

Ethnobiology Study: Game in Dayak Lun Dayeh Community at Watershed of Mentarang in Malinau

Medi Hendra*, Dijan Sunar Rukmi, Surianto Effendi, Freminci, Auliana

Department of Biology, Faculty of Mathematics and Natural Sciences, Mulawarman University, Jl. Barong Tongkok, Kampus Gunung Kelua, Samarinda, Indonesia 75123

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Abstract

*Dayak Lun Dayeh is a local community who lives in East Kalimantan, where they have practiced hunting both in traditional and modern ways. They have particular ways to find hunting spots and use hunting techniques. The research about this community was conducted in watershed of Mentarang, in order to determine the various kinds of games, frequently used hunting locations, and hunting ways of Dayak Lun Dayeh community. This study was carried out at two different times, on May–July 2016 and June–August 2021. Research data were collected through open-ended interviews (assisted by a key informant), field observation and photographic record. Data were presented descriptively by an ethnobiology approach. The results showed that this community practices subsistence hunting of games, which comprised mammals (69.73%), reptiles (14.15%), aves (8%), and amphibians (0.4%). The bush meat obtained from hunting was consumed as a protein source and served as a medium in traditional ceremonies or religious rituals based on ancestral teachings. Games such as *Cervus unicolor*, *Sus barbatus*, *Muntiacus atherodes* could be found easily at *abpa' nuvan* (salt-lick) rather than at primary forest, swidden (*latii*), swidden fallow (including *amug*, *jekau* and *ripa*), farm, river, or secondary forest such as the logging roads of former timber companies. Several hunting techniques were applied such as using hunting dogs for tracking the games (*gelibut*), sieging or waiting (*gabang*) at a specific location (*abpa' nuvan*), and setting traps (*ton*).*

Keyword: Dayak Lun Dayeh, hunting, locals, wild life

**Correspondence author, email: medihendra@fmipa.unmul.ac.id*

Introduction

Originally the Dayaks believe in a traditional way, along with cultural boundaries and simple technology, to protect the forest and wildlife at their places. However, those things disappeared many years ago, caused by forest degradation that led to the loss of inhabitants, such as mammals. Several remote areas, surrounded by mountains are the perfect locations to be managed as wildlife sanctuaries. Therefore, Dayaks are eligible to protect their highly valuable area as well as to guide the tourists (or people from the outside), because of their extensive knowledge about forest and its inhabitants (Mackinnon, et al. 2000). Approximately 25,000 residents in Kayan Mentarang National Park in Malinau and Nunukan Regency of North Kalimantan are Dayaks and they are very dependent from forest for almost all their life necessities, starting from food sources (such as upland rice or *beras gunung* and animal protein), building materials, medicines, water, source of cash, and to preserve their culture (Barr et al., 2001; Uluk et al., 2001; Joshi et al. 2004).

Local people have considered the importance of primary forest based on the following things: a) as a source of livelihood (directly or indirectly), b) the existence of historical values that must be preserved until the next generation, and c) has abundant of natural resources with a

great value obtained from plants and animals. Based on local view, the other type of land has a lower value than forest (Sheil et al., 2009). However, Sheil et al. (2004) proposed that the interest or the utilization of forest is determined by the distance of forest itself to local village. The lower the distance, the higher chance of locals using or utilizing natural resources and even managing activities such as hunting in the forest. Hence, one of the most well-known communities that practiced hunting activity in daily life is Dayak.

Dayak is the largest tribe that lives in the remote area of north Kalimantan. Dayak tribe inhabits the river upstream and other lowland areas, even in more isolated areas. Some of them are nomadic but the rest lives in groups in different places. Most people in this community use rivers as the main transportation for daily activities. The Dayak community consists of a few ethnic Dayaks with different languages and cultures. At first, Dayak in Borneo is divided into seven major ethnicities *viz.* Ngaju, Klemantan, Apo Kayan, Ot Danum, Punan, Murut, and Iban. The previous seven ethnics then were subdivided into 18 sub-tribes (tribal children) and 405 smaller sub-ethnic groups (Coomans, 1987; Riwut, 2007; Hidayah, 2015; Zainuri, 2018). In our studied area, there is one sub-tribe, called Lun Dayeh and they apply distinctive customary law by themselves (Wulffrat, 2005).

Migration of tribal people from Dayak Lun Dayeh to the watershed of Mentarang has occurred since the head-hunting and ancient tribal wartime. Y. Daring recounted that “*the migration started from the Krayan region along the Kayan River, Puruk River, Mentarang River, and the smaller river to find fertile areas that would be maintained to develop traditional farms and harvest forest products*” (personal communication, June 05, 2016). The migration process occurred gradually and was led by an elder for each group. F. Yakub narrated that “*tribal wars between Dayak Lun Dayeh and Dayak Abay at Long Berang Village were won by Dayak Lun Dayeh, made that area owned by Dayak Lun Dayeh, then they managed it as residential area (or referred as riverine colonist)*” (personal communication, June 05, 2016). Y. They told us “*In the 1980s (before the expansion of Malinau District), the government of Bulungan District relocated Lun Dayeh community, then create a new settlement along the upstream of Mentarang River (Long Berang, Long Gapit, Long Bisai) to the Singai Terang village, in order to facilitate a better access for children education, economy, and administrative service*” (personal communication, June 05, 2016). However, during the previous journey, there were people who could not survive and decided to return to their homeland. Levang et al. (2009) mentioned that all communities that depend on forests in Malinau, have been exposed to changes up to a certain degree in the political and socio-economic sectors since the district has been developed. People who lived close to the capital of Malinau district undergo substantial changes, whereas people who lived in remote areas, such as river upstream experienced fewer changes.

According to Iskandar and Iskandar (2017), a study on ethnobotany, ethnoecology and ethnozoology has an important role and significant contribution to the relationship of locals toward natural resources and their surrounding environment. The traditional knowledge system/cognitive knowledge (corpus), deep insight or belief by locals (cosmos) and traditional culture were developed by environmental factors and thus would maintain high biodiversity in their area (Joshi et al., 2004). In order to obtain the daily needs, locals who lived in Kayan Mentarang and adjacent area practice swidden agriculture, wet rice cultivation, hunting, fishing and collecting forest products (Eghenter & Sellato, 2003). Besides to fulfill animal protein or practicing livestock cultivation, hunting activity could provide a better income to locals by selling the games in the fresh market (Konradus, 2003). Generally, Dayaks in East and North Kalimantan depend on nature, cultivate their rightful lands, hunt, fish, and yield forest products in a less modern way to fulfill their daily needs (Frans, 2003). Thus, this study is important to determine whether the hunting level at present still guarantees animal biodiversity for the next years. The aims of this research are to determine the hunting activity of Dayak Lun Dayeh community based on their traditional and modern ways, discover the location commonly used for hunting and learn hunting techniques used by locals daily. Furthermore, we explore the possibility of conservation and wisdom by locals in order to avoid overhunting in this community.

Methods

The research was conducted from May until July 2016 in three large villages at the watershed of Mentarang River followed by the next research in June to August 2021 at Mentarang Sub-District, Malinau District (Figure 1). In 2016, we conducted the first research as a preliminary study, while in 2021 we focused more on conservation aspect. The zoological data were collected and we conducted semi-structured interview (Ellen, 1993). The interviews were managed by open-ended interviews, followed by field observation, captured images of games and their identification. As interviewees, they are hunters, blowgun artists, village head or *kepala desa*, traditional leader or *kepala adat*, respected villager or *tetua*, and locals. Before the interview, we brought pre-prepared questionnaire sheets to the studied area (Supiandi et al., 2021).

Open-ended interview was assisted by key informants, who are people with expertise in hunting, participated in small to large scale hunting(s) and had small talks with local youth who enjoy hunting activity. In the second research, we specifically applied purposive sampling to determine our informants. We opt for only local people, who know about hunting, understand the culture or traditional customs, are aged more than 19 years old and stayed in the studied area for more than 5 years (Firdaus et al., 2019). Our observation started by following hunters (key informants), local youth and locals who intend to hunt in the forest. Along the journey, the interviewee was asked about hunting (his thought or observation freely), while we would ask more detailed questions on any matters regarding hunting (Eghenter & Sellato, 2003). Any game encountered by hunters was recorded. On any occasion, if we could not participate in hunting activity, therefore we asked locals about the hunting location, animal behavior and their habitat. Different from the past, in the last research, we asked 19 participants from locals as representatives from each household at the studied location, consisting of 6 men and 13 women. These interviews gave more variable results because not only we collected data from fresh hunted games and but also the artifacts made from animal products as well. The first study only obtained fresh (dead/alive) games from hunting activity. Our observation continued as we took photos of all the journeys and interviews, all photos from the games, the remain of the games (dried skin or skull), and games found around the longhouse or field. A number of games were captured live, half damaged or even death caused by blowgun, gun, or trap.

All data from open ended interviews have gotten permission to be published by all speakers. We realize that all results about research substance belonged to Lun Dayeh community, including verbal information and biological response. We had asked the approval from locals, therefore they gave us information freely, autonomously, and voluntarily after they fully understand our research, especially the benefit and risks of participating in it. Moreover, one of our authors is a native of Lun Dayeh community (Freminci). At first, she sought *kepala adat* (traditional leader), *kepala desa* (village head), or *tetua* (respected villager), where she gave them a short

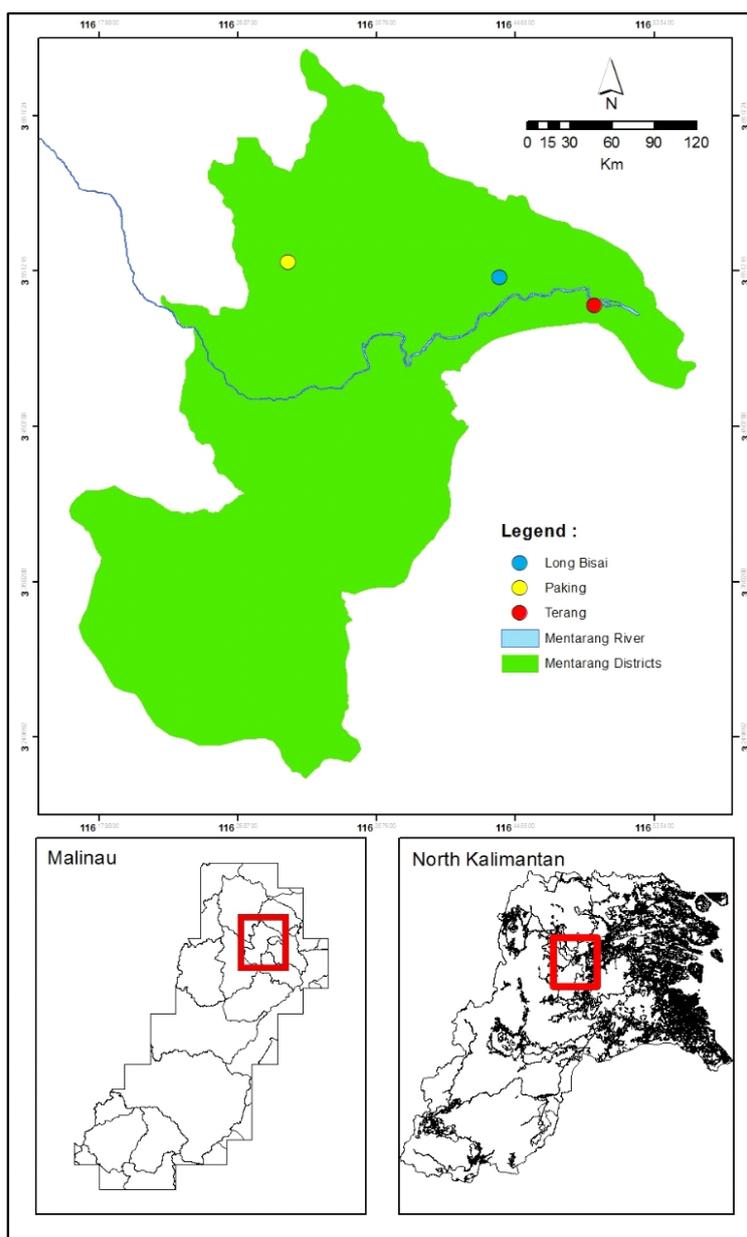


Figure 1 Three villages of research location at Mentarang Sub-District, Malinau District of North Kalimantan.

introduction, objectives, and working plan (or methods) of our research, then she asked permission from them to conduct interviews to locals, especially hunters or anyone who has experience in hunting activity or related to hunting (Saragih, 2011).

Field observation data contains vernacular names, Indonesian name, scientific name and their family, and results from 2016 and 2021 are presented in Table 1. Game species were identified based on the mammals of Borneo, Sarawak, and Sabah (Payne et al., 2000); mammals of Gunung Kabut National Park in West Java (Suyanto, 2002); birds of Sumatera, Java, Bali, and Kalimantan (MacKinnon et al., 1992); reptiles and amphibians (Iskandar, 1998), and freshwater fishes of Western Indonesia and Sulawesi (Kottelat et al., 1993). All data from interviews, field notes,

and the games, were described qualitatively, filled in a table, or displayed in percentages using a pie chart.

Results and Discussion

Hunting activity Hunting(s) in Dayak Lun Dayeh community is well known as *ngilip* or *nganup*, considered an important activity, although it would not be classified as one of the main activities in their daily life. According to government regulation (Minister of Environment and Forestry of Republic of Indonesia, Number P.20/MENLHK/SETJEN/KUM.1/6/2018 and newer version Number P.106/MENLHK/SETJEN/KUM.1/12/2018) hunting activity by this community is aimed to fulfill protein requirement, therefore this activity could be considered as subsistence of hunting. This practice tends to be more

Table 1 Games hunted by Dayak Lun Dayeh (in 2016 and 2021)

No.	Vernacular name	Indonesian name	Scientific name	Family	2016	2021
Mammals						
1	Kalio	Banteng	<i>Bos javanicus</i>	Bovidae		√
2	Kambing	Kambing ternak	<i>Capra hircus</i>	Bovidae		√
3	Bungkaro	Bekantan	<i>Nasalis larvatus</i>	Cercopithecidae		√
4	Berangad	Lutung Banggat	<i>Presbytis hosei</i>	Cercopithecidae	√	√
5	Kelabet	Lutung kelabu	<i>Trachypithecus cristatus</i>	Cercopithecidae		√
6	Becuk	Monyet buruk	<i>Macaca nemestrina</i>	Cercopithecidae	√	√
7	Kuyad	Monyet kra	<i>Macaca fascicularis</i>	Cercopithecidae	√	√
8	Talau	Kijang kuning	<i>Muntiacus atherodes</i>	Cervidae	√	√
9	Talau	Kijang muncak	<i>Muntiacus muntjac</i>	Cervidae		√
10	Fayo	Rusa sambar	<i>Cervus unicolor</i>	Cervidae	√	√
11	Kubung mabu	Kubung malaya	<i>Galeopterus borneanus</i>	Cynocephalidae		√
12	Tubang	Kucing batu	<i>Pardofelis marmorata</i>	Felidae		√
13	Usi' fulung	Kucing kuwuk	<i>Felis bengalensis</i>	Felidae	√	
14	Kuir	Macan dahan besar	<i>Neofelis diardi</i>	Felidae		√
15	Kuir	Macan dahan	<i>Neofelis nebulosi</i>	Felidae		√
16	Becuk	Owa kalawat	<i>Hylobates muelleri</i>	Hylobatidae	√	
17	Afan	Landak raya	<i>Hystrix brachyura</i>	Hystricidae		√
18	Terutung	Landak	<i>Hystrix</i> sp.	Hystricidae	√	
19	Arem	Trenggiling	<i>Manis javanica</i>	Manidae	√	√
20	Sudu	Teledu sigung	<i>Mydaus javanensis</i>	Mephitidae	√	√
21	Dengen	Sero ambrang	<i>Aonyx cinerea</i>	Mustelidae		√
22	Fawat	Kalong besar	<i>Pteropus</i> sp.	Pteropodidae	√	
23	Kelelit	Kalong besar	<i>Pteropus vampyrus</i>	Pteropodidae		√
24	Temecur	Badak sumatra	<i>Dicerorhinus sumatrensis</i>	Rhinocerotidae		√
25	Labo Saga	Bajing kelapa	<i>Callociurus notattus</i>	Sciuridae	√	√
26	Labo fur	Tangkarawak	<i>Ratufa affinis</i>	Sciuridae		√
27	Babui/Baka	Babi berjenggot	<i>Sus barbatus</i>	Suidae	√	√
28	Ikau	Krabukuingkat	<i>Tarsius bancanus</i>	Tarsiidae	√	
29	Pelanduk	Pelanduk kancil	<i>Tragulus javanicus</i>	Tragulidae	√	√
30	Labo	Tupai bergaris	<i>Tupaia dorsalis</i>	Tupaiaidae	√	
31	Labo fuan	Tupai kecil	<i>Tupaia minor</i>	Tupaiaidae		√
32	Labo siga	Tupai tanah	<i>Tupaia tana</i>	Tupaiaidae		√
33	Beruang	Beruang madu	<i>Helarctos malayanus</i>	Ursidae	√	√
34	-	Binturung	<i>Arctictis binturong</i>	Viverridae		√
35	Badan	Musang air	<i>Cynogale bennettii</i>	Viverridae		√
36	Fugo	Musang akar	<i>Arctogalidia trivirgata</i>	Viverridae	√	√
37	Badan	Musang belang	<i>Diplogalederbyanus</i>	Viverridae	√	
38	Fayu	Musang luwak	<i>Paradoxurus hermaphroditus</i>	Viverridae		√
Aves						
39	Menudun	Rangkong badak	<i>Rhinoplax vigil</i>	Bucerotidae	√	√
40	Menudun	Rangkong gading	<i>Buceros rhinoceros</i>	Bucerotidae	√	√
41	Tuwao	Kuau raja	<i>Argusianus argus</i>	Phasianidae		√
Reptiles						
42	Ebu	Kura-kura bergerigi	<i>Cyclemys dentata</i>	Geoemydidae		√
43	Menelen	Sanca kembang	<i>Malayopython reticulatus</i>	Pythonidae		√
44	Menelen	Ular Phyton	<i>Python reticulatus</i>	Pythonidae	√	
45	Ebuu	Kura-kura	<i>Leucocephalon</i> sp.	Testudinae	√	
46	Beladan	Labi-labi	<i>Amyda cartilaginea</i>	Trionychidae	√	
47	Lenei	Labi-labi hutan	<i>Pelodiscus</i> sp.	Trionychidae		√
48	Kebaren	Biawak	<i>Varanus salvator</i>	Varanidae	√	√
Amphibia						
49	Etit/Tiit	Katak	<i>Rana</i> sp.	Ranidae	√	
Total			49 species	27 families		

beneficial for family consumption or food security and it is more important than commercial purposes (economy). Basically, animal protein source in Dayak Lun Dayeh is obtained from fish, but fishing could not be categorized as hunting. The main activities of this community are farming, gardening, and harvesting gaharu (*Aquilaria* spp.) especially for man, in remote areas of forest due to its high economic value.

Y. Murang told us that “the hunting activities along Mentarang River have changed significantly at the moment, especially for people who live near the capital city” (personal communication, June 05, 2016). Their dependence on games has been far decreased than people who live around Mentarang River. Different from the past, hunting is currently practiced only for pleasure or to meet the requirements for large ceremonies, such as weddings (*irau awe*), a welcoming ceremony for important guests, or the district head. Hunting will be practiced eventually if the traditional market cannot fulfill their need for bush meat to serve on those occasions (Figure 2). Occasionally, hunting is practiced in the slack period, while managing rice fields, harvesting *gaharu*, or on the way home from the previous trip.

Games hunted from this community are varied, grouped by purpose, hunter age, hunter skill and natural factors. This result was obtained from our interviews with locals. Preys such *Macaca fascicularis*, *Presbytis hosei*, and *Trachypithecus cristatus* could be captured only by experienced hunters. The body parts of *Sus barbatus*, *M. fascicularis*, *P. hosei*, *T. cristatus*, and *Python reticulatus* were processed to decorate their long house or traditional clothes, even with their traditional weapon (Figure 3). According to Government Regulation Number 13/1994, the animals hunted (game) are unprotected wild animals only. Game is classified into small, or large animals and bird species. The category of birds in this regulation encompasses all types of wild birds in nature.

Dayak Lun Dayeh is known as omnivorous, where they can consume any type of game, except the crocodile as they regarded it as a tribal symbol. The other tribe from Flores, *viz.* Manggarai also performs protection to their natural resources by protecting and conserving such particular areas as sacred forests, establishing local idioms, or intensifying the role of local institutions in conservation. Moreover, they preserve

some local species as sacred species or consider them as significant species; ecology and utilization of non-timber resources in a sustainable way (Iswandono et al., 2015). Based on the obtained data from the first observation in 2016, about 73% of games hunted by Dayak Lun Dayeh at those locations were mammals (Figure 4, left), especially large mammals that were easily found in Malinau forests. Large mammals that became the target of hunting were family Cervidae, like *fayo* (*C. unicolor*), *talau* (*M. atherodes*); family Suidae like *babui* (*S. barbatus*); and family Ursidae (*H. malayanus*). The others are Cercopithecidae like *kuyad* (*M. fascicularis*), *becuk* (*M. nemestrina*); and *P. hosei*; the last game was hunted as it was considered a pest. Mammals were preferably hunted by locals because they could harvest more portion of bush meat than any other classes. Secondly is the reptile, approximately 15% of the game, a group that was incidentally observed or met in the forest, or sometimes it was caught in a trap that is already prepared by hunters. Aves was 8 % of the game, especially the large aves where it could be consumed as a protein source and occasionally to earn cash income. For example, in helmeted hornbill (*Rhinoplax vigil*), where the casque has a high value in the black market (the older the casque, the higher its price), therefore the overhunting of it happened more often in the local community. Amphibians (4%) were the smallest portion, they hunted at night and consumed as a side dish, while the hunter hunted in forests. There were slight differences from the results obtained in 2021, where they captured less bush meat than previous research, especially for mammals and reptiles. They even managed to not capture any amphibians in the last observation in 2021 (Figure 4, right). The first observed data from 2016 was less diverse than the next research because, in the first study, the data was obtained from dead/alive games or bush meat only (after hunting). Furthermore, the intensity of hunting activity was lesser than in the first observation. This happened because the results were from the fresh hunting by locals and animal artifacts as well. This result was obtained presumably from the awareness of forest conservation by locals, assisted with the socialization by rangers and a persuasive approach through *ketua adat* (traditional leader).

The problem arising from hunting activity is some games are categorized as protected species (mammals) and rare species (amphibians). Mammals such as orang utan were



Figure 2 Burn boar skin to remove its hair (left); *gotong royong* (mutual assistance) in cooking raw meat to serve important guests (right).



Figure 3 Artifact of games collected by locals (above); male traditional clothes (below left); and *mandau* (below right).

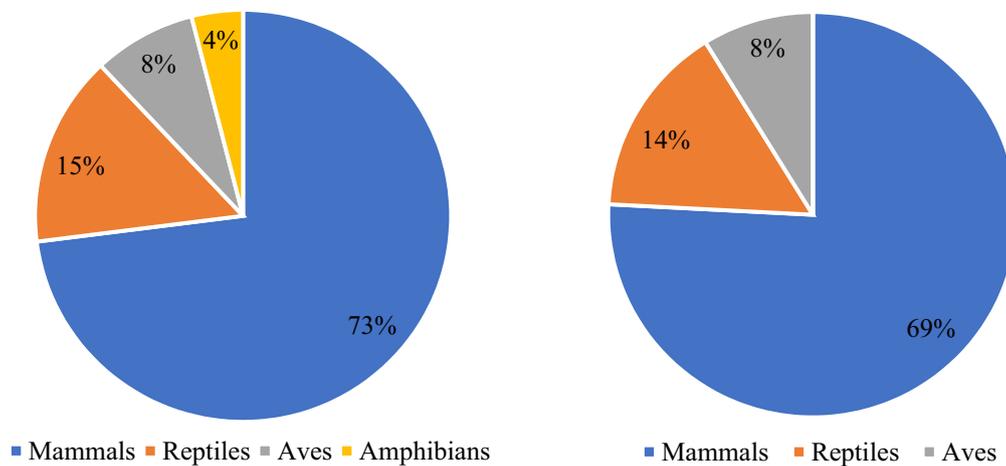


Figure 4 Composition of games hunted by locals at watersheds of Mentarang in Malinau, North Kalimantan in 2016 (left) and 2021 (right).

hunted to get their skulls for souvenirs (Mackinnon et al., 2000). Moreover, this community has consumed several variants of frogs. It might possible that they accidentally consumed a new species, which has not been identified yet, it has already been extinct. Meanwhile, we were once told that a hunter ever captured rangkong gading (*Buceros vigil*), extracted skulls from its head, then sold off that skull to buyers from the outside. They did this action because buyers

would presumably give them a higher price for each captured prey and the high demand for these animal products from overseas consumers. They could earn some money about IDR3 million kg^{-1} . If this practice continues, it will cause a negative impact on the diversity of wild animals in the future.

Folk classification by locals is a system of animal naming and was practiced by this community. It is happened naturally

and based on their language and linguistics. Name of certain animals has been created and taught hereditary. The purpose of this activity is to introduce the animal species as well as to differentiate certain animals among them. Local names were created either from important body parts of species, their utilization or from their empirical experience.

According to Ellen (1993), language is basic and becomes a very effective way of naming an animal. The human brain has limitations in storing information and remembering everything. Therefore, culture is utilized as a mnemonic device to overcome human limitations in examining, memorizing and storing information about all environmental aspects.

Dayak Lun Dayeh could modify their linguistic aspects in terms of naming (encoding) everything in the environment where they lived. Then it would simplify the understanding of communication among them. Although there are some differences between the language of Dayak Lun Dayeh in Malinau with Dayak Lun Dayeh in Nunukan, most of the Dayak Lun Dayeh use uninomial (single name) in naming all creatures that exist in nature, in order to facilitate communication. An example of the previous act is *kuyad* (long-tailed macaque/*M. fascicularis*), sometimes uninomial name was used as a prefix for species with similar characteristics yet, it has a salient feature, for example, bird, where it is classified as *Suiit* (uninomial) into a *suit menudun* (rhinoceros hornbill/*Buceros rhinoceros*) or changes into binomial name. Ellen (1993) stated that the encoding constitutes the use of uninomial, binomial, and trinomial, even polynomial names, thus it is important to do this in a modern way by taxonomic nomenclature where it consists of two or more segments morfosintactys.

Hunting tradition Tradition in hunting which came from Dayak Lun Dayeh's belief, hunch, and restrictions still practices lately, as it is considered taboo, especially for locals who live far away from the town. Taboo for hunters such as

never asking the specific times for hunting, because if it is answered, the hunter will go back home empty handed. Another belief, if one encounters certain bird species, such as birds called *suit mengei* and *suit tik badan* during hunting, they have to return immediately, because it is a sign of bad luck (Figure 5). Furthermore, they shall not grill the animal skin over 6 pm, because it can invite scary and horrible animals. Bush meat must be shared fairly, and slaughtered from head to tail. The body part where the hunting dog has bitten usually are given to dogs.

Hunting location There is no standard rule in Dayak Lun Dayeh community regarding hunting location. They simply hunt based on where games come often or had been seen lately. Multiple locations are commonly used as a hunting ground, such as *abpa' nuvan* (salt lick), an ecological term for an area, that functions as a place for the game to drink and lick the mineral salt, such as sodium. *C. unicolor* and *M. antherodes* are usually observed at the brine source. Montenegro (2004) also reported that salt lick could be found in certain areas in varied habitats, frequently visited by games to lick or forage dirt. Salt lick is located in spring, and develops like puddles, sometimes in small upstream areas of the forest. According to Barero (2006), the presence of game in salt lick was determined strongly by natural conditions in the adjacent area and the salt lick itself. In Dayak community, these places are very famous for hunting grounds, although each tribe mentions it by different names and special terms, which are based on each area and its significance. For example, Dayak community at our studied location is named as *abpa' nuvan*, while Dayak Benuaq named it *sopatn*, or *sepan-sepan* from one Dayak tribe in Senamang river (Hendra, 2009).

Mammals and other games are hunted as well in the forest (*fulung*) which includes primary and secondary forests. According to Indriyanto (2006), forests or games are inseparable parts of plant communities. In addition to plant



Figure 5 Bird: *Suiit mengei* (*Prionochilus* sp.) as a sign of bad luck believed by locals.

consumption, animals make use of vegetation to migrate and manage daily activity, it was practiced by arboreal species including monkeys, squirrels, tree tigers, gibbons, orangutans and bird species.

Hunting was conducted in secondary forest including forest patches or particular areas that experienced changes in the composition of forest elements. The forest is developed from open field such as unoccupied land of ex-timber company, the road opening among villages, and long abandoned roads after timber company. Furthermore, hunters usually follow the migration of bearded pig (*S. barbatus*) based on the fruit ripening period (*fung* in Lun Dayeh language) which is started from northern to southern area of Borneo. These mammals are the most preferred species to be consumed among Dayaks.

Swidden (*latii*) is a location to grow upland rice. Hunting activity in this location was intended only to hunt games that disturbed farms (pest). Hunting in the garden also had similar to hunting way on the farm, apart from managing the garden, the intensity of hunting depends on the number of pests.

River (*abpa'*) is a location for hunting games that drink usually at the creek. According to Mackinnon et al. (2000), watershed habitat supports games with a high density, such as amphibians and water snakes. Large herbivores move from forest to outside for drinking or foraging plants at watersheds. The bearded pig (*S. barbatus*) paw the herbs, while Sambar deer (*C. unicolor*) and barking deer (*Muntiacus* spp.) were foraging at night.

Swidden fallow is an area that is abandoned after cultivation period is over. Basically, this area is part of secondary forests as a result of succession. The location is intentionally left and expected to develop natural succession, therefore open area would be recovered by itself. The location could be planted with fruit trees as markers, to mark the area they had planted before, and sometimes it is referred to as *jekau*.

Swidden fallow (or shifting cultivation) is divided into 2 groups, *Amug* a plateau where it is still actively cultivated (estimate age 220 years), while *Ripa* is uncultivated land, that would not be planted nor cultivated for a long period (estimate age over 25 years). According to locals, hunting location was determined by the games, thus they decided the hunting direction. However, not all places could be chosen or could be described as prohibited areas for hunting grounds. These places are private forest that belongs to certain people, protected area or indigenous forest under the authority of a particular tribe, where they forbid outsider and only allow themselves for hunting or doing any activity in that area.

As a result of regional government policy (regional autonomy established by Law Number 22/1999), forest sustainability was seriously threatened either by granting rights to logging concession/concessionaire, mining management or illegal logging. This incident has caused wild animals to lose their habitats, specifically arboreal animals that lost trees as a food source, shelter, and nesting places. In order to reduce the negative effect of overhunting, the Dayaks have an unwritten rule, where they prohibited anyone to conduct hunting activity in custom forests to preserve the natural resources within. At present day, Dayak Lun Dayeh still would not allow oil palm plantations within their area.

Hunting techniques The hunting activities are grouped into two categories *i.e.* active and passive hunting. Active hunting spends a lot of energy and time precisely to track down the game, while passive hunting requires less energy to set a trap at a certain location, then wait for the desired game to approach and trap it.

Here are some commonly used techniques by locals: 1) *gelibut* is a technique accompanied by a dog, using a spear, blowgun and gun while practicing only from morning to noon. The hunter follows the track, which is usually passed by game or is commonplace for game foraging. They also consider that chasing it by following downwind way; 2) *gabang* (*eme gabang*) is one technique for waiting and besieging game in the forest. This technique requires more than one person, for example, hunting with *gabang nuvan* or around the salt lick (*abpa'nuvan*); and 3) hunting using a trap. *Ton/efung* is a trap that is usually practiced to capture *fayo* (the Sambar deer), *baka* (wild boar) and *talau* (kijang).

Traditional hunting tools Dayak Lun Dayeh has both traditional and modern ways of hunting activity. The traditional tools are made only from natural ingredients (Figure 6), while the modern tools are invented by humans, such as guns and airguns (air rifles). All hunters of this tribe must own these types of equipment. In general, Dayak tribes in Borneo have tool similarities among them, such as blowgun, mandau (saber), and spear which are the primary tools. The slight differences are names used for tools, weapon shapes, and materials used to produce tools. One example is blowgun = *sipet* (in Ngaju language), *sipet* (in Katingan language), and *sopot* (in Ot Danum language) (Riwut, 2007).

Blowgun production Blowguns (*sumpit*) and spears are traditional tools of this community. The tools are inherited from their predecessor. Blowgun (*evut/etut* in Lun Dayeh language) requires special skills and accuracy in order to drill, because it determines the outcome of the hole, either could it be bent or straight, and its quality. Blowgun is created in one to seven days, depending on the wood material, the sharpness of iron drill to make holes and the spare time of the artist. The wood source is *ipil* wood (*Intsia amboinensis*) and *ulin* wood/*tagas* (*Eusideroxylon zwageri*). However, other people prefer to make blowguns from *Ipil* wood, because this species is easier to drill, while still wet (fresh cut), and it has soft fiber as well.

The bullet of blowgun (*langan*) is made of palm tree leaves (*labing fulod* = *Arenga undulatifolia*). *Langan* itself consists of head (*arau*), which is made of petiole cortex from Arau tree (*Eugeissona utilis*), and has function as a catapult cork driven by wind. Once the dart (bullet) is finished, then inserted into *telungan* (bullet container). If the user wants to use the blowgun, the bullet will be dipped in poison of tree sap from Farir tree (*Antiaris toxicaria*).

The Farir sap is collected and stored in a container for 24 hours (one day and one night) until dry. After drying process is finished, the hunter stored it in a smaller container for easier carry. If the hunter wants to shoot the prey, the poison will be re-wetted and the bullets will be dipped in it. In other areas, some hunters use a tuber of *Homalomena* sp. to wet the



Figure 6 Blowgun (*evut/etut*) production by a local artist; (a) *langan*; (b) cork booster (*arau*); (c) poison container; (d) *telangan*; (e) *Homalomena* sp.; (f) blowgun/*evut* (with spearhead at the end of blowgun); (g) blowgun drill; (h) ipil wood (raw material); (i) finished blowgun.

blowgun bullets, therefore its toxin spread through the game's body quicker.

Modern hunting tools The circulation of guns in this community has caused the traditional ones to be abandoned. Modern tools are more effective to immobilize games, especially large mammals. Furthermore, the hunter doesn't need to prepare poison for blowgun bullets, or spears and other materials, therefore the preparation time can be shortened. However, the use of modern tools has an impact on the number of games, because it will cause overhunting.

Hunting activities (*ngilip* or *nganup*) in traditional ways, are basically performed only to fulfill protein needs, especially for people of inland Kalimantan. Hunting techniques such as *gelibut*, will bring greater loss of animal biodiversity if hunters intend to use modern tools like guns to capture prey for economical reasons. The other techniques such as *gabang* and *ton* presumably more harmless than *gelibut*, because it applies in a less modern way. *Abpa' nuvan* (salt lick), *fulung* (forest), *latii* (swidden), *abpa'* (river), *amug* (new swidden fallow), and *jekau* (old swidden fallow) are places for doing hunting activity by locals. Despite these various types of used lands, they still have places where they are dedicated to preserving natural resources, namely customary forests. Indeed, traditional ecological knowledge and biodiversity conservation can support one for another to manage national parks in Indonesia as such areas are established in customary forests (Susanti & Zuhud, 2019). There is Kayan Mentarang National Park in our studied area

which is built to preserve natural resources. Lastly, the locals only prefer hunting practices in the forest along the Mentarang River in their territory to ensure the sustainability of animal diversity.

Conclusion

The game of Dayak Lun Dayeh community at the watershed of Mentarang River consisted of 69.73% mammals, 14.15% of reptiles (except crocodiles), 8% of bird species, and 0.4% of amphibians. From our observation, hunting was mostly held to meet protein needs, special events, or religious ceremonies held by older generations, while the rest of the body parts were processed into crafts. In short, hunting was practiced especially for consumption only. The locations were used as hunting grounds for this community depending on the type of game to be hunted, such as the river (*abpa'*), primary and secondary forest, salt lick area (*apa'ruvan*), garden, swidden (*latii*), swidden fallow/*jekau* (*amug* and *ripa*). Other hunting techniques accompanied by dog(s) (*gelibut*) was performed to explore the route that passed by games and stalk or besiege it at a certain location (*gabang*), and set a trap using mesh (*ton*). In spite of the less harmful of traditional hunting (which is rare nowadays), we could not underestimate the possibility of a loss of animal diversity in the following years. Therefore, we urge local and regional governments to pay more attention to conservation and forest management sustainability to avoid greater losses afterward.

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