



Norwegian University of  
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# Costs and benefits associated with natural resource exploitation in Chatthin Wildlife Sanctuary in Myanmar, and its impact on thamin (*Rucervus eldii thamin*) conservation

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Natural Resources Management

Submission date: May 2017

Supervisor: Eivin Røskaft, IBI

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## **List of abbreviations**

AHPs	ASEAN (Association of Southeast Asian Nations) Heritage Parks
BANCA	Biodiversity and Nature Conservation Association
CWS	Chatthin Wildlife Sanctuary
IUCN	International Union for Conservation of Nature
km <sup>2</sup>	Kilometer square
NCWD	Nature and Wildlife Conservation Division
NTNU	Norwegian University of Science and Technology
PA	Protected Area
SPSS	Statistical Package for the Social Sciences
UNDP	United Nations Development Programme
US\$	United States Dollar

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## **Abstract**

The conservation of wildlife in the Anthropocene inevitably depends on an understanding of how human populations interact with wildlife and its habitat. This involves understanding (1) how they exploit the natural resources of a given area, (2) any conflicts they have with wildlife, and (3) their attitudes towards wildlife and its conservation. This study aimed to examine the costs and benefits that local people experienced from living near a protected area (PA) that has been established in central Myanmar to protect one of the last populations of an endangered thamin (*Rucervus eldii thamin*), and consequently gain insights into how they viewed and responded to their conservation. A questionnaire survey was conducted in nine villages with 209 respondents. The results showed that the people living inside the PA exploited many of the area's natural resources, but also they at the same time suffered many costs associated with conflicts caused by the wildlife in PA. Despite this, they still held positive attitudes towards both thamin and the PA. Thamin was identified as the most common crop raider among the medium-sized wildlife. Communities living inside the PA had better knowledge about PA's operations and to some extent supported the thamin conservation, than those from communities along the edge of the PA or outside, however the enclaved communities stated that they were less likely to report thamin poaching to the authorities. Illegal thamin hunting is apparently still going on in the area and the local people living within the PA were more aware about the recent thamin population decline than those from the edge or external villages.

**Key words:** Attitudes, crop damage, local people, natural resources, perceptions, protected area, thamin

## **Introduction**

### **Background information**

Globally, land use changes, unsustainable utilization of natural resources, climate change, introduction of invasive alien species and pollution have accelerated the biodiversity loss faster than naturally causes of extinction (<http://wwf.panda.org>). Human activities are the main causes for such biodiversity loss (Kideghesho 2006, Primack 2014). Negative impacts by humans such as habitat destruction, overharvesting, spread of alien species and pollution are threatening 99 % of the IUCN Red List species (IUCN 2006 in Kideghesho 2006) with extinction. The 2013 IUCN Red List, which was updated in June 2012 shows that 19,817 species were listed under the endangered category including 25 % of mammals, 13 % of birds and 41 % of amphibians. Therefore, in order to sustainably conserve the planet's biodiversity as well as to reduce the pace of wildlife extinction, protected areas (PAs) have been established since 1872 (the first National Park in the world, Yellowstone National Park), and 12.5 % of the terrestrial land in the world is currently protected (Watson et al. 2014).

However, biodiversity in general as well as wildlife species in particular in PAs are still exposed to multiple threats due to high human demands for natural resources, and species are frequently becoming locally extinct, even in the core area of PAs. Most PAs have been administered in the past under “*fences and fines*” or “*fortress conservation*” policies (Terborgh 1999); and the local people in and around the PAs were denied direct access to the natural resources and were relocated outside the PAs (see example in Torri 2011, Coad et al. 2008). Subsequently, local communities have experienced numerous social and economic costs that result as unintended side effects of the process of biodiversity conservation. As a result, conflicts and antagonism between local residents and PAs are widespread (Madhusudan and Mishra 2003), and human activities like poaching, overgrazing, deforestation and land encroachment have negatively affected wildlife species and habitats. Since the 1980s, wildlife conservation scholars have increasingly considered the importance of involvement of local people in wildlife and PA management (Hackel 1999), and rural communities are encouraged to become involved in conservation (Western and Wright 1994, Mfunda 2001). In the 4<sup>th</sup> World Parks Congress in Caracas, the president of IUCN addressed in the opening that “quite simply, if local people do not support protected areas, then protected areas cannot last” (Ramphal 1993 in Holmes 2013). Thus, the success of conservation in PAs fundamentally relies on local support towards PAs. The study of local people perceptions and attitudes towards PAs and their associated wildlife is therefore critical

for the assessment and understanding of acceptance of local residents, and the effect of implementation of conservation policies (Holmes 2003, McClanahan et al. 2005, Røskoft et al. 2007). Associated with this is a need to understand the full range of the costs and benefits that local communities receive from PAs and wildlife. A better understanding on how to minimize the costs and how to maximize the benefits associated with PAs will improve the management and conservation of wildlife in PAs (Holmes 2013).

Myanmar has a total land area of 676,577 km<sup>2</sup>, and is one of the most biodiversity rich regions in Asia (Myers et al. 2000, Wikramanayake et al. 2002). A large extent of Myanmar's natural ecosystems still remains relatively unexploited (Leimgruber et al. 2003). There are over 18,000 plants species, about 300 mammal species, 1,100 birds species, 290 reptiles and 120 amphibian species, as well as 1,200 butterflies species in Myanmar, whereas 61 plant species, 47 species of mammals, and 45 species of birds are listed as being globally threatened (Forest Department 2015). Although the first two PAs were established in 1918 in Myanmar, a more effective and systematic management of conservation was only initiated at the beginning of the 1980s. From 1981 to 1984, the government of Myanmar and the United Nations Development Programme (UNDP) cooperated on a biodiversity conservation project, named the Nature Conservation National Park Project (NCNPP). Within this project's implementation period, the Nature and Wildlife Conservation Division (NWCD) was organized in order to effectively conserve the biodiversity and PAs in the country. In 2014, there were 39 PAs in Myanmar covering 5.75 % (38,906 km<sup>2</sup>) of the total land area, and among them, seven PAs were designated as ASEAN Heritage Parks (AHPs) (Forest Department 2015). Three of these have been recognized as Ramsar Sites, as Wetlands of International Importance (<http://www.ramsar.org/wetland/Myanmar>).

Among the threats to biological diversity identified in IUCN assessments, "Biological Resource Use" was identified as the most significant threat to Myanmar's PAs. Under this category of threat, poaching, unsustainable timber logging, human colonization and shifting cultivation were the most critical threats identified in the study of 30 PAs. Fishing was identified as threatening in 8 PAs and collection of plants derived resources in 6 PAs (Istituto Oikos and BANCA 2011).

One example of a protected area is Chatthin Wildlife Sanctuary (CWS) in the north central part of Myanmar. It was created in September 1941 (Zug et al. 1998, Aung et al. 2004) specifically to protect an endangered species, thamin (*Rucervus eldii thamin*), also known as Eld's deer or brow-antlered deer. The CWS is on the list of IUCN Protected Area Category

IV (Istituto Oikos and BANCA 2011). The most significant threats from the local residents in CWS are utilization of natural resources provisioning such as illegal logging, firewood, hunting, land encroachment, grazing and non-timber forest products (Aung et al. 2004, Allendorf et al. 2012).

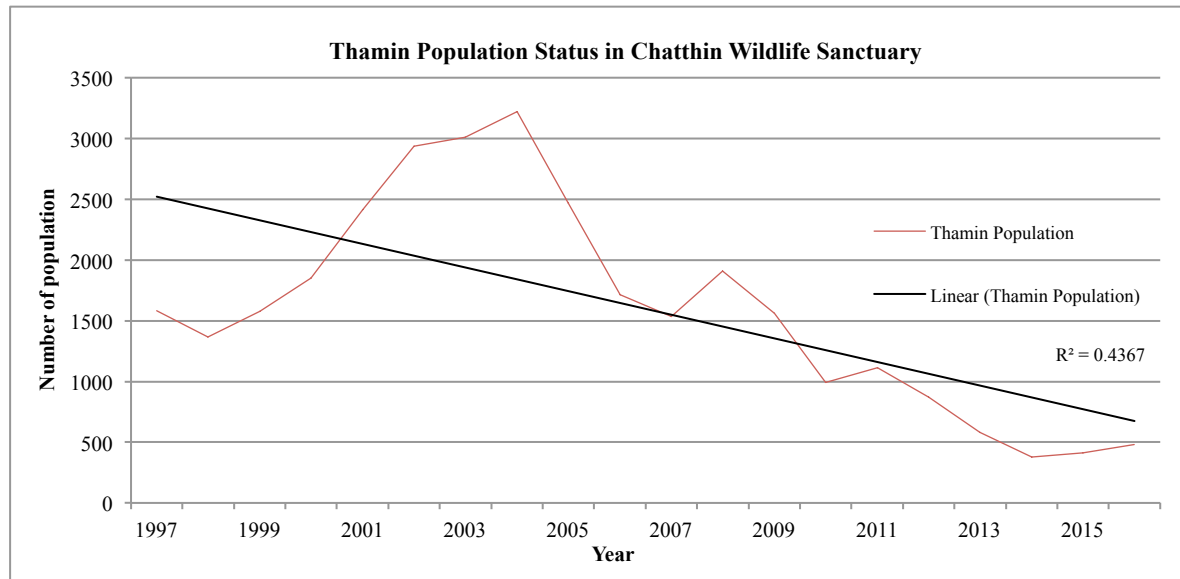
### **Study Species**

Thamin are mixed feeders (grazers and opportunistic browsers) (Ahrestani et al. 2016) and they forage on grasses, forbs, farmer's crops and some fruits in the dry forests (McShea et al. 2001). There are three subspecies of thamin and they are all categorized under IUCN Red Lists as endangered. The subspecies *Rucervus eldii eldii* is found in India; *Rucervus eldii thamin* in Myanmar and western Thailand; *Rucervus eldii siamensis* is found in Lao PDR, Cambodia, Thailand, China and Viet Nam; however, the subpopulation *Rucervus eldii hainanus* found on Hainan island in China is under consideration to be listed as an another subspecies (Balakrishnan et al. 2003, Gray et al. 2015). The thamin subspecies (*Rucervus eldi thamin*) is native to Myanmar and they still occur in many locations of the central dry zone of the country. The nationwide thamin surveys conducted in 1992 found that thamin were found in 28 townships, however, surveys in 1997 reported that they were located in 23 out of the 24 surveyed townships (McShea et al. 1999, Gray et al. 2015). Similar investigations in 2007 indicated that the thamin were only found in 14 townships throughout the country (Gray et al. 2015). This situation has continued to worsen, and currently the conservation of the thamin in Myanmar is mainly carried out in Shweseztaw Wildlife Sanctuary and Chatthin Wildlife Sanctuary (CWS). Although CWS was an area where a high thamin population has been found in the past, the recent survey information has indicated that the Shweseztaw Wildlife Sanctuary thamin population is bigger than the one in CWS (Gray et al. 2015).

### **Justification of Research questions**

During 1983 to 1995, the thamin population declined by 40 % in CWS (McShea et al. 2005), and by a further 60 % from 1997 to 2016 (Figure 1). Aung et al. (2004) concluded that three possible factors triggered the population decrease: 1) the high market demand for live or dead thamin in Thailand and China, 2) the reduction of crop yields due to low rainfall between 1983 and 1994, and 3) the demonetization of national currency in 1985 and 1987. The subsequent socioeconomic hardships stimulated the local people to increase the rate of thamin hunting and land encroachment for cultivation in and around CWS. The government of Myanmar started a cooperation project focusing on thamin conservation with the

Smithsonian Institution in 1994, which included a focus on studying thamin ecology, and conducting training courses for ecology and inventory techniques (Aung et al. 2004). The cooperation brought the initiation of a “Community Education Project” around 1996 to improve the conservation awareness of local residents about thamin as well as the protected area. The collaboration stopped after 2003 (Gray et al. 2015) and the thamin population in CWS has dramatically declined since 2004 (Allendorf et al. 2012, unpublished data from CWS office) (Figure 1).



**Figure 1:** Population status of thamin in the study area from 1997 to 2016 (data from CWS office).

Gray et al. (2015) speculated that the decline of the thamin population in Myanmar is probably driven by loss of habitats and illegal hunting. Thamin hunting is mostly practiced for meat (Salter & Sayer 1986) and antlers. The methods of hunting include passive hunting (wire snares) and active hunting (spears, spotlighting at night and the use of weapons like firearms). Illegal thamin hunting is likely to be the most serious threat to the population in CWS (Wemmer et al. 2000). The households that located very close to CWS are believed to most likely be involved in hunting (Wemmer et al. 2000, Songer 2006). There were supposed to be hunters in the six villages within and adjacent to CWS using firearms and two villages using spears for poaching. They hunted approximately 30 - 40 thamin per year (Wemmer et al. 2000). This bushmeat contributed not only to protein source available from PA, but also to earning of cash for local people. Unregulated hunting for food, traditional culture or medicine has driven many wildlife declines in the tropics (Corlett 2007, Nasi et al. 2008). Similarly, thamin hunting has occurred in Cambodia, Lao PDR and Viet Nam for local consumption as

well as the bushmeat trade (Duckworth et al. 1999, Tordoff et al. 2005, Gray et al. 2015). As a result, hunting has caused local extinction of thamin in Viet Nam (Bennett and Rao 2002). Furthermore, forest clearances from the “slash-and-burn” or shifting agriculture and land conversion of Dipterocarp dry forest have caused habitat loss, fragmentation and degradation of habitat quality. Thamin are then increasingly vulnerable to severe hunting.

Koy et al. (2005) demonstrated that forest canopy cover patterns were negatively interlinked with the increasing human population growth and suggested that if the population of human continued to grow, the threats to thamin would also increase. From 1989 to 2004, the human population in and around CWS increased by 62% because of relocation of six villages to the CWS boundary due to construction of the adjacent Thapansaik Dam in 1996 (Songer 2006). From 2004 to 2016 the human population increased by further 30% (unpublished data from CWS office). In addition, the habitat corridor between CWS and adjacent forests has been destroyed because of construction of this huge dam on the western part of PA boundary. The high human population pressure has accelerated the high demands for illegal land use and extraction of natural resources from the PA.

A study by Rao et al. (2002), in 20 out of 31 PAs in Myanmar, showed that use of natural resources like extraction of non-timber forest products was found in 85 % of Myanmar’ PAs, along with hunting, grazing, firewood collection and human settlement in over 50 % of PAs. Likewise, 75 % of the households in CWS depended on the forest natural resources for food and 94 % for firewood while another 14 % depended on illegal hunting and fishing (Songer 2006). The time spent in the PA when entering CWS to exploit its natural resources has increased and this might further disturb the thamin. Human disturbances and local dependency of resources are likely to negatively correlate with the thamin population status. Thamin may have to avoid essential waterholes during the hot seasons because of human activity, and this might impact the survival of thamin (Allendorf et al. 2012).

Additionally, over 50 % of households grazed livestock inside the PA and the buffer zone (Songer 2006). Grazing has been shown to have a negative impact on the PA vegetation (Tobler et al. 2003), forest regeneration and biological diversity (Cabin et al. 2000) and can be expected to have increased the competition for forage between wildlife and livestock (Madhusudan 2004) as well as increase the risk for disease transmission between livestock and wildlife (Morgan et al. 2006). To date, livestock grazing commonly occurs in CWS. In addition, domestic dogs often accompany with the villagers when they enter CWS, and these



dogs could disturb and threaten the thamin, especially through predation by domestic dogs on fawns (Allendorf et al. 2012, Gompper 2014). Although the local resource dependency on the CWS has increased over time, there is still lack of alternative livelihoods for the local residents.

It is no doubt that the local residents often experience the costs from the conservation of the PA, especially due to wildlife induced crop damage. For example, Studsrød and Wegge (1995) found in their study in three villages in the Royal Bardia National Park, Nepal that the depredation of crop and livestock was the main problem caused by wildlife from the PA. In addition, serious crop damage incurred by Asiatic one-horned rhinoceros (*Rhinoceros unicornis*) was reported in the Royal Chitwon National Park, Nepal (Jnawali 1989). Bajracharya et al. (2006) found that 84 % of respondents in Annapura Conservation Area, Nepal suffered crop losses by wildlife. Similarly, about 50 % of people who lived adjacent to Sariska Tiger Reserve in India experienced the crop damage and livestock depredation (Sekhar 1998). According to McShea et al. (2001), thamin mostly raid the crop fields near the CWS boundary during the wet and cool seasons. These periods are the time for crop cultivation for most of the farmers. These crop raids by wildlife result in the reduction of local farmers' income from agricultural crops and create conflicts between local people and PA. As a result, the relationship between these two communities might be affected because of wildlife problems (Kideghesho et al. 2007).

The fundamental point is to realize that the PA-people relationship is by means of understanding and knowing the perceptions and attitudes of local people towards the PA (Allendorf et al. 2012). The long-term survival and success of conservation relies on local support (Ite 1996) and the conservation support from local people is often influenced by their perceptions and attitudes towards PAs and PA management (Heinen 1993). Local people's perceptions and attitudes towards the PA can be further affected by the availability of benefits from the PA and costs derived from PA conservation (Heinen 1993, Newmark et al. 1993). Despite its importance, we currently lack knowledge about the attitudes that local people have towards CWS in general and thamin in particular. In order to fill this gap, my study aims to examine; 1) what kind of benefits the local residents obtain from their access to the PA, 2) what kind of costs they experience with wildlife from the PA, 3) how they view the PA and 4) how they respond to the PA thamin conservation efforts.

## **Research questions**

The overall question concerns understanding to extent to which costs and benefits associated with the presence of a protected area are distributed across the landscape (along a gradient from inside the PA to outside), and how the net effect of these influences the attitudes of local communities towards thamin conservation. Specifically;

- 1) To investigate the kinds of natural resources that are utilized by the local people who live in and around CWS, and explore how the extent of such use shape their perceptions and attitudes towards CWS and thamin conservation.
- 2) To record and evaluate the intensity of problems or losses caused to local inhabitants associated with living close to a protected area; and how these costs affect the attitudes of local residents towards conservation.

## **Hypotheses**

People's attitudes towards the sanctuary depend on the costs or benefits they acquire from the sanctuary. Attitudes towards the PA and thamin conservation will also be influenced by gender, age, educational level, occupation and landholding status.

## **Predictions**

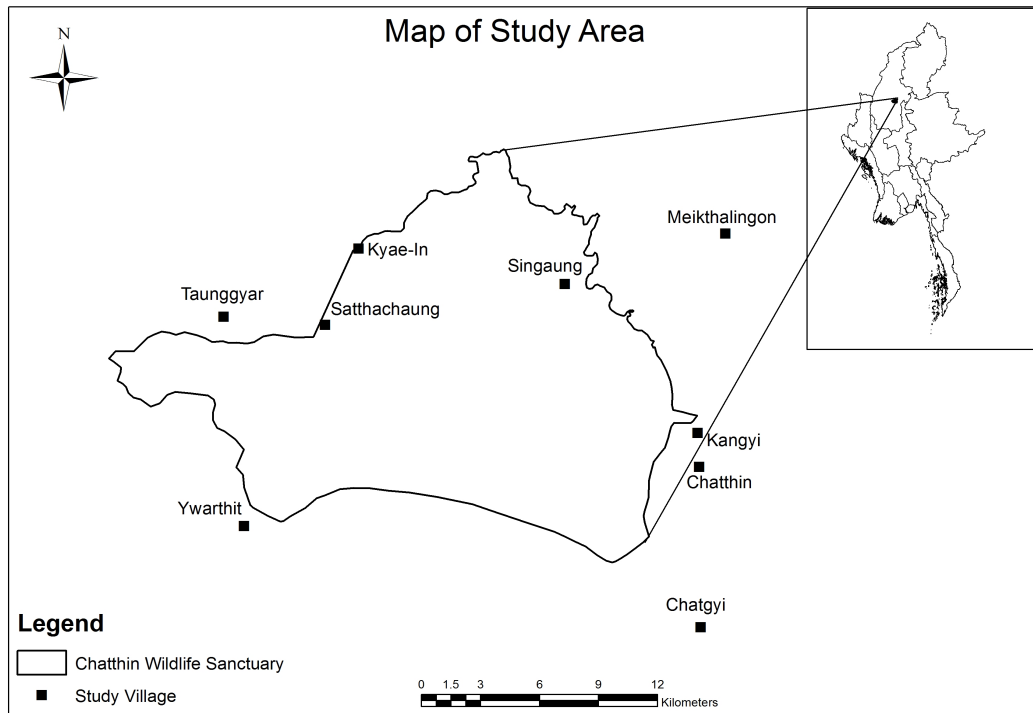
- P<sub>1</sub> The people who live adjacent to the sanctuary and utilize more natural resources from the protected area will have more positive attitudes towards the protected area.
- P<sub>2</sub> The people who live adjacent to the sanctuary and suffer losses due to wildlife crop raiding will have more negative attitudes towards the protected area.
- P<sub>3</sub> Local people do not perceive their own activities as being detrimental for thamin conservation.
- P<sub>4</sub> The people who know the PA's operations and have a close contact with the PA staff are more likely to be involved in wildlife conservation.

## Material and Methods

### Description of Study area

The study area, Chatthin Wildlife Sanctuary is situated between 95° 24' E - 95° 40' E and 23° 30' N - 23° 42' N at the northern edge of Myanmar's central dry zone (Songer 2006) (Figure 2). The sanctuary area is 269 km<sup>2</sup> and it is located in Kanbalu and Kawlin townships of Sagaing Region in Upper Myanmar. The sanctuary was established as a wildlife sanctuary in 1941 (Zug et al. 1998, Aung et al. 2004). It is one of two wildlife sanctuaries mainly established for the conservation of the endangered thamin population. The climate in CWS is monsoonal and there are three seasons, in which the hot and dry (summer) season extends from February to June, the wet (rainy) season extends from June to September, and the cool and dry (winter) season from October to January (Aung et al. 2004). The dominant forest species in the study area is *Dipterocarpus tuberculatus*, locally known as “Indaing”, with characteristics of slow growth, hardwood, and large leaves. Other associated species found in the area are *Melanorrhoea usitata* (thitsi), *Pentacme suavis* (ingyin), and *Terminalia tomentosa* (taukkyan). The shorter grass species (thatch), locally known as “thekke” grows in the periodically flooded area in the forest, and tall grasses (*Saccharum* spp) grows near the waterholes. Other flora consists of 111 tree species, 27 shrubs, 40 creepers or climbers, 71 herbs, 56 grasses and 39 species of medicinal plants (unpublished data from CWS office). In addition, there are many other fauna including 223 bird species, of which four species are endemic as well as, 24 mammal species including Indian muntjac (*Muntiacus muntjak*) and rhesus macaque (*Macaca spp.*) (Allendorf et al. 2012). It is likely that hog deer (*Axis porcinus*) and dhole (*Cuon alpinus*) have recently become extinct in the area. Furthermore, 34 reptile (20 snakes, 12 lizards and 2 turtles species) and 16 amphibian (frogs) species (Zug et al., 1998) as well as, 65 butterflies and 48 fish species occur in the area (unpublished data from CWS office).

There are 25 villages (up to 4 km from CWS) near the sanctuary boundary and three villages inside the area. Attempts were made to resettle the three remaining villages inside CWS in 1996, but the resettlement did not succeed. A demographic survey found that the villages in and around CWS have increased in human population by 62% from 1989 to 2004 (Songer 2006) and from 2004 to 2016 by about 30%. Most people living in and around CWS depend heavily on the PA for natural resources and livelihoods. The crops villagers cultivate are rice, maize, groundnut, sugarcane and several varieties of bean. The common livestock they own are cattle, buffaloes, pigs and chickens.



**Figure 2:** Map of Chatthin Wildlife Sanctuary with study villages in black dots.

### Field survey with questionnaires

The study was conducted using a questionnaire survey, administered using face-to-face interviews. The questions were mostly structured to be close-ended, but a few questions were open-ended. A stratified random sampling method was applied by dividing the villages into three strata relative to the PA's border: inside, edge and outside. Three villages (75 households) from inside, four villages (84 households) from the edge (up to 1.5 km from PA) and two villages (50 households) regarded as control from outside (up to 8 km from PA) were selected to participate in the survey. For each village, an image from Google Earth was downloaded and printed, and 25 households per village were randomly chosen for the survey with a great care to avoid observer bias (except that 10 households were interviewed in one village and 24 households were surveyed in one edged village because of incomplete answers from one respondent). Therefore, I interviewed a total of 209 individuals from nine villages. In addition, a pilot study was carried out in Chatthin village before conducting the actual study to test whether the respondents were able to understand what they were being asked. An informal meeting was held with some park staff and village leaders to facilitate the survey process. Then, some modifications and changes to the survey form were made to reduce misunderstandings to questions, and to increase the incidence of reliable and accurate

answers.

Prior to the interview, the respondents were briefly explained about the goals of the research, and I tried to reduce any concerns about the study, and then asked them whether they wanted to participate in the survey or not. For ethical concerns, the name of the respondents was not recorded and they were told that their answers would be recorded as anonymous. More importantly, the use of electronic devices such as cameras, mobile phones or sound recorders was avoided during the interviews. The respondents' permission was requested prior to taking photos.

Questions about resource use were aimed at the household level, whereas questions about opinions and attitudes were directed at the individual being interviewed. Because of the socio-economic and cultural status of the villages where this study was conducted, I was forced to use a relatively simple questionnaire, with binary (yes/no) or at most three (e.g. agree, neutral, disagree) options rather than the more customary 5-points Likert scale that is used in most social science studies. Furthermore, villagers' level of education and general suspicion of authority made it impractical to use questions that touched on politically or culturally sensitive issues or abstractions. This made it impossible to assess more general environmental attitudes by using methods such as the New Environmental Paradigm scale (Decker et al. 2001). There has been very little quantitative social science environmental research in Southeast Asia; therefore no locally adapted framework was available.

### **Types of collected and surveyed data**

The primary data were collected from the field interview surveys and the secondary data consisted of annual reports, documents and research data from CWS office, and the scientific papers and relevant books from NTNU library and online databases.

### **Characteristics of respondents**

The recorded socioeconomic characteristics of interviewees included gender, age, religion, education, occupation and residency. Gender was almost balanced, as 52.6 % of respondents were women while 47.4 % were men. Age was classified into four groups: 18-29 years, 30-39 years, 40-49 years, and 50 years and above. Most of the respondents belonged to the oldest age group (> 50 years; 41.6 %), 30 - 39 and 40 - 49 groups shared 22.0 % and 23.9 % respectively, while the youngest group (18 - 29) made up 12.4 % of the respondents. As the majority of the respondents (99.5 %) were Buddhists while 0.5 % was Christians, religion will

not be considered further. Education was categorized into three groups: never been to school, primary school, and secondary or higher education. About 28.2 % had no formal education while half of the respondents (50.2 %) had primary education, whereas only 21.5 % had finished secondary or higher education. Occupation was originally divided into five categories: farmer, farm labour, employed job, businessperson, and others. However, it was later pooled in the analyses to be two categories: farmers and others, because 78.9 % of respondents worked as farmers while only 21.1 % had other jobs. Residency was divided into four categories: 1) been there < 1 year, 2) between 2-10 years, 3) > 10 years, and 4) born in this village. Later, I pooled residency into two categories: native and non-native, as 71.8 % of the respondents were native while only 28.2 % were non-natives. However, this will not be considered further as this variable did not contribute significantly to the variation of the tested questions.

At the household level, I recorded the number of household members, the size of landholdings, number of livestock, and where livestock pastured. Number of children and other household members (parents, other kin) were counted to be included into the family size because parents and other relatives usually live together with most families in rural Myanmar. 40.7 % were small families (2 - 4), 53.6 % medium sized families (5 - 7), while 5.7 % had 8 - 11 family members. However, numbers of household member were not considered further because they did not significantly contribute in explaining the variation in the tested questions. Furthermore, numbers of livestock surveyed were cows, buffalos, goats, pigs, chicken and ducks. The mean number of livestock per household was cows ( $3.2 \pm 4.2$  SD), buffalos ( $1.4 \pm 2.6$  SD), pigs ( $2.6 \pm 2.4$  SD), chicken ( $11.4 \pm 12.2$  SD), and ducks ( $0.13 \pm 1.2$  SD). No goats were found in the survey. In addition, type of building and other household belongings such as mobile phone, television, or motorbike were recorded. Then, the cumulative values of these key possessions were estimated to assess the wealth of household, including the value of their agricultural land. 41.6 % possessed under 10,000 US\$, and 42.1 % (10,000 – 20,000 US\$) while 16.3 % had a wealth > 20,000 US\$. However, wealth will not be considered later because of its' non-significant contribution in explaining the variation in my results.

Landholding for agriculture is a significant property asset in Myanmar's rural areas. Hence, land size was divided into four categories: landless, small (< 5 acres<sup>1</sup>), medium (between 5 - 10 acres), and large (> 10 acres) areas, however, it was later pooled into three

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<sup>1</sup> 1 Acre = 0.405 Hectare

categories as 52.2 % owned small land areas (1 - 10 acres), 33.0 % possessed land over 10 acres while 14.8 % owned no land for crop cultivation. Grazing activities in the PA were recorded in four categories: 1) within PA, 2) within the PA and the vicinity of the PA boundary (0.5 km around the PA, grazing both areas), 3) near PA boundary (within 0.5 km from the PA boundary, not pasturing inside the PA), and 4) far from the PA (more than 2 km away from the PA). However, the activities were pooled into two categories: 44.0 % pastured within the sanctuary and near the boundary while 56.0 % were grazing far from the PA. When respondents were asked if their livestock were vaccinated, 47.6 % said “yes” and 52.4 % answered “no”. Rice (82.8 %) was the main agricultural crop grown in the study area; a variety of bean (28.2 %), groundnut (26.8 %), sugarcane (13.9 %) and maize (11.5 %) were also grown for household consumption as well as cash crops (these sum to more than 100 % because most families grew multiple crops).

### **Use of natural resources and PA land**

Use of natural resources and PA land, which was supposed as being benefits from the protected area, included fruits, honey, medicinal plants, thatch, bamboo, mushrooms, fuel wood, timber, posts and poles, wild meat, other products like bamboo shoots, fish or lacquer sap, and grazing activities within and near the PA boundary. These resources were the most frequently extracted resources, and they were pooled into three categories to create a number of use of natural resources and land as: 1) no use (no resources were used by the respondents) 2) 1 – 5 resources were used (the respondents used 1 - 5 resources) and 3) 6 – 9 resources used (6 – 9 resources were utilized by the respondents). None of the respondents utilized all natural resources studied (11 resources were surveyed in the questionnaire).

### **Conflicts with wildlife from the PA**

Thamin is the major target species for conservation in CWS, however, other herbivores and birds occur in the PA. Therefore, crop raiding was assumed to be a main problem caused by wildlife from the PA. The crop damages from thamin, rhesus macaque, wild boars, muntjac, and others were categorized by calculating a wildlife problem index to test the intensity of crop damages and how many wild species from the PA caused this problem in the study area. The problem index included three categories: 1) no damage, 2) damage by one species and 3) damage by 2 – 3 species.

## **Data analysis**

The primary data from the field study were analyzed with SPSS version 24 and Microsoft Excel. I firstly calculated descriptive statistics to identify frequencies of the different variables and to test the relationship between the dependent and independent variables by using Chi-square tests to find the significant factors. Finally, logistic and linear regression analyses were carried out to investigate whether the dependent and independent variables were correlated with each other or which independent variables more significantly contributed to the dependent variable. The threshold level of significance for all tests was set at  $p = 0.05$ .



## Results

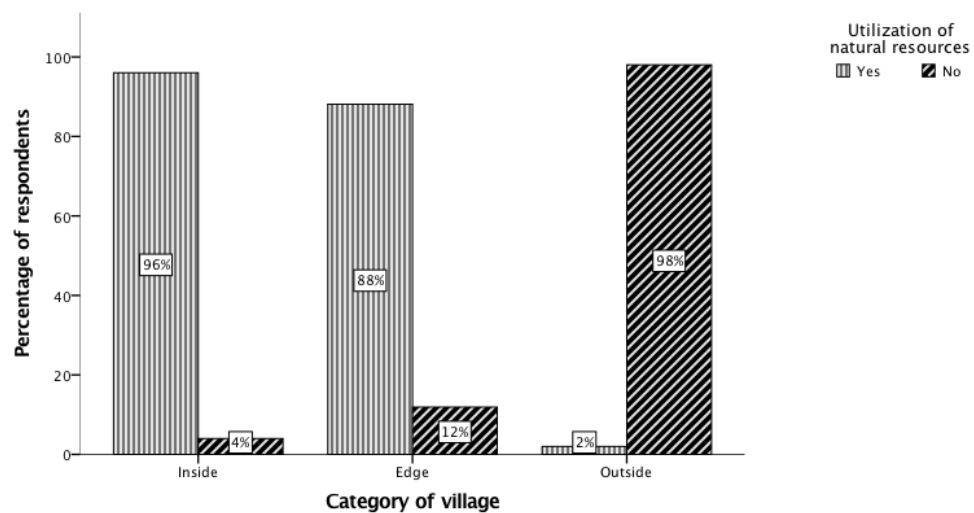
### Use of natural resources from CWS

Regarding number of natural resources used (0, 1 – 5, 6 – 9), 29.7 % of respondents used no resources directly from CWS while 61.2 % exploited 1 – 5 resources, and 9.1 % utilized 6 - 9 different resources from the PA. Thus, in the further analyses I use two categories (No resources (zero), resources (1 to 9)). Of these natural resources, the most frequently used was firewood (60.8 %) for cooking. Among these users, 71.1 % (91 of 127) seasonally collected it and 98.4 % (125 of 127) used it only for their household, not as a source of income generation. The second most common extractive resource obtained from the PA was mushrooms and truffles (46.9 % of respondents). Additionally, out of these mushroom pickers, 61.2 % (60 of 98) used mushrooms for both cash generation and household consumption. The third most frequent use was grazing for livestock (44.0 % of respondents) (Table1).

**Table 1:** Natural resources used by the respondents (Yes = more than one resource utilized, No = no resources utilized) (N = 209).

Natural resources	Utilization	
	Yes %	No %
<b>Fuelwood</b>	60.8	39.2
<b>Mushrooms and truffles</b>	46.9	53.1
<b>Grazing</b>	44.0	56.0
<b>Thatch</b>	26.3	73.7
<b>Timber, poles and posts</b>	24.4	75.6
<b>Medicinal plants</b>	14.8	85.2
<b>Fruits</b>	8.1	91.9
<b>Wild meat</b>	5.7	94.3
<b>Honey</b>	5.3	94.7
<b>Bamboo</b>	1.9	98.1
<b>Others (fish, lacquer sap, etc.)</b>	14.8	85.2

There was a significant difference in use of natural resources among the three categories of villages ( $\chi^2 = 155.1$ ,  $df = 4$ ,  $N = 209$ ,  $p < 0.001$ ). Those villages inside the PA and at the edge utilized more resources than villages outside the PA (Figure 3). Other socioeconomic variables (gender, age, education, occupation and landholding status) did not differ significantly in the use of natural resources. However, after pooling the natural resources as two dichotomous variables (no-use and use) in a logistic regression analysis, location explained most of the variation in use of natural resources, while gender also contributed significantly in explaining the variation (Table 2). The villagers inside the PA obtained most benefits and men were most actively involved in resource exploitation (Table 2). These two variables explained 73.7 % of the variation (Nagelkerke  $r^2 = 0.737$ ).



**Figure 3:** Natural resources utilization in relation to distance from the protected area.

**Table 2:** A binary logistic regression analysis of utilization of natural resources from CWS as dependent variable (yes, no) and with location and gender as independent variables.

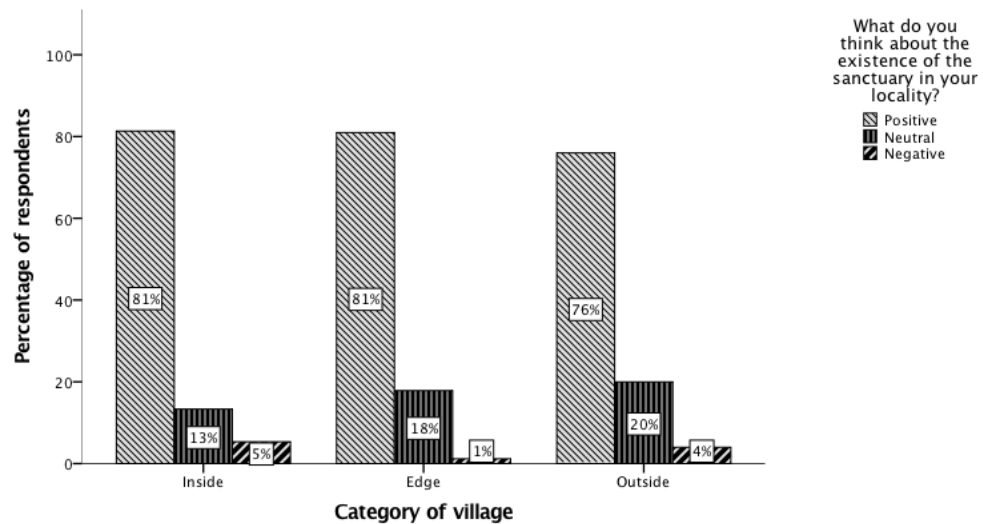
Factors	B	S.E.	Wald	df	p =
Category of village (Inside = 1)	-4.521	.667	45.952	1	.000
Gender (Female = 0)	1.637	.606	7.301	1	.007
Constant	9.913	1.398	50.314	1	.000

When the respondents were asked whether they obtained any benefits from CWS, 18.2 % claimed they gained nothing, 37.3 % said they got a little whereas 44.5 % agreed that they received a lot of benefits. Village location ( $\chi^2 = 22.1$ ,  $df = 4$ ,  $p < 0.001$ ) and gender ( $\chi^2 = 13.5$ ,  $df = 2$ ,  $p = 0.001$ ) differed significantly with regard to perceptions of benefits gained. None of the other socioeconomic variables were significant. A linear regression with benefits as a dependent variable, and with location and gender as independent variables was carried out (Table 3). There was a significant relationship between the dependent and independent variables, ( $F_{(2,206)} = 10.9$ ,  $p < 0.001$ ). The model only explained 9.6 % ( $r^2 = 0.096$ ) of the variance in the benefits. Both gender and village location contributed statistical significance in explaining this variation.

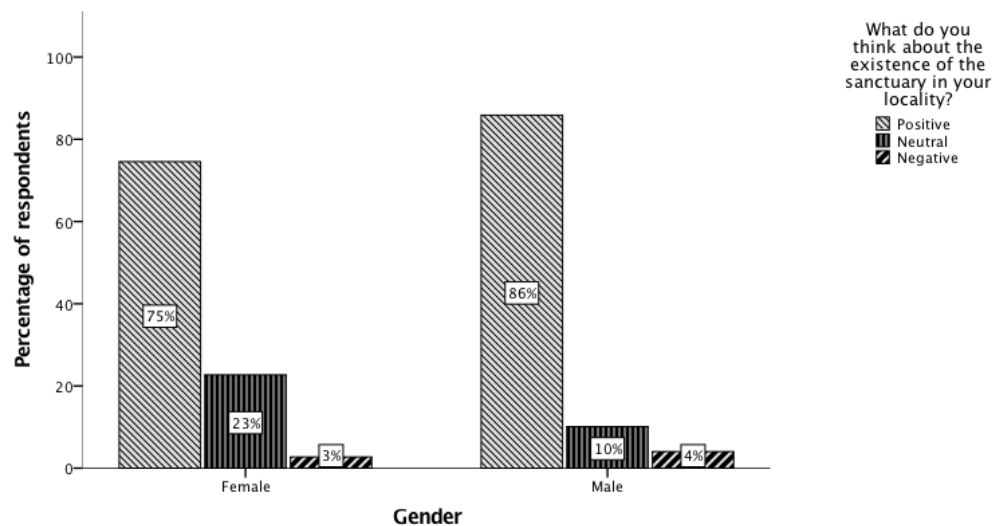
**Table 3:** A linear regression analysis with the question "Do you get any benefits from the PA?" as the dependent variable, and gender and location as independent variables.

Model	Unstandardized		Standardized	t	p =
	Coefficients		Coefficients		
	B	Std. Error	Beta		
1 (Constant)	2.429	.136		17.905	.000
Gender	.396	.100	.264	3.967	.000
Category of village	-.188	.065	-.192	-2.883	.004

Furthermore, the respondents were asked "What do you think about the existence of the PA in your locality?" with three categories of responses: positive, neutral and negative. 3.3 % of the respondents were negative to the PA's existence, 16.7 % were neutral while 79.9 % were positive. Men were significantly more frequently positive than women ( $\chi^2 = 6.1$ ,  $df = 2$ ,  $p = 0.048$ ; Figure 5). Location did not explain any variation in perception about the PA's existence ( $\chi^2 = 3.1$ ,  $df = 4$ ,  $p = 0.535$ ; Figure 4); neither did any other socioeconomic variables. Interestingly, the respondents in the three zones (inside, edge and outside) perceived similar frequencies of positive perceptions towards the PA (Figure 4).



**Figure 4:** Respondents' answers towards "What do you think about the existence of the PA in your locality?" in relation to location.



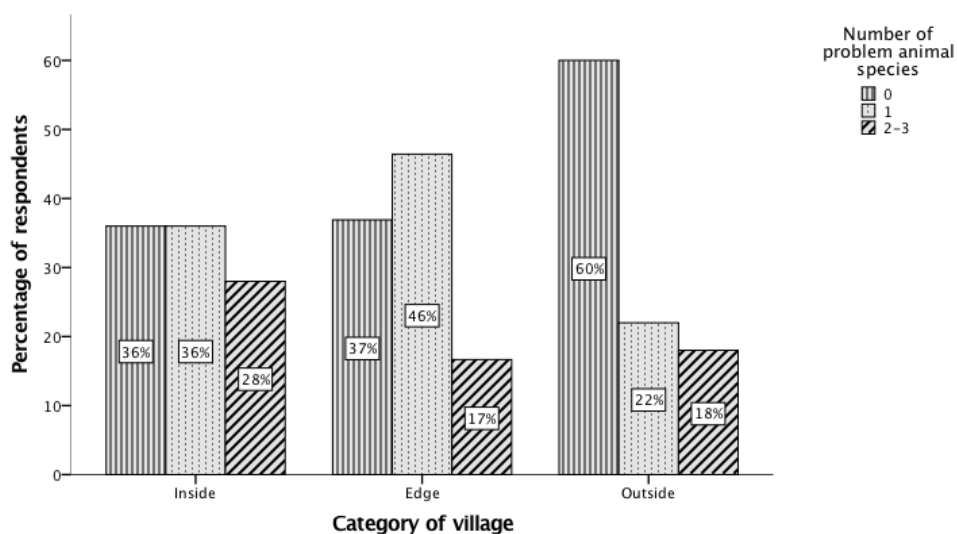
**Figure 5:** Respondents' answers towards "What do you think about the existence of the PA in your locality?" in relation to gender.

### Wildlife crop raiding in and around CWS

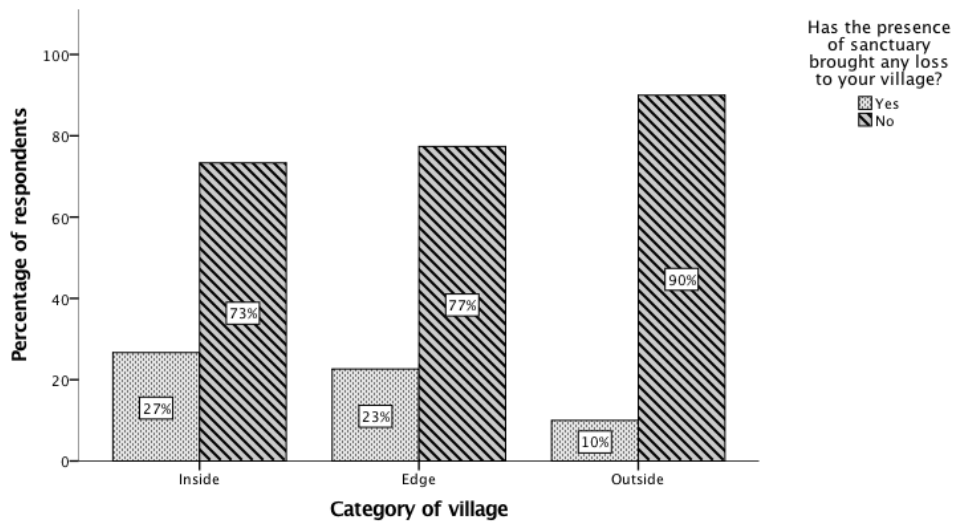
When asking about how many wildlife species caused crop damages, 42.1 % replied that wild animals caused no crop damage while 57.9 % responded that they incurred crop raiding by some species. A total of 36.8 % claimed damage was caused by one species, and 21.1 % claimed that damage was due to 2 - 3 wildlife species. Out of these wildlife problems, 1.2 % (2 of 178) suffered losses from Rhesusmacaque, and 2.8 % (5 of 178) from muntjac while thamin were identified as the cause of damage by 32.6 % (50 of 178). Finally, 56.7 %

experienced crop losses from small pest animals such as birds, rats, rabbits or squirrels. Interestingly, there was no evidence of problems from wild boars in the study area. The crops raided by thamin were rice (20.7 % of respondents), some crops including maize or groundnut (43.1 % of respondents), and, in some cases they raided almost all crops (27.6 % of respondents) that the farmers were growing.

Regarding the respondents' reaction to crop raiders, over 80 % of respondents answered that they chased thamin or birds away by shouting, placing scarecrows or long sections of rope or tape (e.g. VCR tape) around the fields, beating tin cans, nighttime guarding in the fields, or building thorny fences. Even though they experienced these damages, 99.0 % did not report any losses to the wildlife authority or village leaders. Only one person reported it to the PA staff. The inside and edge areas suffered higher crop loss due to many pests (Figure 6) and the more they suffered loss by many wild species, the more negative their attitudes to the PA (Figure 7). There were significant differences in wildlife problems associated with the location in relation to the PA ( $\chi^2 = 12.8$ ,  $df = 4$ ,  $p = 0.012$ ; Figure 6). 21.1 % of the respondents claimed that the presence of the sanctuary brought crop loss to their villages while a large percentage of the respondent (78.9 %) replied it did not bring any loss. However, location and attitudes toward crop damage did not differ statistically significantly, although almost significantly so ( $\chi^2 = 5.2$ ,  $df = 2$ ,  $p = 0.073$ ); the respondents inside the PA held more negative attitudes regarding crop damage than other areas (Figure 7).



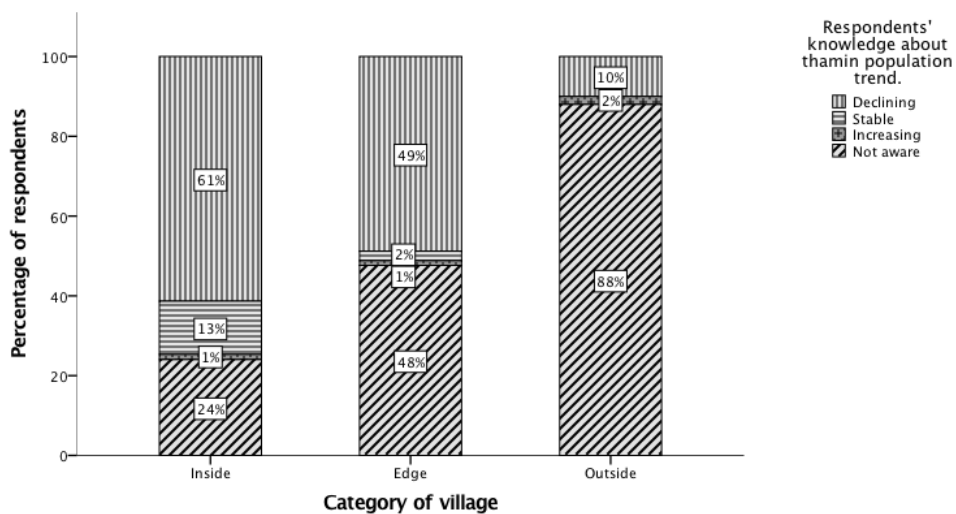
**Figure 6:** Number of wildlife species, which performs crop raiding in different localities (inside, edge and outside) of the protected area.



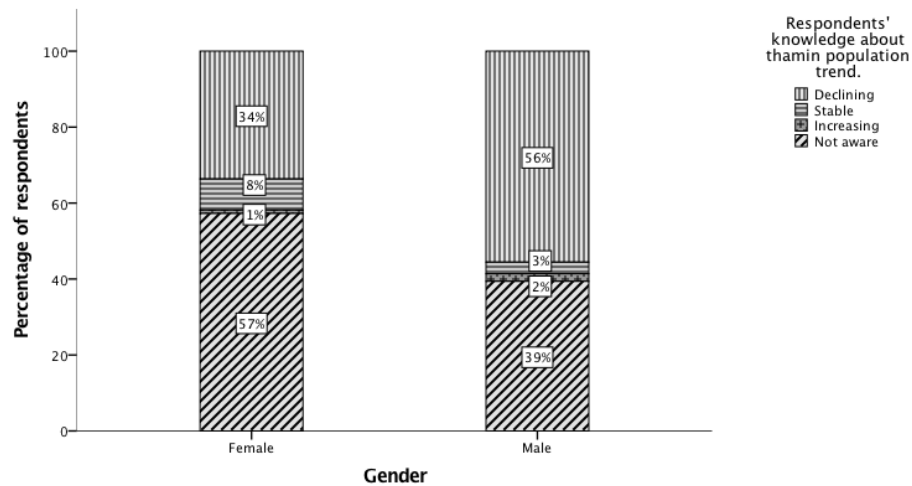
**Figure 7:** Responses of local people towards "Has the presence of sanctuary brought any loss to your village?" in different localities (inside, edge and outside) of the protected area.

### Perceptions of local people to thamin conservation

When asked how the respondents viewed the population trend of thamin in the sanctuary; 1.4 % claimed it was increasing, 5.7 % thought it was stable and 44.0 % stated that it was declining, although 48.8 % had no opinion of its trend. People from inside the PA were more likely to feel it was declining than people from the outside areas ( $\chi^2 = 56.1, df = 6, p < 0.001$ ; Figure 8) and men were more aware about the thamin population decline than the women ( $\chi^2 = 11.9, df = 3, p = 0.008$ ; Figure 9). Other socioeconomic characteristics were not significant with respect to change in thamin population.



**Figure 8:** Knowledge about the thamin population trend in the PA in relation to location.



**Figure 9:** Respondents' knowledge about the thamin population status in relation to gender.

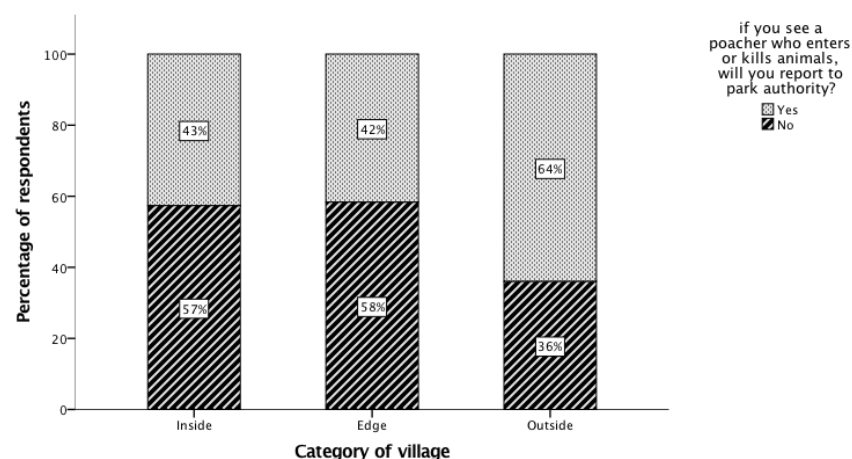
With regard to the question about “Do you think human activity is the major cause of thamin population decline?”; 28.2 % said “no”, 31.6 % replied “don’t know”, while 40.2 % responded “yes”. The people inside CWS answered most “yes” and women replied most “don’t know” to this question. Location ( $\chi^2 = 94.1$ ,  $df = 4$ ,  $p < 0.001$ ), education ( $\chi^2 = 11.2$ ,  $df = 4$ ,  $p = 0.025$ ) were significant factors in explaining this, and gender ( $\chi^2 = 5.4$ ,  $df = 2$ ,  $p = 0.068$ ) was just almost significant while other variables were not significant. There was a statistically significant relation between the dependent and independent variables, ( $F_{(3,205)} = 21.1$ ,  $p < 0.001$ ) in a linear regression analysis. The model explained 23.6 % ( $r^2 = 0.236$ ) of the variance in this attitude. Village location and gender did both significantly contributed in explaining this variation whereas education was not statistically significant in a linear regression analysis (Table. 4).

**Table 4:** A linear regression analysis with the question “Do you think human activity is the major cause of thamin population decline?”; as the dependent variable, and location, gender and education as independent variables.

Model	Unstandardized		Standardized	t	p =
	Coefficients		Coefficients		
	B	Std. Error	Beta		
1 (Constant)	1.120	.146		7.685	.000
Category of village	.522	.070	.473	7.505	.000
Gender	-.321	.104	-.190	-3.077	.002
Education	-.037	.076	-.031	-.493	.623

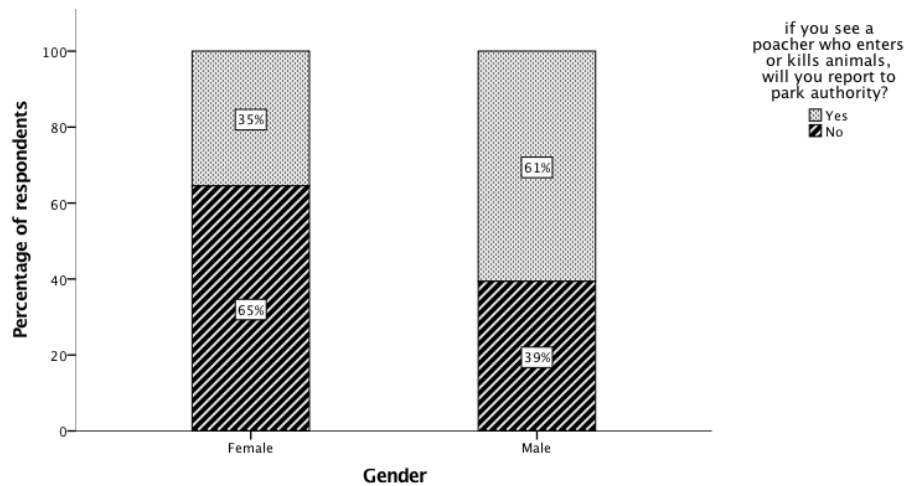
In addition, 12.9 % of the respondents said they heard about illegal thamin hunting from the neighboring villages, while 87.1 % responded they had not. Gender ( $\chi^2 = 6.6$ ,  $df = 1$ ,  $p = 0.010$ ), occupation ( $\chi^2 = 13.7$ ,  $df = 1$ ,  $p < 0.001$ ) and landholding status ( $\chi^2 = 10.3$ ,  $df = 2$ ,  $p = 0.006$ ) were all statistically significant in their response to this question, but other variables were not significant. A logistic regression analysis was performed with hunting information to be dependent variable, and gender, occupation and landholding status as independent variables. The model explained 17.2 % of the variation (Nagelkerke  $r^2 = 0.172$ ). Occupation was the most significant variable in explaining respondents' awareness about illegal hunting (Wald = 11.76,  $df = 1$ ,  $p = 0.001$ ) followed by gender (Wald = 6.75,  $df = 1$ ,  $p = 0.009$ ) while landholding status was not significant ( $p = 0.319$ ).

Furthermore, 47.0 % of the respondents answered "yes" to the question, "If you see a poacher who enters to the PA or kills animals, will you report to PA authority?", and 53.0 % responded "no". Villages outside the PA ( $\chi^2 = 7.3$ ,  $df = 2$ ,  $p = 0.026$ ; Figure 10), men ( $\chi^2 = 13.2$ ,  $df = 1$ ,  $p < 0.001$ ; Figure 11), and most educated people ( $\chi^2 = 6.2$ ,  $df = 2$ ,  $p = 0.045$ ) had a higher stated willingness to report about poachers or had an inclination to fight against poaching. A logistic regression with "If you see a poacher who enters to the PA or kills animals, will you report to PA authority?" (yes, no) as the dependent variable, and with location, gender and education status as independent variables was carried out. The three socioeconomic variables explained 11.6 % of variance (Nagelkerke  $r^2 = 0.116$ ). Gender was the most significant variable in explaining respondents' tendency to fight against poaching (Wald = 10.68,  $df = 1$ ,  $p = 0.001$ ) while education (Wald = 2.36,  $df = 1$ ,  $p = 0.125$ ) and location (Wald = 2.07,  $df = 1$ ,  $p = 0.150$ ) were not significant.



**Figure 10:** Relationship between the perception of "If you see a poacher who enters to the PA or kills animals, will you report to the PA authority?" and location of village .





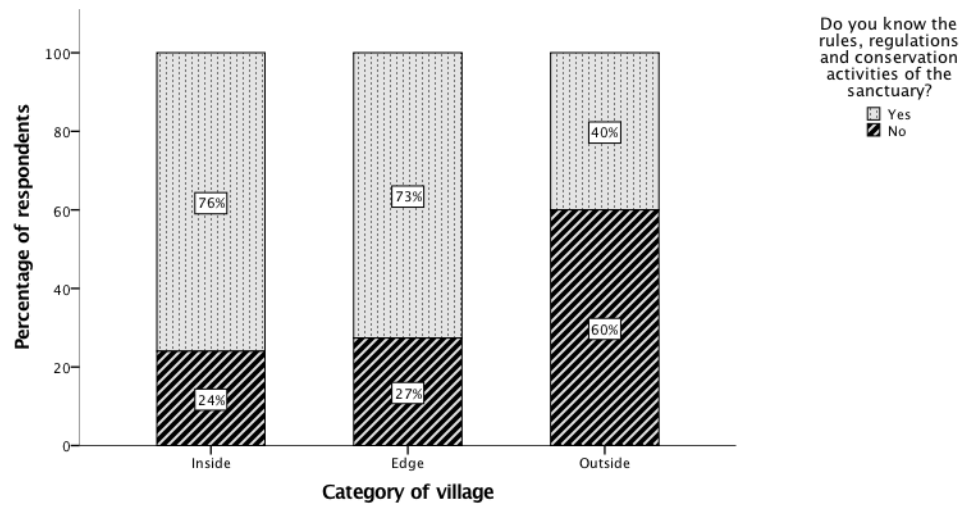
**Figure 11:** Relationship between the perception of "If you see a poacher who enters to the PA or kills animals, will you report to the PA authority?" and gender.

### Local involvement in wildlife conservation

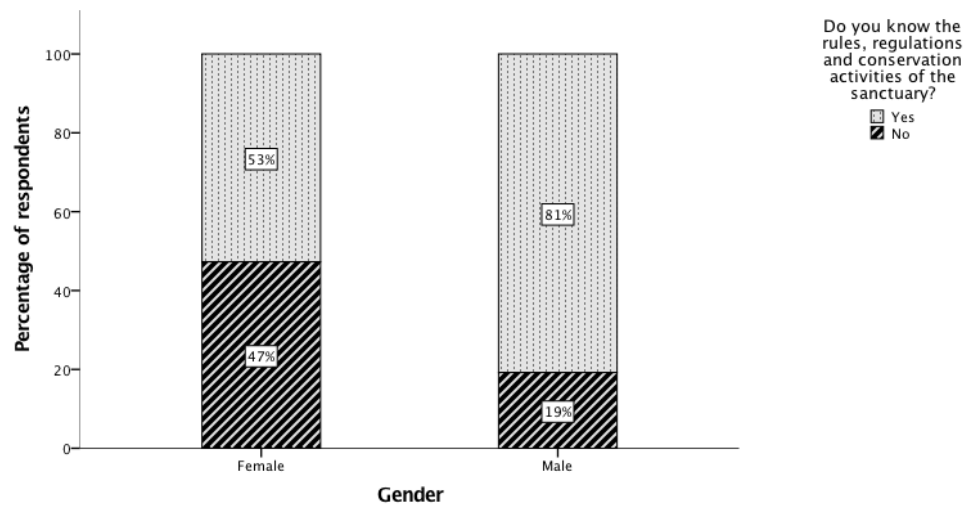
To the question “Do you know the rules, regulations and conservation activities of the PA?”, 34.0 % of the respondents answered no while 66.0 % replied yes. Men had better knowledge about the PA’s operations than women ( $\chi^2 = 18.3, df = 2, p < 0.001$ ; Figure 13) as had the villages inside and close to the PA than those further away ( $\chi^2 = 20.0, df = 4, p < 0.001$ ; Figure 12). However, other variables including education were not significant in explaining the association of respondents’ knowledge about PA’s operations. A logistic regression with the respondents’ knowledge about PA rules and operations (yes, no) as dependent variable, and gender and location as independent variables indicated that gender and location were the two variables that significantly explained 24.7 % of the variation in this question (Nagelkerke  $r^2 = 0.247$ ) (Table 5).

**Table 5:** A binary logistic regression analysis with "Do you know the rules, regulations and conservation activities of the PA?" (yes, no) as dependent variable, and with gender and location as independent variables.

Factors	B	S.E.	Wald	df	p =
Gender (Female = 0)	1.668	.354	22.153	1	.000
Category of village (Inside = 1)	-1.005	.227	19.615	1	.000
Constant	1.923	.456	17.755	1	.000



**Figure 12:** Knowledge "Do you know the rules, regulations and conservation activities of the PA?" in relation to location of village.



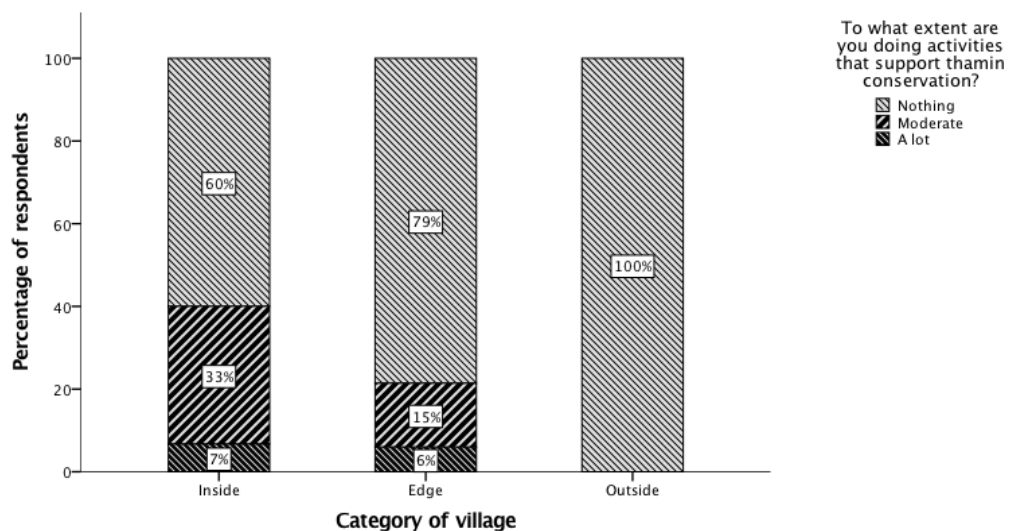
**Figure 13:** Knowledge "Do you know the rules, regulations and conservation activities of the PA?" in relation to gender.

Concerning the question "How do the PA staff treat you when they see you in the forest?", 3.8 % stated that the staff punished them with a fine, 20.1 % said that the staff explained or warned them not to enter again into the PA, while 68.9 % answered they did not see or meet the staff in the PA, or had no comment. People from inside the protected area met more staff, those from the edge area tried not to meet or see them when collecting resources or entering to the PA while people further away seldom entered the PA ( $\chi^2 = 55.9$ ,  $df = 8$ ,  $p < 0.001$ ). Based upon these questions, the respondents were asked whether they trusted the PA rangers, 39.7 % said no and 60.3 % answered yes. Location played a significant role in

response to this question; the people who lived inside the PA and had more contact with the PA staff showed more trust towards them ( $\chi^2 = 40.6, df = 2, p < 0.001$ ).

When the respondents were asked about how much they provided support to conservation activities, 4.8 % claimed a lot, 34.9 % said to a moderate degree while 60.3 % admitted to providing no support. People from inside the PA participated more in conservation while people from outside never engaged themselves in conservation ( $\chi^2 = 28.4, df = 4, p < 0.001$ ; Figure 14). Also, men were more active in conservation support than women ( $\chi^2 = 9.8, df = 2, p = 0.007$ ).

The very sensitive question about if they had ever eaten thamin meat was asked to the respondents to gain knowledge about illegal hunting. 41.6 % said yes and 58.4 % replied no. The respondents from the inside and edge area had more frequently tasted thamin meat than those from the outside ( $\chi^2 = 38.4, df = 2, p < 0.001$ ). The people who had no formal education admitted to having tasted more thamin bush meat ( $\chi^2 = 7.9, df = 2, p = 0.019$ ).



**Figure 14:** Relationship between location and local conservation support.

## Discussion

### Use of natural resources from CWS

Almost all (96 %) of the households inside the PA benefited from exploiting provisioning natural resources from its area, followed by 88 % of respondents from edge area. In contrast, only 2 % of people from the outside villages utilized such resources. Resources like fuelwood, mushrooms and grazing were the most commonly exploited resources from CWS. 85 % of people inside and 75 % of those people from the edge area utilized fuelwood from the PA as their main source of energy for cooking, however, no one from the outside area admitted to using firewood obtained directly from the PA. After the crops are harvested (March), the villagers usually enter CWS and collect firewood for the whole year. Firewood consumption in the study area potentially threatens the thamin's habitat, and Leimgruber et al. (2005) reported that on the periphery of the Myanmar central dry region, the consumption of the firewood is a main driver to the noticeable deforestation of dry forests; these dry forests are the major habitats for thamin (McShea et al. 1999, 2005).

Mushrooms and truffles were picked by about 50 % of all respondents after the start of the rainy season (approximately during July) and not only contributed to household consumption, but also to income generation. One respondent from Kye-in village said that the income earned from forest mushroom picking contributed to between 100 to 300 US\$ per household annually and so, 75 % of people inside and 50 % of those people from the edge area were mushroom pickers. Wemmer et al. (2000) suggested that spending much time inside the PA (often accompanied by dogs) causes disturbances to thamin and local people should be allowed to collect mushrooms only in July and allocated quotas about 10 viss<sup>2</sup> (a unit of weight in Myanmar) per household.

44 % of responding households used CWS as pastureland for their cattle: 96 % of inside villagers and 29 % of edge villagers grazed within and adjacent to the PA. My results are similar to those of Songer (2006) who found that the respondents who grazed inside the PA utilized more natural resources. Wemmer et al. (2000) stated that the three villages within CWS grazed in the core zone and nine villages from the edge area grazed their cattle on the PA boundary, totally around 2000-3000 cattle. The highest grazing pressure occurred from November to February and it is the most important periods for the lactation of female thamin and preparing of rut for male thamin. Therefore, grazing during this period might negatively

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<sup>2</sup> 1 viss = 1.633 kilograms or 3.6 pounds

affect thamin. The study suggests that there is a need for more detailed studies to quantify the impacts of grazing on thamin and develop grazing control in some critical areas for thamin.

The study by Songer (2006) in CWS found that 94 % of the households used firewood and other products like forest food (75 %), medicinal plants (75 %), grazing (over 50 %), and illegal hunting and fishing (14 %). About 15 % owned no legal land for crop cultivation, and illegal agricultural land encroachment within the PA is one of the most serious challenges causing the deterioration of wildlife habitats and the ecosystem in CWS. Additionally, most people in Kye-in village (inside the PA) illegally used the pond within the PA as rice paddy fields in summer by discharging the water. This land use conflict caused water shortage for wildlife as well as deterioration of wetland habitats for waterfowl.

About 90 % of the respondents from inside and edge areas replied that their households gained benefits from CWS, especially they pointed out direct use resources such as fuelwood, timber, mushroom, etc. Bajracharya et al. (2006) and Allendorf et al. (2006) found that the local residents pointed out that the natural resources like timber and minor forest products were the benefits they gained from the PA. However, 60 % of those people from the outside area also answered that they gained benefits from the PA, mainly highlighting regulating services like a better local climate. Allendorf et al. (2006) suggested that conservation benefits like forest conservation or improving climate should be given higher attention to improve the relationship between PA and local people.

My results showed that there was a significant relationship between attitudes of benefits gained, location and gender. About 80 % of all respondents in the three locations (inside, edge and outside) held positive attitudes towards the existence of CWS. Allendorf et al. (2006) stated that although the conflicts between CWS and local inhabitants are severe, local residents hold positive attitudes towards PA. In addition, Allendorf and Yang (2013) found that gender, ethnicity, education, age and types of crops cultivated were significant factors for local people in perceiving the benefits from Gaoligongshan Nature Reserve in China. However, my study revealed that only gender was a significant predictor of the local attitudes towards the PA's existence as well as the value of natural resources provided by the PA. Men were more positive than women because they were also more active in gathering or accessing natural resources from the PA. Similarly, the case studies in Gillingham and Lee (1999), Mehta and Heinen (2001), and Xu et al. (2006) also found that men held more positive attitudes towards various PAs than women. In the study by Allendorf and Allendorf (2013) in four PAs in Myanmar, men were more likely to hold positive attitudes than women

with an expression of their perceptions about problems and benefits from PAs. Sekhar (1998, 2003) found that the local residents who obtained individual benefits from a PA showed more positive attitudes towards the PA. Infield (1998) also found that the respondents who received direct benefits from PA showed more positive attitudes towards conservation. It can be concluded that the results fully support the prediction  $P_1$  that the people who lived adjacent to the PA exploit more natural resources from it. However, there was only partial support for the idea that the people who gained most resources would hold more positive attitudes towards the PA.

### **Wildlife crop raiding in and around CWS**

In general, 58 % of respondents reported suffering crop losses from wildlife. Wildlife crop raiding was significantly related to village location and the farmers who grew crops inside the PA and edge area experienced higher crop loss than those from the outside villages. 33 % of respondents claimed that it was thamin that caused the damage to their crops; and the damage was somewhat more severe in the edge area than inside, especially in the southeast and southern part of the sanctuary. McShea et al. (2001) found that the thamin (especially females) usually raid the crop fields near the PA boundary during the monsoonal season and cool season. There are three management zones in CWS, which are used when conducting the annual thamin censuses, and zone 1 is the area where most thamin were found (unpublished data from CWS office). The farmlands adjacent to zone 1 of the PA were much more likely to experience thamin crop depredation. In the vicinity of that area, respondents claimed that thamin raided rice, maize, groundnuts and even sugarcane while some respondents said thamin damaged almost all the crops they grew. In a similar study, Bajracharya et al. (2006) found that 84 % of respondents inside the Annapurna Conservation Area, Nepal suffered crop losses by wildlife such as monkeys, deer, etc. and the crop damage was more severe inside the PA than outside areas. Similarly, Sekhar (1998) reported that about 75 % of local people thought crop loss was a serious problem to them and the places where inside and at the edge of Sariska Tiger Reserve in India experienced more crop damage.

One respondent showed how the thamin raided on corn plants where thamin attacked some soft leaves and upper parts of the corn plants, especially the flowering cum. As a result of these raids, the corn plants could not produce any corn although the plants still survived; subsequently, local farmers experienced loss of income. One respondent from the area most

exposed to thamin crop raiding explained that she had conflicting attitudes: she felt pity for the thamin but was annoyed about the crop damage. She subsequently replied that if she received some compensation for crop loss, she would support conservation and love to have thamin around. There is no compensation programme in the study area, and Sekhar (1998) also reported that the PAs where crop damages mostly happened were lacking or had insufficient compensation schemes. However, compensation programmes are controversial as their effectiveness is poorly understood, and there may even be undesired side effects (Agarwala et al. 2010, Bulte and Rondeau 2005, Schwerdtner and Gruber 2007). Wells et al. (1992) found that monetary compensation was probable instrumental in attracting new residents to PAs, and actually created further problems. Studsrød and Wegge (1995) and Sekhar (1998) have suggested that PA authority should counter crop depredation with “in kind” compensation by supporting the legal rights of access to firewood and fodder from PAs instead of paying cash compensation, but no such theme is formally in place in CWS.

The local farmers had to invest time to guard or protect their crops from thamin raiding. Rhesus macaque and muntjac caused very little crop loss in the study area, and no wild boar were implicated in crop damage. Therefore, among the medium-sized animals, the thamin seem to be an especially problematic animal for the farmers. In addition, small pest animals such as birds, rabbits, rats, or squirrels, caused crop loss for 57 % of the households, with most complaints coming from the inside as these pests were responsible for more crop raiding inside the PA than at the edge or outside areas. More than 80 % of respondents admitted they chased thamin or other wildlife away. In spite of being exposed to crop raiding, almost all the respondents said that they did not report such damages to the authority or village headman because they explained that reporting about their crop loss to the authority was not an effective way to go, as the authorities did not react. This is similar with the study by Htun et al. (2012) that most PA authorities rarely reacted to local people’ complaints in Myanmar. Rao et al. (2003) found that the although local people were aware of and supported the conservation objectives, they opposed the PA management authority because the PA authority failed to comprehend the perceptions and aspirations of local residents in the Nanda Devi Biosphere Reserve, India. The study suggests that the CWS authority has some way to go in building a positive relationship with local community.

In spite of experiencing such crop depredations, only 27 % of respondents from inside CWS thought that the PA brought losses to their villages, and it was even less in the other areas. Location did not significantly influence local attitudes towards the costs of the PA. It is

probable that local communities illegally get access to natural resources from the PA and the benefits they gained considerably outweighed the amount of crop loss. In other studies it has found that although local residents experienced crop damages and livestock losses, they hold positive attitudes toward conservation if they are permitted extraction rights (Bajracharya et al. 2006, Karanth and Nepal 2012, Studsrød and Wegge 1995). Similarly, Sekhar (1998) found that although the local people suffered depredation of crops and livestock, they held positive attitudes towards Sariska Tiger Reserve in India due to their access to fuelwood, and fodder, as well as due to their religious beliefs. These findings support my findings but not to prediction P<sub>2</sub>. Actually, the farmers inside the PA compared to other areas incurred more crop losses; they seemed likely to show more negative attitudes regarding crop loss, but the finding was only just significant. Therefore, it is difficult to conclude that my findings support the prediction P<sub>2</sub>.

### **Perceptions of local people towards thamin conservation**

The thamin population in CWS has declined dramatically since 2004 (Allendorf et al. 2012, unpublished data from CWS office). When the respondents were asked whether they were aware of the thamin's population status, 61 % of the respondents from the inside and 49 % from the edge villages replied that the population has declined, however, 88 % of the respondents from the outside villages did not know what the population trend was in the area. The people who lived inside the PA were more aware about the population decline than those who lived in edge or outside area. In addition, men were more aware about the thamin decline than women because they were primary natural resource gatherers and spent more time in CWS.

About 40 % of the respondents thought human activity was the major cause of population decline. Village location and gender significantly correlated with the local perception towards the role of human activities. The men who live adjacent to the PA were more likely to state that they believed in the seriousness of human impacts on thamin conservation. In some villages, there are some local volunteers for thamin conservation groups. Supporting these groups with some small funds and materials may create some effective local spokespeople for thamin conservation.

From informal discussions with some PA staff, it is known that the three inside villages and some villages from the periphery of PA were the most involved in thamin



poaching. Nevertheless, 87 % of the respondents replied they did not know about illegal thamin hunting from the surrounding villages. This is somewhat contradicting to what the PA staff's were saying. Songer (2006) found that 14 % of the respondents in CWS confessed to being involved in illegal hunting for medium-sized wildlife like muntjac, rats, jungle cats or pangolins, and fishing, but none of the respondents declared that they poached thamin. Collecting this type of sensitive information about illegal activities like poaching is notoriously difficult unless very specialized methods are used (John et al. 2010). This was the reason that questions were phrased indirectly to get some idea of the extent of the issue, rather than asking people directly if they poached. The results from my study showed that non-farmer men were more willing to report about thamin poaching than others, although farmers clearly did not want to talk about or inform about illegal hunting. In another study, Roe (2015) reported that local farmers whose agricultural crops were commonly raided by wild animals were favourable to poachers. In addition, illegal thamin hunting was supposed to be severe in the area and it was confirmed that 42 % admitted they had tasted thamin meat. The areas adjacent to the PA were found to be easily accessible to thamin bushmeat because the people who inhabited within and at the edge of the PA claimed to have tasted more meat than people from further away. Newmark (1993) found that 74 % of the respondents perceived poachers as law-breakers. Those who had tasted less bushmeat were more negative towards poaching while those who had tasted the bushmeat were more positive towards poaching.

Furthermore, 53 % did not want to report if they knew a poacher was inside the PA. This is because most respondents feared that the poachers would harm or threaten them. Some respondents claimed they did not want to give such information because the hunters had poaching as their livelihoods. It is believed that there were many hunter groups in the inside villages of the PA and some villages in the edge areas (Songer 2006, Wemmer 2000), that the villagers from these areas may be concerned about attacks from local hunters, and some women admitted they were afraid of them. Nasi et al. (2008) also reported that a significant hunting pressure generally came from local communities. On the other hand, Roe (2015) suggested that local cooperation with law enforcement organizations would be an essential strategy for successful fighting of poaching. The men with higher education in the villages from the outside area held a higher tendency to report about hunting or had a greater inclination to oppose poaching. It has been suggested that there should be a reward system for people who contribute to anti-poaching activities (Wemmer et al. 2000) and build a local reputation for ensuring the safety of informants. Education, gender and location were the

significant predictors of local awareness of the human impacts on thamin; gender and education were the important predictors for local willingness to participate in fighting against poaching. Fiallo and Jacobson (1995) also found that level of education was a significant factor to establish positive attitudes towards wildlife conservation among local people. These findings do not support the prediction P<sub>3</sub>.

### **Local involvement in wildlife conservation**

66 % of respondents knew about the operations of the PA and the people who lived inside and close to the sanctuary acknowledged than awareness of its conservation activities. Some respondents from the outside villages replied that they had never been to CWS although they only lived about 8 km from the PA. Htun et al. (2012) found that the people who had more knowledge about PA operations held more positive attitudes. Likewise, Allendorf and Young (2013) found that the level of local people' knowledge about Gaoligongshan Nature Reserve in China determined the local appreciation of benefits from PA. However, PA staff behavior plays a dominant role in shaping the relationship and trust between the PA and local people. Nearly 70 % of respondents replied they did not see or meet with the staff in CWS, or they had no comment about them while 20 % responded that the staff explained or warned them not to enter again into CWS. Also, the villagers who entered CWS from the edge area tried to avoid meeting or seeing the PA rangers when they were in the sanctuary to access to natural resources. They said they could guess when and where the rangers would patrol in the forest. Infield and Namara (2001) suggested that law enforcement should be an essential tool to protect PAs, however, the relationship between PAs and people was greatly influenced by the behaviour of PA rangers; their interactions and physical behaviour reflected to the local community.

The results found that 60 % admitted they did not participate in any activities in conservation, while just about 5 % supported thamin conservation a lot. The people inside CWS participated more in conservation activities such as helping the growing of crops (pigeon pea) for thamin in CWS and tree planting operations. Men supported more cooperation in conservation than the women. However, little local conservation support was observed in this study. Allendorf et al. (2012) found that local conservation support was influenced by local perceptions and attitudes towards PA. Changes in management strategies to include local perceptions and needs increased positive perceptions and decreased negative

perceptions. Infield and Namara (2001) found that local people who received certain amounts of support from community conservation programmes showed positive attitudes towards PA. However, their behavior remained unchanged – illegal grazing and hunting still occurred and their support to conservation remained low. These findings support my finding, however, it is difficult to conclude that my findings support prediction P<sub>4</sub>. It is suggested that conservation authorities including wardens and rangers should try to change their perceptions towards local people as potential partners and at the same time develop local people's perceptions towards them as a friendly neighbour (Infield and Namara 2001).

## **Conclusion and recommendations**

### **Conclusion**

The paradox is that the people living close to or in the PA get more benefits from the PA, and also bear most of the costs from crop raiding. Although people are generally positive to CWS as well as thamin conservation, they identified the thamin as the main crop raider and admit that there is still illegal thamin killing going on. People in and around CWS have a major resource dependency on the protected forest for subsistence and livelihoods. However, men were more likely to gain knowledge about CWS operations and therefore performed more positive attitudes than women. They were also more likely to report about poaching as well as more active in conservation. Educated persons were also more aware about human impacts on thamin population. Many of human activities are potentially damaging to the dry forests and can conflict with thamin conservation, but there are no specific studies that really look at the sustainability of resource uses and the impacts of human activities within CWS. This is a key area for future work in order to really quantify their impacts and develop limit for permitted human harvest of natural resources. However, these restrictions are likely to reduce resource access to levels that don't allow viable incomes such that- there will therefore be a need to invest in alternative livelihood streams. In addition, ecotourism is one option, but is not a magic bullet – especially if there are few thamin. Therefore, there is a major requirement to consider if it is advisable to invest in forest based livelihoods or encourage alternative futures.

### **Recommendations**

1. Local people should be assisted in developing practices and technologies to reduce their dependency on forest resources, for example, through the provisioning of efficient wood cooking stoves, gas stoves, solar power or possibly electricity from the nearest station (out of nine study villages, four villages access to electricity but not to every households in these villages) to reduce their fuelwood consumption. People living adjacent to CWS might need to be given some help in protecting crops – such as fencing, or through a switch to less palatable crops that deer avoid. Some form of compensation, preferably not in a direct monetary form, should be evaluated. There is a need to set clear limits for natural resource harvest, which also give priority access to forest residents. The advantage of this is twofold. Firstly, it will set limits on a sustainable level. Secondly, it can be used to increase awareness of their dependence on the protected area for their resource access. Linking resource access to compliance

with laws that protect thamin may make this more explicit.

2. Law enforcement and effective patrolling should be prioritized and control mechanisms for thamin poaching should be developed.
3. There is a need for improved outreach and communication activities by the CWS staff to improve trust and dialogue.

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## Appendix (Surveyed Questionnaire form)

### General Information

1. Questionnaire No.....
2. Date of interview: .....
3. Household number: .....
4. Name of Village: .....

### (A). Household status and Demographic characteristics

1. Sex:
  1. Female ( )
  2. Male ( )
2. Age of respondent: Real age ( )
  1. 18 – 29 ( )
  2. 30 - 39 ( )
  3. 40 - 49 ( )
  4. 50 and Over ( )
3. Religious: 1. Buddhism ( ) 2. Christian ( ) 3. Muslim ( ) 4. Others .....
4. Education:
  1. None ( )
  2. Primary School ( )
  3. Secondary or higher ( )
5. Occupation
  1. Farmer ( )
  2. Farm laborer ( )
  3. Salaried job ( )
  4. Business person ( )
  5. Others (Specify) .....
6. How many years have you lived in this village?
  1. Less than 1 year ( )
  2. Between 2-10 years ( )
  3. Over 10 years ( )
  4. Born in this village ( )
7. Household information:

No.	Relation	Age (year)	Sex	Education level	Main economic activity
1.					
2.					
3.					
4.					
5.					
6.					

8. Farm/land size:
  1. Landless ( )
  2. Small (less than 5 acres) ( )
  3. Medium (between 5-10 acres) ( )
  4. Large (over 10 acres) ( )
9. (a) Do you have animals? 1. Yes ( ) 2. No ( )

(b) If yes, please specify below:

No.	Animal	Number
1.	Cow	
2.	Buffalo	
3.	Goat	
4.	Pig	
5.	Chicken	
6.	Dog	
7.	Duck	

10. Where do you pasture for your livestock?
1. Within PA ( )
  2. Near PA boundary ( )
  3. Far from the PA ( )
  4. Within and near the PA ( )
11. Do you care regularly vaccination like foot and mouth disease and anthrax for your animals? 1. Yes ( ) 2. No ( )
12. If not, why?
1. I can't afford it ( )
  2. Veterinarian doesn't ever come ( )
  3. Others (Specify) .....

**(B). Land use and use of natural resources**

13. If crop farming is a major source of household income, what kind of crop do you cultivate?
1. Rice ( ) Area ( ) acre
  2. Maize ( ) Area ( ) acre
  3. Sugarcane ( ) Area ( ) acre
  4. Groundnut ( ) Area ( ) acre
  5. A variety of bean ( ) Area ( ) acre
  6. Other (Specify) .....
14. Where is your farmland? Distance from home,
1. Within the PA ( )
  2. From 0 to 0.5 mile ( )
  3. From 0.5 to 1 mile ( )
  4. From 1 to 2 miles ( )
  5. > 2 miles ( )

15. If you exploit natural resources (provisioning) from the forest, please specify the following:

<b>Natural resources</b>	<b>Use</b> 1. Yes 2. No	<b>How often do you enter to the PA?</b> 1. Weekly 2. Monthly 3. Rare 4. Seasonal	<b>Trend</b> 1. Declining a lot 2. Declining a little bit 3. Stable 4. Increasing a little 5. Increasing a lot 6. I don't know	<b>Important use</b> 1. Own use 2. Cash (for sale) 3. Own use and Selling
1. Fruits (*)				
2. Honey				
3. Medicinal plants				
4. Thatch				
5. Bamboo				
6. Mushrooms/turffles				
7. Fuelwood				
8. Timber, poles and posts				
9. Wild meat				
10. Others .....				

(\*)Khabaung = *Lectis cinnamomea*, Phangar = *Terminalia chebula*, Ziphyu = *Phyllanthus pomiferus*

16. Are you allowed to exploit these resources from the PA authority?

1. Yes ( ) 2. No ( ) 3. Illegal, but no problem ( )

**(C). Conflicts between local people and wildlife**

17. What animals usually cause problems to your crop, please rank from the most serious to the least?

<b>Species</b>	<b>How big a problem is this species for your crops?</b> 1. No impact at all 2. Small loss 3. High loss	<b>Which crop does it raid?</b> 1. Rice 2. Maize 3. Sugarcane 4. Groundnut 5. Some crops 6. All crops 7. Others	<b>What is your response?</b> 1. Reporting to PA authority 2. Chasing them away 3. Injure them 4. Kill them 5. Others	<b>When does the crop raiding happen?</b> 1. From January to March 2. From April to June 3. From July to September 4. From October to December 5. Most months 6. All the whole year
Rhesus macaque				
Muntjac				
Thamin				
Wild boar				
Others.....				

18. If crop raiding occurs, where do you report such incidents?

1. Village leader ( )  
2. Park Staff ( )  
3. PA Warden ( )  
4. Others (Specify) .....

19. When you report your loss to PA authority, how do they respond to your case?
  1. Very negative ( )
  2. Negative ( )
  3. Fair ( )
  4. Positive ( )
  5. Very positive ( )
20. When was the last time you saw a thamin?
  1. Within a week ( )
  2. Within a month ( )
  3. Within a year ( )
  4. Over one year ( )
  5. Never seen ( )

**(D). Perceptions and Attitudes of local people**

21. Do you know how the thamin population trend in CWS? They are:
  1. Declining ( )
  2. Stable ( )
  3. Increasing ( )
  4. Not aware ( )
22. If you agree that the thamin population has decreased, why do you think it is?
  1. Food scarcity ( )
  2. Habitat loss ( )
  3. Human disturbances ( )
  4. Migration to outside ( )
  5. Poaching ( )
  6. Dog disturbances ( )
  7. Human disturbance and other factors ( )
  8. Several factors ( )
  9. Others (Specify) .....
23. Do you think human activity is the major cause of thamin population decline?
  1. Yes ( ) 2. No ( ) 3. I don't know ( )
24. Have you heard about anybody from a neighboring village poaching thamin?
  1. Yes ( ) 2. No ( )
25. If so, why?
  1. For meat ( ) 2. For selling ( ) 3. Because they damage the crops ( ) 4. Others ...
26. (a) If you see a poacher who enters in the PA or kill animals, will you report this case to the PA authority?
  1. Yes ( ) 2. No ( )
 (b) If yes or no, why?
 

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27. To what extent are you doing activities that support for thamin or other animals' conservation in the area?
  1. Nothing ( ) 2. Moderate ( ) 3. A lot
28. What do you think about the existence of the PA in your locality?
  1. Strongly Positive ( ) 2. Positive ( ) 3. Neural ( ) 4. Negative ( ) 5. Strongly Negative ( )
29. Do you obtain any benefits from the PA?
  1. Nothing ( ) 2. Little ( ) 3. A lot ( )
30. Has the presence of sanctuary brought any losses to your village?
  1. Yes ( ) 2. No ( )

31. How do the PA staffs treat you when they see you in the forest?
1. Explain why we should not enter ( )
  2. Warn us not to enter later ( )
  3. Punish us with a fine ( )
  4. More than one factor ( )
  5. Others .....
32. Do you trust the PA staff?
1. Yes ( ) 2.No ( )
- If so, why?  
 .....
33. Do you know the rules, regulations and conservation activities of the PA?
1. Yes ( ) 2.No ( )
34. (a) Have you ever eaten thamin meat?      1. Yes ( )    2.No ( )  
 (b) If yes, then do you like it?            1. Yes ( )    2.No ( )

The standard of the house

Type of building .....

TV ( ) /motorbike ( ) /mobile phone ( )/farm machine or cattle for cultivation ( )  
 /Electricity/Solar ( )

Thank you very much.