

# Hunting at the Abun Regional Marine Protected Areas: A Link Between Wildmeat and Food Security

FREDDY PATTISELANNO<sup>1\*</sup>, MUHAMMAD IRFANSYAH LUBIS<sup>2</sup>

<sup>1</sup>*Tropical Environmental and Sustainability Science (TESS), James Cook University, Cairns, Queensland 4870, Australia*

<sup>2</sup>*Centre for Environmental Research (PPLH), Bogor Agricultural University, Darmaga Campus, Bogor 16680, Indonesia*

Received June 3, 2014/Accepted November 17, 2014

Native Papuans are relied on hunting for subsistence purposes and significantly contributed to traditional cultures. However, in Papua information on hunting is limited and largely restricted to anthropological setting with most observations were done on the forest sites in lowland and highland landscapes. This study focuses on the contribution of hunting on food security along the coastal forests at the Bird's Head Peninsula. Do people live near coastal sites mostly rely on marine resources as protein source? We gathered data on hunting by the majority of Karon ethnic group in the Abun district of Tambrau Regency at the Bird's Head Peninsula of Papua, Indonesia. We used information from in-depth interviews with hunters and households meal survey at four villages of Abun: Waibem, Wau, Warmandi and Saubeba. Reasons for hunting were varies among respondents but mostly conducted for trade. Six species of mammals and three birds were commonly hunted by using six different hunting techniques. Wild pig and rusa deer were the major targets in hunting to meet the demand of meat for both trading and household consumption. Meals containing wildmeat was the most consumed meal, greater than meals containing fish, animal products and vegetables, and noodles.

Key words: hunting, coast landscape, Bird's Head Peninsula of Papua, food security

## INTRODUCTION

Historically, tropical-forest people have been hunting wildlife for food for at least between 40,000 years and 10,000 years, and today many peoples across the tropics continue the practice (Bennett 2002). The reason is because wildlife products are valuable commodities, and wildmeat is considered as premium value, because it has a high value per unit weight compared with other forest products (Robinson & Bennett 2000).

The preferences for different wildlife species are usually influenced by economic activity, access to domestic meat, ethnic origin, geographical isolation, local wildlife availability and the biological attributes of species that are hunted (Ling *et al.* 2002; Naranjo *et al.* 2004). In addition, other factors have influenced prey preference, such as the social, cultural and political characteristics of the ethnic groups that hunt (Fa *et al.* 2002).

Hunting in tropical forests is generally done to obtain food, generate income and to perform

cultural rites (Robinson & Bennett 2000). Some findings in the scientific literature argue that wildlife hunting in tropical forests is mostly for the purpose of subsistence (Robinson & Bennett 2000; Milner-Gulland *et al.* 2003; Fa & Brown 2009). Therefore, many people who hunt wildlife in tropical forests rely on the accessible and ready source of protein to feed their families. Fa and Yuste (2001) stated that wild animal meat was the staple diet of forest-dwelling peoples in tropical areas during ancient times. The World Food Summit of 1996 defined food security as existing "when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life" (<http://who.int/trade/glossary/story028/en/>). Commonly, the concept of food security is defined as including both physical and economic access to food that meets people's dietary needs as well as their food preferences.

Limited or no access to alternative sources of protein is one among several factors influencing wildlife hunting, and consequently in some cases people still rely on wild meat and cannot readily make the switch to other sources (Bennett 2002). In contrast, Bennett and Rao (2002) argued that people who lived near coastal sites such as in Southeast Asia and West Africa were able to find available alternative protein, and decreased their dependence on wild meat.

\*Current address: Department of Animal Science, Universitas Negeri Papua (UNIPA), Manokwari 98314, Papua Barat, Indonesia

\*Corresponding author. Phone: +62-986-212156, Fax: +62-986-211455, E-mail: [freddy.pattiselanno@my.jcu.edu.au](mailto:freddy.pattiselanno@my.jcu.edu.au), [freddy.pattiselanno@fppk.unipa.ac.id](mailto:freddy.pattiselanno@fppk.unipa.ac.id)

Our knowledge of hunting in Papua is, unfortunately, behind similar research in the Neotropics and Afrotropics, even our neighbouring Papua New Guinea. In Papua, only few studies have been conducted and most observations were carried out at the forest edge in lowland and highland landscape with its contribution to cultural and local livelihoods (Petocz 1994; Pattiselanno & Koibur 2008; Pattiselanno & Arobaya 2013).

Despite the fact that hunting contributes significantly to local livelihood, available alternative protein such as livestock meat and fish might reduce the reliance of household on wild meat (Brashares *et al.* 2004). Bennett and Rao (2002) for example, found that people who lived near coastal sites such as in Southeast Asia and West Africa were able to find available alternative protein, and decreased their dependence on wild meat.

Therefore, this study focuses on the hunting practice along the coastal forests at the Bird's Head Peninsula of Papua, in particular Kawasan Konservasi Perairan Daerah (KKPD) – Abun Regional Marine Protected Area (ARMPA) landscape. We documented the importance of hunting and the practice of hunting along the coast landscape with regards to wildmeat consumption.

## MATERIALS AND METHODS

**Time and Place.** Research was conducted between June 2012 and December 2013 at Abun District which includes four villages: Subeba, Warmandi, Wau and Waibem, at the Bird's Head Peninsula (BHP) (Figure 1). All villages can only be reached using boats, as there is no road connection between villages to the nearest towns.

**Description of the Study Site.** Abun district has been declared as a Kawasan Konservasi Perairan Daerah – Regional Marine Protected Area under a Government Decree, SK Bupati Sorong No. 142/2005. It covers 862.43 km<sup>2</sup>, which is located at 132°14'–132° 98' E and 0° 32'–0° 58' S approximately 200 km north-east of Sorong.

The land area of Abun consists of the coastline and adjacent rocky hill areas that give way to more hilly areas and then mountainous parts. It is mostly covered by primary forest and secondary forest. The coastal forest is dominated by vegetation such as *Ipomoea pescaprae* and *Scaevola serillae* in the seaward, and in the landward area by *Barringtonia asiatica*, *Terminalia catappa*, and *Pandanus*.

**Methodology.** Available administration data at the regency, district and village levels was

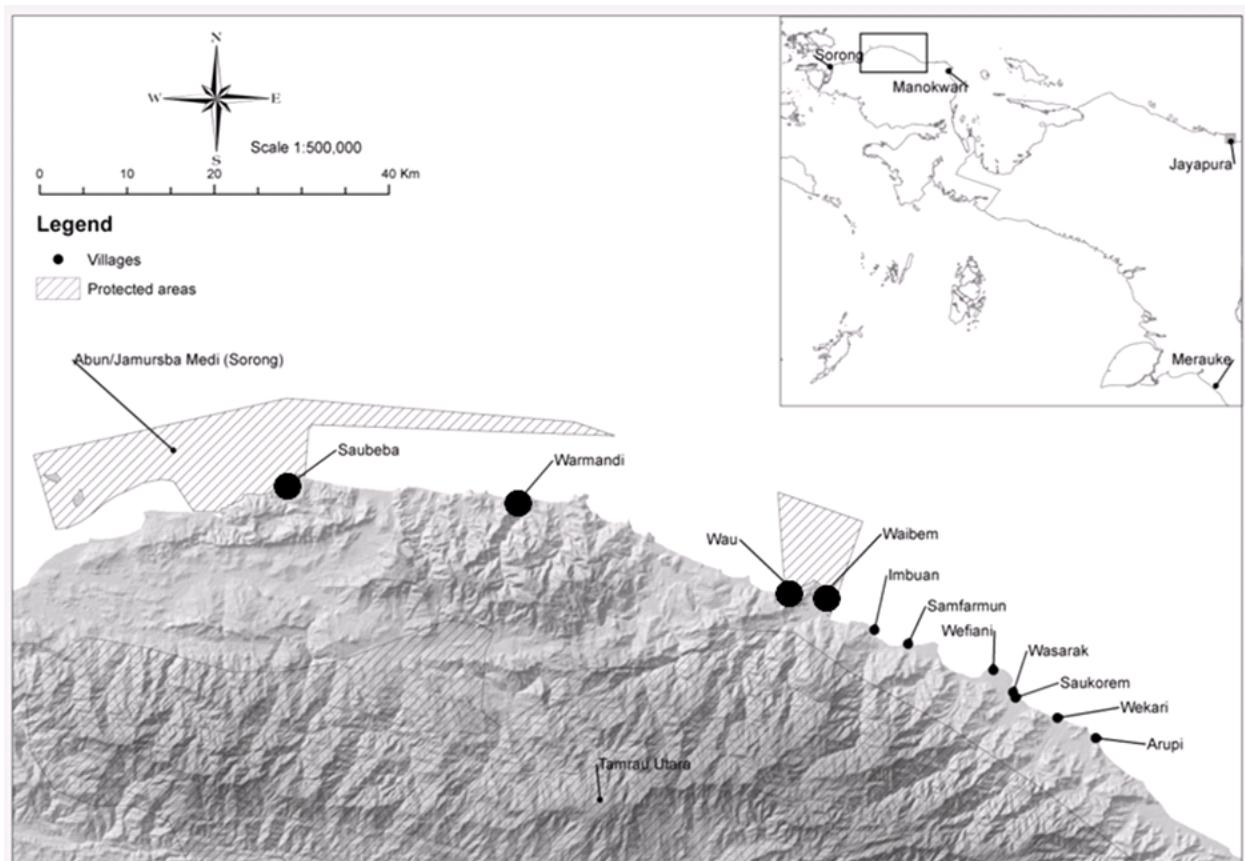


Figure 1. Large dots show a relative location of the study site.

collected to provide the baseline information about the village situation. Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA) were also conducted to obtain economic background and an overview of village condition (Chambers 1984; Chambers 1994).

Collecting eggs and turtles hunting along the coast of BHP was not a part of this study. Thus, this study only focused on the terrestrial wildlife hunting. Information about hunting was gathered through interviews with 80 focal hunters using the Wildlife Conservation Society hunting questionnaire (Rao *et al.* 2005). In order to gain an overview on hunting from people who were not actively hunting with different occupational background across the whole community in the sampled villages, one hundred questionnaires were distributed to random respondents (excluding the 20 “focal respondents”) in each of the four villages. Two hundred and thirty-eight questionnaires were returned for further analysis.

Household meal surveys were conducted to determine the level of consumption of wildmeat and other food items (e.g. fish, meats, eggs, canned meat and vegetables including noodles). These surveys consisted of interviews with housewives or those responsible for food preparation in the households (n = 200). People were asked about kind of meals were served each day and for frequency within a week those meals were consumed.

We employed statistical analysis S<sup>+</sup> for the Analysis Biological Data (Jones *et al.* 2012) using chi-square to examine the association between categorical variables and the difference within the sampled villages and mosaic plot was used to describe the results of analysis.

## RESULTS

**Hunter’s Profile.** Karon is the major ethnic group which settled at Abun. There are several clans belonging to Karon that own the land and natural resources in each village. About 66% of our respondents were Karon and the rest (34%) comprises of the mixture Papuans (Mpur, Kebar, Sausapor, Sorong, Biak, and Serui) and non-Papuans (Timor, Ambon, Manado, Bugis, Toraja, and Banggai). Like any other Papuans, the Karons subsist largely through horticulture, practising swidden and fallow cultivation. Although they eat rice, they still rely on tuber crops (cassava and taro), bananas and some vegetables. Most of the households rely on agriculture (66%) while some earned money from labouring (12%), fishing (7%) and government

employment (6%). They also herd livestock such as chicken, goat and pig.

**Hunting Practices and Aims.** Half of the respondents (50%) committed hunting for trading purpose. Tradeable meat (mostly venison and bacon) were sold fresh to the middlemen who regularly visited villages along the coastal with their boats. The local price per kilogram was Rp. 25,000 and 15,000 for venison and bacon, respectively, and the meat were sold to Sorong, Manokwari or Makasar. Acquiring meat for personal consumption was primarily done by 39% of respondents. Hunting for festive events performed by 9.74% respondents and hunting to reduce crop damage and as a means of pest control was only done by 1.25% of respondents. Purpose of hunting between respondents within the sampled villages (Figure 2) was significantly different ( $\chi^2 = 205.6$ ,  $df = 3$ ,  $P < 0.01$ ).

Nine species of animals were hunted within the sampled villages including six mammals and three birds. The most frequently hunted animals in the study site were wild pig (*Sus scrofa*; 34%) and rusa deer (*Cervus timorensis*; 32%). Other species were killed much less frequently were dusky pademelon (*Thylogale brunii*), grizzled tree kangaroo (*Dendrolagus inustus*), spiny bandicoots (*Echymipera kalubu*), spotted cuscus (*Spiloguscus maculatus*), northern cassowary (*Casuarius unappendiculatus*), papuan hornbill (*Rhyticeros plicatus*), and pinon imperial-pigeon (*Ducula pinon*). For analysis purpose, species that were killed less frequently were merged and categorised as others.

Several different hunting techniques were used (Figure 3) and the most used technique in hunting was hunting with dog (32%) whilst the least used technique was gun (6.10%). In this study we recognised six different techniques, but spear is commonly used together with blade, thus we merged

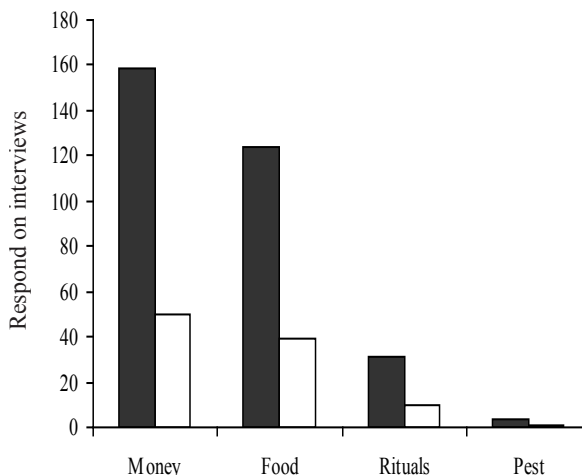


Figure 2. Reasons of hunting in the study sites. ■ Number of respondents, □ percentage.

the use of spear and blade together. Our finding showed that difference among hunting techniques employed to catch animals in this study was significant ( $\chi^2 = 66.2638$ ,  $df = 8$ ,  $P = 0$ ).

Hunted species and techniques used in hunting corresponded closely to hunting tenures (Figure 4). Most of the killing (38%) was done in the primary forests followed by 24% in secondary forests, 21% along the river's side and 16% at the plantations. The probability to hunt pig and deer in primary forest is higher than in other hunting tenure and the difference was significant ( $\chi^2 = 62.4789$ ,  $df = 6$ ,  $P = 0$ ).

Furthermore, animal protein production was further increased because abandoned fields often revert to secondary forests, which in addition to

provide many forest products that can be harvested frequently, they were also productive for some wild game species, particularly ungulates. Ungulates such as pigs and deer are preferred prey and contribute a significant proportion of animal biomass harvests.

**Household Diets.** Types of meals consumed by the households were categorised based on meals consumption encountered during preliminary household survey, and they were meals containing wildmeat, fish, livestock products, including meat, egg and canned meat; and meals containing vegetables and noodles.

Meals containing wildmeat was the most consumed meal by 49%, greater than meals containing fish, animal products and vegetables, and noodles. However, the difference between the wildmeat and non-wildmeat (fish, livestock products, vegetables and noodles) consumption was not significant ( $n = 200$ ,  $\chi^2 = 0.08$ ,  $P > 0.05$ ). Although commercial hunting was primarily done by half of the respondents in the study site, before animals sold to the wholesalers, heads, bones, legs and internal organs were removed for household consumptions. Further interviews with hunters indicated that estimated number of days which wildmeat was consumed was  $2.69 \pm 0.12$ ;  $n = 140$  or 30% higher than actual number of days wildmeat was consumed  $2.07 \pm 0.11$ ;  $n = 179$  and the difference was significant  $P < 0.0001$ .

We presumed that fish to be the most ubiquitous source of animal protein consumed because the sites were located along the coast. However, our finding showed that having fish in household diets along the coast were lesser (23%) than wildmeat. The reasons were (i) most of our respondents were farmers who spent most of their time on the farms; (ii) we also encountered opportunistic hunting occurred during their work on farms; (iii) although results from hunting were sold, hunters removed heads, bones, legs and intestines for family tables before selling the animals to the middlemen; and (iv) fishing was only conducted as a minor activity using traditional fishing equipment such as fishing rods, nets and spears.

**DISCUSSION**

**Karon Hunting Practice Along the Coast.**

Our results show that our respondents along the coast were primarily rely on agriculture, 66% of respondents are farmer while fishers are only 7.2% of respondents. Most hunters growing crops such as coconut, cacao, banana, peanuts, tuber, areca nuts, betel, and vegetables on land ranging from 250 to 10,000 m<sup>2</sup>.

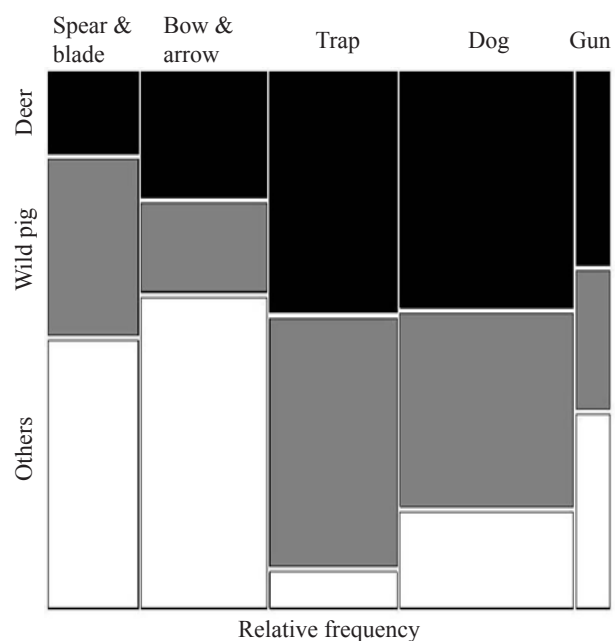


Figure 3. Target species killed by different techniques.

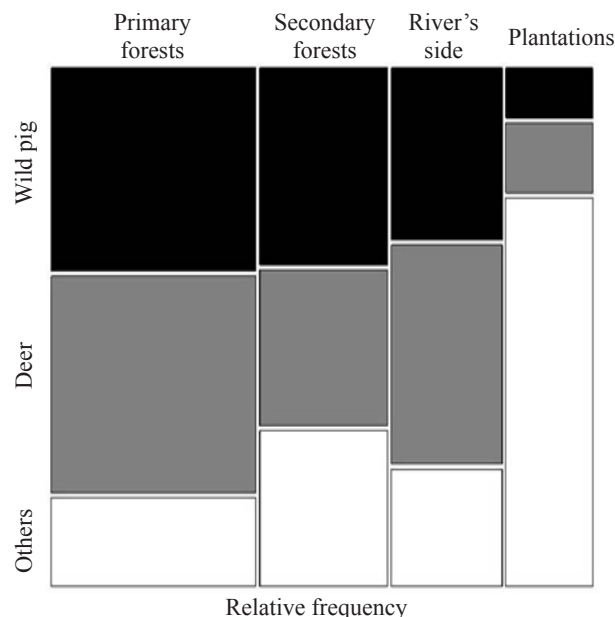


Figure 4. Target species hunted in different hunting tenures.



For people involved in agriculture like Karon, crop lands allow the production of much greater amounts of carbohydrates such as tuber crops and bananas. Despite the increase in carbohydrate production, crop lands do not provide enough animal protein available to the households. Therefore, hunting is performed in order to supply a family consumption with complete meals.

Our data also express that hunting for trading is done by half of the respondents in the sampled villages. It means that people regard wildlife as a significant source of income, although agriculture productions are mainly sold. Difficulties in transporting products to the nearest market have resulted in low demand for agricultural crops. Keep in mind that there is no road access to the study sites, thus access to the sampled villages is by boats. This situation has forced many rural farmers to seek alternative sources of income from hunting. This situation agrees on a report of Nasi *et al.* (2008) which explained that in enclave areas with limited access to roads, hunting is likely to be more profitable than farming. The reason is because the price to weight ratio of wild meat is typically higher than for any agricultural crop, and only small quantities of goods can be transported on foot to markets.

Across the humid tropics, millions of people rely on wildlife hunting for an alternative source of family revenue (Bennett & Robinson 2000; Bennett 2002; Mendelson *et al.* 2003; Hilaluddin *et al.* 2005). Though results from hunting clearly support low level household income, in some countries hunting is also the basis of a substantial business. For instance, meat from adult wild pigs sells at around Rs. 2500 (USD 55), and represents approximately 50% of the average annual per capita income of the hunters in the large towns of Dakshina Kannada in India (Madhusudan & Karanth 2002). Equally, terrestrial vertebrate species are hunted for both subsistence and the bushmeat market in the North Sulawesi province in Indonesia (O'Brien & Kinnaird 1996; Lee *et al.* 2005).

Hunting in tropical forests is also generally done to obtain food (Bennett & Robinson 2000; Robinson & Bennett 2000; Loiboki *et al.* 2002). Many people who hunt wildlife in tropical forests rely on the accessible and ready source of protein to feed their families. Robinson and Bodmer (1999) explain that the main reason for hunting in tropical forests is because wildlife is not only the most accessible animal protein, but also the only available source especially for those in the rural areas.

In this study people hunt for both obtaining food and gaining extra income for the household. Therefore the common target species are animals

with high body mass such as deer and wild pig. However some small species that endemic to Papua are also hunted but not as much as deer and wild pig. Similarly, in North-eastern Papua, both deer and wild pig are the most frequently killed animals by hunters for both subsistence and commercial purposes (Pangau-Adam *et al.* 2012). Luskin *et al.* (2014) also discovered that wild pig and deer are mostly hunted for personal consumption as well as for sale at the oil palm plantation-dominated landscapes of Sumatra.

According to Smith (2005), a preference for many animals as edible games are relied on body mass, ease of preparation, taste, and cultural attitudes towards different species. In addition, other cultural mediator factors also urge the demand for bushmeat such as familiarity, tradition and prestige (Wilkie *et al.* 2005; Schenk *et al.* 2006).

Although various hunting techniques employed by hunters, hunting with dog was predominant. Commonly native Papuans use traditional hunting weapons such as traps, bow-and-arrow and spear made from forest materials (Pattiselanno 2006; Pattiselanno 2008). Other techniques used in this study are hunting using traps, bow-and-arrow and spear and blade; these methods are widely practiced in tropical Asia (Corlett 2007). However, hunters acknowledge some benefits in hunting with dogs for example: dogs can locate, chase and catch prey animals. Similarly, dogs also assist hunters by killing prey animals in wildlife hunting at the North-eastern Papua (Pangau-Adam *et al.* 2012). In the Eastern Highland of Papua New Guinea, dogs contribute significantly in hunting as well (Mack & West 2005).

In this study, shotguns were the least techniques that used by only 6.10% percent of hunters, but this indicating a current complex array of social and cultural change of forest-dwelling people. This also indicates the shift of subsistence to market-based hunting (Pangau-Adam *et al.* 2012; Luskin *et al.* 2014). Evidence from other studies show the increase use of guns as they are a very effective and powerful to kill hunting preys so hunters can maximise hunting take to supply both household consumption and trade (Carpaneto & Fusari 2000; Robinson & Bennett 2000; Bennett *et al.* 2002; Milner-Gulland *et al.* 2003; Fa & Brown 2009; Luskin *et al.* 2014).

Most of the animals, especially deer and wild pig, are killed in primary forests while hunting in secondary forest and at river's sides shared the same percentage (26 and 25%), respectively. Similarly, Mack and West (2005) pointed out at Crater Mountain Wildlife Management Areas (CMWMA) in Papua New Guinea, kill locations were mostly in primary forests (51%) and secondary forests (30%). Our

findings suggest that large numbers of the hunting targets are generally found where there are no people live around. According to Robinson and Bennett (2000), wildlife populations tend to be extirpated near human habitations.

However, habitat modification through shifting cultivation and rotational agriculture (gardens and fallows in various stages of succession) creates habitat mosaics for certain species (Achard *et al.* 2002; Smith 2005). Therefore, in this study, medium and small species including some mammal and bird species mostly killed in plantation sites. This allowing garden hunting that commonly opportunistically conducted with no exception that females are also involved.

**Role of Wildmeat in Household Diets.** The proportion of wildmeat in the diet varies between households. However, most households rely on wildmeat as animal protein source. The dependence on wildmeat was reflected by higher meals containing wildmeat consumed at almost half of the respondents (49%) or twice than fish consumption (23%). Equally, Bennett *et al.* (2000) found that remote inland communities in Sarawak obtained 67% of their diets from wildmeat. Sometimes wild meat from hunting is more accessible and often a major dietary protein available to rural communities (Rao & McGowan 2002).

Our findings however quite opposite to a study of Bennett and Rao (2002) who argued that the percentage of people able to find alternative protein is high in Southeast Asia and West Africa because those areas are located near coastal sites where fish are available as a chief dietary protein. For example, Brashares *et al.* (2004) showed that wild terrestrial mammals were the second source of animal protein (after fish) in Ghana.

**Indigenous Hunting and Food Security.** This study provides new information on hunting practices in relation to food security at the coast sites. Firstly, there is a shift from subsistence to market-based hunting that marked a notion of indigenous hunting practice at the North-western Papua. Thus, there is a tendency to increase harvest rate to gain more benefits from hunting. This was previously experienced by indigenous people in Afrotropics, the Neotropics even Asia including some other parts in Indonesia. Secondly, to a certain extent, due to a tendency of change to market-based hunting, the use of modern hunting techniques such as guns, is used to maximise harvest rates for both consumption and sale purposes, which was evidenced in Africa as well. Furthermore, in terms of food consumption, Karon mostly rely on wildmeat as animal protein source in their diets.

This in contrast to similar studies in Southeast Asia and Africa. Overall, the previous lines of evidence indicate that indigenous hunting along the ARMPA not only lessen food-insecurity, but also provide extra income for local communities in the study site.

## ACKNOWLEDGEMENT

We thank the local government of Abun for granting us permission to conduct our study. We sincerely thank residents of Abun district (Waibem, Wau, Warmandi, and Suabeba villages) for their participation and assistance in this study. This research would not have been possible without assistance from Kartika, Stenly, Bastian, Yusuf and Nerius during field work. Benja Mambai from WWF Sahul, Jayapura, not only support this study, but also give insights and valuable information for this paper. We acknowledged Skyrail Foundation, Rufford Foundation Grant 10569-1, and Seed Fund for Research and Training (SFRT) Program of SEARCA Grant GCS11-4203 (to FP) for financial support.

## REFERENCES

- Achard F, Eva HD, Stibig HJ, Mayaux P, Gallego J, Richards T, Malingreau JP. 2002. Determination of deforestation rates of the world's humid tropical forests. *Science* 297:999-1002. <http://dx.doi.org/10.1126/science.1070656>
- Bennett EL. 2002. Is there a link between wild meat and food security? *Conserv Biol* 16:590-592. <http://dx.doi.org/10.1046/j.1523-1739.2002.01637.x>
- Bennett EL, Milner-Gulland EJ, Bakarr M, Eves HE, Robinson JG, Wilkie DS. 2002. Hunting the world's wildlife to extinction. *Oryx* 36:328-329. <http://dx.doi.org/10.1017/S0030605302000637>
- Bennett EL, Nyaoi AJ, Sompud J. 2000. Saving Borneo's bacon: the sustainability of hunting in Sarawak and Sabah. In: Robinson JG, Bennett EL (eds). *Hunting for Sustainability in Tropical Forests*. New York: Columbia Univ Pr. p 305-324.
- Bennett EL, Rao M. 2002. Wild meat consumption in Asian tropical forest countries: Is this a glimpse of the future for Africa? In: Mainka SA, Trivedi M (eds). *Links between Biodiversity Conservation, Livelihoods and Food Security: The sustainable use of wild species for meat*. Switzerland and Cambridge: IUCN, Gland. p 39-44.
- Bennett EL, Robinson JG. 2000. Hunting for sustainability: the start of a synthesis. In: Robinson JG, Bennett EL (eds). *Hunting for Sustainability in Tropical Forests*. New York: Columbia Univ Pr. p 499-519.
- Brashares JS, Arcese P, Sam MK, Coppolillo PB, Sinclair ARE, Balmford A. 2004. Bushmeat hunting, wildlife declines, and fish supply in West Africa. *Science* 306:1180-1183. <http://dx.doi.org/10.1126/science.1102425>
- Carpaneto GM, Fusari A. 2000. Subsistence hunting and bushmeat exploitation in central-western Tanzania. *Biodiversity Conserv* 9:1571-1585. <http://dx.doi.org/10.1023/A:1008943003752>

- Chambers R. 1984. Rapid Rural Appraisal: Rationale and repertoire. *Public Admin Develop* 1:95-106. <http://dx.doi.org/10.1002/pad.4230010202>
- Chambers R. 1994. Participatory Rural Appraisal (PRA): Analysis of experience. *World Develop* 22:1253-1268. [http://dx.doi.org/10.1016/0305-750X\(94\)90141-4](http://dx.doi.org/10.1016/0305-750X(94)90141-4)
- Corlett RT. 2007. The impact of hunting on the mammalian fauna of Tropical Asian Forests. *Biotropica* 39:292-303. <http://dx.doi.org/10.1111/j.1744-7429.2007.00271.x>
- Fa JE, Brown D. 2009. Impacts of hunting on mammals in African tropical moist forests: a review and synthesis. *Mammal Rev* 39:231-264. <http://dx.doi.org/10.1111/j.1365-2907.2009.00149.x>
- Fa JE, Peres CA, Meeuwig J. 2002. Bushmeat exploitation in tropical forests: an intercontinental comparison. *Conserv Biol* 16:232-237. <http://dx.doi.org/10.1046/j.1523-1739.2002.00275.x>
- Fa JE, Yuste JEG. 2001. Commercial bushmeat hunting in the Monte Mitra forests, Equatorial Guinea: extent and impact. *Anim Biodivers Conserv* 24:31-52.
- Hilaluddin, Kaul R, Ghose D. 2005. Conservation implications of wild animal biomass extractions in Northeast India. *Anim Biodivers Conserv* 28:169-179.
- Jones R, Giliver R, Robson R, Edwards W. 2012. S-Plus for The Analysis of Biological Data. Townsville, Australia: James Cook University.
- Lee RJ, Gorog AJ, Dwiyahreni A, Siwu S, Riley J, Alexander H, Paoli GD, Ramono W. 2005. Wildlife trade and implications for law enforcement in Indonesia: a case study from North Sulawesi. *Biol Conserv* 123:477-488. <http://dx.doi.org/10.1016/j.biocon.2005.01.009>
- Ling S, Kumpel N, Albrechtsen L. 2002. No new recipes for bushmeat. *Oryx* 36:330. <http://dx.doi.org/10.1017/S0030605302000649>
- Loiboki M, Hofer H, Campbell KLI, East ML. 2002. Bushmeat hunting by communities adjacent to the Serengeti National Park, Tanzania: the importance of livestock ownership and alternative sources of protein and income. *Environ Conserv* 29:391-398. <http://dx.doi.org/10.1017/S0376892902000279>
- Luskin MS, Christina ED, Kelley LC, Potts MD. 2014. Modern hunting practices and wild meat trade in the oil plantation-dominated landscape of Sumatra. *Hum Ecol* 42:35-45. <http://dx.doi.org/10.1007/s10745-013-9606-8>
- Mack AL, West P. 2005. Ten thousand tonnes of small animals: wildlife consumption in Papua New Guinea, a vital resource in need of management. Resource Management in Asia-Pacific Working Paper No. 61. Canberra: Resource Management in Asia-Pacific Program, Australian National University.
- Madhusudan MD, Karanth U. 2002. Local hunting and the conservation of large mammals in India. *Ambio* 31:49-54. <http://dx.doi.org/10.1579/0044-7447-31.1.49>
- Mendelson S, Cowlshaw G, Rowcliffe JM. 2003. Anatomy of a bushmeat commodity chain in Takoradi, Ghana. *J Peasant Stud* 31:73-100. <http://dx.doi.org/10.1080/030661503100016934>
- Milner-Gulland EJ, Bennett EL, Abernethy K, Bakarr M, Bodmer R, Brashares J, Cowlshaw G, Elkan P, Eves HE, Fa J, Peres C, Robinson J, Wilkie D. 2003. Wild meat: the bigger picture. *Trends Ecol Evol* 18:351-357. [http://dx.doi.org/10.1016/S0169-5347\(03\)00123-X](http://dx.doi.org/10.1016/S0169-5347(03)00123-X)
- Naranjo EJ, Guerra MM, Bodmer RE, Bolaños JE. 2004. Subsistence hunting by three ethnic groups of the Lacandon Forest, Mexico. *J Ethnobiol* 24:233-253.
- Nasi R, Brown D, Wilkie D, Bennett EL, Tutin C, van Tol G, Christophersen T. 2008. Conservation and use of wildlife-based resources: the bushmeat crisis. Technical Series no. 33. Montreal & Bogor: Secretariat of the Convention on Biological Diversity and Center for International Forestry Research (CIFOR).
- O'Brien TG, Kinnaird MF. 1996. Changing populations of birds and mammals in North Sulawesi. *Oryx* 30:15-156. <http://dx.doi.org/10.1017/S0030605300021530>
- Pangau-Adam M, Noske R, Muehlenberg M. 2012. Wildmeat or bushmeat? Subsistence hunting and commercial harvesting in Papua (West New Guinea), Indonesia. *Hum Ecol* 40:611-621. <http://dx.doi.org/10.1007/s10745-012-9492-5>
- Pattiselanno F. 2006. Wildlife hunting in Papua. *Biota* XI:59-61.
- Pattiselanno F. 2008. Man-wildlife interaction: Understanding the concept of conservation ethics in Papua. *Tigerpaper* 35:10-12.
- Pattiselanno F, Arobaya AYS. 2013. Sustainance hunting by Napan ethnic group in Nabire, Papua, Indonesia. *Tigerpaper* XL:23-29.
- Pattiselanno F, Koibur JF. 2008. Cuscus (*Phalangeridae*) hunting by Biak ethnic group in surrounding North Biak strict nature reserve, Papua. *Hayati J Biosci* 15:1301-134.
- Petocz RG. 1994. Mamalia Darat Irian Jaya. Jakarta: WWF Indonesia Programme dan PT. Gramedia Pustaka Utama.
- Rao M, McGowan PJK. 2002. Wild-meat use, food security, livelihoods, and conservation. *Conserv Biol* 16:580-583. <http://dx.doi.org/10.1046/j.1523-1739.2002.01634.x>
- Rao M, Myint T, Zaw T, Htun S. 2005. Hunting patterns in tropical forests adjoining the Hkakaborazi National Park, north Myanmar. *Oryx* 39:292-300. <http://dx.doi.org/10.1017/S0030605305000724>
- Robinson JG, Bennett EL. (eds). 2000. Hunting for sustainability in Tropical Forests. New York, USA: Columbia University Press.
- Robinson JG, Bodmer RE. 1999. Towards wildlife management in tropical forests. *J Wildl Manag* 63:1-13. <http://dx.doi.org/10.2307/3802482>
- Schenck M, Effa EN, Starkey M, Wilkie D, Abernethy K, Telfer P, Godoy R, Treves A. 2006. Why people eat bushmeat: Results from two-choice, taste test in Gabon, Central Africa. *Hum Ecol* 34:433-445. <http://dx.doi.org/10.1007/s10745-006-9025-1>
- Smith DA. 2005. Garden game: shifting cultivation, indigenous hunting and wildlife ecology in western panama. *Hum Ecol* 33:505-537. <http://dx.doi.org/10.1007/s10745-005-5157-Y>
- Wilkie DS, Starkey M, Abernethy K, Effa EN, Telfer P, Godoy RA. 2005. Role of prices and wealth in consumer demand for bushmeat in Gabon, Central Africa. *Conserv Biol* 19:268-274. <http://dx.doi.org/10.1111/j.1523-1739.2005.00372.x>