# An Evaluation of Subsistence Hunting in the Community of Buayan-Kionop, Sabah.

**Final Report to the Rufford Foundation.** 



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#### 1. Introduction and Background

The Crocker Range Park (gazetted 1984) covers approximately 140,000 hectares of lowland and montane tropical rainforest and is one of Sabah's most biologically diverse protected areas. Sabah Parks is the state government agency responsible for managing the Park. A pressing dilemma for Sabah Parks is that several indigenous communities live either in close proximity to the Park or actually within its borders. These communities carry out various subsistence activities; including swidden (or shifting) agriculture, collection of forest products, and hunting of wild animals. In the case of the community of Buayan-Kionop these activities occur largely within the Park. Comprising a population of roughly 300 people of the indigenous Dusun ethnic group, the Buayan-Kionop community depends entirely on the use of natural resources inside the Park for daily subsistence. They have been living and interacting with this environment since long before the Park was established, and consider this area to be their ancestral lands, placing Native Customary Rights land claims upon the area. In most instances they have no alternative livelihood opportunities to which they can turn. Community resource use inside the park, however, is in direct contravention of the Parks Enactment (1984), which prohibits all human modification of natural landscapes and extraction of natural resources inside a park.

This is a longstanding source of conflict, which Sabah Parks is seeking to resolve through the implementation of an innovative management plan which introduces a zoning policy; zoning areas inside the Park according to various biodiversity conservation and management objectives such as watershed protection and preservation of endangered plant and animal habitats. Of key importance is the proposal for the establishment of a Community Use Zone (CUZ) in Buayan-Kionop, which will allow the community legal access to land inside the Park for continued subsistence agricultural, hunting and gathering activities. The exact size, location of CUZ boundaries and regulations governing permitted activities within the CUZ are to be discussed and formalised in a Collaborative Management Agreement between Sabah Parks and the people of Buayan-Kionop. However, a fundamental weakness in this undertaking is that Sabah Parks does not have sufficient biological and sociocultural information regarding the natural resource use and livelihood strategies of this community, nor the trained staff available to conduct such studies. Scientific research into patterns of subsistence resource use in Buayan-Kionop is fundamental if the CUZ strategy is to succeed; without it the CUZ may fail both in providing for the community's resource needs and in meeting the management objectives of Sabah Parks.

My research on subsistence hunting is being conducted in collaboration with UK-based NGO the Global Diversity Foundation (GDF), as part of the Darwin Initiative funded project "Ethnobiology of proposed traditional use zones in Crocker Range Park". The results of the hunting research will assist Sabah Parks in the formulation of a CUZ management strategy which will be based on detailed ethnobiological knowledge of resource use patterns and the livelihood needs of the community. Hunting is being investigated using a multi-disciplinary and multi-focal approach, emphasising participatory research with community members to investigate: hunted species and the extent of hunting offtake, spatial and temporal distributions of hunting activities, local perceptions and classification of hunted animals, local ecological knowledge, and the role of hunting among other subsistence strategies employed by the community. The remainder of this report details the methods which have been employed to address these research questions, and the results produced to date.

#### 2. Forest Wildlife Surveys

These wildlife surveys were instigated as a means of investigating the population densities of hunted wildlife species in the forest surrounding the community of Buayan. Standardised methods were employed (similar to those used by many researchers studying mammalian populations across the tropics), whereby a single investigator traverses a trail (or transect) of known length, recording sightings and vocalisations of all target species, and their distance from the trail. The intention was that data sets would be built up, initially of presence and absence, and eventually of abundance and/or density of individual species. It would also be possible to examine the frequency of different sightings at various times of day and times of year. The target species selected were all species of mammals (excluding bats, rats and mice), since initial investigations revealed that a) mammals make up the vast majority of forest game consumed by the community and b) practically all species of mammals occurring in the area are consumed by people. Sightings of conspicuous birds and reptiles were also recorded during surveys.

Wildlife surveys were conducted from July 2005 to February 2006, along four hunting trails used by the community. Before commencing sampling on each trail, a visit was made to take GPS recordings and make notes on habitat and topography. During each survey, standardised data sheets were used, which included information on sightings, weather and other general information (e.g. fresh disturbance in the forest, fruiting trees and animal tracks or diggings). The majority of surveys took place in the morning between the hours of 7am and 1 pm, with an average duration of 2-4 hours. Surveys were also conducted opportunistically in the afternoon, but this was often precluded by heavy rains. Several night surveys were also conducted for nocturnal mammal species. Altogether, 31 surveys were carried out between July 2005 and February 2006, totalling approximately 80 hours of survey time.

The frequency of mammal sightings was very low throughout the surveys, irrespective of time of day or year (mean encounter rate =0.46/hour). There were however a consistently higher rate of sightings during the August 2005 surveys (mean encounter rate =0.61/hour). This in part reflects the fact that this was a particularly sampling-heavy period (11 of the 31 surveys were conducted in this month), but sightings per unit of time were also greater during this period than at others. A possible explanation for this is because many tree species in the forest undergo mast fruiting around August-September, and many mammal species hunted by humans in the area are either partially or wholly frugivorous. Evidence of fruit piles and partially consumed fruits were commonplace during this period. It may be that some mammals are more active than usual around fruiting trees during mast fruiting events, and are thus more easily observed. Many community members from Buayan believe this to be the case, and hunters are particularly active around this time of year.

More mammal sightings were made during the morning that the afternoon. Again time spent surveying was biased in this regard, but per unit of time mammal sightings during afternoon surveys were still less frequent (AM mean encounter rate =0.62/hour, PM mean encounter rate =0.3/hour).

By far the most commonly encountered group of mammals which are regularly consumed by local community members were Sciurids (squirrels). Chief among these was the fairly large-bodied Prevost's squirrel (*Callosciurus prevostii*), which was commonly sighted in old secondary forest (especially in areas dominated by Sago palm), and also in young secondary forest. Also commonly encountered were small species such as Low's squirrel (*Sundasciurus lowi*) and the Plantain squirrel (*Callosciurus notatus*), although these were often difficult to identify at a distance. The Giant squirrel (*Ratufa affinis*) was only sighted on four occasions, but was often identified by its loud and distinctive call.

Several of the larger mammal species favoured by hunters were also encountered during surveys, albeit infrequently. These included the highly prized Bearded pig (Sus barbatus), the long-tailed macaque (Macaca fascicularis), the lesser mousedeer (Tragalus *javanicus*) and the small-toothed palm civet (Arctogalida trivirgata); the latter encountered on several occasions during night surveys. Other species of interest encountered included treeshrews (TUPAIIDAE), hornbills (BUCEROTIDAE) and an unidentified species of small wildcat (probably Felis bengalensis). These species are not commonly hunted in the community (though all are taken on occasion), but their presence is testament to the fact that the secondary forest around the community of Buayan supports a high diversity of vertebrate species. Several mammal species known to be of hunting importance for members of Buayan were not encountered during surveys, but were known to be present in the area as they were caught by hunters during the field period. These included the Sambar deer (Cervus unicolor), Common barking deer (Muntiacus muntjac) and Pangolin (Manis javanica). A hunter also captured an infant pig-tailed macaque (Macaca nemestrina), though this was kept as a pet rather than consumed.

Survey data gathered to date therefore give some indication of the presence and absence of hunted mammal species in the forest surrounding Buayan, though the amount of sightings are inadequate for analyses of population densities (with the possible exception of *Callosciurus prevostii*). Moreover, the ratio of sighting frequencies against time invested in survey work suggests that even with a great deal of additional time spent on these surveys over the next several years, data sets for many hunted species may remain inadequate, whilst for others enough sighting data may be obtainable but may come from such a wide spatial and temporal range as to make population density analyses problematic. There are several likely reasons for this, including seasonal movements and migrations, difficulty in making sightings in steep and dense hill forest, and the fact that many hunted species are fairly solitary and naturally occur at low densities. Thus, the relative scarcity of hunted mammals observed during surveys can in no way be taken as an indication of the effects of over-hunting around Buayan; rather they are a reflection of both habitat and the ecological attributes of the species in question. The 2006-2006 wildlife surveys posed a warning concerning the dangers over-reliance on population density studies during the research, and it was decided that if accurate population density estimates were likely to require a huge investment of field time (and likely remain impossible for many species), a more profitable return on time invested could be gained by placing greater emphasis on participatory monitoring of hunting activities (see section 4).

#### 3. Semi-Structured and Unstructured Interviewing

A great deal of qualitative information on hunting in Buayan-Kionop has been gathered from hunters and other community members during formal semi-structured interviews with some of the key hunters in the community, and informal and opportunistic discussions (for example following a successful hunt).

An initial step was to perform specimen identification tasks by presenting hunters with images of all the mammal species found (or thought to be found) in the area; and forming a list of their names in the local language, which species are hunted by the community and whether each species is commonly encountered in the forest or not. Although there were some discrepancies between individuals in identifying certain species from the images (especially those which are uncommon or not found in the area), in general consensus was very high and a list of hunted species and their local names was compiled fairly rapidly (Appendix 1). Local nomenclature and classification of hunted animals was further explored using freelisting and pilesorting techniques (see section 6).

Interviews focused on the identification of hunted catchment areas (with the aid of community maps), methods used in hunting, average frequency of hunting forays, and wild animals as crop pests *inter alia*. Opportunistic discussions tended to focus on where

an animal was captured, the circumstances involved (i.e. whether any particular techniques were employed), the animal's age and sex, and whether it was a good time of year to hunt in general. In addition, a list was compiled to document local knowledge on fruits and plants are commonly consumed by game animals (Appendix 2), and serve as a baseline from which studies on the feeding ecology of hunted species may be launched in the future of this research. Some of the principal interview data on hunting in Buayan-Kionop is detailed below.

The time of day that hunters embark on forays is likely a mixture of commitments to other activities and personal preference. Some hunters prefer hunting in the day, and there are obvious practical advantages to hunting during daylight. Many others seem to hunt mostly at night, and this may offer other advantages; for instance camouflage for the hunter, animals are often less wary at night and some animals are easily dazzled by torchlight. Also, some of the largest and/or most highly prized animals (e.g. civets, sambar deer) are strictly nocturnal, whilst the Bearded pig is largely nocturnal (but sometimes also active by day). The list of hunted mammal species contains a broadly equal mix of diurnal and nocturnal animals, albeit with a few more nocturnal species. This list however is not a reflection of the frequency of captures or the time they took place.

Active hunting is almost exclusively conducted using firearms, and is usually done alone. Some hunters use dogs to help them locate and chase down terrestrial mammals, but this is by no means a universal practice. Some active hunting of birds is done using a rubber catapult (especially by children). A practice also exists of hunting birds with *sumpit* (blowpipe); coating the dart with a poison made from the sap of the *Paliu* tree. This practice is probably very uncommon nowadays however, and may be dying out.

Some passive hunting (i.e. hunting whereby the hunter does not need to be present and actively searching for game) using traditional traps is also done, though this appears to be of secondary importance to active hunting. Several types of traditional traps have been identified; including *sungul*, *sodik*, *tasip*, *tingkawa* and *pimpin*. These are often used to catch pests in agricultural land, though they may also be set in the forest. These traps mostly catch squirrels and rats, and thus are not entirely indiscriminate (cf. wire snares used in many parts of the tropics).

Hunting does not appear to be a full-time occupation among any members of Buayan-Kionop; rather it is an activity which must be fit in around other needs, in particular agriculture. Therefore it is perhaps not a defining characteristic of a person's occupation, but one activity they pursue among many others. Moreover, it is largely a pragmatic affair. Hunting is not conducted according to dates on a cultural calendar, but when the need, opportunity (available time/energy) and practicalities (e.g. suitable weather, enough ammunition) arise. Hunting is not conducted for the sake of the experience (except perhaps when a father is teaching his son), but for the meat. Therefore an unsuccessful hunt is very much wasted time and energy; both of which are under considerable demand from other activities.

Another cue which may influence the frequency of hunting forays is fruiting seasons; general mast fruiting of several species of forest trees is considered a good time to hunt (presumably because animals are more often active foraging in fruiting trees during these periods). This also has some influence on particular strategies used in hunting. For example, despite the very broad diet of the Bearded pig, it is widely known to have a particular preference for the acorns of the oak *Tikalod*. When this species is fruiting, hunters may wait close by a tree and wait for Bearded pig to come and feed. *Tikalod* is also said to have the same fruiting times as *Tarap* (which grows wild in the forest and is also grown in the community), so *Tarap* fruiting in the village can be used as an indicator of when *Tikalod* is fruiting in the forest. It is not known how common this practice is among hunters, or whether they may do the same with some other fruit trees or species of animal. Other techniques used by some hunters to find or attract game include following tracks left in suitable soil, and luring by simulating animal calls (especially of the common barking deer). These techniques demonstrate how hunter ecological knowledge is used to maximise the likelihood of success during hunting trips.

It appears that very little hunted meat leaves Buayan-Kionop for outside sale; and there are obvious practical reasons for this. The carcass of a large mammal caught in the forest must oftentimes be carried a considerable distance and at considerable effort (for example a large bearded pig, even after being decapitated and gutted in the forest where killed, may still weigh 60 kilos or more) to return it to the hunter's residence. Without road

access, opportunities for members of Buayan-Kionop to market hunted meat in local towns are severely limited by logistics.

Meat from an animal the size of a civet or smaller is unlikely to go outside the family (except in the form of *pusas* or if guests come and visit), whilst excess meat from a large catch may be sold locally at  $\approx$  RM5/kg. Excess meat is often also preserved for later consumption by *salai* (smoke/dry over a fire). Another preservation method (especially used with Bearded pig, and some fish) involves the use of salt and a ground powder made from the *pangi* and *tuo* plants.

Most hunters seem to have been taught how to hunt by their fathers, beginning in their early teens. More study needs to be done on this, but teaching in the case of one community member at first involved familiarisation with the forest; hunting trips with his father being initially close to home, then progressively farther and farther away. When he began to hunt alone his father gave him extensive advice on where to go, and how to find rivers and return to the village if he got lost. Teaching presumably also involves transmission of knowledge on animal ecology, trees often visited by certain animals and their fruiting times, and the like. Teaching is likely most often performed whilst actually hunting, rather than elsewhere, as this is simplest and most practical. Periods spent learning with the father before beginning to hunt alone may be very variable; e.g. for one hunter interviewed it was only six months, with another several years.

Most hunters appear to have a good knowledge of animal feeding ecology. During interviews they could usually name several or many forest tree species whose fruits attracted animals, and often had a good idea of which species of animal feed on which fruits (Appendix 2). It remains unknown whether hunters believe that primary (*Puru*) forest is superior for hunting to old secondary (*kapanggor*) forest. Hunters from Buayan often seem to make the long trek to *puru* to hunt, but there may reasons for this other than it being superior for hunting; for example any hunting trip is unlikely to yield a catch before an (often considerable) amount of time has been expended, and trails from Buayan to the south and east lead to *puru* forest eventually. Some hunters have claimed that if it is "fruiting season" (presumably meaning that several of the fruit tree species preferred by game animals are mast fruiting at a given time), then *kapanggor* is as good for hunting as *puru*.

Several forest animals have been cited as agricultural pests. Besides rats and small squirrels (for which traditional traps are sometimes set, seemingly more to prevent crop damage than for food), species which were frequently mentioned are *bakas* (bearded pig, *Sus barbatus*), *tambang* (sambar deer, *Cervus unicolor*), *palanuk* (mousedeer, *Tragalus javanicus* and *T. napu*), and *paus* (barking deer, *Muntiacus muntjac* and *M. atherodes*). The three genera of deer are said to be particularly destructive in *mundok* (tapioca), but *bakas* is said to be the most destructive overall. Two hunters claimed that primates (one specifically mentioned *gobuk* [pig tailed macaque, *Macaca nemestrina*] and *kara* [long tailed macaque, *Macaca fascicularis*] as the responsible species) used to be a problem in agricultural areas, but had learnt not to enter after several shootings. One hunter claimed that *monggoluton* (Prevost's squirrel, *Callosciurus prevostii*) sometimes causes damage in hill rice fields. A mustelid, *silou pingas* (yellow-throated marten, *Martes flavigula*) has been blamed by several people for entering the village and killing chickens.

#### 4. Monitoring using Hunting Registers

Monitoring of hunting activities using registers has been ongoing in Buayan-Kionop since 2005, and is providing invaluable insights into patterns of subsistence hunting in the community. Register data is usually collected by community research assistants, who visit participating hunters with data sheets and interview them about any recent hunting forays during which one or more animals were caught. Although the data sheets have recently undergone modification, the core data fields remain the same and include information on the trip (dates left and returned, toponym of area where kill was made, the forest type in that area, and whether animal populations are perceived to be abundant in that area), the capture event (hunting techniques and technologies used), the animal(s) caught (Dusun name, sex, pregnancy, estimated weight, and activity at time when sighted), and processing of the kill (animal parts discarded in the forest, whether meat was used for family subsistence only or was sold locally).

The register database currently contains data from 11 participating hunters, and documents 110 hunting trips conducted over two years. 178 animals representing 20 species were caught during these trips. Of these, 97.1% of animals caught were mammals,

1.7% birds and 1.2% reptiles. Figure 4.1 below illustrates the proportions of captures by species. For the ten species of which capture of more than one individual has been recorded, captures are skewed towards males (figure 4.2). This is unlikely to be a result of conscious decision-making on the part of hunters, since most of these species display little or no sexual dimorphism. This pattern may be more a reflection of differential male foraging and territorial behaviours in certain species, or behaviour when encountered by a hunter in gregarious species. Whatever the reason, male-skewed offtake may aid the sustainability of hunting in Buayan-Kionop, since most mammal populations are capable of remaining reproductively stable even if a significant number of males are removed, but are far less resilient to loss of females.



Figure 4.1: Proportion of hunted offtake by species. Species represented by a single caught individual are combined in one category



*Figure 4.2: Offtake of males and females for all species represented by >1 individual caught.* 

The registers support the findings from community mapping and interviews; that animals are hunted in a very broad geographical area. Most captures are made in old secondary forest or primary forest, using firearms. Meat from small-medium sized animals is not generally distributed beyond the family, though excess meat is sometimes sold locally from larger bodied animals such as bearded pig and barking deer.

# **5.** Community Mapping

One activity conducted during a hunting workshop held Buayan in November 2006 was the production of a community hunting map, which displayed the locations of hunting grounds in the Buayan-Kionop area. The map was produced by a group of young and middle aged hunters, and elderly ex-hunters, from the community. To begin with, the group was asked to list the local toponyms of the all the hunting grounds they know in the area; whether or not these are hunting grounds they themselves frequent. The group was then asked to assign each hunting ground to one of four categories of importance, ranging from "most important" to "least important". The criteria to be used in judging the relative importance of each hunting ground was left to the discretion of the hunters. Once the group had discussed the hunting grounds among themselves and assigned each one to category, a large community map was prepared depicting the local rivers and main tributaries, village settlements and the borders of the Crocker Range Park. Hunters were then asked to plot the location of each hunting ground on the community map.

Hunters produced a list of 75 toponyms during the exercise, of which 30 were assigned to the category "most important", 17 to the category "important", 9 to "quite important", and 14 to "least important". 5 toponyms remained uncategorised where group members could not reach an agreement. Hunters explained that they had assigned the highest importance rating to those hunting grounds which were the most reliable sources of game, irrespective of distance from village settlements. Grounds which were moderate to good sources of game were ranked "important", again regardless of distance. "Quite important" hunting grounds were considered fairly unreliable but were close to the village, those "least important" were both unreliable sources of game and difficult to reach.

The mapping exercise produced some important management implications; principally that the importance of hunting areas does not necessarily correlate with distance from the village. Studies of tropical forest hunting often make the assumption that hunting pressure decreases linearly with distance from village settlements, but this does not appear to hold in Buayan-Kionop. In fact many of the most important hunting grounds occur at a considerable distance from habitation, whilst those nearby are often deemed inferior for hunting. A likely explanation is that the less disturbed forest areas further from the village are capable of supporting higher population densities of hunted species than the frequently disturbed forest closer to, and thus hunting success tends to increase with distance travelled from the village. This would suggest that hunters require a considerable area in order to meet the subsistence hunting needs, and that any spatial restrictions placed on hunter access should carefully consider the relationship between forest heterogeneity and hunting success.

The results of the community hunting map are being integrated into the Resource Catchment Area (RCA) (a comprehensive GIS map detailing settlements and ethnobiological resource use in Buayan-Kionop, currently being developed by GDF), to give spatial references for each hunting ground.

# 6. Freelisting and Pilesorting

Ethnobiological research techniques were used to explore community perceptions, knowledge, classifications and valuations of hunted animals. Firstly, freelisting was used to determine the culturally-relevant constituents of the domain "hunted animals"; in other words which species community members consider to be hunted animals, and which they consider to be the most important. Participants were asked to list all the animals they know (giving names in the Dusun language) which are locally hunted in the forest; regardless of whether they are frequently or rarely caught, and whether or not the participant had first-hand experience of the capture of any particular animal. The adoption of such a broad definition was necessary since many participants were not themselves hunters. Moreover, individual hunters typically know the names of many hunted animals which they themselves have never before encountered, and limiting the domain to those animals which the hunters present at the workshop had previously caught was thus viewed to be overly restrictive.

22 participants produced freelists, with an average length of 41 items. The total number of items listed was 185, later reduced to 169 following the removal of synonyms. Consensus Analysis performed using ANTHROPAC software revealed a high degree of consensus among informants (pseudo-reliability= .962, average knowledge score= .73), indicating that community members (irrespective of age, gender, and whether or not they are themselves hunters) agreed strongly on which items constitute the domain "hunted animals". Three participants were outliers with much lower than average knowledge scores, as they produced long lists and were responsible for most of the domain items with low frequency of mention. These three participants comprised one middle-aged active hunter and two elderly ex-hunters, and their scores may thus represent specialised knowledge not shared by the majority of community members.

Further analysis of the freelist data revealed that of the hunted animals listed, 52% belong to a Dusun category which can be glossed in English as "mammals" (*Ninterusan*), 39% to

a category "birds" (*Tombolog*), and 9% to a category "snakes" (*Tulanut*). Of the mammals, all those identified as frequently caught (especially those caught using firearms) had received high Smith's Salience scores (meaning that they were mentioned by the majority of respondents, and were usually among the first few items listed) in the freelisting analysis, whilst those infrequently caught were generally of lower salience. The majority of hunted birds were of low salience, and were found to be hunted infrequently; predominantly by young males using slingshot. Only three bird taxa (*sunggang*, *longut* and *kondiu*) were of high salience and included in the consensus model, and these were discovered to be large-bodied hornbills and eagles captured using firearms. All reptiles were of low cultural salience and were reported to be caught only rarely.

Whilst some further work is needed, the freelisting analysis to date shows us that *i*) the most culturally salient hunted animals are almost exclusively mammals, but *ii*) cultural salience in this domain may be more a function of frequency and mode of capture than taxonomic status. Additionally *iii*) there is overwhelming consensus between hunters and non-hunters, men and women, and young and old as to which are the most culturally salient hunted animals, but *iv*) there are many other species which are hunted less frequently, and knowledge of these taxa may be held unequally between experienced hunters and other members of the community.

Freelisting salience scores appear to correlate strongly with the hunting register data (section 4). Figure 6.1 below shows a significant relationship ( $r^2$ = .57, P= .001) between the offtake of hunted animals and the salience scores of those animals in the freelisting exercises. This indicates that the cultural importance of hunted animals in Buayan-Kionop may largely depend on their contribution to subsistence.



Figure 6.1: Linear regression of freelist salience scores against animal offtake.

Pilesorting was used a method to further explore the classifications used by community members to group and associate hunted animals, and the reasons given for these groupings. Four identical decks of 25 cards were produced, each card bearing an illustration of a hunted animal, its name in the Dusun language and a number from 1 to 25. Animals were selected for inclusion based on salience scores from freelisting exercises and capture records from hunting registers. Before pilesorting began, participants were shown the cards and asked whether they recognised the animals depicted, whether the Dusun names allocated to them were correct and whether they considered them to be hunted animals. The objectives and methods of the exercise were then explained, and it was clarified that the animals chosen for the exercise were in no way intended to represent the full spectrum of animals hunted by the community. Participants were interviewed individually and asked to make groups of cards based on any criteria they wished. Once participants had completed a sort, the numbers of the cards were recorded and the respondent asked to give reasons for the formation of each group.

They were then asked to perform a second sort, to allow the expression of other associations between hunted animals based on different criteria.

11 participants performed pilesorts including men and women, hunters and non-hunters. Consensus was high (pseudo-reliability= .899), indicating that respondents tended to form similar groups regardless of gender and whether or not they are hunters. Multi Dimensional Scaling (MDS) indicates that respondents often formed groups based on morphological/taxonomic similarity.

However, examination of the reasons given for forming groups indicates that they were not formed based on morphology and taxonomy alone. The majority of reasons related to capture and encounter (frequency and ease/difficulty, techniques used), aspects of utility (palatability and medicinal properties of meat), or ecological knowledge of the animal (feeding, activity and preferred habitat). Groupings based on morphological attributes were in fact relatively uncommon.

There may be several reasons for this discrepancy. Firstly, it may be that animals which are grouped based on the above criteria just happen to be morphologically similar. This indeed seems likely; for instance capture techniques used for deer may be wholly inappropriate for the capture of porcupines, the activity patterns of diurnal squirrels clearly differ from those of nocturnal palm civets. Secondly, it may be that respondents made initial groupings which were non-consciously based on physical similarity, and then justified these groupings using other criteria. This also seems valid since respondents commonly gave the same reason for forming several of the groups within a sort. It is probable that these two factors operate concurrently, and that the precise nature of classification of hunted animals in Buayan-Kionop is exceeding complex. Nonetheless, the pilesorting analyses demonstrate that hunted animals are not grouped based on morphological features alone, and that practical utilitarian values and ecological knowledge play important roles in the ways that community members conceive of and associate hunted animals.

#### 7. Conclusions and Recommendations

The multi-disciplinary approach to the study of subsistence hunting reported herein allows a multi-faceted understanding; from both etic (scientific outsider) and emic (local community) perspectives. Monitoring, freelisting and interview methods all concur that villagers hunt a wide variety of mammal species, but that only a few medium to largebodied species constitute the vast majority of hunted offtake.

Subsistence hunting in Buayan-Kionop occurs over a wide geographical area, which is unsurprising given the finding that mammal species occur locally at low densities. Low population densities however are not necessarily indicative of overhunting, as medium to large bodied mammals inhabiting tropical forests typically occur at low densities even where hunting pressure is slight or completely absent. The fact that community members have been hunting in the area for generations and area still able to procure adequate supplies of game may indeed be testament to the sustainability of hunting in Buayan-Kionop. Management interventions concerning zonation must take into account that overly-restrictive delimitation of legal hunting grounds may preclude villagers from the ability to harvest sufficient game for subsistence, whilst producing few tangible conservation benefits. The most heavily hunted mammal species are ungulates with moderate to high intrinsic rates of natural increase. In a community with a fairly small population and little ability to hunt for market sale, these species are unlikely to be under serious threat of extirpation. A suggested management intervention would be to negotiate with the community a moratorium on the hunting of species of local and international conservation concern, (i.e. those protected under state and federal enactments, and internationally by the IUCN), which are in any case extremely rare and provide little contribution to community subsistence. Also, future research should pay particular attention to any demographic increases in the community and/or increased access to outside markets by community members and access to the area by outside hunters.

The study of subsistence hunting in Buayan-Kionop will be greatly augmented by the establishment of a participatory monitoring system for community hunting. This initiative is being undertaken by GDF, and will build upon the hunting monitoring system described in this report; expanding it and eventually conferring full responsibility for data collection and management to trained community participants. This is a major step

towards responsible community co-management of natural resource use in a tropical forest habitat, and is an initiative which is being embraced and supported by Park management authorities, local non-governmental organisations and the community themselves.

Hunting in Buayan-Kionop is clearly a critical subsistence activity; since community members have no direct access to markets and generally receive little or no monetary income. With little suitable land for livestock and animal husbandry, subsistence hunting and fishing constitute the only source of available protein for the community. Furthermore, the practice of subsistence hunting is deeply embedded in the cultural identity of the Buayan-Kionop Dusun. A key part of their identity stems from access to their ancestral lands, and thus their continued ability to hunt in these areas is of vital importance for the survival both the people themselves and the ecological and cultural knowledge they possess.

# 8. Acknowledgements

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# **Appendix 1:** List of mammal species identified by at least one hunter as having previously been caught and consumed.

DUSUN NAME	COMMON NAME	SCIENTIFIC NAME
Monosop	Grey Leaf monkey	Presbytis hosei
Babo	Tufted Ground squirrel	Rheithrosciurus macrotis
Bulukun	Pangolin	Manis javanica
Pungit	Bats (generic)	Chiroptera (Order)
Maragang	Red Leaf monkey	Presbytis rubicunda
Kara	Long-Tailed macaque	Macaca fascicularis
Gobuk	Pig-Tailed macaque	Macaca nemestrina
Kalawot	Bornean gibbon	Hylobates muelleri
Manggas	Giant squirrel	Ratufa affinis
Bosing	Small squirrels (generic)	SCIURIDAE
Monggoluton	Prevost's squirrel	Callosciurus prevostii
Tompin	Flying squirrels (generic)	SCIURIDAE
Hutun	Common porcupine	Hystrix brachyura
Lisis	Long-Tailed porcupine	Trichys fasciculata
Bohuang	Malayan sun bear	Helarctos malayanus
Silou Pingas	Yellow-Throated marten	Martes flavigula
Posis	Malay weasel	Mustela nudipes
Tudu	Teledu (Malay badger)	Mydaus javanicus
Bongol	Otters (generic)	MUSTELIDAE
Pasui	Binturong	Arctitis binturong
Tinggorgorot	Malay civet	Viverra tangalunga
Tomuning	Small -Toothed palm civet	Arctogalida trivirgata
Kirabas	Masked palm civet	Paguma larvata
Pangal	Common palm civet	Paradoxurus hermaphroditus
Sintukadtukad	Banded linsang	Prionodon linsang
Tantaburui	Treeshrews (generic)	TUPAIIDAE
Palanuk timbalabog	Lesser mousedeer	Tragalus javanicus
Palanuk tindudungau	Greater mousedeer	Tragalus napu
Paus	Barking deer (common and yellow)	Muntiacus muntjac/atherodes
Tambang	Sambar deer	Cervus unicolor
Bosing ratau	Four-Striped ground squirrel	Lariscus hosei
Sigindur	Norway rat	Rattus norvegicus
Purak Tian	Brown spiny rat	Maxomys rajah
Gayat	Grey Tree rat	Lanothrix canus
Borud	Long-Tailed giant rat	Leopoldamys sabanus
Bungangar	Banded palm civet	Hemigalus derbyanus
Gawir	Flying Fox	Pteropus vampyrus
Bakas	Bearded pig	Sus barbatus
Kudurau	Moonrat	Echinosorex gymnurus
Langah	Colugo	Cynocephalus variegatus
Tananasad	Clouded leopard	Neofelis nebulosa
Tagawot	Black flying squirrel/red giant flying squirrel	Aeromys tephromelas/Petaurista petaurista

Dusun name	Predator species	Part eaten	Notes
Pongoi	All deer	Leaf	Found in Puru
Burini	All deer, prob. many others	Fruit	Medium sized soft fruit
Nunuk	All deer	Fruit	Strangler fig
Tikalod	Bearded pig	Seed/acorn	Oak, mast fruiting times said to correspond
			with those of <i>Tarap</i>
Nungkalang	Sambar deer	Leaf	Large-leaved herbaceous plant
Petai	Bearded pig	Seed/bud	Small legumes found on forest floor
Puruput	Civets	Fruit	Medium sized green fruit
Lemog Lemog	All deer	Fruit	
Tarap	All deer, prob. others	Fruit/seed	Grows wild, but also grown domestically
Mundok	All deer, perhaps especially	Leaf/stem	Crop plant; tapioca
	barking		
Natu	Bearded pig	Fruit	
Kapur	Bearded pig	Fruit/seed	Dipterocarp, wind-dispersed winged fruit
Miripiri	Bearded pig, possibly Barking	Fruit	
	deer		
Malugus	Bearded pig	Fruit	
Rambutan	Bearded pig, rats, squirrels, PT	Fruit	Species of wild rambutan
Hutan	macaque, LT macaque,		-
	barking deer, giant squirrel		
Bodung	Bearded pig, LT macaque, PT	Fruit	
_	macaque		
Pongi	Bearded pig, Sambar deer,		
	barking deer		
Polod	Bearded pig, Masked PC,		
	small toothed PC, common PC		
Paliu			Not food plant; sap used for blowpipe poison
			(sumpit-Ma, sapuk-Du) for small birds
Bungug	Bearded pig, monkeys, giant	Fruit	
	squirrel, small squirrels		
Pogoh	Bearded pig, squirrels, giant	Fruit	
	squirrel, monkeys		
Lilimboon	TG squirrel, squirrels, rats	Fruit	
Kondis	PT macaque, LT macaque,	Fruit	Wild mangosteen
	squirrels		
Timbagan	LT macaque, PT macaque,		
	bearded pig, Sambar deer,		
	mousedeer, barking deer		
Tolibung	Bearded pig	Cone	Tall Sago palm
Ronggitom	Prob. many	Fruit	Wild Rambutan

# **Appendix 2:** Fruits and plants consumed by hunted mammals, as identified by hunters.

#### Abbreviations

"All deer" refers to: Sambar deer, both species of Barking deer and both species of Mousedeer

- "PT" macaque refers to the "Pig-Tailed" macaque "LT" macaque refers to the "Long-Tailed" macaque "PC" refers to "Palm Civet"; species indicated by prefix "TG" squirrel refers to the "Tufted Ground" squirrel