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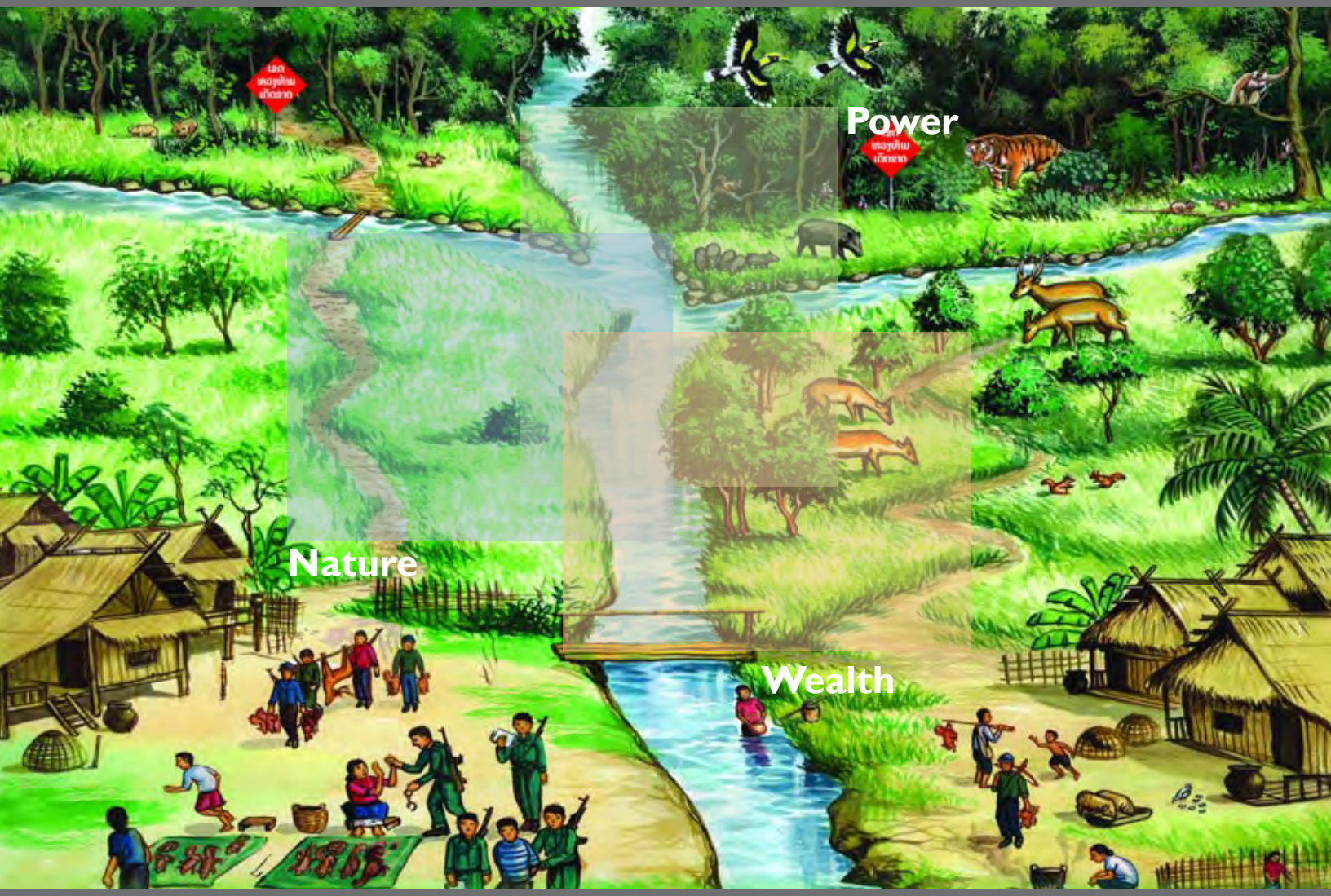

Finding the Linkages between Wildlife Management and Household Food Consumption in the Uplands of Lao People's Democratic Republic:

A Case Study from the Nam Et-Phou Louey National Protected Area

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Case Study

Finding the Linkages between Wildlife Management and Household Food Consumption in the Uplands of Lao People's Democratic Republic:
A Case Study from the Nam Et-Phou Louey National Protected Area

Report prepared for WCS TransLinks Program

Arlyne Johnson, **Jutta Krahn** and **Sengvilay Seateun**
Wildlife Conservation Society – Lao PDR

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Author Contact Information:
Arlyne Johnson
WILDLIFE CONSERVATION SOCIETY
WCS - Lao PDR
Box 6712
Vientiane, Lao Peoples Democratic Republic
ajohnson@wcs.org

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Glossary

Dietary adequacy: achieved, in the rural Uplands of Laos, when daily diets contain diverse foods from all six food groups (staples, vegetables, fruits, meat/fish/other aquatic animals or invertebrates/ eggs/plant alternatives, calcium rich foods, and oil/fats) in sufficient amounts.

Food security: achieved when adequate food (quantity, quality, safety, socio-cultural acceptability) is available, accessible and satisfactorily utilized by all individuals in all regions, at all times, to live a healthy and active life.

Food[1]: any substance which humans consume and/or drink in fresh, cooked, raw or processed form, except drugs.

Habitat[2]: the area where wildlife live, move, rest, feed, breed and cover. The habitat includes all forest areas, forest types and wetlands, whether inside or outside the protected area.

Hunting[2]: catching, shooting, killing, obtaining or collecting, whether carcasses or products derived from wildlife.

Inclusive growth: growth that allows for rapid and sustained poverty reduction; to which people from the large part of the country's labor force contribute, and from which they benefit.

National protected area[2]: the forest area legally set aside by the government for conserving biodiversity and ecologically functioning systems of wildlife and habitats.

Nutrition[1]: the consumption of nutritional, useful and safe food in order to enhance physical growth and regulate the mental development of the body.

Wildlife[2]: all animals living, growing and breeding in a natural, undomesticated state.

Wildlife Management: the management of wildlife populations – the manipulation or protection of a population to achieve a goal.

1 Source: Lao Food Law, Article 2 and 4.
2 Source: NEPL NPA Regulations 2008, Article 4.

1 Introduction: Wildlife Management and Food Security in Lao PDR

1.1 Status and trends of wildlife decline, poverty and malnutrition

Few countries face such complex challenges of inclusive growth and development as does the Lao People's Democratic Republic (hereafter called Laos) (World Bank/EC 2008). The country's natural resources are being degraded at an unprecedented pace (Duckworth et al. 1999, World Bank 2005), with much of the remaining biodiversity found in the rugged Uplands, a name used to describe the mountainous region covering the northern third of the country and running along its eastern border with Vietnam. In this part of Laos, many people still depend to varying degrees on natural resources for food, medicine, income, fuel and fiber. This area also suffers from the highest levels of rural poverty and malnutrition, coupled with limited access to markets and services. Despite this geographical overlap, until now the linkages between natural resource management, poverty and malnutrition have not been well understood.

Unique among South-east Asian countries, Laos still possesses extensive natural landscapes. With its multiple-use protected area system, covering 13% of the country, and a human population density that is the lowest in the region, Laos is a potential land of opportunity for regional biodiversity conservation. Although the nation still harbors a rich fauna with numerous species of global conservation importance, many of these populations are at alarmingly low levels (Duckworth et al. 1999, IUCN, WCS and WWF 2007). The underlying causes of this decline are unregulated hunting and illegal trade (Nooren and Claridge 2001; World Bank 2005), as well as deforestation driven by shifting cultivation, logging for timber and the conversion of natural forests to cash crops and plantations, which is proceeding at an unprecedented rate (GOL 2005).

Good nutrition is a building block of human capital and a powerful tool in poverty reduction (World Bank 2006). Conversely, malnutrition increases susceptibility to disease and impedes physical and cognitive development, which in turn slows economic growth and perpetuates poverty. Despite having an average annual GDP growth rate of 6.7% from 1998 to 2008 (World Bank 2009), ethnic minority populations in the Uplands continue to exhibit persistent high levels of malnutrition – with stunting (chronic malnutrition) being the biggest problem (WFP 2007). Among non-Lao Tai ethnic groups, about 60% of children under five years of age are stunted; 41% of children younger than five and 64% of children younger than two years of age suffer from anemia. Many also suffer from sub-clinical Vitamin A deficiency (DOS and UNICEF 2008).

Stunting at the individual level is the result of inadequate nutrient intake, disease and other factors, with underlying and interrelated causes including low household food security, inappropriate child and infant caring practices and poor environmental health. While effective

action to improve nutrition outcomes will require a multi-sectoral focus (GOL 2008), it is clear that improving food security and increasing the diversity of food intake will be crucial. The World Food Program (2007) asserts that what differentiates households with acceptable food consumption from households with poor or borderline consumption is animal protein, namely from wild fish and other aquatic animals such as crabs, shrimp, snails, frogs, water insects and other invertebrates.

Despite the high levels of malnutrition in Laos, there has been limited research on the magnitude of its effect and the relative impact of various determinants on human nutrition. In that vein, dietary change – particularly decreased consumption of wild meats – is often overlooked. Previous work has suggested that a reduction in local levels of wildlife consumption, as a result of overharvest and illegal trade, may be one of the major drivers of the lower levels of dietary adequacy found among the poor strata of the Uplands population (Krahn and Johnson 2007). Yet, a recovery of wildlife populations necessary to allow for their sustainable use will be dependent on effective management of the harvest. Although national management regulations do exist, there has been little systematic evaluation of how these guidelines compare with current practices (Johnson et al. 2005) and what impact they may have on the recovery and viability of wildlife populations and the availability of wild meat for household food consumption.

1.2 Natural resource governance – regulating for sustainable use

In the traditional shifting cultivation systems of the Lao Uplands, hunting was an indispensable element that contributed to a seasonally fluctuating food supply that, while marginal, was available year-round. It is likely that the customary diets of ethnic minorities in Southeast Asia were short on rice at times, but regularly included large amounts of terrestrial wildlife (Izikowitz 1951, Clendon 2001, Krahn 2005). By definition, hunting is ‘sustainable’ when the wildlife populations being harvested do not exhibit a continual decline in numbers and there are sufficient numbers of individuals to provide a significant resource to human users (Bennett and Robinson 2000). In Laos today, villagers report a continuous decline in wildlife numbers concurrent with an ever-increasing effort by hunters to find wild meat. Evidence from Clendon (2001), Johnson et al. (2005) and Krahn (2005) suggest that, with population growth and increasing demand for wildlife products, hunting has become unsustainable for most species.

National guidelines and strategies designed to manage wildlife offtake for sustainable use exist, with the aim of contributing to the subsistence of rural villages while also conserving viable wildlife populations (Robichaud et al. 2001). On a national scale, strategies even acknowledge management of natural resources as one of the three essential pillars for poverty eradication (GOL 2005). The specific legal instruments that guide wildlife use include the Forestry Law (GOL 2007a), the Wildlife Law (GOL 2007b) and the Ministry of Agriculture and Forestry (MAF) Regulation No. 0360/2003 (GOL 2003). Although Laos’ current regulations overlook some species that require protection and

apply protection to some species that do not require it, they represent the first steps towards outlining what can be harvested, by whom, where, during which seasons, and with which methods of harvest.

Core Zones for Wildlife Production

The National Forestry Law mandates the establishment of *core zones*[3], areas within National Protected Areas (NPAs) where hunting is prohibited and that provide essential natural refuge for wild animals to safely reproduce (GOL 2007a) (Figure 1). The rationale behind creating core zones is that surplus animals will disperse out from these zones and become available for harvest, while the viability and genetic diversity of wild populations can be maintained by linking these core zones together via corridors. The establishment of permanent refuges, such as core zones, is the most widely used mechanism worldwide for protecting species from over-exploitation (Robinson 2001), and is seen as an essential component of maintaining biodiversity in landscapes where hunting is present (Peres and Zimmerman 2001).

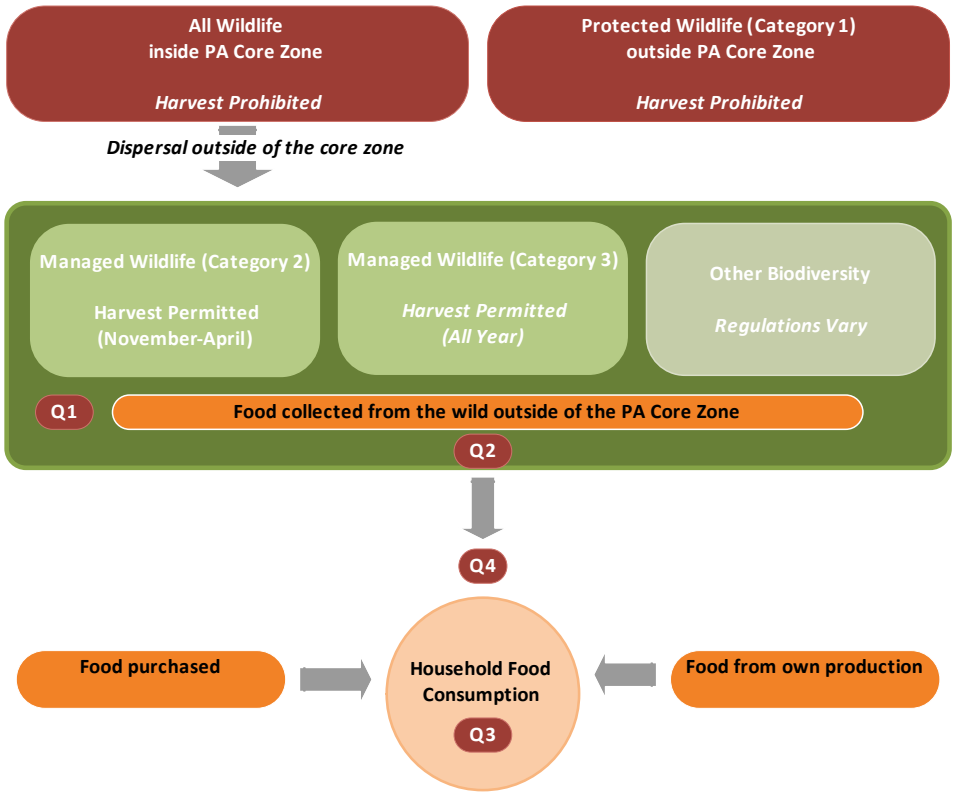

Figure 1. The diagram illustrates the three sources of food for household consumption, including foods collected from the wild, foods purchased and food produced by the household. The four research questions asked by this study, as shown in the diagram, are: **Q1.** How does Protected Area management and village governance impact the abundance and use of managed wildlife species and other biodiversity? **Q2.** What is the offtake of managed species and is it sustainable? If unsustainable, what mechanisms are needed to mitigate adverse impacts on biodiversity? **Q3.** What is the adequacy of human nutrition? If inadequate, what mechanisms are needed to improve human nutrition? **Q4.** What is the role of wild meat in household food consumption as compared to meat (and plant alternatives) coming from other sources - domestic production and the market?

3 Also referred to as Totally Protected Zones (GOL 2007a).

Cooking up 'Managed' Species but not 'Protected' Species

The Ministry of Agriculture and Forestry classifies wildlife into two groups: Managed Species and Protected Species (GOL 2007b) . Protected Species (Category 1) are those that are naturally rare or reproduce slowly (e.g. gibbon, gaur, serow) and will not persist if hunted (Table 1), while Managed Species are typically animals with naturally higher rates of reproduction that can sustain some degree of hunting (e.g. red muntjac, wild pig, porcupine). However, estimated sustainable annual offtake rates for species can vary greatly; while some rodent species can sustain a rate of offtake that exceeds 50% of standing biomass, the figure for ungulates is lower (~20%) and for primates even lower (~5%) (Robinson and Bennett 2004). Therefore, the Lao Wildlife Law further divides Managed Species into a Category 2 group, which can be harvested only during six months of the year, and a Category 3 group (those species with very high rates of reproduction such as rats and mice), which can be harvested year-round (see Figure 1).

Table 1. Estimated reproductive parameters, relative rates of growth and status in the Lao PDR for various primates, ungulates and large rodents.

Common name	Type of animal	Young per reproductive event	Reproductive events per year	Years to first reproduction	Rate of growth	Status in the Lao PDR
Gibbon	Primate	1	0.25-0.5	8-9	Slow	At risk
Macaque	Primate	1	0.5	2.5-4	Slow	Potentially at risk
Gaur	Ungulate	1	0.5	2-3	Slow	At risk
Serow	Ungulate	1	0.5-1	2.5-3	Slow-Moderate	Potentially at risk
Sambar deer	Ungulate	1	0.5-1	2	Moderate	Potentially at risk
Black Giant Squirrel	Rodent	1-3	1-2	2	Moderate	Potentially at risk
Red Muntjac	Ungulate	1	1	1	Moderate	Secure in short to medium term
Brush-tailed Porcupine	Rodent	1-2	2-3	2	Rapid	Secure in short to medium term
Wild Pig	Ungulate	4-8	1	0.75-1.5	Rapid	Status unclear

Sources: Nowak, 1991; Lekagul & McNeely, 1977; Duckworth et al, 1999.

Along with zoning, the distinction between hunted and taboo species is widely recognized as a successful management practice employed in sustainable hunting regimes around the world. Although this classification exists and has been widely communicated in Laos, implementation remains sporadic where funding and support for State enforcement is absent and community-based governance is lacking (Robichaud et al. 2001). In the absence of this management, most wildlife populations have slipped below normal levels of abundance and some are at risk of extirpation in Laos, even those species that may be secure elsewhere in the world (Table 1). This means that, in Laos, harvest of even the most rapidly growing species must now be carefully managed to allow populations to recover to their full reproductive potential.

1.3 Food sources

Beyond those foods which are harvested directly from the wild, other sources of food for household consumption are those obtained by domestic production or via market purchase (Figure 1). However, the poor strata of the population often takes longer to increase domestic livestock production than wealthier families do, and typically has less income to spend on the purchase of domestic meats.

1.4 Research questions

Given the relatively recent development of wildlife regulations in Laos, and the lack of understanding of the linkages between natural resource management, poverty and malnutrition, the aim of this study was to examine the impact of increased natural resource governance on the sustainability of wildlife offtake and, consequently, on household food consumption and dietary adequacy. Given our knowledge of the underlying causes of wildlife decline, our assumption was that the adoption of national guidelines for natural resource governance will, over time, contribute to increases in managed wildlife populations and their eventual, sustainable offtake. This will, in turn, result in greater availability of wild meat for subsistence consumption, contributing to increased food security, especially for those households in the low income strata (as depicted in Figure 2). On a broader scale, this study explores the extent to which a reduction in malnutrition is contingent upon effective natural resource governance, especially in light of unprecedented land-use pressures.

When reviewing the results of this, the first phase of the study, it is essential to bear in mind that conclusions have been drawn from data collected during the monsoon season, a period of high agricultural labor demand. Previous surveys in Laos have shown that hunting effort is typically reduced, and occurs largely within areas closer to the village, during this season (Johnson et al. 2005). Thus, the quantity and type of wildlife harvested is likely not to be representative of other times of the year, when villagers can afford to hunt and gather over greater distances from the village.

Given that a study of this kind had not been conducted in Laos before, the aim of this first phase was to test and refine the methods for collecting data and training national counterparts, with the objective of applying the lessons learned to implementation with various ethnic groups at different wealth levels in several villages during a future, second phase. During this first phase, we tested methods to investigate four main questions (see Figure 1):

Q1. How does Protected Area management and village governance impact the abundance and use of managed wildlife species and other biodiversity?
Q2. What is the offtake of managed species? Is it sustainable? If unsustainable, what mechanisms are needed to mitigate adverse impacts on biodiversity?
Q3. What is the adequacy of human nutrition? If inadequate, what mechanisms are needed to improve human nutrition?
Q4. What is the role of wild meat in household food consumption? How does wild meat compare to meat (and plant alternatives) from other sources, such as domestic production or the market?

2 Study Area

2.1 Nam Et-Phou Louey National Protected Area

The study was conducted in the Nam Et-Phou Louey (NEPL) National Protected Area (NPA), which covers 5,950 km^2 of dry tropical mixed deciduous and evergreen forest in northern Lao PDR between latitude 19°50' and 20°50' N, and longitude 103°00' and 103°53' E (Figure 3). The northern boundary of the NPA adjoins Vietnam and the protected area spans seven districts in three provinces (Luang Prabang, Houaphan and Xieng Khuang). The NEPL NPA Management Unit (Appendix 1) is administered by the Provincial Agriculture and Forestry Office under the national Department of Forestry, Ministry of Agriculture and Forestry. The Unit contains six sections, with this study falling under the Research and Monitoring Section.

Altitudes in the NPA range from 400-2,257 m, with over 60% of the land area located above 1,000 m and 91% on slopes greater than 12%. The climate is tropical monsoonal, with a rainy season lasting from May to October followed by a distinct dry season for the remainder of the year. Annual rainfall ranges from 1,400 to 1,800 mm. Temperatures may drop to less than 5°C from December to February and rise to over 30°C from April to July.

The NEPL NPA landscape has a long history of human settlement, which is evident today in the patches of secondary forest, stands of bamboo and anthropogenic grasslands that were traditionally burned for hunting and cattle grazing. In 2007, the NPA proposed a 3,000 km^2 core zone where access and extraction of resources are prohibited (Figure 3). The remaining 2,950 km^2 of the NPA is designated as a controlled use zone where villages remain and villagers are allowed to

harvest natural resources for subsistence, so long as they follow government guidelines as outlined in the introduction of this paper.

There are 98 villages bordering the NPA core zone, with a mean population of 313 people per village (Schlemmer 2002). The population is made up of three major ethno-linguistic groups: the Tai-Kadai; the Mon-Khmer; and the Hmong-Mien. Most families are engaged in subsistence livelihoods with little integration in the market economy. Rice is the staple food and is primarily produced through rotations of shifting cultivation on steep mountainous slopes. Meat and vegetables are either raised or harvested from the forest. Hunting and fishing techniques are diverse and extensive, and include the use of traps, snares, bows and guns to capture a wide range of animals.

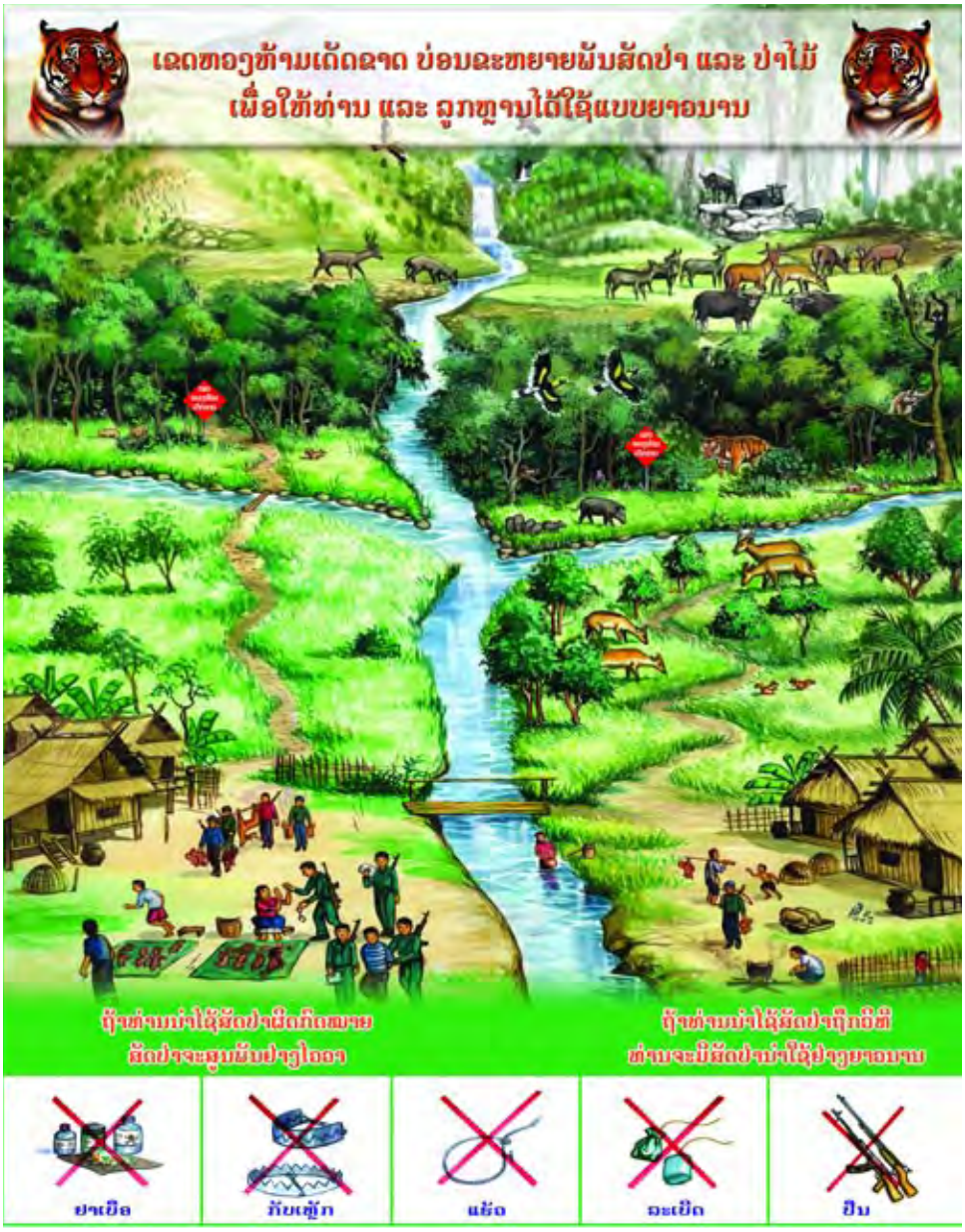

Figure 2. A conservation education poster from the Nam Et-Phou Louey National Protected Area illustrating how adoption of national guidelines for natural resource governance will contribute to an increase in wildlife populations and the sustainability of the harvest, which will in turn result in greater availability of wild meat for household food consumption.

Schlemmer (2002) recorded livestock as the main source of income for most villages, with cattle being sold outside the district or province since the 1980s. The cattle are grazed freely in forested areas and grasslands deep inside the forest, sometimes hours away from the villages, and far away from where the crops are grown. Additional income (approximately USD 100 per household per year) was reported from the sale of NTFPs such as cardamom, sugar palm, rattan, mulberry and bamboo. This amount does not take into account unrecorded income from illegal activities which, in this area, include opium cultivation and wildlife trade. In past years, villages reported weekly commerce in wildlife products with Vietnamese traders (Davidson 1998), with gaur gall bladders and sambar deer antlers among the products most commonly sold (Vongkhamheng 2002). Since 2005, NPA enforcement teams have apprehended illegal trade of tiger, bear species, East Asian porcupine, pangolin, impressed tortoise, big-headed turtle and orchid species (NEPL NPA unpublished data).

2.2 Houey Dtern village

A trial of the methods described below was conducted in Houey Dtern village, Viengthong District, which consists of 39 families (346 people) of the Mien ethnic group. Fifty-one percent of the population is under 15 years of age.

The village's subsistence land area, allocated by the government in 2001, covers 30.4 km^2 of the controlled use zone of the NEPL NPA, of which 40 ha is cultivated for the production of rice, corn and cassava (Figure 3). The village has a primary school and is one hour by truck from the Vienthong District Capital and a health center.

District authorities recommended this village for the study because it has: 1) a low dependency on market foods and some degree of wildlife use; 2) a good relationship with the NEPL NPA management unit; and 3) close proximity to the NPA core zone. In addition, the Houey Dtern village authorities indicated a genuine interest in the topics of natural resource management and human nutrition and have received technical assistance on natural resource management from the NPA since 2000.

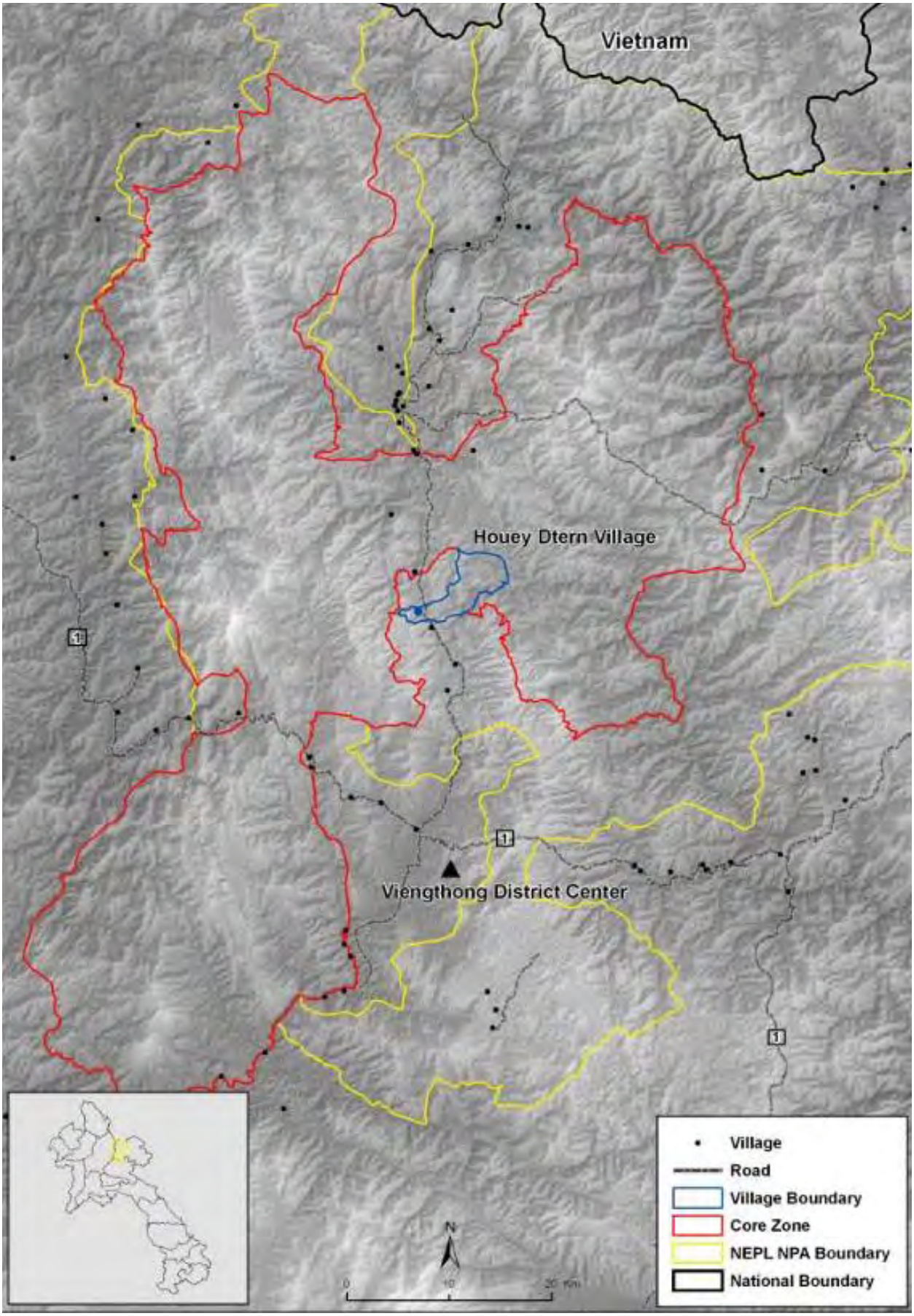

Figure 3. Location of Houey Dtern village area (blue polygon) in the Nam Et-Phou Louey National Protected Area, Lao PDR.

Villagers and district authorities compiled the following timeline of events that have impacted wildlife abundance and management in the village area over the last 20+ years:

1987:	Vietnamese traders are present in the area.
1991-1994:	Gravel road is constructed linking the village to the Viengthong District Capital; open trading of wildlife is present in the district.
1993:	The NEPL NPA is established but there is no active management.
1997:	Houey Dtern village moves to its present-day location, near the road.
1998-1999:	Bus service begins; airport opens in Sam Neua, the provincial capital.
2000:	Management of the NEPL NPA begins.
2001-2006:	Muskets are collected by the government and land is officially allocated to villages.
2007:	An NPA ranger substation is established in the nearby core zone; the NPA conservation extension team introduces natural resource management principles to the village; farmers begin cash crop production of corn, using herbicides to clear the grass.
2008:	The district introduces forages for feeding livestock and fodder for pig production, to reduce livestock grazing pressure in the forest.

3 Methods

3.1 Understanding household food consumption and wildlife offtake in NEPL NPA villages

To initiate the study, a two-day workshop was conducted in February 2009 with 12 representatives from the Viengthong District government (health, education, rural development and ethnic minorities), the Nam Et-Phou Louey National Protected Area Management Unit as well as representatives of four different ethnic groups from the NPA controlled use zone villages (Johnson and Krahn 2009). The objective of the workshop was to provide background on the principles of human nutrition in Laos and principles of managing wildlife for sustainable use. Participatory Rural Assessment (PRA) exercises on the following topics were conducted to gather background information on hunting and household food consumption:

- What foods do people eat in NEPL NPA villages?
  Foods listed by participants included: rice, taro, sweet potato, bamboo, vegetables, rock algae, mushrooms, fruits, fish, other aquatic organisms, wildlife, domestic meat, insects, frogs, shrimps, crabs, egg, spices, chili paste and fat/oil.

- What is eaten from the meat/fish/plant alternative (protein) food group?
  Participants said that wild fish is the most important animal source followed by domestic meat, other aquatic organisms, wildlife and insects. The most common wildlife consumed included rats, squirrels, birds, wild pig, muntjac and junglefowl.

- What is the trend in abundance of wildlife in the NPA over the last 20 years? Why?
  Participants prepared graphs showing steady declines in wildlife populations over the last 20 years, with some increase in populations over the last two years (see Figure 4). Participants said that these declines were the result of unmanaged hunting and fishing for subsistence and for trade.

- What are the determinants and seasonality of consumption of meat/fish/protein alternatives?
  Charts and figures prepared by participants indicated that wild meats (including vertebrates, insects and other aquatic organisms) were customarily eaten, easy to access and free of charge. People spent less time in the forest for wild food collection during the rainy season (June-September). Domestic livestock was available but largely reserved for guests and ceremonies.

- What are the spatial aspects of hunting and wild meat consumption?
  Participants indicated that villagers collect and cook foods in three different locations: 1) the village; 2) the "sanam" where livestock were kept; and 3) the forest near rivers for fishing (see Figure 5).

The results were used to design the data collection methods and select Houey Dtern as the pilot village for testing the methods.

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Figure 4. Participant-prepared graphs showed steady declines in wildlife populations over the last 20 years. Some increase in populations was perceived over the last two years due to increased government protection within the NPA.

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Figure 5. Maps prepared by participants showed villagers collecting and cooking foods in three different locations: 1) the village; 2) the "sanam" where livestock were kept; and 3) the forest near rivers for fishing. Up to 30% of the year may be spent away from the village in sanams.

3.2 Monitoring daily household food consumption and wildlife offtake

During a nine-day workshop in May 2009, a four-person field research team was trained in the methods to be used for monitoring household food consumption and hunting. The team consisted of a university-trained coordinator fluent in the Mien language, an NPA government officer and two literate field assistants (1 male and 1 female). The workshop included an introduction of the study objectives to the Houey Dtern community using an interactive nutrition education outreach program facilitated by the district health department (Figure 6). The village selected two families to participate in the trial of the methods for quantitative data collection. These two families (Table 2) met the

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Figure 6. An interactive nutrition education outreach activity facilitated by the district health department to introduce the study objectives in Houey Dtern village.

following criteria: 1) they had expressed interest in having their family be part of a nutrition study; 2) at least one member of the family was literate and able to assist with data collection; and 3) they had "sanams" (livestock grazing areas) that were within three hours of each other and the village, to facilitate data collection.

Table 2. Description of pilot families participating in study of household food consumption and wildlife offtake in Houey Dtern village from May to August 2009.

	Family Description	House and Possessions	Sources of Income (Last Year)	Livestock Owned
Family 1	Eight people including father, mother, 3 sons, 2 daughters and 1 daughter-in-law, ranging from 7-44 years old. All speak Lao language. Only one cannot read or write Lao language.	Wooden house with concrete floor and tile roof. Own a bicycle. Do not own a TV, radio, motorbike or tractor.	Sale of fruit, corn, pigs and chickens.	Eighteen livestock including: 10 chickens, 6 pigs and 2 other poultry.
Family 2	Six people including father, mother, 2 sons and 2 daughters, ranging from 9-41 years old. All are able to support agriculture, hunt and fish. All speak Lao language. Only one cannot read or write Lao language.	Wooden house with dirt floor and tile roof. Own a radio. Do not own a TV, motorbike, bicycle or tractor.	Sale of corn, pigs, chickens and paper made from bamboo.	Thirty-five livestock including: 15 chickens, 8 buffalo, 7 pigs, 3 goats and 2 other poultry.

One field assistant lived with each of the two pilot families and data were collected daily for three months (May-August 2009) using the following instruments:

Household Profile Form

Objective: To assess each family's demographic and socio-economic data, as proxy indicators for household wealth.

Usage: Collected once at the start of field work during an interview with the family head and spouse.

Household Weighing Record *(Appendix 2)*

Objective: To quantify total food intake per family per day.

Usage: Food was recorded before being cooked for each meal. Standardized codes (Appendix 3) were used to record foods consumed, source (wild, domestic or purchased), amount (edible parts were weighed with a Pesola scale), preparation technique, number of people eating, for what type of meal (breakfast, lunch, dinner, snack) and where (in the house, field, etc.).

Household Wildlife Form *(Appendix 4)*

Objective: To quantify the harvest of wild mammals, birds and reptiles per family per day.

Usage: Before being cooked, animals were photographed (dorsally, ventrally and from the side), measured (length from head to tail), sexed and weighed with a Pesola scale (see Figure 7). Blood spots were collected from mammals and birds for genetic analysis to confirm species identification, when needed. Standardized codes (Appendix 5) were used to record harvest location, hunter details (gender, age, relationship to the family) and gear used.

Village Wildlife Form

Objective: To opportunistically monitor the offtake of wild mammals, birds and reptiles by other families in the village.

Usage: Field workers opportunistically recorded animals harvested, hunter details and gear, location of harvest and whether the animal was used for food or sold.

Household Food Collection Sites Form *(Appendix 6)*

Objective: To determine the area of each family's wild food collection/capture area (catchment area).

Usage: Data was recorded by a field assistant and family member using a GPS, compass and digital camera to document UTM coordinates and photograph the habitats where wild foods were collected.

Household Livestock Slaughter Form

Objective: To monitor the slaughter of domestic livestock per family per week.

Usage: Data were recorded daily on type and number of livestock slaughtered.

Household Income and Expenditure Form

Objective: To record weekly food and non-food expenditures and income data.

Usage: Data were recorded daily on items purchased and/or income generated.

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Figure 7. Before being cooked, animals were photographed, measured, sexed and weighed.

3.3 Documenting the trends and context of household food consumption and wildlife offtake

A 3-day workshop in August 2009 was used to train the field research team in participatory methods to document villagers' perceptions of:

- historic and future trends of wildlife abundance, offtake, governance, overall food consumption, sources of food and access to food; and
- determinants of food consumption, including perceptions of food taste and nutritive value.

Data was collected by the field research team with the two pilot families and the village headman's family from August 18-21 2009, using the following instruments (Johnson et al. 2009):

Trends in Food Consumption *(Appendix 7)*

Objective: To understand villagers' perceptions of changes in consumption (volume) of various food items over time.

Trends in Food Sources *(Appendix 8)*

Objective: To understand villagers' perceptions of proportional changes in sources (domestic, wild, purchased) of food (such as meats, vegetables, fruits, rice) over time.

Trends in Abundance and Offtake of Wildlife *(Appendix 9)*

Objective: To understand villagers' perceptions of changes in the relative abundance and offtake of wildlife over time.

Trends in Governance of Wildlife Offtake *(Appendix 10)*

Objective: To understand villagers' perceptions of changes in household and village rules governing wildlife offtake over time.

Perceptions of Nutritional Value *(Appendix 11)*

Objective: To understand villagers' perceptions of the nutritional value of various food items; in particular, to identify any perceived differences between wild and domestic foods.

Taste Preference *(Appendix 12)*

Objective: To understand villagers' taste preference for food items; in particular, differences in preference between wild and domestic foods (Figure 8).

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Figure 8. Villagers arrange the food items around each circle card to rank taste preference.

4 Results

This section illustrates what was learned during the trial period (from May 24 to August 24, 2009) about the overall adequacy of the diet, the role of wild foods in household food consumption, the impact of State and village governance on the availability of and access to wild food, and perceptions of historical trends and future options for wildlife management and household food consumption. When reviewing these results, it is essential to bear in mind that trial data collection occurred during a period of high agricultural labor demand during the monsoon season, when hunting is typically reduced and largely occurs in areas closer to the village. As a result, the quantity and type of wildlife harvested is unlikely to be representative of other times of the year, when villagers can afford to hunt and gather over greater distances from the village.

4.1 Contemporary household food consumption

4.1.1 Total food consumption by volume

From May to August 2009, the volume of food consumed was recorded with the weighing form for a total of 277 meals over a period of 93 days for family 1, and for a total of 272 meals over 91 days for family 2. The results showed that, on average, families consumed three meals per day (Table 3). Although consumption of three meals per day is sometimes used as a generic proxy for sufficient access to food (see FANTA and FAM 2003), the following sections illustrate how the diets of the trial families were actually nutritionally inadequate despite a sufficient number of meals per day.

Table 3. Overview of meal pattern by two families in Houey Dtern village from May 24 to August 24, 2009.

Family	No. of days	No. of meals	Average number of meals per day
1	93	277	2.98
2	91	272	2.98

The analysis of data collected via the weighing form allowed us to evaluate food consumption per key food group: staples, vegetables, fruits, meat/fish, plant-based protein alternatives, calcium rich foods and oil/fats. Each food group was further broken down by food item type (e.g. bamboo shoots, beans, mushrooms, etc.). Total volume (the fresh weight of edible parts), mean food intake per family/capita per day, ranges of intake per meal and the ratio of food items within each food group were recorded (Table 4).

The results showed that overall intake of meat, fish, other aquatic animals (hereafter abbreviated OAA), eggs and plant-based protein alternatives was extremely low. In fact, the findings suggest a mean meat consumption of only 30 g per capita per day (this 30 g weight also includes the weight of bones, skin and viscera which are not consumed and therefore inflate the data). Intake was arguably much lower, therefore, considering that the weight of usable meat and edible body parts of wild-harvested species would only be expected to be 50-70% of

the total weight (see Krahn 2005, referring to White 1953). The low per capita intake of animal food was not buffered by a sufficient intake of plant alternatives or chicken eggs (only 1 gram each of soybeans, nuts/seeds and eggs was consumed per capita per day).

Wild meat formed 59% of the total meat intake while 41% of meat intake was domestic. Average wild meat consumption per family included 6,510 g mammals, 3,598 g fish and smaller amounts of birds, land insects, amphibians, and other aquatic animals (OAA). Domestic meat consumption, meanwhile, was only 4,950 g chicken, 2,675 g pork and 150 g raised fish. The low intake of animal food was paralleled by a low fat intake, 3 g per capita per day, which was exclusively derived from pork lard; no vegetable oil was consumed.

Rice was the mainstay of local diets, forming the bulk (72%) of staple intake. Mean per capita rice consumption was 307 g of non-glutinous rice and 31 g of glutinous rice. The additional daily consumption of 120 g of corn and 20 g of cassava was most likely not a matter of choice but a necessity. Mixed staple intake was likely the result of the substitution of cash crop production for rice production (see section 4.3.1). Average rice consumption per family was 220,221 g (or about 73 kg per family per month).

Daily per capita consumption of vegetables (282 g) and fruits (117 g) was moderate. Vegetables included primarily bamboo shoots (33%) and leafy vegetables (31%), followed by fruit-like vegetables with soft skin, beans and mushrooms. Fruit consumption included largely melons (37%), stone fruits (24%) and bananas (22%), followed by pineapples, fruits with thick skin, small berries, sugar cane, citrus and fruits with no or edible stones. Average vegetable consumption per family was 176,328 g and fruit consumption averaged 79,470 g per family (or about 59 kg and 26 kg per family per month, respectively).

The weighing form was also used to record intake of snacks, approximately 86% of which were eaten at home. Animal foods, such as insects in the field, were not consumed as snacks. Instead, snacks were mainly fruits, followed by sweets and staples. Alcohol (beer and rice whiskey) was rarely consumed.

4.1.2 Frequency of animal food consumption

The data from the weighing form were used to determine consumption frequencies of various foods, analysis confirmed that overall animal food intake was low not only in volume but also in frequency. For many days we can attest to vegan diets. Out of a total of 549 meals (including both families), 67% of meals contained pork lard while other animal foods were consumed far less frequently (Table 5). Only 2% of meals included domestic eggs and only 4% contained some domestic meat (pork, chicken and/or pond fish). In comparison, 16% of the meals contained wild meat (mammals, birds, frogs, OAA, fish and/or insects). In contrast, an average of 70% of meals contained vegetables. Given that families consumed approximately three meals per day, about two of these meals, on average, contained some type of vegetables.

Table 4. Total food intake and mean daily food intake* per capita and per family by two families in Houey Dtern village from May 24 to August 24, 2009.

Food	Family 2 (g)	Family 1 (g)	Mean (g)	Range per meal (g)	Mean per family/day (g)	Mean per capita/day	
						(g)	(%)
Non-glutinous rice	149,870	252,365	201,118	300-3,000	2,180	307[1]	65.1
Maize (kernels)[3]	77,001	73,186	75,093	80-18,300	817	120	24.3
Glutinous rice	21,255	16,950	19,103	5-2,900	208	31[2]	6.2
Cassava[3]	8,338	18,414	13,376	150-2,300	145	20	4.3
Noodles (dried)	440	275	358	55-330	4	1	0.1
Total staples	**256,904**	**361,190**	**309,048**		**3,353**	**478**	**100**
Bamboo shoots[3]	57,820	56,860	57,340	140-6,000	623	91	32.5
Leafy vegetables[3]	57,540	50,350	53,945	5-1,210	587	87	30.6
Fruit like vegetable (soft skin, edible)	28,690	26,080	27,385	20-1,800	298	44	15.5
Beans (only string and wing beans)	25,820	13,000	19,410	50-1,800	212	32	11
Mushrooms[3]	11,780	19,395	15,588	20-3,500	169	24	8.8
Fruit like vegetables (without inedible thick skin)	0	2,500	1,250	0	13	2	0.7
Other shoots[3]	360	1,400	880	30-1,400	10	1	0.5
Flowers[3]	760	300	530	100-200	6	1	0.3
Total vegetables	**182,770**	**169,885**	**176,328**		**1,918**	**282**	**100**
Melons (without skin)	11,920	45,920	28,920	80-5,440	312	42	36.4
Stone fruits (without stone)	21,340	17,050	19,195	20-3,900	209	31	24.2
Banana (without peel)	9,364	25,683	17,523	40-3,200	190	26	22
Pineapple[3]	0	9,300	4,650	0-1,900	50	6	5.9
Fruits with thick skin[3]	39	5,891	2,965	0-5,120	32	4	3.7
Small berries	192	3,776	1,984	4-2,400	21	3	2.5
Sugarcane	0	3,670	1,835	280-450	20	2	2.3
Citrus[3]	46	2,440	1,243	0-1,250	13	2	1.6
Fruits w/edible or no stone	0	2,310	1,155	0-500	12	2	1.5
Total fruits	**42,901**	**116,040**	**79,470**		**860**	**117**	**100**
Chicken[4]	8,100	1,800	4,950	350-4,600	54	9	26.1
Pork[4]	1,000	4,350	2,675	20-3,000	29	4	14.1
Pond fish (meat, bones)	0	300	150	0-300	2	0	0.8
Wild mammal[4]	5,970	7,050	6,510	40-850	71	10	34.3
Wild fish[5]	2,690	4,505	3,598	40-600	39	5	19
Wild bird[4]	585	320	453	20-305	5	1	2.4
Land insects (total)	880	1	441	280-600	5	1	2.3
Amphibian[4]	0	300	150	0	2	0	0.8
Snail, crab, shrimp, water insects (with carapace)	0	50	25	0-50	0	0	0.1
Total meats/fish/OAA[6]	**19,225**	**18,676**	**18,952**		**266**	**30**	**100**
Nuts and seeds (with skin)	0	2,098	1,049	0	11	1	54.4
Soybeans	0	1,350	675	0-750	7	1	35
Nuts and seeds (no skin)	126	280	203	10-603	2	0	10.5
Total plant alternatives (legumes, nuts, seeds)	**126**	**3,728**	**1,927**		**21**	**3**	**100**
Fish can	0	4	0	0	0	0	n.d.
Eggs (chicken)	1,150	350	750	n.d.	8	1	n.d.
Total others							
Animal lard (pork)	1,526	1,806	1,666	7-14	18	3	100
Total oil/fats	**1,526**	**1,806**	**1,666**		**18**	**3**	**100**

Table 4 Notes:

All food items listed are raw (fresh weight)

[1] equivalent to 829g non-glutinous rice (steamed)

[2] equivalent to 48g glutinous rice (steamed)

[3] edible parts

[4] includes meat, bones, viscera and skin

[5] includes meat and bones

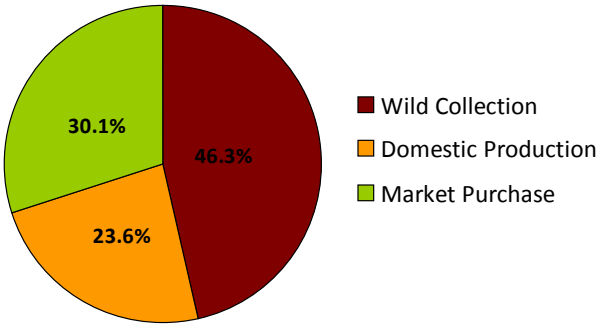
[6] other aquatic animals

Table 5. Frequency of animal food consumption in total meals by two families in Houey Dtern village from May 24 to August 24, 2009.

Meal	# of meals	Animal fat	Eggs	Domestic meats			Wild meats					
		Pork lard	Domestic	Pork	Chicken	Pond fish	Mammals	Birds	Frogs	OAA	Fish	Insects
Breakfast	184	165	5	3	6	1	26	3	0	1	12	0
Lunch	182	49	4	2	0	0	9	2	0	0	4	0
Dinner	183	151	2	2	7	0	14	4	2	0	8	1
Total	**549**	**365**	**11**	**7**	**13**	**1**	**49**	**9**	**2**	**1**	**24**	**1**
%	**100**	**66.5**	**2**	**1.3**	**2.4**	**0.2**	**8.9**	**1.6**	**0.4**	**0.2**	**4.4**	**0.2**

4.2 Food sources

Data from the weighing form indicated that the majority of the animal foods consumed (48,281 g) were collected from the wild (46%), with fewer produced by the family (23%) or purchased (30%) (Figure 9, Table 6). Sixty-seven percent of meat (excluding pork fat, pork lard and eggs) was collected from the wild (Figure 10), which means that over two-thirds of all meat consumed was hunted or collected. Only 3.5% of the meat consumed was purchased, a very low amount which is far below the national average for rural areas as reported in the LECS surveys. In contrast to the meats, most (88%) of the plant foods consumed, including staples, vegetables, fruits, seeds and nuts (807,734g), were produced domestically, while only about 12% were collected from the wild, and a very small amount (<1%) was purchased. But these proportions varied greatly within the plant group; for example, nearly half of the vegetables consumed were collected from the



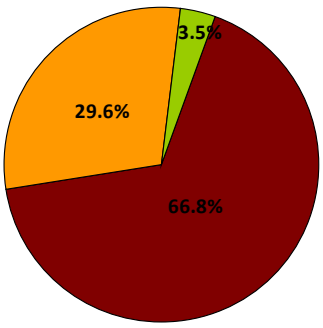


Figure 9 (left). Total animal foods, by source, consumed by two families from May 24-August 24, 2009.

Figure 10 (right). Meats, by source, consumed by two families from May 24-August 24, 2009.

wild (85,642 g of a total of 172,953 g vegetables; Figure 11) while only 3% of the fruits were (4,094 g of a total of 131,446 g fruits; Figure 12). Overall, these data indicate a high dependency on the consumption of wild meats and vegetables, despite the typical propensity by the Mien group for domestic meats (especially pork) and garden vegetables as has been shown in other surveys (e.g. WFP 2007).

Table 6. Volume of animal foods and meats collected from the wild, domestically produced and purchased by the two families between May 24 and August 24, 2009.

	All animal foods[1]		Meats only[2]	
Food source	Volume (g)	Volume (%)	Volume (g)	Volume (%)
Wild	22,351	46.3	22,351	66.8
Production	11,400	23.6	9,900	29.6
Purchase	14,530	30.1	1,185	3.5
Total	**48,281**	**100**	**33,436**	**100**

[1] including: meat, fish, other aquatic animals (crab, frog, etc), insects, pork lard, pork fat and eggs.

[2] including: meat, fish, other aquatic animals (crab, frog, etc) and insects.

Figure 11 (left). Total vegetables, by source, consumed by two families, from May 24-August 24, 2009.

Figure 12 (right). Total fruits, by source, consumed by two families, from May 24-August 24, 2009.

4.2.1 Food collected from the wild

Animals

The family wildlife form, along with the weighing form, was used to determine that the total reported volume of wild animals harvested by the two families during the three-month period was 23,831 g (see Table 7), with the majority (61%) coming from small-bodied mammals (<1 kg in size), followed by fish (30.2%), small birds and insects (each 3.7%). Comparing this to household food intake (Table 4), a small proportion of the harvested mammals (1,508 g; 10.4%) and birds (60 g; 6.8%) were not eaten by the family but were instead given to others.

Table 7. Quantity of wild animals (n=22,951 g) harvested by two families in Houey Dtern village from May 24 to August 24, 2009.

Animal Group	Weight (g)	% of Total
Mammals	14,528	61.0%
Fish	7,195	30.2%
Birds	877	3.7%
Insects	881	3.7%
Frogs	300	1.3%
Crabs	50	0.2%

The terrestrial animals harvested included mammals (n=109 individuals) and birds (n=15 individuals) (Table 8). The wild mammal species which were consumed represented four different taxonomic families (tree shrews, bats, squirrels and rats/mice), ranging in weight from 5 g to 680 g, with an average weight of 135 g. Most of these (squirrels, rats and mice) were rodents, which ranged in size from the relatively small Indochinese Shrewlike Mouse (18 g) up to the very large Berdmore's Rat (680 g).

At least 14 different species of rats and mice were harvested. The most common was the Indochinese Mountain Niviventer, which is mainly found along the ground in low vines and fallen logs and is relatively widespread in the hill forests of Southeast Asia (1,000-2,000 m above sea level). In contrast, the Indochinese Arboreal Niviventer is more often found in trees and is suspected to be declining due to loss of forest across its range. Various Rattus spp. were also commonly collected. Most of these were some form of the House Rat, a common village and Upland garden pest in all parts of Laos. The Pacific Rat also frequents village gardens and rice fields but is not commonly encountered in northern Laos. The largest forest rats collected weighed between 300 and 680 g and included Berdmore's Rat and Bower's/Mackenzie's Rat, both terrestrial and living in burrows, and the Edward's Giant Rat and Red Spiny Maxomys. All of the mice species harvested (Cook's, Fawn-coloured and Indochinese Shrewlike), except for the House Mouse, are known from hill forest mixed with grasslands and rice fields. The House Mouse is exclusively found in buildings and these possible records would be the first known incidences of this species in Laos, which could potentially have an enormous negative impact on rice and corn stores.

Both of the squirrel species are relatively common, active during the day, primarily arboreal and occur in a variety of forest types. The Northern Treeshrew is widespread and common, largely active during the day in low bushes in a variety of forest types, frequently near streams and rivers. The Large-eared Roundleaf Bat roosts mainly in caves but also in hollow trees, is relatively common and is found in variety of forest types (Figure 13).

The wild birds that were consumed were from four different taxonomic families (barbets, owls, shrikes and flycatchers) and ranged in weight from 20-170 g, with an average weight of 59 g (Table 8). Barbets inhabit treetops and feed on insects and fruits. Those harvested were juvenile birds and likely collected from their tree cavity nests. The Asian Barred Owlet is a meat-eating bird of prey found in a variety of forest types, including disturbed areas (Figure 13). The owlet was also a juvenile and likely collected from its tree cavity nest. The shrikes are meat-eaters that frequent open forested areas, feeding on insects and small animals. Flycatchers are a large group of several species that feed on insects while flying. The three species harvested are relatively common and widespread residents in Laos; the Blue Whistling Thrush frequents forested areas near rocky streams, the White-rumped Shama occurs in secondary forests and bamboo areas, and the Oriental Magpie Robin inhabits secondary growth and residential areas.

The majority of the mammals and birds harvested (70%; n=124) are Category 3 species that, following the National Wildlife Law (2008) and NEPL NPA regulations (2008), can be harvested throughout the year (Table 8). Most of the remaining species (29%) are Category 2 species that were incorrectly harvested during the national 'closed season' from May to October, while only one individual, the owlet, is a Category 1 species that is prohibited to harvest. None of the species harvested are considered 'At Risk' in Lao PDR (Duckworth et al. 1999) or are categorized as globally threatened species (IUCN 2009). Observations by field assistants that worked with families to collect the wildlife data suggest that both families were very aware

Figure 13. Animals harvested for household food consumption included, clockwise from upper left: Large-eared Roundleaf Bats, an Asian Barred Owlet, an Edward's Giant Rat and catfish.

Table 8. Diversity of wild birds and mammals harvested for consumption by two families in Houey Dtern village from May 24 to August 24, 2009.

Scientific name	English name	Number of individuals	Category[1]
Birds		**15**	
Family Megalaimidae (Barbets)			
Megalaima spp.	barbet	2	2
Family Strigidae (Typical owls)			
Glaucidium cuculoides	Asian Barred Owlet	1	1
Family Laniidae (Shrikes)			
Lanius schach	Long-tailed Shrike	5	2
Lanius tigrinus	Tiger Shrike	1	2
unidentified	shrike	2	2
Family Muscicapidae (Thushes, Flycatchers)			
Myophonus caeruleus	Blue Whistling Thrush	1	2
Copsychus saularis	Oriental Magpie Robin	1	2
Copsychus malabaricus	White-rumped Shama	1	2
unidentified	-	1	
Mammals		**109**	
Family Tupaiidae (Treeshrews)			
Tupaia belangeri	Northern Treeshrew	1	2
Family Hipposideridae (Roundleaf Bats)			
Hipposideros pomona	Large-eared Roundleaf Bat	21	2
Family Sciuridae (Squirrels)			
Dremomys rufigenis	Red-cheeked Squirrel	7	3
Tamiops maritimus	Eastern Striped Squirrel	1	3
Family Muridae (Rats and Mice)			
Rattus exulans	Pacific Rat	7	3
Rattus spp.	rat	13	3
Berylmys berdmorei	Berdmore's Rat	3	3
Berlymys cf bowersi / mackenzii	Bower's or Mackenzie's rat	2	3
Niviventer cf confucianus	Confucian Niviventer	1	3
Niviventer cf fulvescens	Indomalayan Niviventer	4	3
Niviventer cf langbianis	Indochinese Arboreal Niviventer	2	3
Niviventer cf tenaster	Indochinese Mountain Niviventer	20	3
Niviventer sp.	niviventer	1	3
Leopoldamys cf edwardsae	Edward's Giant Rat	8	3
Maxomys surifer	Red Spiny Maxomys	1	3
Mus cf musculus	Asian House Mouse	4	3
Mus cf cookii	Cook's Mouse	2	3
Mus cf cervicolor	Fawn-coloured Mouse	1	3
Mus cf pahari	Indochinese Shrewlike Mouse	2	3
unidentified	-	8	3

[1] Category of protection under the 2007 Lao PDR Wildlife Law and the NEPL NPA Regulations 2008: 1) protected species that cannot be harvested at any time of the year; 2) managed species that can be harvested from November 1 to April 30; and 3) species that can be harvested at any time of the year.

that hunting regulations exist for the NPA and were concerned about violating those regulations, but that none of the family members had a clear understanding of the details of which species could be harvested and when, especially for the smaller vertebrates (e.g. birds, rodents and bats).

Taxonomic data was not collected on the wild fish, frogs, crabs or insects that were consumed. Opportunistic photographs were taken of the aquatic animals harvested, which showed several different fish species including *Garra* spp. (cyprinids), *Ompok* spp. (catfish) and *Clarius* spp. (walking catfish), as well as freshwater prawns and crabs.

Opportunistic sightings by field researchers of other wildlife harvested in the village were recorded using the Village Wildlife Form to assess whether the type of animals recorded in the two study families was representative of what other families in the village were harvesting. Over a two-month period, researchers observed at least four different families catch a minimum of 38 animals with the majority of those being rats (78.9%) and birds (10.5%) (Table 9), similar to what was recorded from the two study families. In addition to these smaller vertebrates, the families also harvested four larger animals, varying in weight from the approximately 2,000 g bamboo rat up to the 22,000 g muntjac. All of these were used for food, except for a porcupine that was purchased by a merchant from a neighboring village. As far as the NPA regulations, most are Category 3 species (rats and bamboo rats) that can be harvested throughout the year. The muntjac is a Category 2 species that was incorrectly harvested during the closed season (May to October) and the tortoise and the porcupine are Category 1 species that are restricted from harvest. The hunting regulations also prohibit sale of wildlife from the NPA.

Table 9. Opportunistic observations of other terrestrial vertebrates harvested by four families in Houey Dtern village from June 19 to August 16, 2009 (n=38).

Animal	Number	% of Total
Rats (spp. not recorded)	30	78.9%
Birds (spp. not recorded)	4	10.5%
Impressed tortoise (*Manouria impressa*)	1	2.6%
Bamboo rat (sp. not recorded)	1	2.6%
East Asian porcupine (*Hystrix brachyura*)	1	2.6%
Muntjac (*Muntiacus* sp.)	1	2.6%

Plants and mushrooms

As noted earlier, half of the vegetables consumed were collected from the wild, as were a small proportion of the fruits (3%). A total of 175 kg of wild plants and fungi were collected for consumption. Each time a wild plant or fungi was eaten in a meal or as a snack a record was made on the Weighing Form. A total of 264 records of consumption of wild plants and fungi were compiled from May to August 2009 for the two families (Table 10). The majority of these records were

wild vegetables (90.9% of records), followed by seven different types of wild fruits, and a wild nut (Figure 14). Within the wild vegetable group (168 kg), bamboo shoots made up the majority (60.5%) of total weight, followed by wild mushrooms (20.7%).

Figure 14. Wild chestnuts and mushrooms collected for household food consumption.

Table 10. Diversity and quantity of wild plants and mushrooms harvested for consumption by two families in Houey Dtern village from May 24 and August 24, 2009.

Scientific Name	Lao Name	English Name	Part(s) Eaten	Meal Records	Weight (g)
Vegetables					
Bambusoideae (subfamily)	Noh mai	Bamboo	Shoots	86	101,670
Various families, spp.	Het	Mushrooms	Whole	71	34,825
Cratoxylum formosum	Phak toun teng	Ginger	Leaves	63	24,750
Solanum sp.	Mak khaeng	Eggplant	Fruit	5	2,350
Centella asiatica	Phak nok	Asiatic pennywort	Leaves	4	2,150
Melientha suavis	Nhod phak van	-	Leaves	6	1,240
Crassocephalum crepidioides	Phak anamung	Thickhead	Leaves	1	450
Diplazium esculentum	Phak kout	Fiddlehead fern	Leaves, stems	2	380
Spilanthes paniculata	Phak kh'aad	Spot flower	Leaves, stems	1	150
-	Phak saao	Spring onion	Leaves	1	20
Fruits					
Baccaurea ramiflora	Mak fai	Burmese grape	Fruit	3	2,592
Ficus semicordata	Mak nhod din	Fig	Fruit	8	1,432
Nephelium sp.	Mak ngor	Rambutan	Fruit	2	1,176
-	Mak khao khay	-	Fruit	4	672
Rubus multibracteatus	Mak thoum	Raspberry	Fruit	3	444
-	Mak hor	-	Fruit	1	200
Passiflora foetida	Phak bouang	Passionflower	Fruit	1	40
Nuts					
Castanopis spp.	Mak ko	Chestnut	Nuts	2	126

Size and habitat types of the collection areas

The Food Collection Sites Form and the Family Wildlife Form were used to define the area and understand which habitats were used for the collection of wild foods. Family 1 (eight people) collected wild animals and plants from 21 locations over an area of approximately 22.7 km^2, while Family 2 (six people) gathered wild foods from 12 locations over an area covering 9.6 km^2 (Figure 15). Although the land allocated by the government to Houey Dtern village in the NPA Controlled use zone is 30.4 km^2 in size, only 51.5% of all food collection sites (n=33) were within this allocated Houey Dtern village area. The remaining sites were within the Phonsong village area (45.5%) to the north and the Bouamfard village area (3%) to the south.

Table 11. Habitat at wild food collection sites (n=33).

Habitat	Sites	% of Sites
Agriculture	**25**	**75.8%**
Upland Corn Fields	*6*	
Upland Rice Fields	*5*	
Fallow Fields	*5*	
Cassava Fields	*2*	
Wetland Rice Fields	*2*	
Trap Sites	*3*	
Livestock Grazing Areas	*2*	
Fruit/Vegetable Gardens	*1*	
Secondary Forest	**4**	**12.1%**
Trap SItes	*1*	
River	**2**	**6.1%**
Village Gardens	**2**	**6.1%**

The majority (75.8%) of wild food collection sites were within agricultural areas where crops (corn, rice, or cassava) were grown, or that were currently fallow or for grazing livestock (Table 11). The rest of the sites were in secondary forest (12.1%), rivers (6.1%) or village gardens (6.1%) (see Figure 16). Traps for catching wild animals were set at three agricultural sites and one forest site. In two of these sites, traps were set in caves.

Hunters and their methods

The Family Wildlife Form was used to identify the hunters and the methods that they used to collect wild animals. The results indicated that all wild mammals and birds harvested by the two families (n=122) were collected by the males within the family and the majority of animals (89.7%) were collected by the younger sons, who were less than 15 years old (Figure 17). Most wild mammals and birds (73.2%; n=123) were collected using small metal claw traps, purchased in the village from Vietnamese traders, or with cross bows (19.5%). Bats (n=21) were collected by hand. Nets were used to cast for fish on the rivers (Figures 18 and 19).

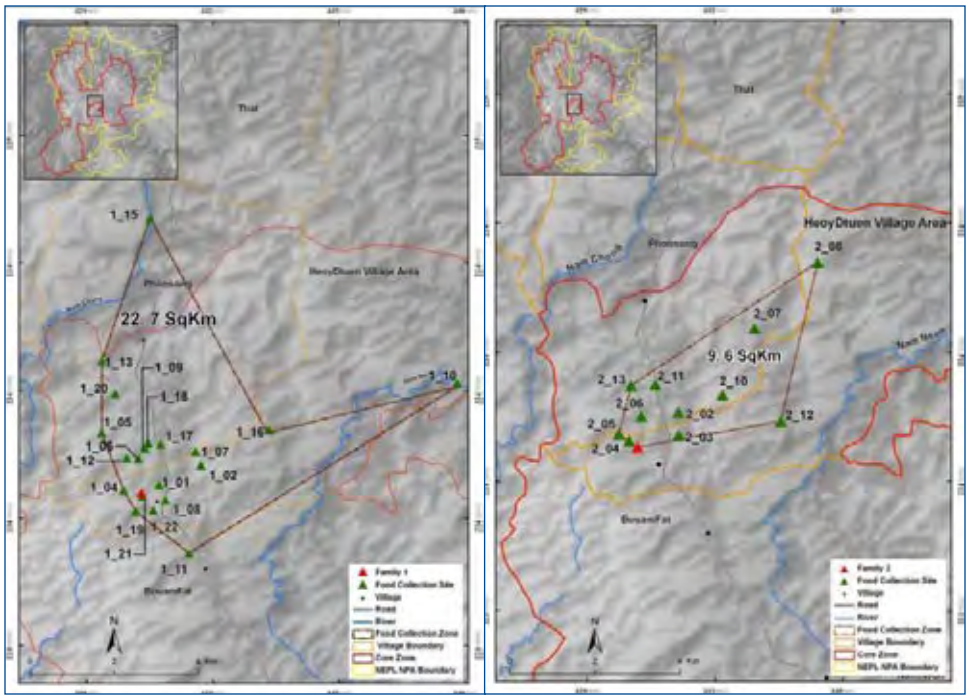
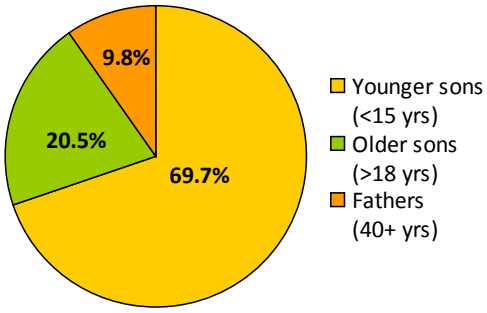


Figure 15. Area and location of wild food collection sites of Family 1 (left; n=21) and Family 2 (right; n=12) from May to August 2009.

Figure 16. Examples of habitats where wild foods were collected included (clockwise from upper left): upland corn fields, secondary forest habitat, fallow fields and village gardens.



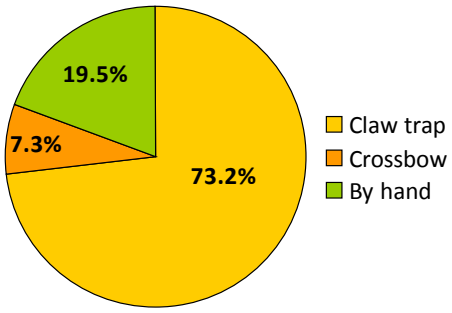


Figure 17 (left). Age of the hunters from two families collecting wild mammals and birds (n=122).
Figure 18 (right). Type of hunting gear used to collect wild mammals and birds (n=123).

Figure 19. Clockwise from upper left: examples of rodents caught by metal claw traps; young boy setting claw trap; young boys hunting with crossbows; men fishing with nets on the Nam Nern river.

4.2.2 Domestic production of foods

The findings from the Domestic Animal Slaughter Form revealed a very low propensity for the killing of domestic livestock, apart from chickens, for household food consumption. However, 56% of the chickens owned were killed during the three month research period (Table 12). The low overall intake of domestic meats suggests that a deeper understanding of domestic production issues may be needed as the barriers to increased consumption seem to relate not to taste nor value (see Section 4.3.4) but rather to limited rates of production and the propensity to keep livestock as a 'safety net'. The Slaughter Form also proved to be a useful tool for cross-checking consumption of domestic foods recorded with the Weighing Form.

Table 12. Possession and consumption of adult domestic livestock by two families from May to August 2009.

	Buffalo	Goat	Pig	Chicken (adult)	Other poultry
Owned	8	3	13	25	4
Killed	0	0	0	14	0
Percent	0%	0%	0%	56%	0%

Despite the importance of agriculture, the current research methods did not capture the issues, pattern and trends of crop production, as this first phase of research was largely focused on conducting a trial of the methods necessary to understand wildlife offtake and the role of wild meat in human diets.

4.2.3 Purchased foods

Results from the Income and Expenditure Form revealed low levels and diversity of both expenditures and income. During the study period, the mean three-month income per family was 109,000 Kip (approximately US$13), which was mainly obtained by selling domestic produce (80%) and labour (18%; see Table 13). There were no records of sales of non-timber forest products (NTFPs) by families during the study period. During the same period, the total mean expenditure by each of the two families was 587,500 Kip (~US$69), of which 176,000 Kip (~US$21) was spent on food (mainly pork lard and other animal foods) and 411,500 Kip (~US$48) on non-food items (Table 14).

Table 13. Mean household income by source for two families in Houey Dtern village from May 24 to August 24, 2009.

	Income		
Sources	**Kip**	**$US**	**Share (in%)**
Domestic produce	87,000	10.2	80
Labour	20,000	2.4	18
Other	2,000	0.2	2
Wild produce	0	0	0
Total	**109,000**	**12.8**	**100**

Taken together, these findings suggest that families went into debt during this time period. However, it is likely that either more income is earned during other months of the year to offset these expenditures or income was underreported. The share of expenditures spent on food is low relative to the national average for rural areas (DOS and World Bank 2010). Such low cash income and expenditures suggest that these families are likely to be highly reliant on natural resources for many aspects of their livelihoods.

Table 14. Mean household expenditures[1] for two families in Houey Dtern village from May 24 to August 24, 2009.

Items	Expenditures		Share (in %)
	Kip	$US	
Meats	101,000	11.9	57
Other (mainly pork fat)	38,000	4.5	22
MSG	19,000	2.2	11
Sweets[2]	6,500	0.8	4
Fruits	5,000	0.6	3
Alcohol	5,000	0.6	0
Other staples	1,500	0.2	1
Total food expenditures	**176,000**	**20.7**	**30**
Total non-food expenditures	**411,500**	**48.4**	**70**
Total expenditures	**587,500**	**69.1**	**100**

[1] No expenditures for rice, vegetables, fish, OAA, dairy, eggs, legumes, seeds, nuts, salt were recorded.

[2] Most candies were given to the children as gift from other households.

4.3 Perceptions of historical trends and future options for wildlife management and household food consumption

4.3.1 Trends in food consumption

The methods used to record perceptions of trends in food consumption (volume) were used to put wild food collection into a broader context and to identify key drivers for the food consumption patterns that we observed. The three families reported their perception of consumption of 12 different food groups, ranging from staples, vegetables, fruits, meats, seeds/nuts, oil/fats and sweets, from the time the village was established (1997) to eleven years into the future (2020; see Table 15, Appendix 13).

Families expect that domestic meat consumption will continue to increase while wild meat consumption declines. But, in fact, the perceived ratio of domestic and wild meat consumption did not match what was actually consumed during the three-month trial period, where wild meats made up two-thirds of overall meat consumption and very few domestic livestock were killed for consumption (Table 12). Villagers perceived trends for consumption of eggs, plant protein and fats to be more or less steady, which merits further investigation into whether villagers perceive the intake of those items to be adequate or not.

For staples, families said they expect rice consumption to drop as they shift to plant more cash crops, such as corn, on their available land. If cash crops cannot be sold to purchase rice, as had happened since 2008, they expect to eat less rice and instead eat more cassava, corn and wild tubers. Families expect that consumption will remain the same as in the past for both domestic and wild vegetables. Their perception that they consume a higher volume of domestic vegetables than vegetables from the wild indicates that they underestimate the

proportion of wild vegetable consumption that was actually observed during the three-month trial period, and the importance of these wild vegetables to their diets. They also reported increasing consumption of condensed milk and sweets, mainly consumed by and given to young infants and children, which are foods that they perceived to be highly nutritive (see section 4.3.4).

Table 15. Example of reported and expected average trends in consumption of 12 food groups from 1997-2020.

Food Group	Consumption	Comments
Rice	High; declining	Change to plant corn; substitution of corn, roots and tubers for rice
Domestic vegetables	High; stable	Seasonal consumption based on production
Wild vegetables	Moderate; stable	Seasonal consumption
Domestic fruits	Moderate; increasing	Increasing production and consumption of fruit over time
Wild fruits	Low; stable	Seasonal consumption
Domestic animals	Low; increasing	Recovering from periodic disease in pigs; currently, domestic meat consumption occurs mainly at ceremonies and with guests; expect to eat more domestic meat in the future because of declining wild meat consumption (see below)
Wild animals	low; declining	Decreasing, as the result of gun collections
Domestic eggs	Low; stable	Many eggs are available but are left to hatch more chickens; high mortality due to disease
Wild eggs	low; declining	Only consumption of eggs of small birds
Soybean, peanuts & sesame	Low; stable	No comments
Pork lard/fat, vegetable oil	High; stable	No comments
Condensed milk, sweets, candy	Low; increasing	Increasing access (village shop and neighboring village)

4.3.2 Trends in abundance, offtake and governance of harvest

Given the significant role of wild meats in overall household meat consumption at the present time, the participatory method was used to document how families felt the availability, use and consumption of 12 wild animal groups (including mammals, birds, reptiles, amphibians, fish and other aquatic organisms) had changed since 1997, when the village was established, and what trends families expected in these various groups up until 2020 (Table 16; Appendix 14).

Contrary to the results from Workshop 1 (Figure 4), families felt that the overall relative abundance of all animals was high, except for junglefowl, turtles and tortoises (moderate) and monitor lizards (low). They reported initial declines for some groups (fish, OAA, large birds) after the village was established but expected all groups, except for turtles/tortoises, to remain the same or increase in the future due

to the enforcement of State regulations by the NPA. They cited unregulated harvest by outsiders and the use of destructive collection methods as the reason for fish declines when the village was first established, stating that village rules had not been strong enough to control the harvest.

Except for fish and rats, which they expect to harvest more in the future, they felt that the collection of other animals is low and they expected the harvest to remain the same or even to decrease in the future. They expect the collection of larger vertebrates (mammals and birds)

Table 16. Example of reported and expected average trends in wildlife abundance, harvest, use and consumption from 1997-2020.

Wildlife type	Abundance	Harvest	Use	Traditional Rules	Consumption	Comments
Fish	High; declined but increasing since 2007	Moderate; declined but increasing since 2007	Food, gift	Yes, but ineffective	Low	River far from village; no time for fishing; fish increasing due to NPA enforcement
OAA	High; declined then increasing since 2008	Low; little change	Food	No	Low	Unsure how to harvest, eat only snail or crab
Frogs/Toads	High; no change	Low; no change	Food	No	Low	Harvest sometimes in rainy season
Monitor Lizard	Low; no change	Do not harvest	No	No	None	-
Turtles/ Tortoises	Moderate; declining	Low; no change	Food	No	Low	Catch depends on encounters; eaten <2 times since 1997
Small birds	High; no change	Low; no change	Food	No	Low	Opportunistic catch during rice harvest season
Large birds	High; declined but increasing since 2001	Low; declining	Food, gift	No	Low	Since 2001, State prohibits guns; catch with snares only
Junglefowl	Moderate; increasing	Low; declining	Food	No	Low	Since 2001, State prohibits guns; catch with snares only
Rats	High; slight increase	Moderate; increasing	Food	No	Moderate; increasing	Eat more since 2001; guns prohibited for catch of other animals
Common Palm Civet	High; increasing	Low; declining	Food, gift	No	Low; declining	Harvest reduced after guns prohibited
Stump-tailed Macaque	High; increasing	Low; declining	Food, gift	No	Low; declining	Harvest reduced after guns prohibited
Wild Pig	High; increasing	Low; declining	Food, gift	No	Low; declining	Harvest reduced after guns prohibited; use militia gun

to decline even further due to State-enforced restrictions on areas of harvest (e.g. restricted access to the core zone) and the collection of guns. The harvest of some wildlife was reportedly low for reasons other than enforcement. For example, most aquatic organisms, frogs/toads and monitor lizards are not well-liked by the Mien and are reportedly rarely or never eaten. They also reported that fishing is limited because the rivers are relatively far, a five-hour walk, from the village.

All animals harvested were reportedly used for food, with a smaller proportion of fish, large birds and mammals (20-40%) given as gifts. No animals were reported to be sold during this time period. Families felt that levels of consumption are low and will remain at the same level or decline for all wildlife except rats, of which they expect to eat more in the future.

4.3.3 Trends in food sources

The participatory methods used with families to proportionally rank their perceptions about changes in food sources over time resulted in clear trends (Figure 20). Overall, families felt that less meat, fruit and vegetables will be sourced from the wild over time and that more have been, and will continue to be, sourced from domestic production. The share of food purchased from the market is perceived to be low throughout all time periods, but for meats is expected to continue to increase into the future.

Although these qualitative results are consistent with previously reported perceptions of consumption (Table 15), they differ from the quantified consumption patterns recorded with the Weighing Form. For example, families reported that, between 2009 and 2020, they believed that approximately 10% of meat would come from the wild, 20% from the market and 70% from domestic production. However, the data from May-August 2009 show that at least 66% of meats consumed came from the wild and less than 4% from the market. Likewise, families felt that only 30% of vegetables were sourced from the wild and up to 65% were domestically produced while, in fact, half of the vegetables consumed during the trial period came from the wild. The data present a good starting point for further investigation. To encourage optimal nutrition, the perceived barriers to the purchase and production of domestic foods and the lack of knowledge of which wildlife species are permitted to be harvested must be understood and addressed.

4.3.4 Taste preferences and perceptions of nutritional value

The results from the participatory method used to rank the taste and perceptions of the nutritional value of wild and domestic foods showed that families ranked the taste and nutritional value of many wild mammals, fish and birds as high as that of domestic meat and eggs (Table 17). A comparison between actual meat consumption (Table 4) during the trial period and these values found that families were consuming only small or moderate amounts of the wild animals they most highly valued, such as wild fish and birds, and none of the larger mammals, wild pig or macaques, which they valued

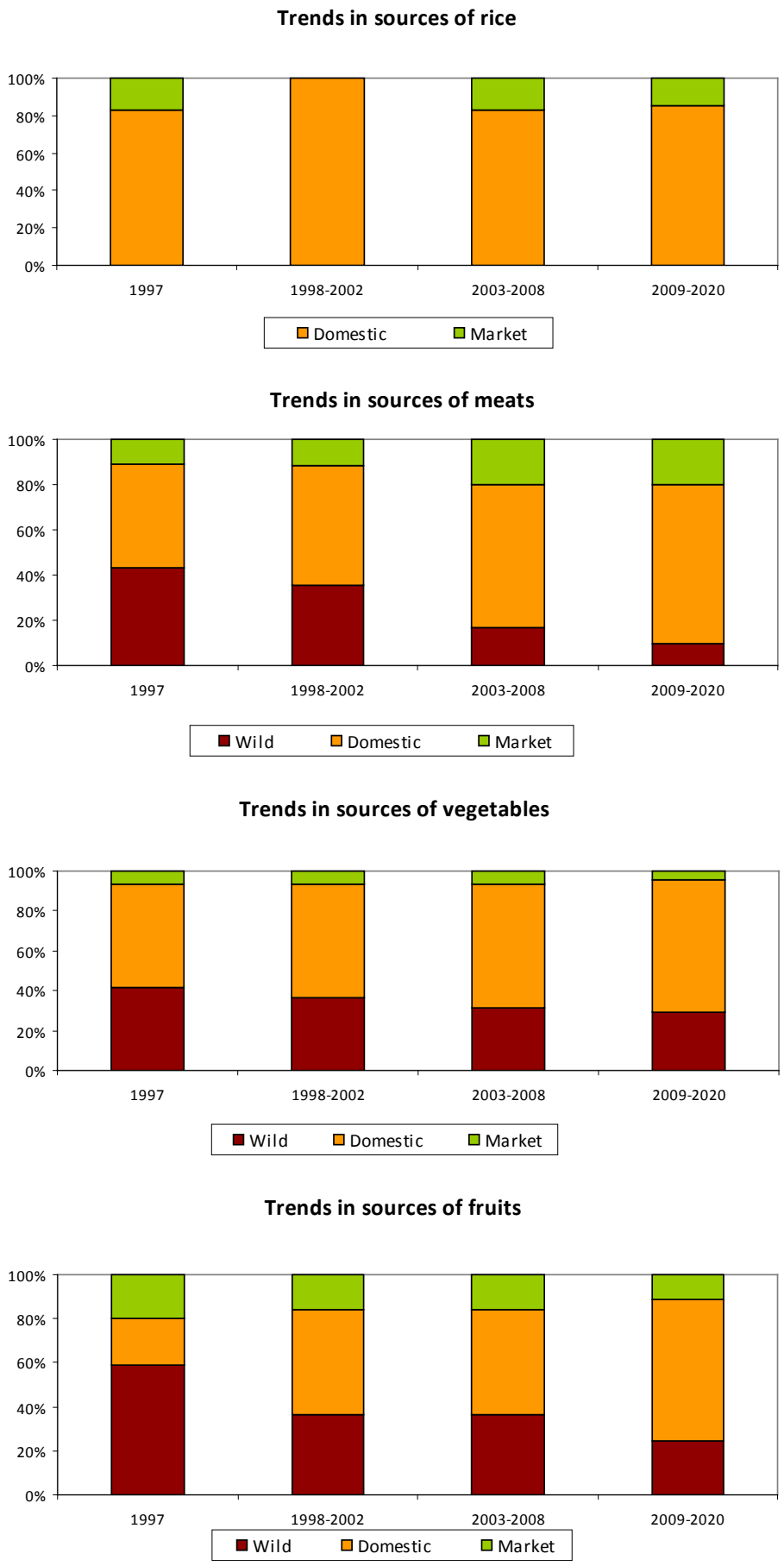


Figure 20. Perceived trends in food sources over time for, from top: rice, meats, vegetables and fruits.

most highly (Figure 21). Instead, the highest volume and frequency of wild meat consumed was from forest rats (see Table 5), which they ranked as of moderate value. Likewise, the volume and frequency of domestic meats consumed was low relative to the high value placed on these meats.

For the other food groups, families placed comparatively less value on wild staples, vegetables and fruits than on those grown domestically (Table 17), even though up to 50% of the vegetables actually consumed (largely bamboo shoots and mushrooms) were from the wild. Field observations recorded children refusing to eat foods if they disliked the taste (e.g., bamboo shoots, corn/rice mix) and complaining of the repetitive character of meals. This, together with the volume (Table 4) and frequency (Table 5) of food consumption, suggest that both families are highly dependent on foods (apart from rice) which are not highly valued for their taste and which they believe are not as highly nutritive as other foods.

These findings provide valuable background information which could be useful in developing programs to increase the intake of protein, fat, haem iron and zinc. Nutritional education measures would need to target the low value placed on insects and plant alternatives if their consumption is to be suggested as an alternative to the current low intake of meat. There is also the potential to build on those foods for which taste is ranked higher than nutritional value, but which are in fact quite nutritious (e.g., soybeans or peanuts).

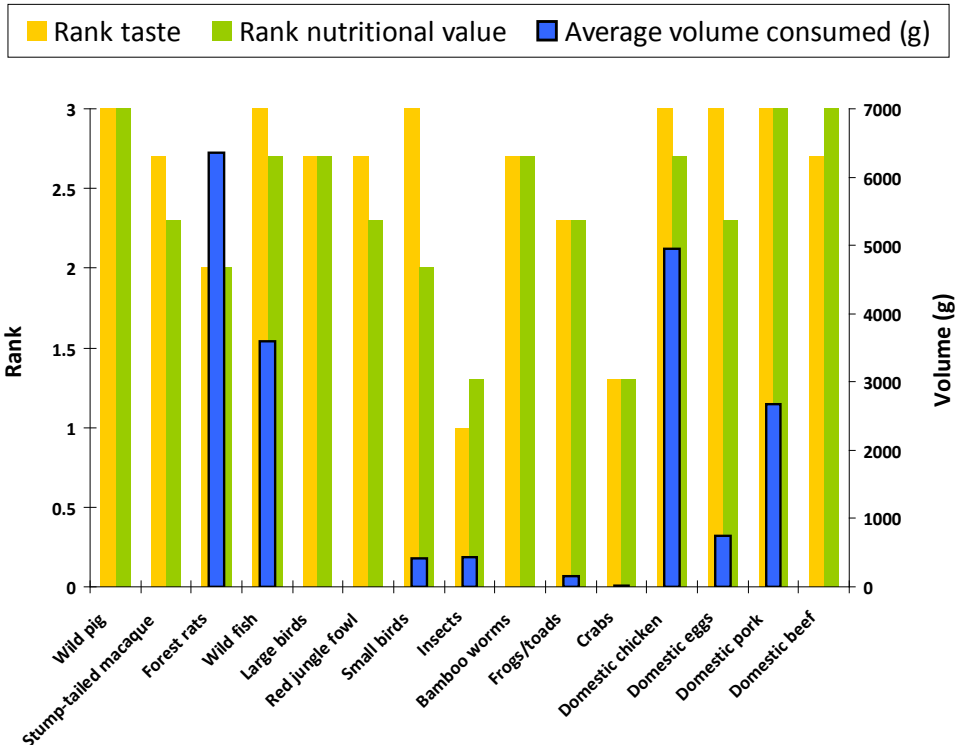


Figure 21. The average ranking by families of the taste and perceptions of the nutritional value of various wild and domestic meats (1=low value, 2=moderate value and 3=high value) compared to the actual total average volume of each meat type consumed during the three-month study period.

Table 17. The average ranking by three families of the taste and perception of the nutritional (value) of various food groups: 1=low value; 2=moderate value; and 3=high value. Wild foods are shown in green.

Food group	Food item	Rank taste	Rank nutritional value
Staples	Rice	3	3
	Corn	2.3	3
	Domestic roots/tubers	1.7	3
	Wild roots/tubers	1	1
Vegetables	Green leafy vegetables domestic	2	3
	Wild green leafy vegetables	1.7	2.3
	Wild bamboo shoots	1.3	2.3
	Wild mushrooms	1	2.3
Fruits	Domestic fruits	2.3	2.7
	Wild fruits	1.3	1
Meats/fish/eggs	Wild pig	3	3
*meats consumed during the study period	Domestic pork*	3	3
	Wild fish*	3	2.7
	Domestic chicken*	3	2.7
	Domestic eggs	3	2.3
	Wild birds (small)*	3	2
	Domestic beef	2.7	3
	Wild birds (large)	2.7	2.7
	Wild bamboo worms	2.7	2.7
	Stump tailed macaque	2.7	2.3
	Red jungle fowl	2.7	2.3
	Frogs/toads*	2.3	2.3
	Shrimp /water insects	2.3	2
	Common palm civet	2.3	1.3
	Wild eggs	2	2
	Wild turtles	2	2
	Forest rats*	2	2
	Snails	1.7	2
	Monitor lizard	1.3	1.3
	Crabs*	1.3	1.3
	Insects*	1	1.3
Plant alternatives	Soybean	2.7	2.3
	Peanut	2.7	2.3
	Sesame	2.3	3
Fats/oils	Pork lard/fats	3	3
	Vegetable oil	3	3
Sweets	Condensed sweetened milk	2.3	3
	Candy	2.3	3

5 Discussion

The overall aim of this project is to evaluate the linkages between wildlife management and household food consumption, examining how increased natural resource governance impacts the sustainability of wildlife offtake and, consequently, household food consumption and dietary adequacy. This understanding is critical for ensuring that viable wildlife populations are maintained. It also allows actors from the rural development sector to engage in a holistic approach to landscape management for biodiversity conservation that also enables rural communities to optimize household food security strategies that include a suite of food sources (wild caught, domestically produced and purchased foods), to ensure adequate food and nutrient intake.

Given what is already known about the underlying causes of wildlife decline and human malnutrition in Lao PDR, we predict that the adoption of national guidelines for natural resource governance will, over time, contribute to the recovery and viability of wildlife populations and the sustainability of offtake. This strategy will, in turn, result in greater availability of wild meat for household food consumption, especially for rural households in the low income strata. Yet it is unreasonable to expect that wild meats alone can meet the nutritional requirements and protein needs of this rapidly growing rural society. For example, Bennett and Robinson (2000) estimate that undisturbed tropical forest can produce sufficient wild meat to meet the human protein needs of only one person/km^2, if that population is wholly reliant on wildlife for its protein. Although food sources are more diversified than this for ethnic minorities in the Lao Uplands today, the preliminary results, along with other surveys, suggest that people are still highly reliant on wild foods. These conditions require the expertise to manage wildlife offtake for sustainable use as urgently as agricultural extension to increase domestic production or generate marketable products for cash income. The preliminary results from this trial study (with only two families from a single ethnic group and village) begin to shed light on the potential linkages that exist between wildlife management and household food consumption in the Lao Uplands today.

5.1 How does Protected Area management and village governance impact the abundance and use of wildlife?

The villagers and district authorities participating in this preliminary study felt that PA management contributes to an increase in wildlife abundance. When Houey Dtern village was established in 1997, the trade in large-bodied wildlife in the district was reportedly already flourishing and we found no evidence that village governance alone had been effective at regulating wildlife harvests. Instead, both villagers and government officers felt that it was the start of active management of the PA in 2000, which included government collection of illegal homemade firearms and enforcement of the ban on extraction from the PA core zone, which contributed to the recovery of large-bodied wildlife in the area.

On the other hand, families in this preliminary study felt that PA management may have a negative impact on their personal use of wildlife. The families said they actually expect to consume fewer large-bodied wild animals in the future because of gun collections and protection of the PA core zone. The families did not fully understand the government regulations that allow villagers to harvest a wide range of large-bodied species (e.g., muntjac, civets) for household consumption for at least part of the year, and wild pigs and small-bodied species (e.g., rodents, frogs and fish) for the entire year. This was in spite of the fact that PA outreach officers have discussed the hunting regulations with the Houey Dtern villagers and headman several times since 2004. Likewise, during the study, families inadvertently harvested some Category 1 and 2 species (e.g. owlets and songbirds) that were legally protected from harvest. It may be that the lack of villagers' clarity about the regulations caused the generally law-abiding families participating in the study to refrain from hunting and/or to be somewhat reluctant to report what and where wildlife was harvested out of concern about inadvertently violating the law.

In contrast to the uncertainty that villagers felt about the details of acceptable species and seasons for hunting, research assistants living in Houey Dtern village observed that residents seemed fully aware of the fact that the sale of wildlife is illegal. Although families involved in the study reported no sale of wildlife and there are no NPA enforcement records of arrests for illegal trade in the village since active enforcement monitoring began in 2007[4], opportunistic observations in the village indicate that some unknown quantity of wildlife is being sold by some individuals in the village. This suggests that wildlife trade is not, or perhaps cannot be, fully controlled by the current village governance system. Likewise, it is not yet clear what proportion of village residents perceive such wildlife trade to be a serious threat to the availability of wild meat for their own household food consumption.

What is striking about the comparison of wild meat consumption and sale is that, although two-thirds of the meat consumed by families in this trial study was from the wild, the actual amount eaten during this period was less than 4 kg per family per month, which is more or less equivalent to the weight of a single porcupine, such as the one that was sold from the village during the same period. The porcupine is an excellent example of how a lack of village governance of wildlife use, whether for local consumption or trade, can impact the long-term availability of wildlife in the village area, especially in cases such as this where the village lies along a major access road to an international border crossing. Porcupines in the NEPL NPA, while once fairly abundant and available to local people for seasonal harvest, have experienced a precipitous decline since 2004, in correlation with an increase in the illegal cross-border trade of wild-caught porcupines to be used as breeding stock for farms in the neighboring Vietnamese province of

4 There has been only one arrest of Houey Dtern villagers since 2007, which was for three people entering into the NPA core zone in May 2009.

Sonla (Brooks 2008; A. Johnson, unpublished data). This illegal trade to porcupine farms (which supply porcupine meat to Hanoi restaurants and, therefore, feed a relatively wealthy urban population) led to the recategorization of Lao's porcupines from Category 2 to Category 1 in 2007, making the porcupine off-limits for local consumption. In this way, a lack of knowledge and governance worked in tandem with the illegal wildlife trade to negatively impact both the wildlife populations in the Lao Uplands and, ultimately, the nutritional adequacy of local human diets (see Section 5.3).

5.2 What is the offtake of managed wildlife species and is it sustainable? If unsustainable, what mechanisms are needed to mitigate adverse impacts on biodiversity?

To evaluate sustainability, it is necessary to compare the actual offtake (kg/km^2) against an estimate of the standing biomass of animals in the area and the maximum sustainable offtake available for harvest as a proportion of the standing biomass (Robinson and Bennett 2004). The actual harvest of wildlife during the preliminary three-month study period averaged only 11.2 kg per family. Each family's harvest was largely composed of mammals (7.3 kg per family), of which the majority were rodents (7.2 kg per family). When reviewing these results, it is essential to take into account that the data were collected during a period of high agricultural labor demand, during the monsoon season. Previous surveys in Laos have shown that hunting is typically reduced during this season, and largely occurs in areas closer to the village (Johnson et al. 2005). During the three-month trial period, wild foods were collected within a three- to five-hour walk from the village. Spatial data compiled during Workshop 1 suggests that hunters will travel farther at other times of the year (Figure 5). From May to August, we found that younger boys in the family did most of the hunting while parents and older siblings were working in the fields. At other times of the year, all family members will likely participate in hunting and gathering, and these activities will take place at greater distances from the village. Thus, the quantity and type of wildlife harvested during this preliminary study is not likely to be representative of other times of the year when villagers can afford to hunt and gather over greater distances from the village. Also, the three-month pilot data collection period occurred during the State's "closed hunting season" (from May to October; see Figure 1) when offtake is not representative of the rest of the year.

While it is premature to estimate sustainability based on the observed levels of wildlife offtake given the limitations of this trial period, it is useful at this stage to consider what the analyses will need to consider when conducted after a full year of data collection and with a wider sample of families and villages. If the offtake from this trial period (11.2 kg per family for three months) were representative of all 39 families in the village over a 12-month period, this would equate to an estimated annual offtake of 1,133 kg of mammals for the entire village. Although the government-allocated village area was 30.4 km^2, the combined

estimated area of food collection for the two study families during the three-month period was actually 40 km^2, as food was being collected from within the boundaries of two neighboring villages as well. Applying this latter area as the minimum collection area for the entire village, and the above estimate of annual offtake, the preliminary annual estimated offtake of mammals for the village would be approximately 28.3 kg/km^2.

The total standing biomass (kg/km^2) of mammals in the NEPL NPA is not known. As this data is typically unavailable for many sites, Robinson and Bennett (2004) provide a useful relationship between mammalian biomass from tropical forest sites and annual rainfall. This relationship indicates that the estimated combined biomass of large-bodied rodents, primates and ungulates (>1 kg) in "relatively undisturbed" dry tropical forests with an annual average rainfall of approximately 1500 mm, similar to NEPL, may average around 7,000 kg/km^2. Robinson and Bennett, drawing from a wide range of studies, suggest that large-bodied slow-reproducing species (primates and large ungulates) typically decline in areas similar to the controlled use zone of the NPA (i.e. "human-influenced systems" where domestic livestock compete with wildlife and where there is hunting), while the biomass of rapidly-reproducing species such as rodents likely increases in such areas. Thus, the standing mammalian biomass in the controlled use zone of the NPA will certainly be lower than the average 7,000 kg/km^2 predicted for relatively undisturbed dry tropical forests. But the human disturbance in the mosaic of farm-fallows and secondary forest in this zone may be contributing to a predominance of small-bodied productive species, such as rodents, that have relatively higher biomass production than would be found in less disturbed forests. Given the high productivity of rodents, it is estimated that the sustainable annual offtake rates for some species can exceed 50% of standing biomass (Robinson 2000). Applying this estimate to the Houey Dtern village area, an annual estimated offtake of 28.3 kg/km^2 of largely rodents would likely be sustainable so long as the standing biomass of the rodent population in the collection area is at least double that amount.

Considering larger mammals such as ungulates and primates, Robinson and Bennett suggest that a maximum sustainable offtake could be 10% of the total standing biomass for moist to dry tropical forests, which would mean that an estimated offtake of 28.3 kg/km^2 may be sustainable only if the total mammalian biomass is at least 283 kg/km^2. In NEPL, a 2008 survey of five ungulate species (Eurasian Wild Pig *Sus scrofa*, Muntjac spp. *Muntiacus* spp., Sambar *Rusa unicolor*, Gaur *Bos frontalis* and Chinese Serow *Capricornis milneedwardsi*) across 2600 km^2 found an occupancy-based abundance index of 3.1-3.5 individuals/km^2 (Vongkhamheng, unpublished data). The most abundant species found were muntjac (43%) and wild pig (42%), with smaller proportions of the larger ungulates. Applying an average weight for each species (Lekagul and McNeely 1977, Nowak 1991, Francis 2008) produces an estimated biomass index of 320-358 kg/km^2. Thus, if the estimated offtake observed during this trial period

(28.3 kg/km^2) were found to be representative of the total annual offtake of the village, this may indeed be sustainable.

But, in fact, even during this trial period there is evidence from the Village Wildlife Form that other families were harvesting larger-bodied wildlife species, ranging from 2 to 25 kg in size, which would significantly increase the village's overall estimated offtake. This level of offtake is consistent with a 2005 questionnaire survey of ten villages in the NEPL controlled use zone, including Houey Dtern, where squirrels, deer, fish, pigs, pheasants and partridges were reported to be the most commonly eaten wild meats on a monthly basis (Johnson, unpublished data). Another questionnaire survey in 2001 reported that households in the NPA annually consumed 141 kg of wild meat, of which 20% was deer and pigs (ICEM 2003), an amount which is almost five times as much as our extrapolation of 28.3 kg per family based on this limited period of data collection. Thus, it seems likely that a wider sample, that includes more families in several villages over an entire year, will reveal a larger annual offtake than that estimated during this trial period. Further study may also show that the offtake of large-bodied animals has been unsustainable for some time, as the data from Workshop 1 suggests, and that the current mosaic of farm-fallows and secondary forest in the NPA controlled use zone yields primarily smaller-bodied wildlife for harvest.

Determining whether hunting is 'sustainable' also requires assessing if there are sufficient animals to provide a significant resource to human users (Bennett and Robinson 2000). Although the families participating in this trial study consumed less than 4 kg of wild meat per month, some proportion of the harvested mammals (10.4%) and birds (6.8%) was not eaten by the family but given away to others. Although the sharing of wild meat could be interpreted as representative of a sufficient resource, other studies indicate that these gifts of food function to build solidarity among friends and relatives in the village and that they do not necessarily represent a plentiful resource (Krahn 2005).

If further research shows that the offtake of managed species has become unsustainable in the controlled use zone, the mechanisms needed to mitigate the adverse effects of such offtake may include PA staff working with villagers on a wildlife management plan for their village area. At the same time, development agencies could be engaged to provide education on nutrition (e.g., meat substitutes, food choices and sources), agricultural extension (e.g., livestock husbandry, consumption of domestic meats, selection of cash crops) and marketing (for generating legal sources of cash income to cover expenditures for meat/meat substitutes).

5.3 What is the adequacy of human diets? If inadequate, what mechanisms are needed to mitigate adverse impacts on human nutrition?

For this work, we have defined dietary adequacy in rural Upland diets as achieved when the daily intake contains sufficient amounts of diverse foods from all six food groups. Eating enough from each food group, a healthy body is likely to get all the macronutrients (fat, protein, carbohydrates) and micronutrients (minerals and vitamins) needed. Without considering extra-physical parameters, this would amount to approximately 300-500 g of mixed staples, 500 g of vegetables (of which about one third comes from green, leafy vegetables), 100-200 g of fruit (about one half from fruits rich in vitamin C), 100-200 g of meat, fish, other aquatic animals, eggs or plant-based protein alternatives, 2 spoons of calcium-rich insects or aquatic animals with a hard carapace, and 30 g of added fats/oils. During days of hard labor, the intake of all food items should increase by approximately 10-20%.

The analyses of the quantity and quality of food consumed by the trial families indicated that the volume of key food groups consumed was suboptimal and the food group ratios were unbalanced. The diets were observed to be highly rice-biased, low in calories and fat and mainly vegan, with insufficient intake of eggs or plant-based meat alternatives such beans, seeds or nuts. These findings are similar to trends established elsewhere (WFP 2007, Krahn 2005, Krahn and Johnson 2007, Lao PDR 2007). Consumption volumes per subgroup shed new light on the dietary debate which, until now, has been largely based on food consumption frequencies as a proxy measure for dietary diversity.

A standard diet – not considering the additional demands of hard physical work - should contain 2,100 food calories (kcal). The following discussion considers a minimum of 2,500 kcal per capita per day. A mean staple intake of 307 g of non-glutinous rice, 31 g of glutinous rice, 120 g of maize kernels and 20 g of cassava, as observed in the trial period, would be within range of sufficiency, providing about 1,550 calories. For a 2,500 calorie diet, about 62% of total necessary calories would be contributed by such a 1,550 calorie staple consumption, which would be adequate if other foods were consumed in the correct amounts to provide the remaining 950 calories. However, the trial families were found to consume only 300 to 400 additional calories, at the most, beyond their consumption of staples, resulting in an estimated caloric deficit of nearly 600-700 calories per capita per day. The observed average intake of about 1,950 calories is lower than an average Lao diet of 2,090 calories, in which cereals contribute 76% of total energy consumption (Lao PDR 2007). In the diets of the trial families, about 79% of calories were found to be derived from staples; an excessive amount that indicates unbalanced food group ratios as well as a risk of reducing the bioavailability of iron (metal phytate compounds).

The family profiles allowed us to establish a mean protein need of 50.6 g per capita per day (protein needed per kilogram of body weight,

based on Thai reference standards per age[5]). The trial findings, though, suggest an inadequate protein intake of only 44.6 g (considering only meat and rice). Consumption of 876 g of steamed rice[6] provides about 39.2 g of plant protein (based on 4.6 g protein in 100 g glutinous rice and 2.2 g protein in non-glutinous steamed rice). In contrast, 30 g of meat provides only 5.4 g of animal protein (assuming an average of 18 g of protein in 100 g of meat). Putting this into perspective, 39.2 grams of rice protein provides 77.5% of the 50.6 g protein needed (although rice-protein is of low bioavailability), while 5.4 grams of meat protein provides only 10.6%. Furthermore, consumption of plant alternatives and eggs is extremely low; their contribution to protein intake is almost nil. In sum, total protein needs are not being met by the observed diet, a situation which is aggravated by the large contribution of low quality rice protein to total protein intake. We also need to bear in mind that a 30 g total intake of animal protein (meat, fish, insects, etc.) is far lower than what has been stated elsewhere (Lao PDR 2004). The trial family's wild fish intake during this period, for example, was only 5 g per capita/day as compared to the 65.7 g daily intake of wild fish/OAA suggested by Hortle (2007)[7].

Also, the observed total fat consumption is grossly suboptimal. The extremely low fat intake from meat (30 g of mainly lean meat may contain a maximum of about 2-3 g fat) is coupled with a distressingly low intake of added pork fat (3 g). The low rate of consumption of fat-rich seeds and nuts (1 g) does little to supplement the low overall fat intake. In the past, the consumption of greater amounts of wildlife is likely to have provided adequate fat to the diet (see also Krahn 2005, Krahn and Johnson 2007), however, a contemporary low fat intake has also been found by other studies (WFP 2007).

Additionally, low intake of animal food (such as meat and eggs) results in low intake of Vitamin A, which is found in organs such as the liver and kidneys. Hence, the consumption of vegetables and fruits plays an important role in the provision of Vitamin A through precursors such as beta-carotene or other carotinoids. However, not only was the observed consumption of vegetables (282 g) and fruit (117 g) at the lower end of sufficiency, but also the trial households mainly consumed species low in beta-carotene; about one-third of all vegetables consumed were bamboo, and about one-half of all fruits consumed were banana or melon. Absorption of beta-carotene is further hampered by the low levels of fat consumption that we observed.

Given that only a small quantity of calcium-rich foods such as insects, crabs, shrimps, bones or calcium-rich seeds, vegetables or fruits (e.g. sesame, tamarind) were consumed, it is likely that the intake of calcium is also far below the recommended level of 800 mg per capita per day (which can be derived from 2 soup spoons

5 For example, this is 1 g of protein per kg body weight per capita per day or 57 g total protein for a man and 52 g for a woman.
6 Once steamed, the 307 g of non-glutinous and 31 g of glutinous rice that were weighed totalled 876 grams of rice (828.9 g non-glutinous and 48.05 g glutinous).
7 Based on a review of 20 consumption studies in Laos.

of invertebrates with a hard carapace). Intake appears to be low for other key nutrients as well, including haem-iron, zinc, Vitamin C and Vitamin B1.

In summary, these dietary findings merit further investigation with a representative sample of households. It is safe to conclude that these results, summarizing the intake of calories, fat, protein, Vitamin A and other micronutrients, are highly alarming and that this level of suboptimal intake is impeding body function and growth – especially in mothers and young children – and is increasing susceptibility to disease and mortality. The key interventions moving forward should include increasing caloric intake from non-staple foods, doubling vegetable consumption (especially of leafy green vegetables), doubling fruit consumption (especially of those rich in Vitamin C), increasing the consumption of animal foods (meat, fish, OAA and invertebrates) by six or sevenfold, encouraging the consumption of invertebrates or calcium-rich plant foods on a regular basis and increasing fat intake by tenfold. Mixed consumption of a diverse set of plant proteins (e.g. rice, amaranth, corn treated with lime, soybeans) and/or seeds, nuts and mushrooms can be a feasible alternative to increased animal food intake, where culturally acceptable, providing complete amino acids to the diet.

5.4 What is the role of wild meat in household food consumption as compared to meat and plant alternatives coming from other sources (i.e. domestic production and the market)?

Our findings from this trial period indicate that approximately two-thirds of all meats are harvested from the wild. As described in the previous section, to improve the adequacy of the diet a six or sevenfold increase in the intake of meat, fish, other aquatic animals, insects, eggs or plant alternatives is warranted. In order to reach this goal, we have to expand our understanding of the changing role of food sources in contemporary and future diets. Looking at three sources (wild collection, household production and purchased foods) allows us to put wildlife harvest into a broader context and to identify the opportunities and risks of optimizing food sources for higher nutrient intake.

Hitherto, when talking about wild animal foods, most studies have noted a high dependency on wild fish (Meusch et al. 2003, Hortle 2007, Baran et al. 2008). However, for the Lao Uplands – an area with great pockets of poverty and chronic malnutrition – it is important to expand the debate to include a broader range of wild animals. Many studies, while pointing out the alarming reduction in wildlife populations and the resultant decline in availability of and access to wild meats (IUCN, WCS and WWF 2007), do not establish trends and patterns in domestic meat production or market purchases, which narrows the opportunities for finding effective solutions moving forward. While it has often been argued that many Upland communities have a low propensity to slaughter and consume their own livestock (e.g. ADB/NSC 2007), limited progress has yet been made to effectively reduce barriers to increasing livestock production. As a result, few – if any – holistic strategies have

been developed for managing landscapes for biodiversity conservation as well as for food, animal and cash crop production, while taking into account new market opportunities (e.g., to sell livestock for cash, to buy domestic meats, or to save money by making informed choices at local markets by buying meat-protein alternatives such as soybeans, seeds, nuts, eggs or nutrient-dense insects).

For Houey Dtern village, we have established daily protein needs of 50.6 g per capita per day (based on the protein needs per kilogram of body weight for the sample families), of which ideally 40 g shall be derived from meat (which would require consuming 200 g of meat per capita per day). By using and updating demographic data from Schlemmer (2002), we can then tentatively estimate a mean protein need of 14 kg of meat per village per day in the 98 villages bordering the NEPL core zone (assuming ~350 people per village), or 420 kg of protein per village per month. Krahn (2005, referring to White 1953) noted that 100 g of edible meat contains on average about 20 g of crude protein and that edible animal body parts (meats, excluding skin, bones, viscera) only make up 50-70% of the total live body weight. Subsequently, sourcing 420 kg protein per village would require about 2.1 metric tons of animal meat, which is equal to about 3-4 tons of animal biomass per month. However, this estimate could be recalculated to consider alternative protein intake from plants such as rice, beans, seeds, nuts, etc.

Then there is the need to identify where the necessary meat should be sourced from. This analysis can be broken down into the harvest of wild meats, and domestic meats sourced either from a family's own production or purchased from the market or neighboring villages. Based on the estimates of animal productivity from tropical forests (Bennett and Robinson 2000), it seems unlikely that the required amount of meat could be sourced exclusively by increasing wild meat harvest through improved wildlife management. Rather, a likely scenario would include developing a combination of wild-caught, village-produced and purchased meats, together with plant alternatives, to meet the dietary needs of the target villages. Such scenarios shall need to be culture-specific as we know, for example, that the Khamu ethnic group has a higher propensity for wild foods, while the Mien and Hmong groups prefer domestic foods over wild-collected plants and animals.

Our trial findings suggest that, through the present day, about two-thirds of all meats are harvested from the wild; which is, in practice, saving money which could be invested into buying foods or non-food items. A realistic goal scenario would be one in which the share of domestic meats produced by each household (currently 29.6%) is increased to 40-50% (in conjunction with increased production and consumption of plant alternatives such as beans, seeds and/or nuts), in parallel with a significant increase in the amount of purchased meats (currently only 3.5%) and/or plant alternatives. This would require educational and technical support to improve the management of livestock for income and consumption as well as education on making better nutritional choices at the market. Currently, market

foods are not a large part of household food consumption. Further analysis would be necessary to determine whether the barriers to meat purchase are access to market, low purchase power or a lack of nutritional knowledge.

In the short term, a significant increase in livestock production and/or market purchase is unlikely to fix the dietary gap. However, given the high population growth rate (3.1% per annum), it is critical to diversify to other sources, beyond wild foods, to address human food security as well as the recovery of viable wildlife populations and healthy ecosystems. Hence, sustainable landscape management is urgently warranted, to ensure sufficient land within core zones to maintain viable wild animal populations that will disperse into controlled use harvest zones, to effectively manage hunting outside of these core zones to ensure that managed species are not lost to the illegal wildlife trade, to increase the efficiency of raising livestock on existing lands (including fodder production), and to increase the efficiency of raising other food crops for household consumption, for cash cropping and for other forms of income generation. The link between consumption data and spatial data (food sources and food collection sites) allows us to put the research findings into the broader context of changing landscapes and the unprecedented pressures put on land and natural resources in Laos.

5.5 Utility of the methods

Given that a multi-disciplinary study of this kind had not been conducted in Laos before, and that the exploration of avenues of wildlife management for household food security has been largely unrecognized, the aim of this first phase was to test and refine the methods for data collection and to train national counterparts, with the objective of applying the lessons learned to later implementation with various ethnic groups, at different wealth levels, in several villages in a second phase.

Overall, national counterparts were able to effectively use the methods developed to gather the data needed to answer the questions posed. Data from Household and Village Wildlife Forms allowed the identification of individual animals to genera, and many cases species, as well as the determination of their age class and sex, based on systematic measurements and photographs, with blood spots collected for additional analysis when needed. The Wild Food Collection Sites Form proved to be sufficient for mapping collection locations and habitats, data which was used to estimate the “catchment area” from which animals are collected. Together, this provides the baseline data needed to estimate the annual offtake of individuals per km2, although it will be necessary to employ these methods over a minimum of one year to determine an accurate estimate of total wildlife offtake across seasons of varying hunting intensity.

Despite being relatively far from the rivers, wild fish still proved to be a relatively large component of the wild meat consumption of

the villagers that participated in this trial period, which is consistent with findings from wider national surveys (WFP 2007). Given that villagers perceive declines in fish populations in the Controlled Use Zone to be caused by unsustainable harvest by outsiders and the use of destructive collection methods, further examination is merited. Future data collection may consider alternative ways to record fish catch per effort, incorporating photographs of individual fish specimens (flattening out the dorsal fin and the anal and caudal fin area) and collecting selected voucher specimens to assist with species identification. Freshwater prawns and crabs from these rivers are currently not well-known and would be worth collecting for identification, if resources permit.

Data on illegal offtake of wildlife was difficult to obtain, but the extent of illegal trade from a village area must be considered in the total offtake estimate. Independent MIST[8] enforcement data can be used to determine if a village is involved in wildlife trade to any degree. Opportunistic observations on the Village Wildlife Form are also useful for understanding if illegal offtake is taking place and, if so, at what frequency. Before implementing this study with more households and villages, increasing the available education on wildlife regulations and providing background information on human nutrition and the study objectives (potentially targeted towards women) may help to ease the existing anxiety about reporting on wild food collection.

Data from the Household Weighing Record was instrumental in understanding the adequacy of the family diet and the role of wild foods relative to other food sources, although it required intensive and skilled supervision to administer. Analyses of the results suggest that sufficient data to answer these questions could potentially be obtained by weighing all foods for only one week per month, while continuing to weigh the volume of meats, plant protein alternatives and eggs (food group 4) each day. In addition, we recommend that per capita consumption data be converted to adult male equivalents to address consumption differences between adults and children, further increasing data accuracy. If desired, the full data set from the Household Weighing Record could provide information that is beyond the scope of this research; for example, intake of key nutrients (such as iron and protein) per food item and per group could be roughly established. The weighing record could also be used to establish mean weekly consumption frequencies of all food groups, to enhance our understanding of dietary diversity (e.g., while the mean consumption frequency of pork meat was less than 1 day per week, pork fat was consumed 7 days a week). Also, a statistical analysis of food intake and determinants such as family income or expenditure levels, or number of livestock owned, could be conducted.

8 MIST (Management Information SysTem) software is a law enforcement monitoring system used to spatially track and quantify enforcement effort and illegal resource use in the PA; see http://www.ecostats.com/software/mist/.

Given the results from this trial period, it appears that sufficient data on household income and expenditures, used to better understand sources of cash income and purchases of meat/meat alternatives, could likely be gathered using a one-week recall method, or derived from a national data set, rather than recorded daily.

The difference between the results compiled from quantitative household records and the results obtained using PRA methods highlight the necessity of quantitative data collection to fully answer the research questions. During this short trial period, reported villager perceptions differed in some cases from the quantitative results (e.g., proportion of foods from various sources, level of fat intake, etc.) This may simply be an anomaly of the short trial period but is nonetheless worth noting. Future PRA methods should employ drawings of generic animals in the ranking exercises (rather than photos of actual species) so that participants are not confused into thinking that their choice of a photo is representative of a single species. To assess governance, PRA exercises need to ask respondents to distinguish between their perceptions of trends in wildlife abundance in the controlled use zone and in the core zone.

6 Conclusions: Linkages Between Household Food Consumption and Wildlife Management

Results from the trial period suggest that wildlife, including animals, plants and fungi, are a fundamental part of household food consumption. Therefore, managing wildlife for sustainable use is crucial not only for the natural resource management sector's conservation of biodiversity, but also as a priority measure for multi-sectoral cooperation in the reduction of poverty and malnutrition in remote areas. The results presented in this report are very preliminary in nature, but highlight the importance of further investigation on the linkages between household food consumption and wildlife management across a wider range of villages bordering the PA core zone, working with families of various ethnic groups. This information is essential, not only to assist villages with managing offtake for sustainable use in the controlled use zone, but also for engaging actors from the rural development sector in a holistic approach to managing landscapes for wildlife conservation while addressing dietary inadequacies. While we recognize that this far exceeds the mandate and funding of protected areas, if left unaddressed, increasingly vegan diets, low nutritional knowledge and lack of opportunities to source meat and plant alternatives together with limited legal income opportunities will likely hamper the acceptance and effective implementation of regulations for wildlife management in the long term.

These complex questions are relevant not only for the Nam Et-Phou Louey NPA but for many of the protected areas in Laos, which, under the administration of the national Department of Forestry, strive to maintain and recover biological diversity amid rapidly growing ethnic minority populations with levels of chronic malnutrition that are among the

highest in the region. At the same time, these questions and methods may also prove relevant to extractive industries in rural landscapes of Laos, where increasing investment in hydropower, mining, large scale plantations and infrastructure warrant an appropriate assessment of how impacts on natural resources affect not only biodiversity conservation but also human livelihoods and nutritional well-being.

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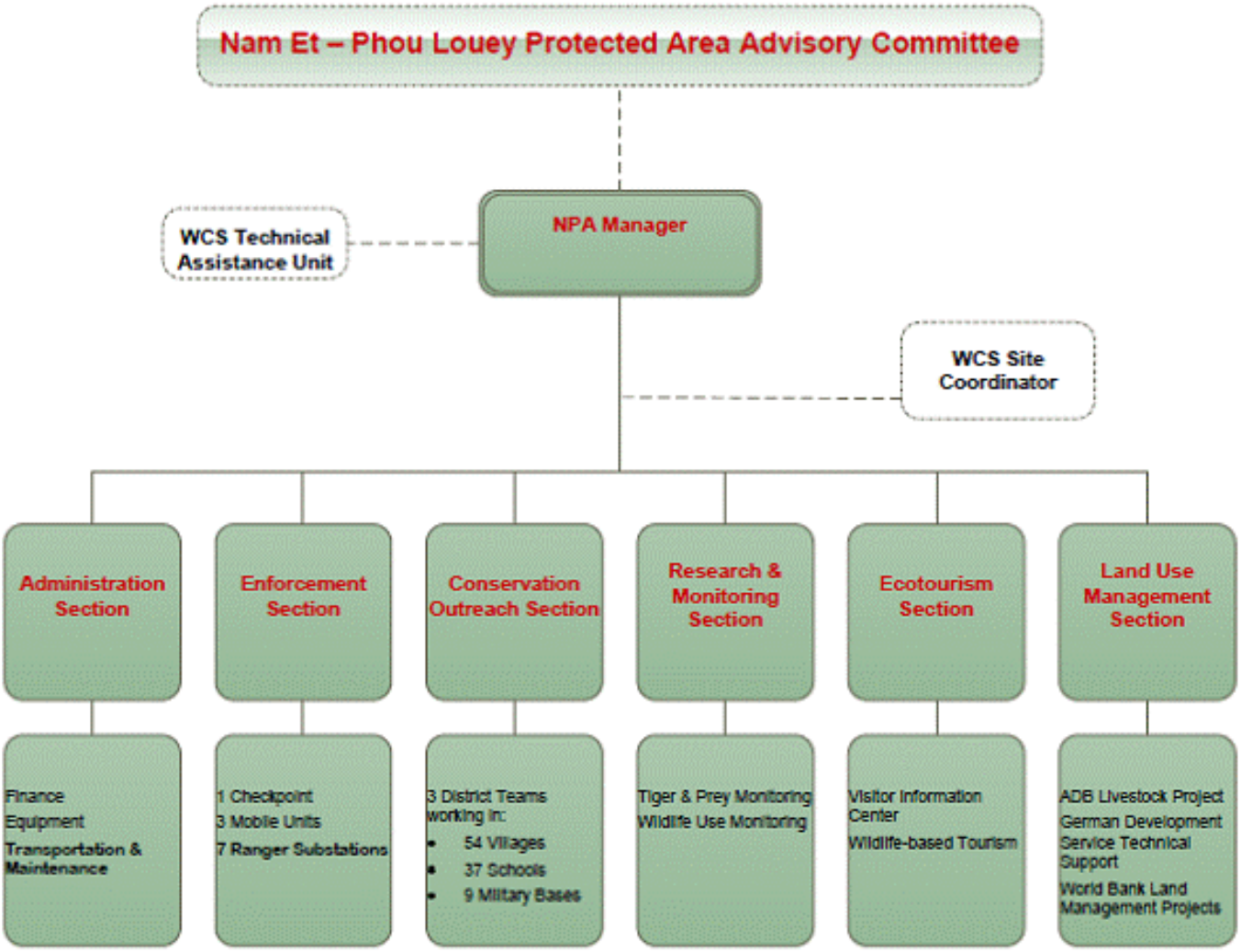
TRANSLINKS

Case Study

Finding the Linkages between Wildlife Management and Household Food Consumption in the Uplands of Lao PDR: A Case Study from the Nam Et-Phou Louey National Protected Area

Appendices

Appendix 1. Institutional Structure of the Nam Et-Phou Louey National Protected Area



Appendix 2. Household Weighing Record

Household Weighing Form

Viillage: Houey Dtern

Family ID: 1

Interviewer:

Date (d/m/y):

Meal code: 1	Time		Dishes:*
Meal code: 2	Time		Dishes:*
Meal code: 3	Time		Dishes:*

* List the record number of ingredients in each dish (e.g. Soup pak #3-6)

Record No.	Food Item	Food item code	Source code	Where did food item come from? (use area code)	Quantity (g)	Part of animal eaten code	Photo wild animals 4.11-4.15 (Time)	Preparation code (for # 1-4&6)	Meal code	Eating location (use area code)	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6	Person 7
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
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25																	

Meal code: 1.Breakfast; 2.Lunch, 3.Dinner, 4.Snack, 5. Festival or Sacrifice

Appendix 3. Food Codes

Food types	Code	Remarks measurement
Staples	1	
Sticky rice	1.1	before soaking, raw
Non-sticky rice	1.2	befre soaking, raw
Maize	1.3	whole cob, raw without peel
Other cereals	1.4	raw
Cassava	1.5	with skin, raw
Others roots /tubers	1.6	with skin, raw
Noodles (dried)	1.7	total weight
Noodles (fresh)	1.8	total weight
Others	1.9	flour, kernels, dried tuber chips, etc
Vegetables	2	
Leafy vegetables	2.1	edible parts
Fruit like vegetables (hard, thick skin, not eaten)	2.2	edible parts (with skin)
Fruit like vegetable (soft skin, eaten)	2.3	edible parts (with skin)
Mushrooms	2.4	edilbe parts
Bamboo shoots	2.5	edible parts (after hard skin has been removed)
Other shoots	2.6	edible parts
Stems	2.7	edible parts
Water vegetables	2.8	edible parts
Beans (fresh, whole pod)	2.9	edible parts
Flowers	2.10	edible parts
Fermented vegetables	2.11	edible parts
Other	2.12	edible parts
Fruits	3	
Banana	3.1	with skin
Small berries	3.2	all berries, no leaves and stem
Citrus	3.3	whole fruit with skin
Pineapple	3.4	whole fruit with skin
Fruits with stone (cannot be eaten)	3.5	whole fruit with skin
Fruits no stone or small stones (eaten)	3.6	wole fruits with skin
Fruits with thick skin (cannot be eaten)	3.7	whole fruits with skin
Melons	3.8	whole fruit or pieces
Sugarcane	3.9	write down number of sections
Others	3.10	---
Group meat/fish/alterntives	4	
Domestic animals		
Pig	4.1	see code meat form (all parts which willl be cooked)
Cow	4.2	see code meat form (all parts which willl be cooked)
Buffalo	4.3	see code meat form (all parts which willl be cooked)
Chicken	4.4	see code meat form (all parts which willl be cooked)
Other poultry (turkey, geese, ducks)	4.5	see code meat form (all parts which willl be cooked)
Goat	4.6	see code meat form (all parts which willl be cooked)
Fish	4.7	see code meat form (all parts which willl be cooked)

Food types	Code	Remarks measurement
Wild animals. Take photo of 4.11-4.15; complete wildlife form for 4.8-4.10		
Mammal**	4.8	see code meat form (all parts which willl be cooked)
Bird**	4.9	see code meat form (all parts which willl be cooked)
Reptile**	4.10	see code meat form (all parts which willl be cooked)
Amphibian	4.11	see code meat form (all parts which willl be cooked)
Fish	4.12	see code meat form (all parts which willl be cooked)
Eel	4.13	see code meat form (all parts which willl be cooked)
Snails, crabs, shrimp, water insects	4.14	see code meat form (all parts which willl be cooked)
Land insects	4.15	see code meat form (all parts which willl be cooked)
Legumes, nuts, seeds		
Soybeans	4.16	raw
Other legumes	4.17	raw
Coconut	4.18	number of nuts
Nuts and seeds (with skin)	4.19	all
Nuts and seeds (no skin)	4.20	all
Other	4.21	---
Dairy products	5	
Sweetened condensed milk	5.1	indicate # spoons
Others	5.2	---
Oil/fats	6	
Vegetable oil	6.1	indicate # spoons
Animal lard (e.g. pork)	6.2	indicate # spoons
Others	6.3	---
Sugar, sweets, beverages	7	
Sugar or palm sugar	7.1	indicate # spoons
Wild honey	7.2	indicate # spoons
Softdrink	7.3	indicate # units (1bottle, 1 pack, etc)
Soymilk	7.4	indicate # units (1bottle, 1 pack, etc)
Coffee, ovaltine	7.5	indicate # glass per person
Ice cream	7.6	indicate # ice-creams per person
Sweets	7.7	indicate # packages per person
Beer Lao	7.8	indicate # glasses / bottles
Lao hai	7.9	indicate # of jars
Lao lao	7.10	indicate # glasses / bottles
Others	7.11	---
Meals eaten outside	8	
Food	8.1	write down dish
Drink	8.2	write down drink
Leftovers	9	---
Others	10	write down name and description

Food types	Code	Remarks measurement
Condiments (describe in remarks for each meal)		
Salt		
MSG		
Fish sauce, soy sauce, etc		
Garlic, onions (dried)		
Chille (dried)		
Chillie (fresh)		
Others		
Source code (write source type)		
Produced		
Gift	if wild animal, record where it came from using Area Code	
Exchanged		
Bought		
Caught/collected		
Area code (get from Food Collection Sites form)		
Meat code: parts of animal eaten		
Whole animal	1	with bones, skull, fur, etc
Fresh meat (piece or pieces)	2	raw
Dried meat	3	not fried, grilled yet
Fresh skin(fatty layers)	4	raw
Dried skin	5	not fried, griled yet
Fermented	6	raw
Organs	7	raw
Fat	8	raw
Scraps (tendons, ligaments)	9	raw
Egg	10	raw
Sausage	11	grams
Blood	12	raw; spoon or grams
Preparation code (write preparation type)		
Boiled		
Steamed		
Fried		
Deep fried		
Fresh		
Braise		
Grill		
Eating location (use area code)		

Appendix 4. Household Wildlife Form

Household Wildlife Form

(mammals, birds & reptiles)

Village:	*Houey Dtern*
Family ID:	
Interviewer:	
Date (D/M/Y):	

	Animal name/code		*Location*	*Hunter*			*Gear*	*Animal Details and Samples*							
Record No.	**Wild animal name**	**Wild animal code**	**Area Code: where was animal collected?**	**Gender (M/F)**	**Age**	**Person code**	**Code**	**Photo: length (cm)**	**Time (24H) of first photo**	**Photo: (sex)**	**Weight (g)**	**Age (A or J)**	**Blood spot collected?**	**Voucher collected?**	**Remarks**
01															
02															
03															
04															
05															
06															
07															
08															
09															
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24															
25															

Person Code: 1) In the Family; 2) In the Household; 3) Outside of the House

Blood Spot and Voucher Label: 1) Family ID; 2) Date; 3) Record Number; 4) Recorder Name

Appendix 5. Wildlife Codes

Wild Animal	Code
Mammal	**4.8**
Pangolin	**4.8.1**
Bat	**4.8.2**
Primate	**4.8.3**
loris	4.8.3.1
macaque	4.8.3.2
langur	4.8.3.3
gibbon	4.8.3.4
Carnivore	**4.8.4**
dog	4.8.4.1
bear	4.8.4.2
marten	4.8.4.3
mongoose,weasel	4.8.4.4
badger	4.8.4.5
otter	4.8.4.6
civet	4.8.4.7
cat	4.8.4.8
Ungulate	**4.8.5**
pig	4.8.5.1
sambar deer	4.8.5.2
muntjac	4.8.5.3
serow	4.8.5.4
gaur	4.8.5.5
Rodent	**4.8.6**
squirrels	4.8.6.1
rats and mice	4.8.6.2
bamboo rats	4.8.6.3
porcupines	4.8.6.4
Birds	**4.9**
Pheasants	4.9.1
Partridges	4.9.2
Pigeons / doves	4.9.3
Water birds	4.9.4
Birds of prey	4.9.5
Hornbills	4.9.6
Swallows/ Swifts	4.9.7
Reptiles	**4.10**
turtles	4.10.1
lizards	4.10.2
snakes	4.10.3
Amphibian	**4.11 ***
Fish	**4.12 ***
Eel	**4.13 ***

Wild Animal	Code
Aquatic invertebrates	**4.14 ****
snails	4.14.1
crabs	4.14.2
shrimp	4.14.3
clams	4.14.4
water insects	4.14.5
Terrestrial invertebrates	**4.15 ****
beetle	4.15.1
larvae	4.15.2
bees	4.15.3
cricket	4.15.4
Gear Type	**Code**
Snare	1
gun snare	1.1
spear & crossbow	1.2
fence	1.3
large spring string	1.4
large spring metal	1.5
small spring string	1.6
Trap	2
hole / pit trap	2.1
log trap	2.2
rock trap	2.3
guillatine (squeeze body)	2.4
bamboo scissor/ pincer (squeeze body)	2.5
triangle noose (squeeze body)	2.6
small claw trap	2.7
Gun	3
Cap gun	3.1
Crossbow spear gun	4
Net	5
Dog	6
Fishing gear	7
Net	7.1
Trap	7.2
Rod	7.3
Battery / electric rod	7.4
Spear gun	7.5
natural poison	7.6
purchased poison	7.7
bomb	7.8
Collected by hand	8

* photograph (dorsal and ventral)
** photograph

Appendix 6. Household Food Collection Sites Form

Area Codes (Food Collection Sites)

Viillage:_____

Family ID:_____

Instructions: The purpose of this form is to record sites where this family frequently collects wild foods. Work with the family to record and photograph the following types of locations:

1. Traps
2. Snares
3. Fishing holes
4. Caves
5. Hai field
6. Paddy field
7. Fallow field
8. Garden
9. Livestock grazing area
10. Mineral lick
11. Other food collection locations

Number	*Site Name*	*Waypoint #*	*UTM East*	*UTM North*	*Time of photo*				*Date recorded*	*Recorder name*
					N	*E*	*S*	*W*		
1										
2										
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Appendix 7. Assessing Trends in Food Consumption

What was the average annual consumption of food items in the past and the expected consumption in next 10 years? Why? *Consumption refers to amount (volume), not frequency*

Materials: 4-A0 sheets of paper; permanent marker, non-permanent marker; seeds; photos of 23 food items –see list below; condensed milk can, sweets; camera; plastic card for writing question number, family name, date and time.

For this question we used 23 food items; villagers are familiar with these food items from the previous questions.

- Staples: rice (1)
- Vegetables: garden (pakad –mustard green photo) and wild (fern photo) (2,3)
- Fruits: garden group (mango photo) and wild group (mak fai photo) (4,5)
- Meats/fish/alternative (FG 4): domestic meat group (pork photo), wild meats (12; as discussed before), wild eggs (monitor lizard egg photo), domestic eggs (chicken egg photo), soybeans/peanut group (peanut/soybean/sesame photos) (6-21)
- Oil/fats: animal lard/vegetable oil (22) (photo vegetable oil and pork fat)
- Sweets: condensed milk/sweets (23) (can of condensed milk and sweets)

Step 1. Explain that you now want to talk about food consumption. Place seeds 1-5 (or 0) for all food item consumption according to ranking scale (0=no consumption, 5=high consumption) and events from previous exercise. Have photo in Column 1 of the food item to assure comprehension (See Figure 6). Spread the 23 food items over 4 different A0 sheets of paper.

Step 2. Where there are changes in consumption (decrease or increase) of a food item in the table, record why there was a change in the cell where the change occurred.

Step 3. After placing all seeds, allow villagers time to reflect on relative consumption and adjust the seed numbers [This exercise should allow us to understand if there was a higher consumption of one food item over another – e.g. increase in squirrel consumption as wild pigs decline]

Step 4. Make a photo of the final tables.

Step 5. Remove the seeds and record the seed number in each cell (write down e.g. 2)

This photo shows how to rank food consumption trends (0-5) across several different periods of time. On the left, see how the food item photos are placed with each row.

Appendix 8. Assessing Trends in Food Sources

How have food sources (domestic, wild, market) for the: i) basic food groups; and ii) total food intake changed over time, especially with regard to the role of wild meats in overall meat and food intake

Materials: 3 white, letter-size sheets of paper with sources-domestic, wild and market; 15 or 20 seeds or candies; non-permanent marker; photo for each group; notebook; camera; plastic card for writing question number, family name, date and time. Food group/items include only 4 groups: 1) rice only; 2) all vegetables; 3) all fruits; 4) all meats.

Step 1. Lay out sheets with the 3 food sources: domestic, wild and market. Explain that you now want to talk about food sources.

Note that market foods can include foods purchased at a market and foods purchased from other households or villages. Market food also includes exchange of one food item for another (e.g., exchange small pig for 3 kg of rice).

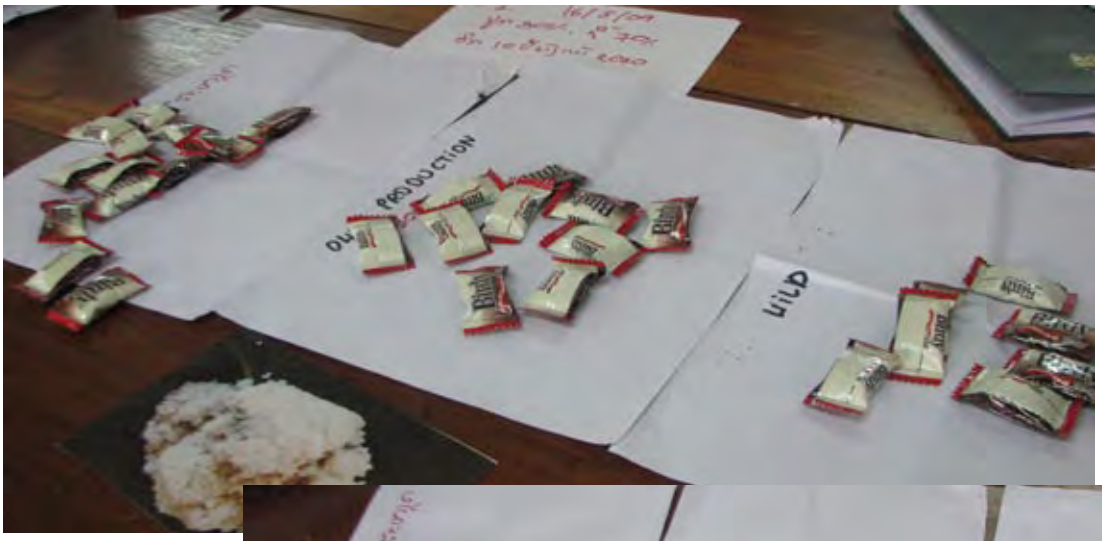
Step 2. Let villagers divide up 15 seeds/candies proportionally for the share of the food item from this source. If villagers say the group comes from only 2 food sources, then use 20 seeds/candies. For example, rice can only come from two sources, which are domestic and market – not wild.

Step 3. Repeat for 4 groups over the following time periods: 1997, 1998- 2002, 2003-2008, 2009-2020. Take a photo.

Step 4. Repeat this exercise for total food intake (all food groups includes rice, meat, fish, vegetables, fruits, etc.)

Step 5. Record the reasons for the proportions in a notebook with the photo date, time, family number and question number. Take a photo.

Step 6. Record the reasons for the proportions in notebook with the photo date, time, family number and question number.



This photo shows how to arrange the sheets and the candies and how to place the photo card showing family number, date, time and question number.

This photo shows how to place some selected food items of the food group next to the sheets. This example shows the meat group.

Appendix 9. Assessing Trends in Abundance and Offtake of Wildlife

What was the harvest of wild animals in the past and the expected harvest in next 10 years? Why? What was the percentage sold/eaten/given as gifts?

Note that harvest could be for many reasons: consumption, trade, elimination of a pest or other reason.

Materials: 6 A0 sheets of paper from question #3; permanent marker, non-permanent marker; photos of 12 wild animals/groups; corn seeds; camera; plastic card for writing the question number, family name, date and time.

Step 1. In the second row, ask the Heads of Household (HH) to estimate **how much was harvested** of this animal over time. Place seeds (0-5) for each time period. After the timeline is complete, leave the seeds and write in the number (0-5). See red box in the figure below.

Step 2. If harvest increases or decreases in a cell, ask the HH **why** this may have happened? Record information in the cell.

Step 3. For each time period, ask **what proportion of the harvest was for consumption, sale, or gift?** Give HH 10 seeds. Place seeds proportionally on each card for each time period. For each time period, record results in the cell.

This photo shows how harvest of animals is recorded (see red box). Do not forget to record the proportion of the harvest that is used for: 1) food; 2) trade; or 3) gift/other.

This photo also shows the sequence of wild animal photos in the order to be shown to the villager, starting with the fish group and finishing with the turtle group.

Appendix 10. Assessing Trends in Governance of Wildlife Offtake

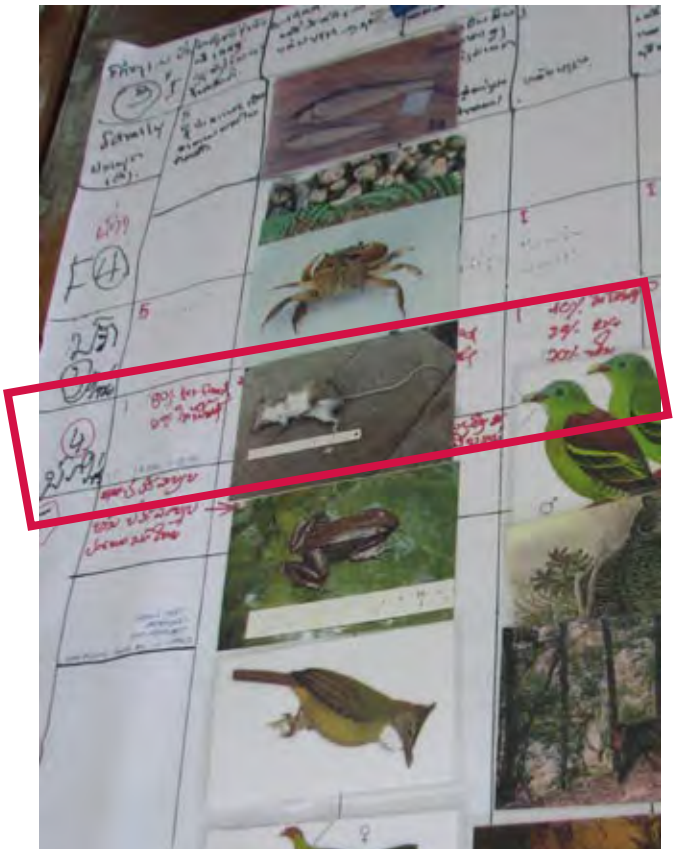
What household and village rules existed about harvest of these wild animals before the NPA was established?

Materials: 6 A0 sheets of paper from question #3; permanent marker, non-permanent marker; notebook for recording results; photos of 12 wild animals/groups; camera; plastic card for writing question number, family name, date and time.

Step 1. When you first learned about the NPA regulations, at that time, did your family or the village have any rules about harvesting this animal?
Answer yes or no on the data form for family and for village. If yes, ask them to explain the rule and record information in the cell about:

- **Who** could harvest and who was forbidden from harvest (e.g., people from the same village, neighboring villages, other people)?
- **When** to harvest? (Buddhist lent, agricultural cycle, moon phase, childbirth, etc.)?
- **Where** to harvest (are there areas specific to your family such as rice fields, sanams, forest areas, fishing spots, etc.)?
- **How** to harvest (types of guns, snares, other permitted methods of harvest)?
- **How** much to harvest (numbers of individuals permitted each year)?
- If you violated these rules, were there options for appeasement (e.g, animal sacrifice, etc)?

NOTE: Complete questions 3-5 for each food item before moving on to the next food item.



This photo shows how to record the family or village rules about each animal (see red box).

Step 2. When you first learned about the NPA regulations, did your HH or the village have any other taboos/rules that regulated offtake of <u>any other</u> wild animals? Record in notebook.

Step 3. Save the completed datasheets. Record all of the information from the data forms and notebook into the computer.

Appendix 11. Assessing Perceptions of Nutritional Value

What are villagers' perceptions on the nutritional value of selected food items [special focus on Food Group 4 – meats and meat alternatives]?

Materials: 3 circle cards: high-good to eat for your health (+++), medium (++), low nutritional value(+); photos of food items (see list below); condensed milk can, sweets; non-permanent marker; camera; plastic card for writing nutritional value, family name, date and time.

Food items include:

[1] rice, corn, domestic roots (for example, cassava), wild root (for example, khoy)

[2] wild mushrooms, domestic green leafy vegetable (phak khat is an example for the whole group), wild green leafy vegetable (for example, fern), bamboo shoot

[3] banana, wild fruits (for example, mak fai), domestic fruits (for example, mango)

[4] Food Group 4:

- soybean, peanut, sesame;
- pork, beef, chicken, wild fish group (pa khing photo) ; frog/toads group (green frog photo), crab, shrimp, snail, insect group (total and bamboo worm), rats group (photo white-bellied forest rat), small bird group (bulbul photo), red junglefowl(species photo), wild pig (species photo), big bird group (pigeon photo), common palm civet (species photo), stump-tailed macaque (species photo), monitor lizard (species photo), turtle group (photo tao kham) ; wild eggs (bird, snake, lizard), domestic eggs

[5] pork lard/pork fat, vegetable oil

[6] condensed milk, sweets (candy) - you will need to buy these beforehand

Step 1. Introduce the food item cards from all 6 food groups. Ask villagers "what do you see?" Go through each card one by one to make sure that everyone agrees on the name of each food item or group (for example, that the picture of the frog represents the frog/toad group).

Step 2. Lay out the circle cards (+, ++, +++) and explain that you want to talk about villagers' perception/knowledge on food items (see above).

Step 3. Work through the 6 food groups individually. Do seven rounds: start with staples: rice, corn, cassava and wild root. Give the cards of the food items to the mother in the family.

Step 4. The mother lays down the cards in consensus with the rest of the family into the three circle cards (make sure she does not work alone and give us her own viewpoint only). Leave the cards there and do not remove for the next round.

Step 5. Arrange the food items around each circle (see Figure 1). Photograph the results for each circle, make sure that all of the food items are clearly visible in the photo. Add sign for question 1, family number, date and time.

This photo shows how to arrange the food items around each circle card. Make sure that all of the food items are clearly visible in the photo.

Appendix 12. Assessing Taste Preference

What is villagers' taste preference for selected food items [special focus on Food Group 4 – meats/ meat alternatives]?

Materials: 3 circle cards: tasty (+++), OK to eat (++), not tasty-prefer not to eat (+); photos of food items (see list below); condensed milk can, sweets; camera; non-permanent marker; plastic card for writing question number, family name, date and time.

Food items include:
[1] rice, corn, domestic roots (for example, cassava), wild root (for example, khoy)
[2] wild mushrooms, domestic green leafy vegetable (phak khat is an example for the whole group), wild green leafy vegetable (for example, fern), bamboo shoot
[3] banana, wild fruits (for example, mak fai), domestic fruits (for example, mango)
[4] Food Group 4:

- soybean, peanut, sesame;
- pork, beef, chicken, wild fish group (pa khing photo) ; frog/toads group (green frog photo), crab, shrimp, snail, insect group (total and bamboo worm), rats group (photo white-bellied forest rat), small bird group (bulbul photo), red junglefowl (species photo), wild pig (species photo), big bird group (pigeon photo), common palm civet (speciess photo), stump-tailed macaque (species photo), monitor lizard (species photo), turtle group (photo impressed tortoise); wild eggs (bird, snake, lizard), domestic eggs

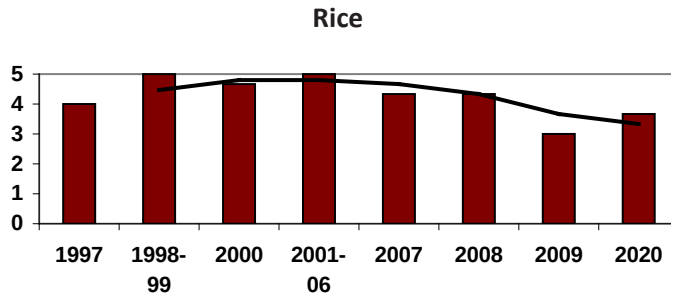
[5] pork lard/pork fat, vegetable oil
[6] condensed milk, sweets (candy)

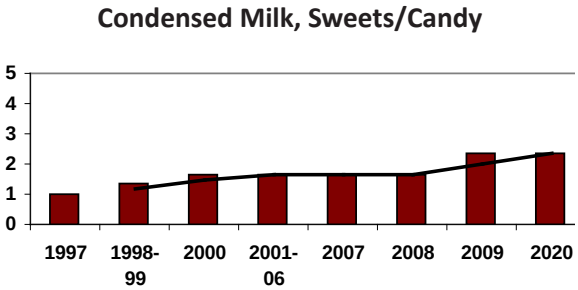
Step 1. Explain that after talking about the nutritional value you want now to talk about family' taste of food items (see above)
Step 2. Work through the 6 food groups individually. Do seven rounds: start with staples: rice, corn, cassava and wild root. Give the cards of the food items to the mother in the family.
Step 3. The mother lays down the cards in consensus with the rest of the family into the three circle cards
Step 4. Arrange the food items around each circle. Photograph the results for each circle, make sure that all the food items are clearly visible in the photo. Add sign for question 1, family number, date and time.

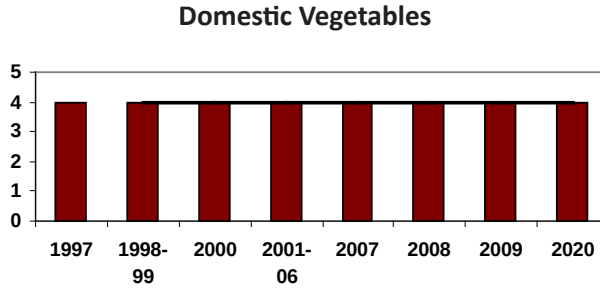
This photo shows how to arrange the food items around each circle card. Make sure that all of the food items are clearly visible in the photo.

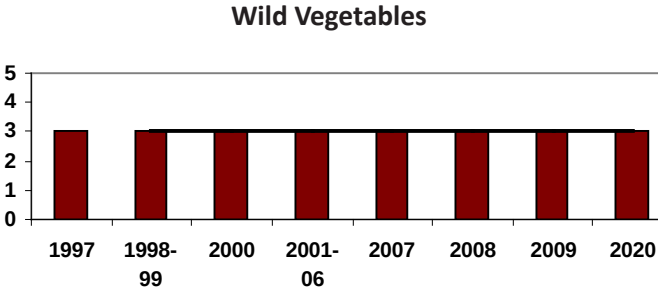
Appendix 13. Average Perceptions of Three Families in Houey Dtern Village about Past and Future Trends in Consumption of 12 Food Groups

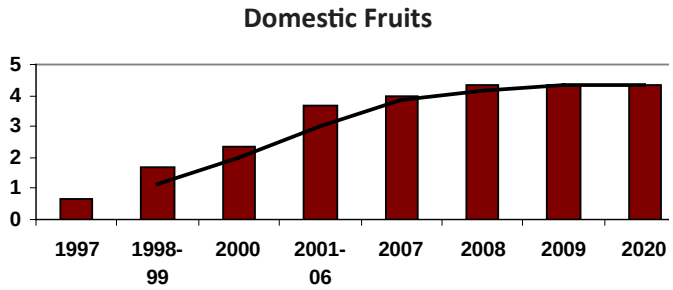
Before 1997: Vietnamese traders active in 1987, road constructed from 1991-1994; district aware of wildlife regulations but no enforcement; open trading of wildlife
1997: Village established at current location near road; at that time (1997) there were regulations about trade of *protected* species
1998-1999: Bus service started on road by village; opened airport in Sam Neua
2000: IUCN project in NPA
2001-2006: Cap gun collection; Land allocation and introduced *core zone* to village
2007: Phonsong substation, conservation extension team introduce natural resource management principles in village; cash crop production – corn with chemicals for clearing grass
2008: CIAT-grow forages for livestock production; fodder for pig production
2009: Today
2020: Youngest child has children

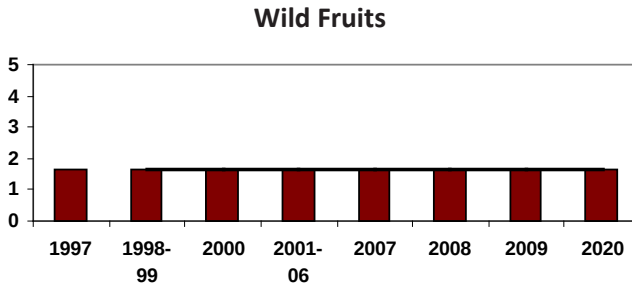


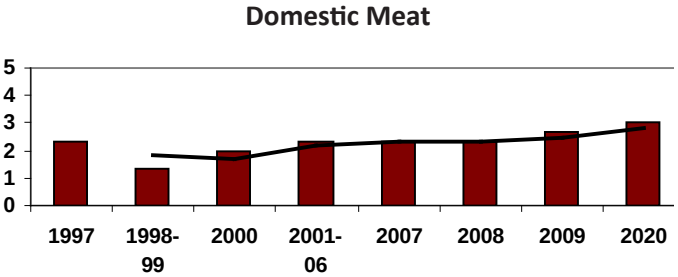


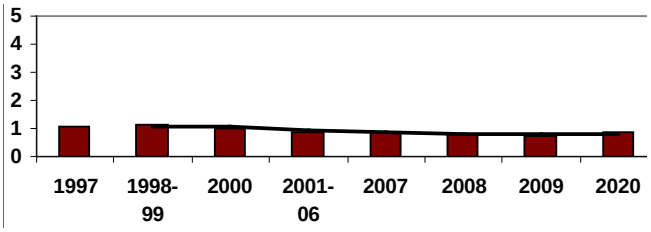


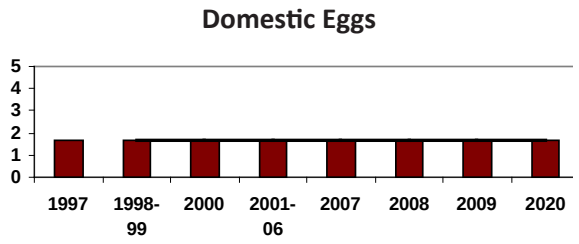


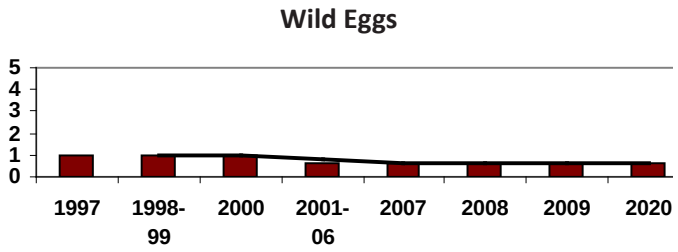


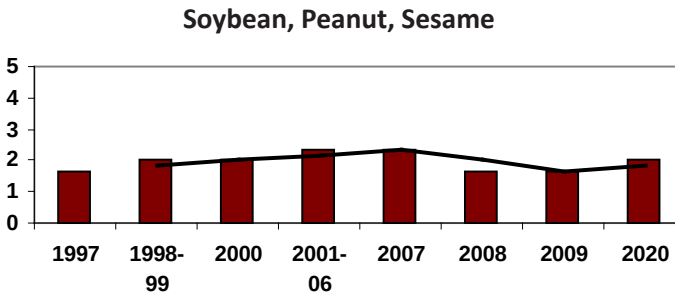


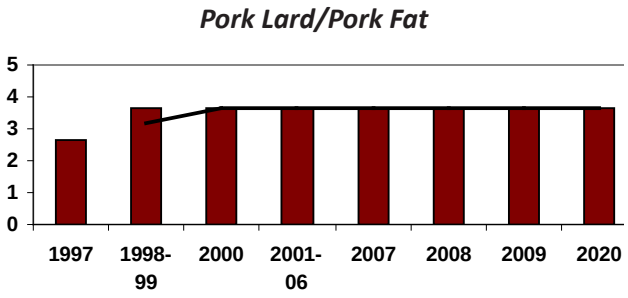





Domestic Eggs
5
4
3
2
1
0
1997
1998-99
2000
2001-06
2007
2008
2009
2020


Wild Eggs
5
4
3
2
1
0
1997
1998-99
2000
2001-06
2007
2008
2009
2020


Soybean, Peanut, Sesame
5
4
3
2
1
0
1997
1998-99
2000
2001-06
2007
2008
2009
2020

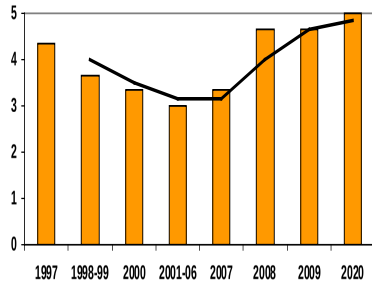

Pork Lard/Pork Fat
5
4
3
2
1
0
1997
1998-99
2000
2001-06
2007
2008
2009
2020

Appendix 14. Average Perceptions of Three Families in Houey Dtern about Past and Future Trends in Abundance, Harvest and Consumption of 12 Wild Animal Groups

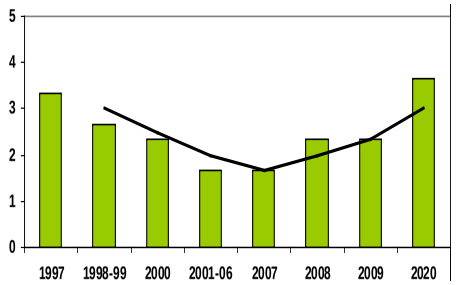
Before 1997: Vietnamese traders active in 1987, road constructed from 1991-1994; district aware of wildlife regulations but no enforcement; open trading of wildlife
1997: Village established at current location near road; at that time (1997) there were regulations about trade of protected species
1998-1999: Bus service started on road by village; opened airport in Sam Neua
2000: IUCN project in NPA
2001-2006: Cap gun collection; Land allocation and introduced core zone to village
2007: Phonsong substation, conservation extension team introduce natural resource management principles in village; cash crop production – corn with chemicals for clearing grass
2008: CIAT-grow forages for livestock production; fodder for pig production
2009: Today
2020: Youngest child has children

1) Wild Fish

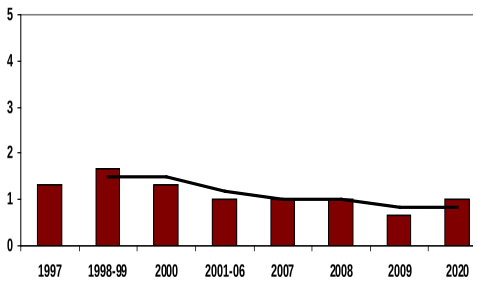
Wild Fish: Abundance



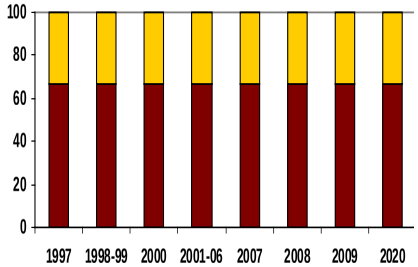
Wild Fish: Harvest



Wild Fish: Consumption

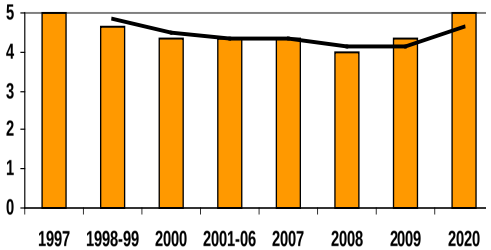


Wild Fish: Proportion of harvest for food (red) or gifts (yellow)

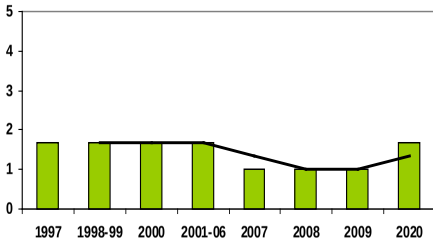


2) Other Aquatic Organisms (crab, snail, shrimp, water insects)

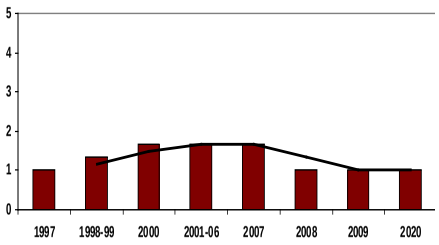
OAA: Abundance



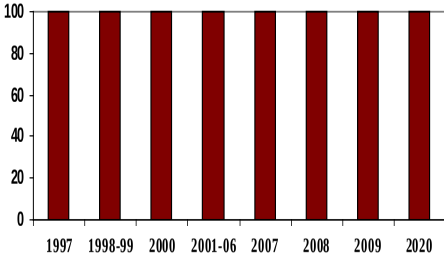
OAA: Harvest



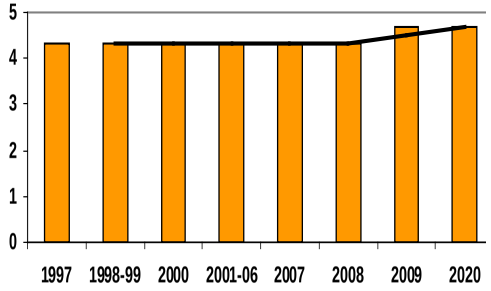
OAA: Consumption

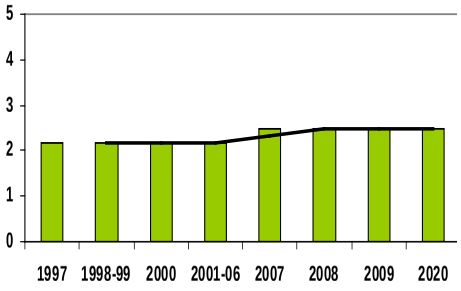


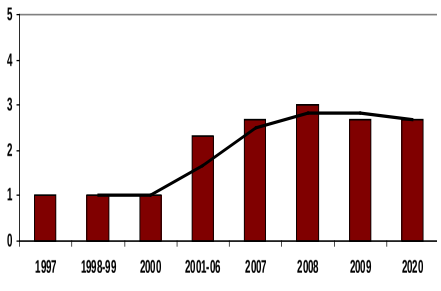
OAA: Proportion of harvest for food (red) or gifts (yellow)

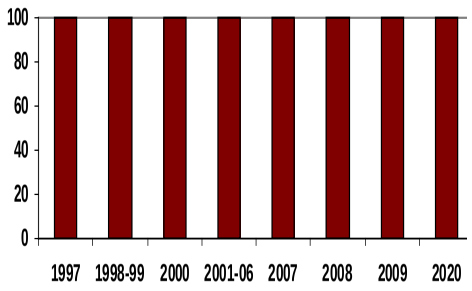


3) Rats

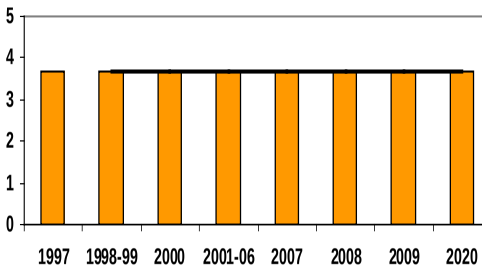


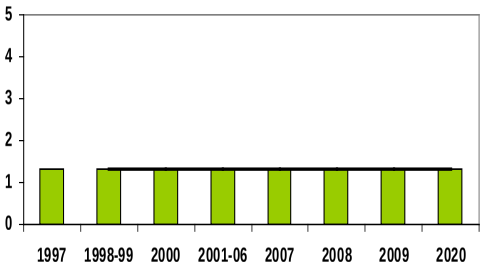


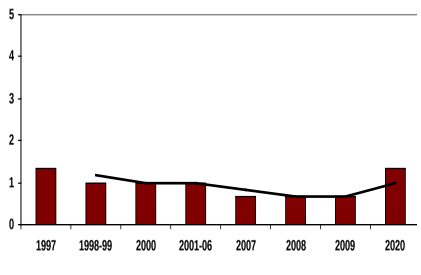


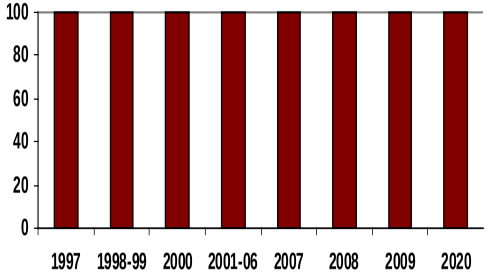


4) Frogs and Toads

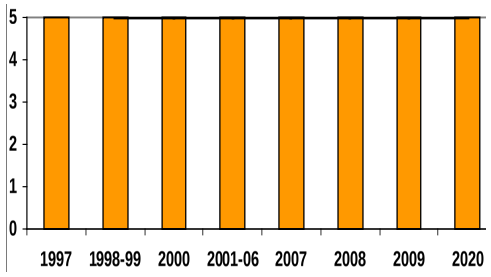


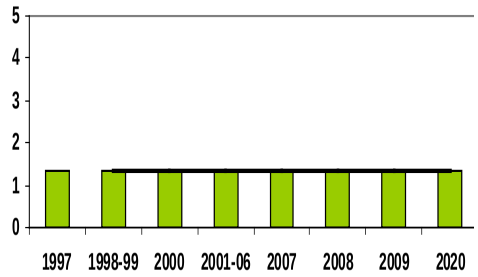


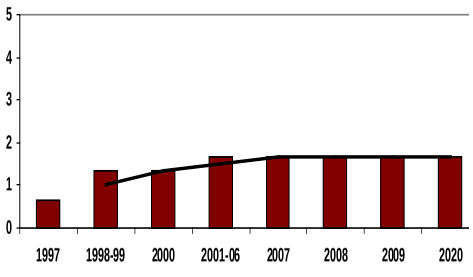


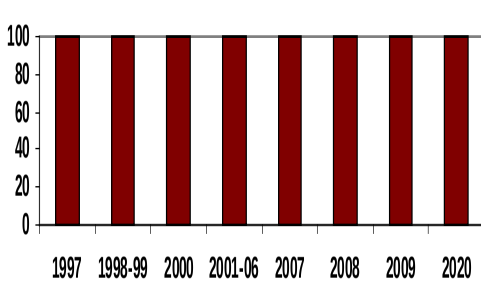


5) Small Birds (e.g. Bulbuls)



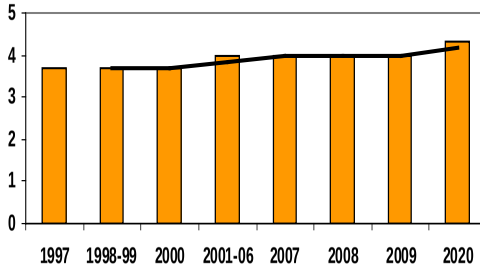




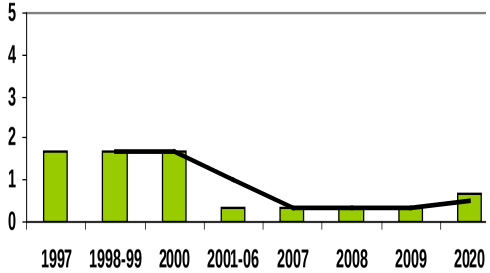


6) Red Junglefowl

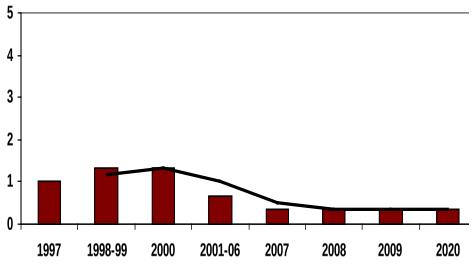
Junglefowl: Abundance



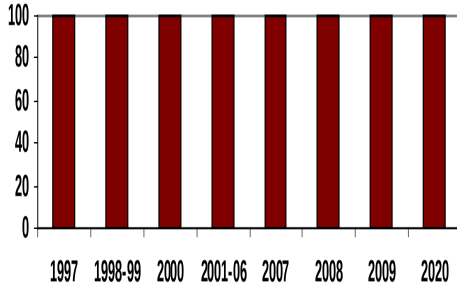
Junglefowl: Harvest



Junglefowl: Consumption

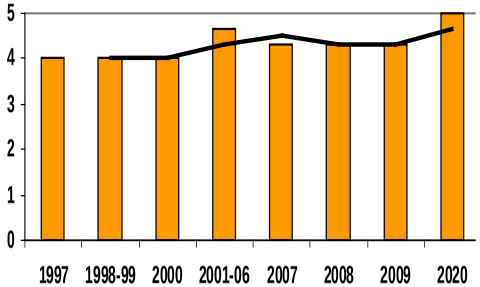


Junglefowl: Proportion of harvest for food (red) or gifts (yellow)

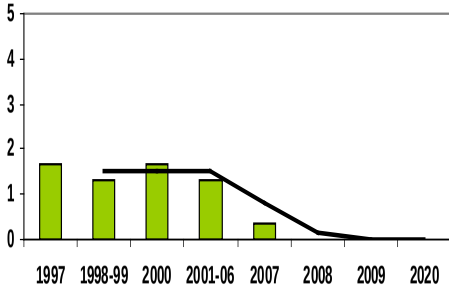


7) Wild Pig

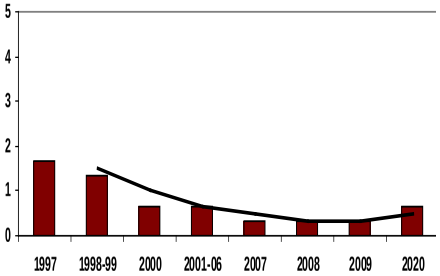
Wild Pig: Abundance



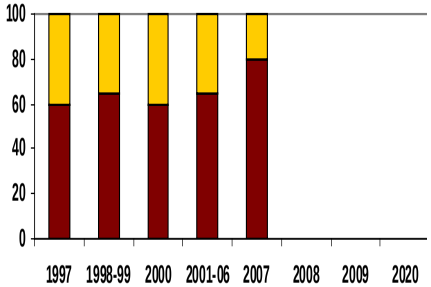
Wild Pig: Harvest



Wild Pig: Consumption

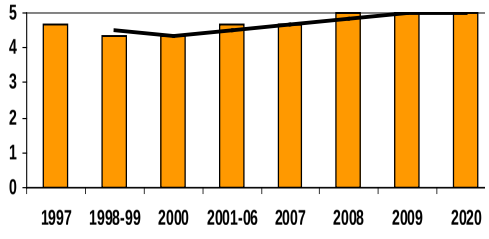


Wild Pig: Proportion of harvest for food (red) or gifts (yellow)

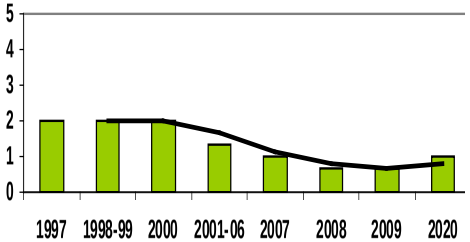


8) Large Birds (e.g. Pigeons)

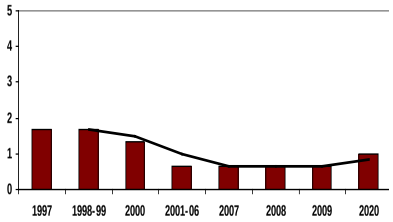
Large Birds: Abundance



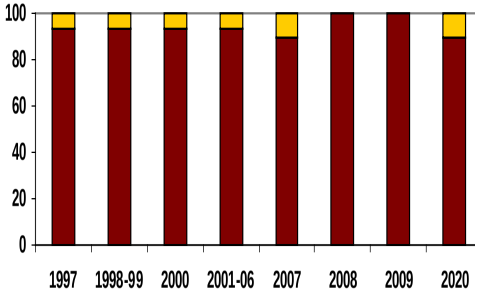
Large Birds: Harvest



Large Birds: Consumption

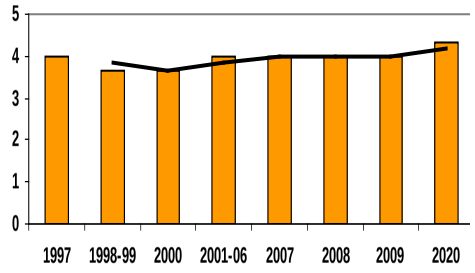


Large Birds: Proportion of harvest for food (red) or gifts (yellow)

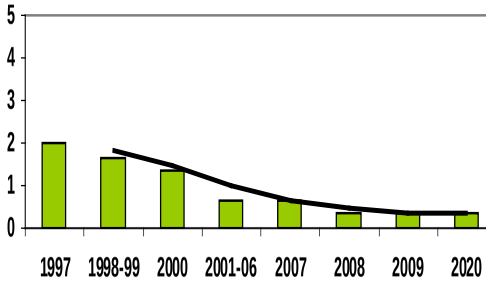


9) Common Palm Civet

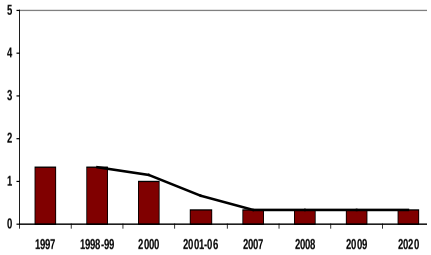
Civet: Abundance



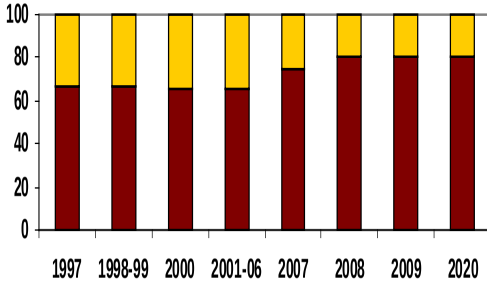
Civet: Harvest



Civet: Consumption

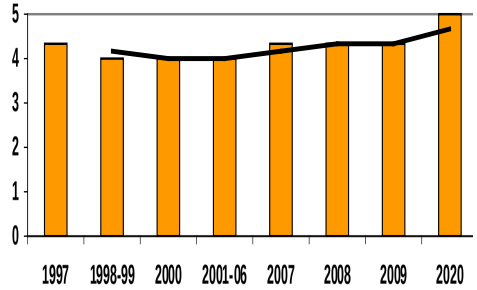


Civet: Proportion of harvest for food (red) or gifts (yellow)

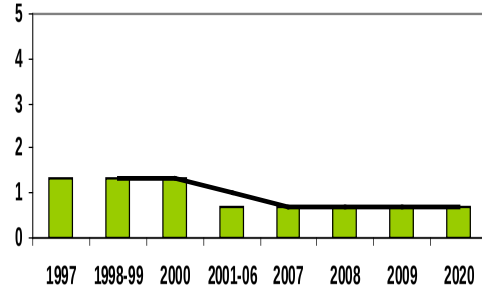


10) Stump-tailed Macaque

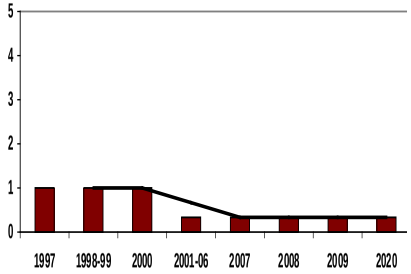
Macaque: Abundance



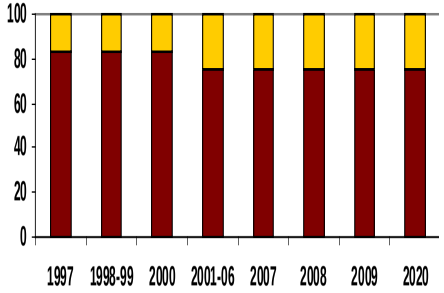
Macaque: Harvest



Macaque: Consumption

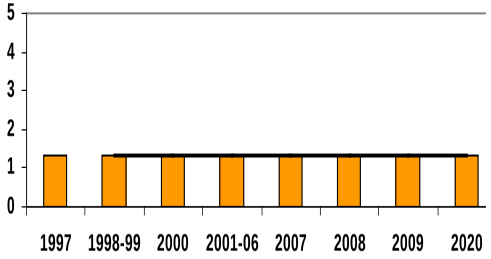


Macaque: Proportion of harvest for food (red) or gifts (yellow)



11) Monitor Lizard

Monitor Lizard: Abundance



Monitor Lizard: Harvest

No harvest

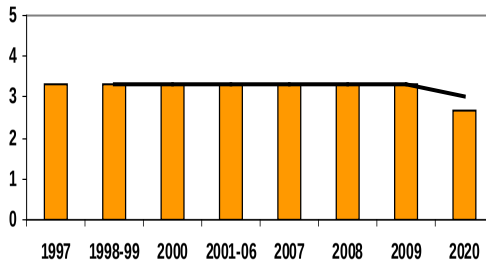
Monitor Lizard: Consumption

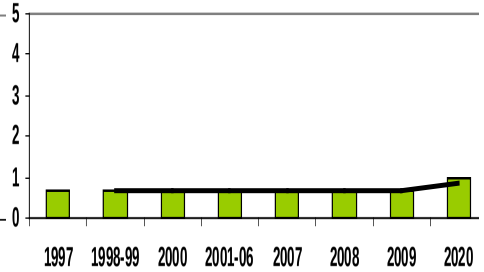
No consumption

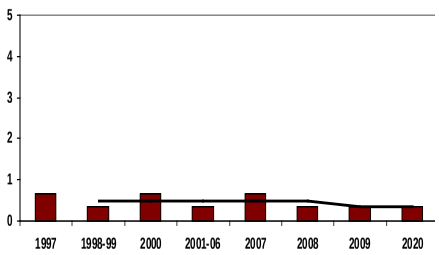
Monitor Lizard: Proportion of harvest for food (red) or gifts (yellow)

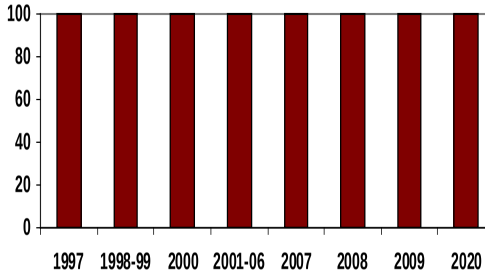
N/A

12) Turtles and Tortoises









TRANSLINKS

TransLinks is a 5-year Leader with Associates cooperative agreement that has been funded by the United States Agency for International Development (USAID) to further the objective of increasing social, economic and environmental benefits through sustainable natural resource management. This new partnership of the Wildlife Conservation Society (lead organization), the Earth Institute of Columbia University, Enterprise Works/VITA, Forest Trends, the Land Tenure Center of the University of Wisconsin, and USAID is designed to support income growth of the rural poor through conservation and sustainable use of the natural resource base upon which their livelihoods depend.

The program is organized around four core activities that will be implemented in overlapping phases over the life of the program. These are:

1. Knowledge building including an initial review, synthesis and dissemination of current knowledge, and applied comparative research in a number of different field locations to help fill gaps in our knowledge;
2. Identification and development of diagnostic and decision support tools that will help us better understand the positive, negative or neutral relationships among natural resource conservation, natural resource governance and alleviation of rural poverty;
3. Cross-partner skill exchange to better enable planning, implementing and adaptively managing projects and programs in ways that maximize synergies among good governance, conservation and wealth creation; and
4. Global dissemination of knowledge, tools and best practices for promoting wealth creation of the rural poor, environmental governance and resource conservation.

Over the 5-year life of the program, TransLinks aims to develop a coherent, compelling and, most importantly, useful corpus of information about the value of, and approaches to, integrating Nature, Wealth and Power. To do this, TransLinks is structuring the work around two core issues – 1) payments for ecosystem services and 2) property rights and resource tenure.

USAID | Wildlife Conservation Society | The Earth Institute Columbia University | EnterpriseWorks/VITA A Division of Relief International | Forest Trends | Land Tenure Center

TRANSLINKS

A partnership of NGOs, Universities and USAID led by The Wildlife Conservation Society, dedicated to finding and sharing practical ways to generate benefits from conserving natural resources that are of global importance, and that serve as the supermarkets, bank accounts and insurance for many of the poorest people on earth.

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