents were selected among males who lived in Suanslutung village from the beginning, when the forest started to be converted to forest plantation. They also have involved in hunting after the company, who developed the forest plantation, went bankrupt. The respondents were then selected among males older than seventeen years old and who lived in the village for at least three years before the date of interview. Eventually, a total of 30 hunters and 2 wildlife traders were interviewed. They represented about half of the hunters and traders in the village. Approximately 40% of the adult male population was surveyed in Suanslutung village.

There are some basic important data obtained from interview surveys. Firstly, these interviews were conducted to determine the locations where hunting occurred. Those persons who indicated that they were involved in hunting were asked

questions about the distance travelled to hunt, the actual places and forest types in which they hunted. Hunters were asked to point out the location on the map of study area where they hunted or caught sambar deer at the same time with research period. Included in this part were details on prevalent hunting techniques and practices, and motivations for hunting. Secondly, besides gathering information

on the presence of sambar deer, we also probed the perceptions of respondents regarding changes in the populations of this species over the last decade. Thirdly, local knowledge about ecology of sambar deer was explored based on the information from experienced hunters. This information can be a valuable addition to field-based efforts to study the ecology of this species

4. Results and Discussion

Some Ecological Features of Sambar Deer

Some ecological characteristics found in the study area can give an insight into sambar deer ecology and distribution in wild habitats. Since observations of sambar deer in East Kalimantan rainforests are extremely rare, this research could be a preliminary to study further this cryptic and elusive mammal.

Morphometrics

The biggest adult stag ever hunted in the Suanslutung village probably had an average weight of carcass (meat without

head and legs) about 130 kg. Hunters estimated that this large specimen had a total weight about 150 kg. Hinds were considerably smaller. Hunters had ever obtained a carcass of the biggest adult hind weighing about 100 kg clean weight and about 120 kg of total weight. Such body sizes for both male and female might be an average for Bornean sambar deer. Considering that sambar deer are highly adaptable and more tolerance to a wide range of forest types, species of sambar deer can also have a broad extent of weight in different areas. It may be affected by food availability and variety of food sources

Pellet piles and tracks

Pellet piles and tracks which are common and recognizable are good

indicators to represent the existence of sambar deer in a certain habitat

Pellet piles

Pellet piles were mostly found on the litter of leaves. This could explain eliminative behaviour of sambar deer, that is getting rid of their faeces in a hidden place on purpose to wash over their presence in the given place, then, to avoid

from their predator (Tomaszewska *et al.*, 1991). The faeces shape of sambar deer is nearly like other large herbivores' faeces such as goat, barking deer and mouse-deer, but sambar deer's faeces is bigger than that of the other. The shape of sambar deer is long-silindrical



Figure 3. The example of pellet pile found in the study area

This study could identify pellet piles from decay stages, namely: (1) Fresh and moist with odour, (2) Completely dry with inner contents also completely dry, (3) Decomposition has begun which is indicated by the presence of some kind of white-small fungi, (4) 50% or more of the pile is decomposed but still recognizable as a unique pile. Pellet pile with an average age of less than 1 month old was usually in the stage 1 or 2. From 4 different hunters, our field guides, they could distinguish not only old and fresh pellet piles, but they could also determine ages of pellet pile found. Estimation of pellet piles' ages by

hunters nearly matched with results of investigation in the sambar deer breeding farm in Api-api village. Very fresh pellet piles are quite soft, are typically dark green in colour from surface to core, and have a very strong herbaceous smell. In addition, they are covered with a very thin film of mucous (not to be confused with rain or dew), unless conditions have been very dry during the day or for a prolonged period such as during the dry season, when they may be brown and much drier on the surface and on the inside and much harder in composition.

Tracks

Mason (2006) mentioned that tracking is not only a matter of finding and following tracks, but also includes determining their freshness, the size and sex of their maker. A track is defined as tracks supposedly belong to one individual. The tracks could be found either as an incomplete track or as a complete track, which means four tracks from one individual of sambar deer. But mostly they were found as incomplete tracks. It was also difficult to identify the

number of animals the tracks belonged to since the tracks were not uniformly dispersed in a certain wallow. It might be an individual or a herd of sambar deer walking back and forth in that area. Tracks of sambar deer were readily detected wherever substrate conditions were appropriate. Such conditions were met dominantly on stream-bank and wallowside (alluvial soil). The substrate is categorized as wet soil. Moist soil also showed as one of suitable substrates, but it might depend on its consistency

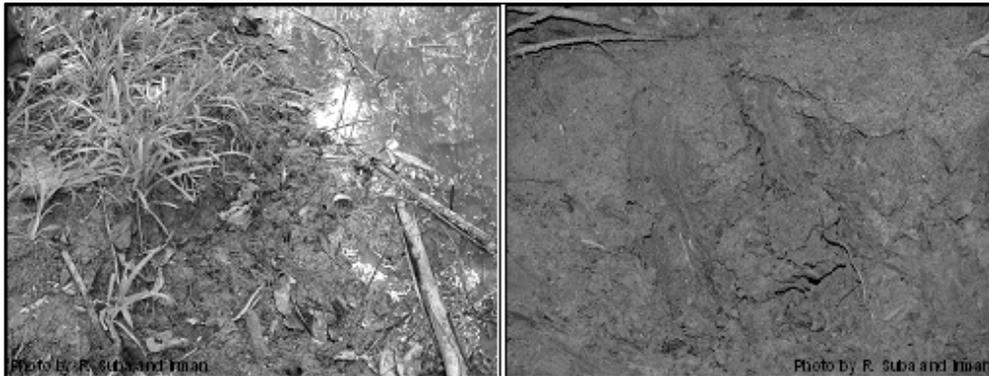


Figure 4. Substrate on a riverbank and an example of track found

It was difficult to determine the age of tracks. Even an experienced hunter could only distinguish old or fresh tracks. Fresh track here means that track has recently left by a sambar deer which passed the trail, probably the last 1 – 2 hours. We have been experiencing with 4 hunters who accompanied us in the field,

Antler

Another possibility to distinguish individual sambar deer are the size of the antlers. Hunters sometimes found free antlers on the ground, dropped naturally. Hunters also ever found parts of antlers because fights between males. Some parts

each of them had different perception of ages of tracks. Tracks were also easily washed away by rainfall. Fallen leaves could also cover tracks that make them difficult to find. Tracks in wallow sometimes did not appear as a track shape because the substrate was so wet or muddy.

sometimes were found hanging on up-rooted bushes and shrubs, possibly hooked onto up-roots when the male walked through the densely bushes and shrubs. The hunters call “rampang enam” (six branches).



Figure 5. The antler of sambar deer owned by a hunter in Suanslutung village

A good quality of photograph captured within considerable horizontal plane from camera traps should have been able to differentiate individuals of not only stags with antlers but also hinds and other classes. However, Kawanishi (2002) underline that the analytical procedure to estimate density of sambar deer using the mark-recapture method based on photographic captures is applicable only for stags with antlers. The antler as one distinct feature of adult stags can be an

important object of monitoring for sambar deer populations in the study area, indeed any wild habitat of sambar deer. Capture histories for mark-recapture method by camera trap can be constructed for stags that are individually identified based on shape and colour of antlers. The mark-recapture method then was not applicable to further study due to limited captures of stags with antlers during the research period (3 photo captures).

Food and related behaviour

The short green grass and the tender shoots of young trees and bushes, may be as food sources of sambar deer. Ground cover shrub, which was very abundant in the study area especially in the open area like abandoned forest plantations, is probably one of main foods of sambar deer. Bornean sambar deer probably subsist on a wider variety of foods. According to hunters, sambar deer also consume fallen fruit of *Gmelina arborea* which they can find in abandoned forest

plantation. Besides, they are fond of eating bark of *Gmelina arborea*. According to Razi (2003), sambar deer has been known as one of pest species in forest plantations because they eat the bark of young trees of *Gmelina arborea*. He reported the occurrence of sambar deer attacks on stands *Gmelina arborea* which attained the age of 2 years old in forest plantation PT ITCIKU by identifying bite marks of sambar deer on stem at 1 m above ground. This could cause deaths of those trees.

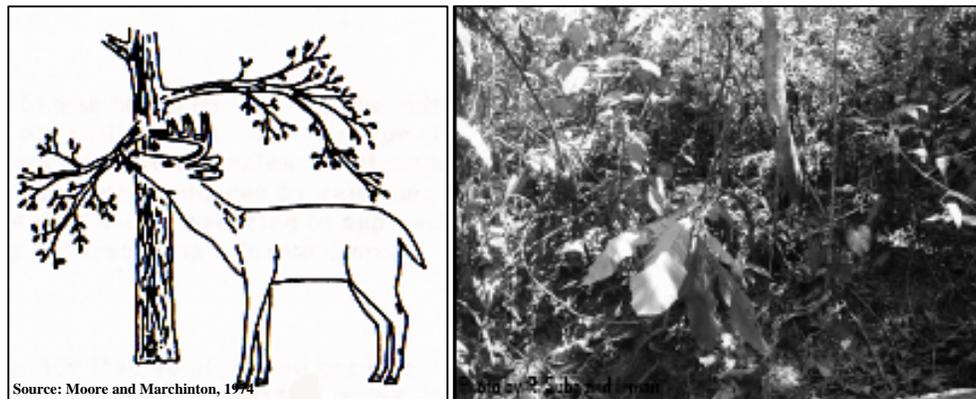


Figure 6. The illustration to show how sambar deer browses on branch a sapling of pulai (*Alstonia scholaris*) which were probably pulled by sambar deer found in the study area

Sambar deer can be a browser as well. Some evidence in the field showed there were some branches of trees browsed by sambar deer. Fig. 6 illustrates how

sambar deer may browse on branch of a tree. In addition, most study also stated that is the part of behaviour of stags. Stags also direct their aggression at bushes and

saplings, which they trash with their antlers until at times only tattered stalks remain (Schaller, 1967). Moore and Marchinton (1974) explained that as an adult stag of white-tailed deer proceeded, he occasionally stopped to mark a low hanging branch by nuzzling, licking and

pulling on the branch with his mouth and somehow by raking it with his antlers. The branches marked were generally about antler height when an adult stag was walking in a normal head up position (Mason, 2006).

Signposting

An indirect sign of the use of antlers by adult stags was found on some trees in the study area.

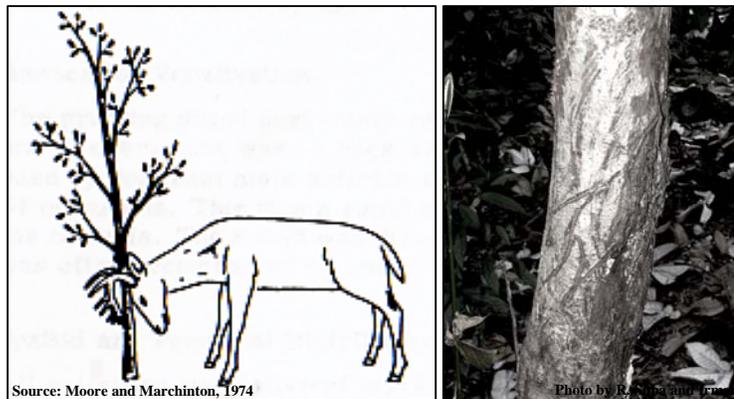


Figure 7. The illustration of antler rubbing behaviour of sambar deer browses on branch and the rubbed tree found in the study area

Field observations could recognize rubbing behaviour of mature stags using their antler. The adult stags are known to rub the antlers to a stem during the rutting season. Antler rubbing behaviour of sambar deer was studied by Mason (2006). Moore and Marchinton (1974) have also

studied ecology of white-tailed deer on marking behaviour and social function. Rubbing usually removed or frayed the bark but the extent to which trees or shrubs were visibly marked depended upon how vigorously they were rubbed.

Stamping Ground

Fig. 8 shows the 'stamping ground' found during field observation. This patch is located in the middle of secondary forest and has the shape of circular bare ground. This site looks very different from its surrounding which is densely vegetated.

Grass could not grow well at this site probably due to intensive use and compaction of the soil. This open ground has been trampled by the hooves of sambar deer meeting at this area. It might also be as a fighting arena for adult stags.



Figure 8. The 'stamping ground' found in the study area was used by sambar deer

The stamping ground found in the study area also appear to complement the "preaching trees" and wallows functionally, all being sign posts communicating the stags' presence to other stags and to hinds. In addition, wallows

(water holes) and salt licks which may occupy only a small fraction of a habitat are crucial to the persistence of sambar deer in the area. Primack (2004) called these features keystone resource.

Wallow

In the study area, there were many wallows being used intensively by sambar deer as water sources. Local people also called "sopan" (Paser Dayak) or "jilatan" (Javanese). According to hunters, certain wallows can be salt licks for sambar deer which they visit frequently. The season

effects on frequency of visit to certain wallows because it can be completely dry during the dry season. Sambar deer visit wallows more frequent during the wet season. Wallowing is probably a rutting behaviour exclusive to dominant stags as only an adult stag was captured by a camera trap with sort of muddy coats.

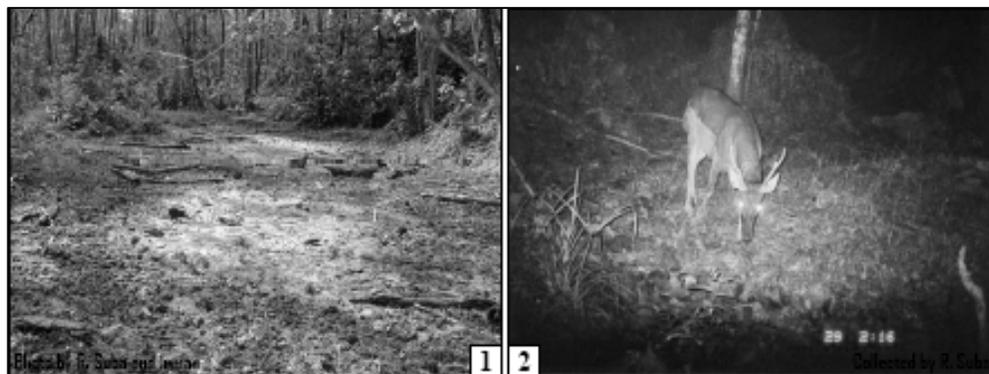


Figure 9. One of wallows found in the study area was used mainly by sambar deer and bearded pigs (1). An adult stag was captured by a camera trap with sort of muddy coats (2).

Activity pattern

Since the forest has been cleared for forest plantation purpose, villagers could easily hunt sambar. Sambar deer in the study area seem more common in open areas, plantation and secondary forest. They rest during the day in dense forest cover and go out during the night in open areas (abandoned forest plantation) looking for food. Sambar deer appear to be

a species that benefits from forest conversion (Meijaard *et al*, 2005 and Payne *et al*, 1985). However, hunting potentially overrides this positive effect.

The activity patterns of sambar deer captured were analyzed by using time and date of the event registered at each photograph. Fig. 10 shows the time of the event when some individuals were captured.

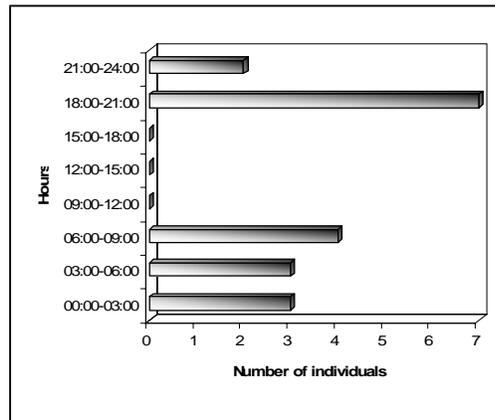


Figure 10. The activity pattern of captured sambar deer

It can be seen that sambar deer were mostly detected at night to 9 hours with a peak between 18.00 – 21.00 hours. After that, 2 – 3 individuals could be detected until 6 am. Around 6 to 9 in the early morning, camera traps could still detect 4 individuals. No sambar deer were detected during the day between 9 am to 6 pm.

The results of camera trapping also shows that sambar deer were mostly active between 18.00 to 21.00. They could still be observed until 9 am. None of sambar deer were observed between 9 am until 6

pm. This means that they rest during the day probably in dense forest cover. Schaller (1967) found that sambar deer are predominantly a forest animal, coming out into the open occasionally at dusk and during the night but seeking the cover of trees within an hour after dawn. They usually approach in the evening, drink and then retreat back into the forest. From about 09.30 to 16.00 or 17.00, sambar deer usually rested. Therefore, based on the time of photographic captures, sambar deer are more nocturnal than diurnal.

5. Local Knowledge and Hunting

Basic local knowledge of sambar deer ecology among hunters actually has developed in relation to hunting. Hunters have the ability to recognize fresh signs (tracks and pellet piles). They were following fresh signs in order to hunt an actual animal. They can also recognize age

classes (structure) and sex from tracks. Later, it is known that hoof width is a much better in indicating a sambar deer's body size than hoof length. However, tracks can be very distinct as actual shape in different substrates. For instance, tracks left in very soft or mud, such as those found on the edge of wallows, can give the false impression because it would look bigger

than the actual size. Fig. 11 shows the difference between the stag and hind hoof. Besides getting information from hunters, we also compared the tracks found (3) and

the hoof of the dead hind in the study area with the actual hooves of sambar deer in the breeding farm, Api-api village. As a result, they nearly matched each other.

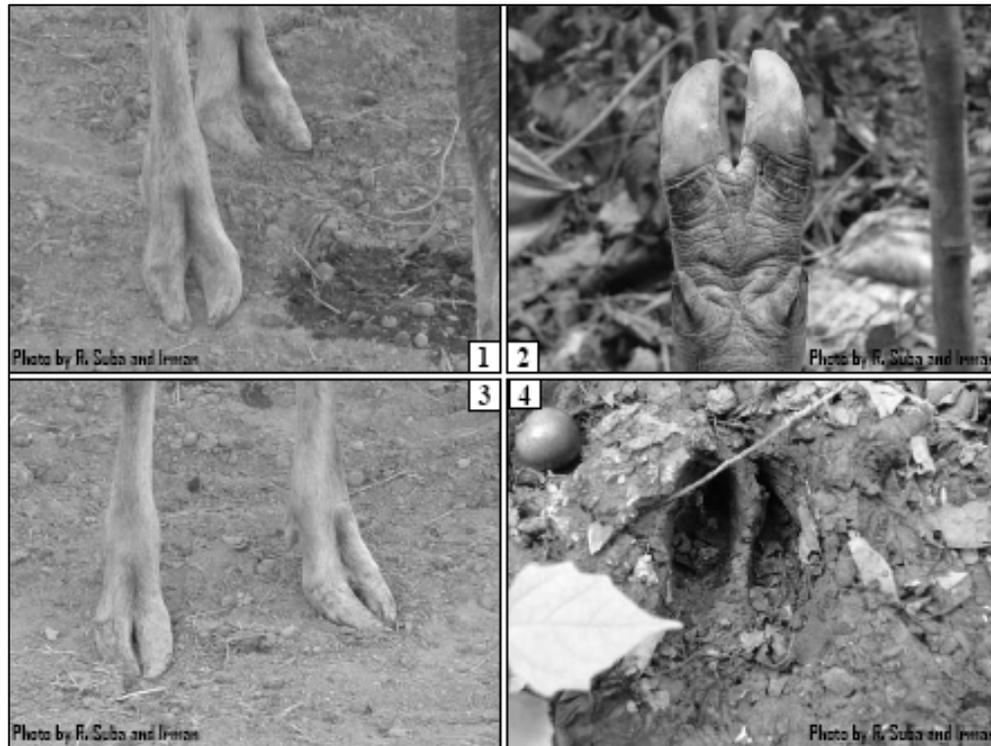


Figure 11. The difference between the hoof of stag and hind: (1) The hoof of hind found in the breeding farm; (2) The hoof of hind shot in the study area; (3) The hoof of stag found in the breeding farm; (4) The track assumed left by a stag.

It can be seen from Fig. 11 that the hooves of stag and hind are quite distinct. The toes of hind hoof are quite open and there is the difference in the length of toes. On the other hand, the toes of stag hoof are much narrower and more pointed. It implicates to the track of stag which is more rectangular.

In addition, hunters can identify trails which are used intensively by sambar deer. Hunters also believe that sambar deer are attracted to certain habitats such as wallows and riverbanks. They apply this basic knowledge to put snare traps and to determine their orientation in hunting. In addition, hunters always hunt according to

wind direction because they believe that sambar deer can smell human appearance approaching to them.

Hunting techniques were documented in the Suanslutung village. Handmade shotgun, locally crafted, was used with matches as gunpowder. This was the most popular means of hunting (47% of hunters), while 37% of hunters reported using steel wire snare traps especially for sambar deer. 16% of hunters use both of techniques. Hunting trip using gun was executed both by day and night. Hunters use spotlights in the night. When animals look at the spotlight, it can make them unconscious for a few second before

they realize that the hunter is ready to shot them. From the interviews, we also learned that the frequency of hunting trips was approximately 1 – 2 days per week. Especially gun hunting by night, it also depends on the moon phase. Hunters usually go hunting at the first phase or “new” moon and the dark of moon. They believe animals are becoming unaware of their approach at the time when night is completely dark. According to hunters, the best time for hunting is after rain both by day and night. Rain can wipe away human odour, so can restrain noises. At the same time, hunters can walk quietly over bushes and shrubs when approaching their target animals.

The total number of hunters interviewed represented diverse ethnic communities (Paser Dayak 50%, Central Javanese 30%, Banjar 17% and Sundanese 3%). Our interviews revealed that besides working in agriculture for their own needs, 75% of the men in the village go out for hunting to get cash. 50% respondents being transmigrants acknowledged their hunting knowledge and traditional techniques by learning from local people (Paser Dayak), for instance how to make traditional snare trap and how to determine hunting time when hunters could get their hunted animals. However, virtually at the village, we also recorded violation of traditional hunting restriction, such as shooting of pregnant hinds and juveniles.

Although literacy levels in Suanslutung village are high, all of hunters interviewed (100%) were unaware of the legal restrictions on hunting. They also reported a general decline in the abundance of game species, especially sambar deer in the past decade. The distance of hunting trips is getting further and further, probably due to the response of animals especially sambar deer to hunting pressure.

The fact that hunting of wild animals is illegal by law and that there seems to be no legal options for hunting permits or

other ways of legalizing village-hunting schemes. Hunters are aware of the illegality of their actions, but also know that the law is not enforced. Most local hunting in Suanslutung village derives from a driven demand for cash, after the forest plantations being abandoned. The attraction of a cash income definitely aggravates hunting pressures on sambar deer. With the increasing of price per kilogram of wild-meat of sambar deer annually, hunters through wildlife traders are increasingly selling bush-meat to markets in nearby urban centres. Price of meat at wildlife traders in the village has increased during the past decade. The price of clean weight of sambar deer per kg was only about Rp 500.- in 1994. At the time of research, meat of sambar deer was sold at around Rp 15,000.- per kg. An antler was worth Rp 40,000 per kg. Other target animals, meat of barking deer was sold at around Rp 8,000.- per kg. Hunters also shot pangoline (*Manis javanica*) for their skin which was worth Rp 200,000.- per animal. In addition, recent socio-cultural changes have had a profound influence on the patterns and intensities of hunting. The availability of locally crafted guns, followed by the ability among hunters to purchase them, has replaced traditional hunting techniques with gun hunting. The adoption of gun hunting, which is a far more efficient technique and ‘less’ effort compared to traditional methods, is likely to have resulted in a greater success. Therefore, with all circumstances above, there has been an erosion of hunting restrictions that are often believed to mediate hunting impacts.

Sambar deer are among the preferred species for hunting because they provide large amounts of good quality meat which can substitute cow meat as a source of protein (Anonymous, 2003a; Anonymous, 2003b). The impact of hunting on sambar deer populations in the study area may be demonstrated by the fact, according to

hunters, that the amount of sambar deer hunted has decreased yearly in the past decade. Unfortunately, there is no such record of hunting history in the village. We actually tried to approach it through interview with hunters and wildlife traders, but we failed because they have never recorded their hunting yield. They could no longer remember how many sambar deer they obtained in the past. Our study only covered several months (August – November) observing hunting activities in the village. Quantitative data on sambar deer hunted in the study area for a certain period (day, week, time or year) might give

a better understanding about the rate of their exploitation. Thus the impact of hunting on sambar deer populations can be assessed.

Mapping the distribution of sambar deer is the first possible step in monitoring their population in East Kalimantan. Owing to their shyness and naturally low densities, the presence of sambar deer in certain habitat types can be expected where hunting and bush-meat market are still prevalent. Local knowledge of sambar deer ecology owned by hunters can be used to get better understanding in the ecology of this species.

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