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# The effect of elephant raids and insurance policies for the Human-elephant conflict (HEC) in Xishuangbanna, China



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## Summary

The Asian elephant population has undergone a severe decrease during the last centuries and is therefore classified as endangered by IUCN. There use to be a large population of Asian elephants (*Elephas maximus*) living in China but today there are only 200-250 individuals left, living in the far south close to the border of Laos and Burma. At the same time as the elephant population has decreased the human population has increased and are now occupying much of what used to be the elephants habitat. In China most elephants live in the autonomous prefecture of Xishuangbanna where they are spread across three sub-reserves that are isolated from each other. With the absence of large connected habitat the elephants tend to depredate on agricultural fields which have led to hostility against elephants among the villagers and created a conflict between humans and elephants (HEC). In 2010 the old insurance policy in Xishuangbanna was replaced with a new one in order to cover more of the villagers' economical losses and ease the aggravation amongst the people.

During the spring of 2013 I conducted a field study in Xishuangbanna where people got to answer a questionnaire regarding the new insurance policy and the conservation of wild elephants in Xishuangbanna. My study shows that even though most people found the new insurance policy to be better than the old one no one thought the compensation to be adequate. The data also show that people who have suffered from larger economical losses are less willing to conserve the elephants in Xishuangbanna.

## Introduction

During the 20<sup>th</sup> century the human population has increased from 1.6 billion to 7.1 billion in 2013 (USCB 2013) with the highest increase in south east Asia (Cincotta *et al.* 2000). This has led to increased competition for resources and land (Vitousek *et al.* 1997, Sodhi *et al.* 2010), resulting in a huge loss of wilderness areas (Leimgruber *et al.* 2003) and increased fragmentation threatening many of the worlds' species survival (Myers *et al.* 2000). In 2011 there were over 16 000 species listed as endangered according to the International Union for Conservation of Nature (IUCN) red list for threatened species (ESI 2011).

As the human population has been growing so has the interest for nature protection (Brooks *et al.* 1999) leading to a new field of interest; "Human-wildlife conflicts". Human-wildlife conflicts (HWC) are defined by IUCN World Parks Congress (WPC) as conflicts that occur when: "the needs and behaviour of wildlife impact negatively on the goals of humans or when the goals of humans negatively impact the needs of wildlife" (Madden 2004). Examples of this are bears foraging on human food or killing livestock (Mattson 1990) or the re-introduction of wolves in Sweden (Ericsson & Heberlein 2003). Another example from China is the human-elephant conflict (henceforth referred to as HEC, Zhang & Wang 2003, Zhang *et al.* 2006, He *et al.* 2011).

There used to be vast areas of remote land in the south of China holding large populations of elephants but as the human population expanded the elephants decreased in number and now there are only 200-250 wild animals left, most living in Xishuangbanna Dai autonomous prefecture in the Yunnan province (Chen 2008). The small elephant population is divided into two sub-populations, isolated from each other by infrastructure and fragmentation which makes them very vulnerable (Zhang *et al.* 2006, Chen 2008, Lin *et al.* 2008). It has become hard for the elephants to find enough food in what little forest is left and they are more often seen in populated areas where they cause damage by trampling or feeding on grown crops or by injuring people (Zhang & Wang 2003, Jin *et al.* 2006). Before 2010 the government reimbursed the farmers through monetary compensations. There was however usually a lack of available funds to cover the expenses, which sometimes led to that aggravated people un-lawfully killed elephants (Zhang *et al.* 2006). Since 2010 compensation is instead issued by the government together with China Pacific Insurance Company (a private enterprise). The objective is to alleviate the villagers' economical losses and that this also will lead to reduced reprisals against elephants and make the villagers more inclined to participate in conservation practices. The HEC is considered to be the biggest threat to preserving the wild elephants in China (Zhang & Wang 2003, Chen 2008) and mitigating HEC is regarded as one of the major conservation challenges in Asia today (Sukumar 2003).

## Aim

It has been shown that people who experience less destruction or economical losses due to wildlife are more prone to support conservation of wildlife (Damiba & Ables 1993, Naughton-Treves 1997, Tisdell & Zhu 1998, O'Connell-Rodwell *et al.* 2000, He *et al.* 2011). Consequently it is plausible that people will be more disposed to increase and protect the Chinese elephant population if they feel that their economical offsets are alleviated. So far there has been no assessment of how people feel about the new insurance policy in Xishuangbanna compared to the old one. With this project I aimed at evaluating the effectiveness of the new insurance policy, focusing on how it is affecting attitudes towards the elephant population in Xishuangbanna. The result may be used for the conservation actions taken in the area, helping to mitigate HEC and improving the new insurance policy.

## Background

### The Asian elephant

The Asian elephant (*Elephas maximus*) is decreasing in numbers and with only 34 000-54 000 animals left (Sukumar 2003), scattered across southern Asia (fig. 1), it is classified as endangered by IUCN (Choudhury *et al.* 2008).

There are three now living subspecies of the Asian elephant: *E. maximus indicus* that lives on the continent and on Sri Lanka, *E. maximus sumatrus* from Sumatra (Indonesia) and *E. maximus bornees* that is found on Borneo. (Fernando *et al.* 2000). The historical distribution of the elephants extended from Syria in the west to south east Asia and from the Yangtze River in China in the north to Sri Lanka, Borneo and Sumatra in the south. Today wild elephants only occupy five percent of that historical range (Sukumar 2006).

The extreme population decrease is attributable to poaching, excessive utilization of resources and extensive loss-, fragmentation- and degradation of habitat (Sukumar 1989a, Sukumar 2003). Asian elephants mainly live in pristine forests, which have decreased rapidly during the last decades due to forest fragmentation and increase of monocultures such as rubber- and fruit plantations (Sukumar 1989a). Elephants require large connecting areas with a mixture of habitat to be able to breed and migrate (Sukumar 1989b), but at present only half of the elephants' geographical range consists of large, unfragmented and undeveloped areas, of which less than twenty percent is under legal protection (Leimgruber *et al.* 2003).

### Ecology

Asian elephants feed on more than 110 different plant species (Jin *et al.* 2006) and by eating for 12-18 hours a day can they consume up to 10% of their body mass in dry weight fodder (Sukumar 1989a). Their diet varies with season and habitat (Sukumar 1989b, Jin *et al.* 2006) but mainly consists of pioneer plant species that are commonly found in secondary forest, such as *Ficus* spp (Moraceae), *Dendrocalamus* spp (Gramineae), *Musa acuminata* (Musaceae) and *Microstegium ciliatum* (Gramineae) (Jin *et al.* 2006).

Elephants live in closely related matriarchal groups of five to twenty individuals, the number of which may vary with season (Sukumar 1989b, Fernando & Lande 2000, Vidya & Sukumar 2005). Males leave the herd when they become mature and usually live alone or in small temporary bull herds, which minimize inbreeding. Elephants' have a low reproductive rate which makes recovery in the wild a very slow process (Shoshani & Eisenberg 1982). Both males and females mature when they are around 10-14 years old and females only produce a calf every four to five years (Sukumar 1989a, Vidya & Sukumar 2005).

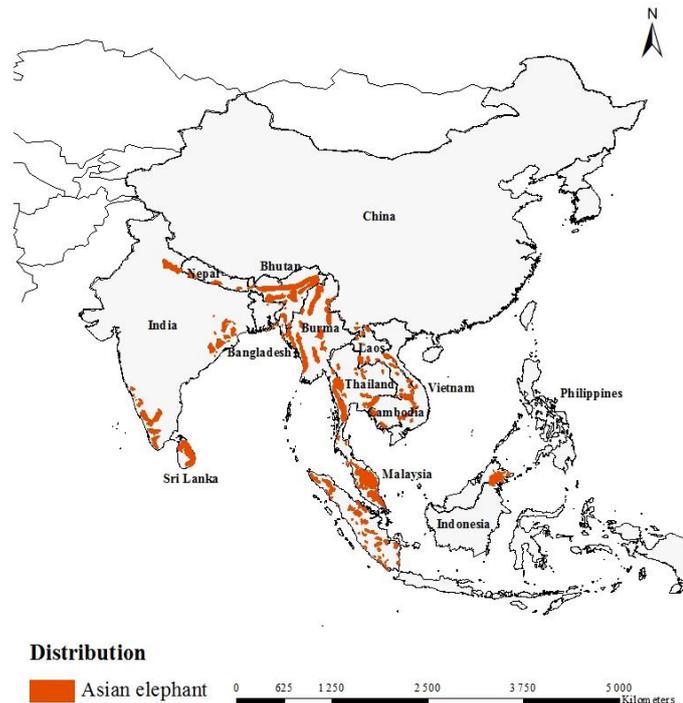


Figure 1. Distribution of the Asian elephant (IUCN 2012).

## Elephants in China

The study of Asian elephants in China is fairly recent, with the first field study conducted in 1976 (Zhang *et al.* 2006). The comprehensive knowledge and understanding about the elephants movements, habitat use and population structure is extremely poor (Fleischer *et al.* 2001, Zhang & Wang 2003, Zhang *et al.* 2006), especially since population estimates are done on an irregular basis with different methods (Blake & Hedges 2004). In China census data are recovered by the Forest department bureau together with scientist using transects counting traces (footprints, faeces, feeding remnants), fixed point monitoring at locations frequently visited by elephants, tracing particular groups or by using camera traps (Zhang & Wang 2003, Zhang *et al.* 2006, Chen 2008). No long term monitoring data exist in China and no elephants wear GPS-transmitters there.

What is known is that large populations of wild elephants used to roam over wide areas in the southern of China, such as the Fujiang, Guangdong, and Guangxi Provinces but with the increased exploitation of land by man the elephants distribution has been severely reduced (Wu & Ou 1995, Tisdell & Zhu 1998). In the 1970s there were only around 150 wild elephants left in China (Zhang & Wang 2003). Due to improved protection during the 1990s the population has increased to 200-250 animals (Sukumar 2003, Zhang & Wang 2003, Zhang *et al.* 2006, Chen 2008). The governmental goal is to increase the population further and elephants now hold a first class protection in China (Choudhury *et al.* 2008). According to The Law of the People's Republic of China on the Protection of Wildlife (1989) article 9:

*"The State shall give special protection to the species of wildlife which are rare or near extinction. The wildlife under special state protection shall consist of two classes: wildlife under first class protection and wildlife under second class protection. Lists or revised lists of wildlife under special state protection shall be drawn up by the department of wildlife administration under the State Council and announced after being submitted to and approved by the State Council".*

Persisting in the mountainous areas in very south of China the elephants can today only be found in a single province; Yunnan. A small part of the population lives in Simao and Lincang prefecture but the majority (90%) lives in or in the buffer zones around Xishuangbanna National Nature Reserve (XBR) in Xishuangbanna prefecture. Xishuangbanna, bordering Laos and Myanmar, is the only prefecture where wild elephants have always been present (Zhang & Wang 2003, Zhang *et al.* 2006, Chen 2008).

### *Xishuangbanna National Nature Reserve (XBR)*

XBR was declared a "State nature reserve" in 1958 and a "UNESCO Man and biosphere reserve" in 1993 due to its rich and unique biodiversity with several species endemic to Yunnan. XBR is today Chinas largest protected tropical rainforest (Wu & Ou 1995).

XBR consists of five sub-reserves; Mengyang, Menglun, Mengla, Sangyong and Mangao making a total area of 2425 km<sup>2</sup> (fig. 2). Two elephant sub-populations are spread across the Mengyang, Mengla and Sangyong sub-reserve, which are large enough to offer suitable habitat for elephants (Chen 2008). The northern sub-population, which is the largest one, consists of 100-120 animals concentrated in the Mengyang sub-reserve. A highway to connect Kunming (capital of Yunnan) and Bangkok was built through the reserve in 2006 (Catibog-Sinha & Wen 2008), cutting through the elephants seasonal migration route from east to west, dividing the population further (He *et al.* 2011). The southern sub-population is distributed across the Mengla- and Sangyong sub-reserves (Chen 2008, He *et al.* 2011), which are linked by a corridor (Lin *et al.* 2008). The population migrates seasonally across the border into Laos to the Nam Ha national biodiversity conservation area in the Luang Namtha

province, which impedes the determination of the population size, although 20-30 elephants are estimated to live in Mengla and another 60-80 in Sangyong (Chen 2008). A suggestion to build another corridor, “the green passage” linking the Mengyang sub-reserve with the Mengla- and Sangyong sub-reserve has been made in order to connect the two sub-populations and increase the limited genetic flow within the population (Lin *et al.* 2008) but since the cost of land acquisition are likely to be very high this has so far not been more than an proposal (Tisdell & Zhu 1998, Lin *et al.* 2008).

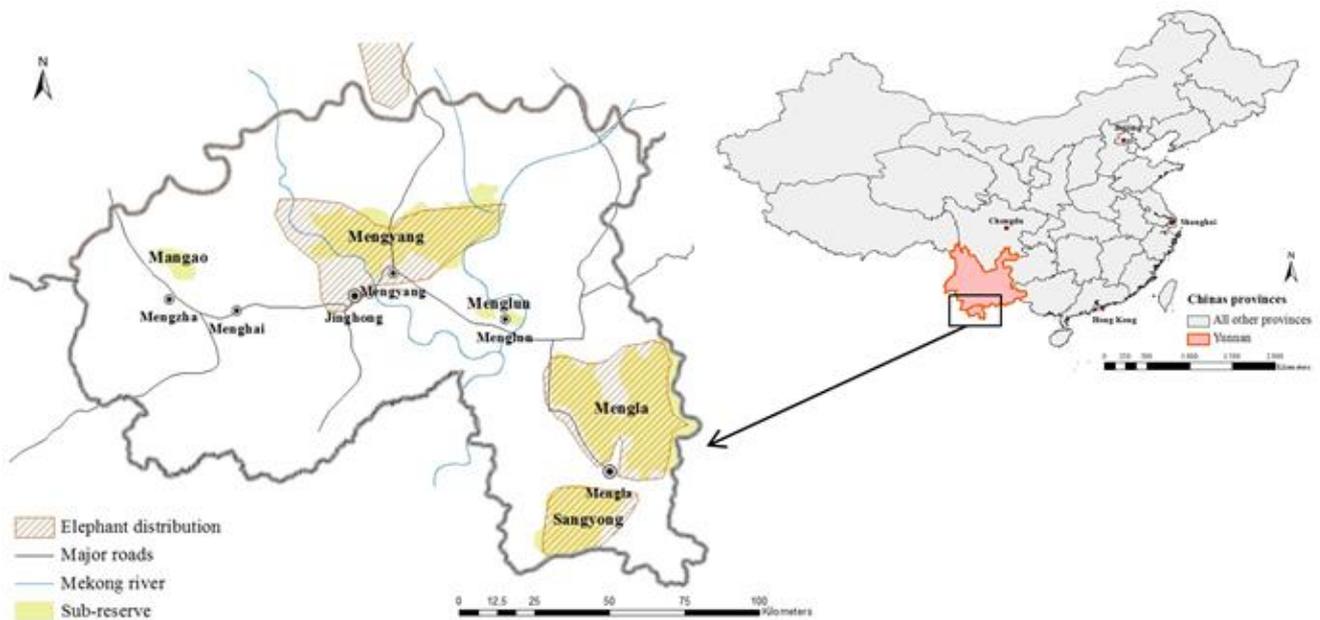


Figure 2. Distribution of the elephants across Xishuangbanna national nature reserve in Yunnan, China (IUCN 2012).

## Isolation

Small, isolated populations are more likely to become locally extinct due to demographic, catastrophic, genetic and environmental stochasticity compared to larger populations (Schaffer 1981). There is no data for the genetic flow or relatedness within the Chinese elephant population but estimates for the whole population of *E. maximus indicus* has shown that the genetic diversity is low compared to other large mammals (Fernando *et al.* 2000). This could be a consequence of the decreased population leading to a long term small effective population size (Gilpin & Soulé 1986).

The low heterozygosity does however not by itself indicate that the elephants should be genetically depauperate (Fernando *et al.* 2000) and several species, as for example the Beaver (Ellegren *et al.* 1993) and the Elephant seals (Bonnell & Selander 1974), seem to thrive even though they have low heterozygosity. High homozygosity within populations can however lead to inbreeding depression (loss of fitness) due to increased risk of expression of recessive deleterious alleles, decreased resistance for diseases and decreased evolutionary possibilities (Crnokrak & Roff 1999). Theoretical recommendations for conservation are usually to keep an effective population size above 50 individuals to avoid inbreeding and a population of at least 500 individuals to achieve long term viability (Gilpin & Soulé 1986). These numbers are as said, theoretical and usually a population viability analysis (PVA) is done based on probabilities to predict the likely fate of a population and determine a minimum viable population (MVP) (Gilpin & Soulé 1986). No such data exist for *E. maximus indicus* in China and the precaution principle should therefore be applied for conservation actions. According to the precaution principle an action should be avoided if there is a risk that it might harm the

environment, even if no scientific proof exists of its deleteriousness. Due to the diminutive genetic flow between the sub-populations is it important that the populations are allowed to increase in number to avoid inbreeding, especially in Mengyang.

### **Conservation values of Asian elephants in China**

Preserving the wild elephants in China is not just of value for biodiversity and for the mean existence of elephants but is also of ecological, economical and cultural importance.

#### *Ecological value*

Elephants have an important role influencing forest dynamics by shaping the landscape due to selective browsing and formation of trails (Sukumar 1989a). This creates gaps and disturbances in the forest that are beneficial for many plant species (Watt 1947, Connell 1978, Whitmore 1989). Being one of few existing megaherbivores in Asia they also have an important role as agents of long distance seed dispersal of large fruits (Sukumar 1989a). Elephants are further regarded as umbrella species due to their requirement of large, unfragmented areas, hence protection of land for the elephant benefits several other species as well (Choudhury *et al.* 2008).

#### *Economical value*

Yunnan is one of the six poorest provinces in China but has become a hotspot for nature tourism owing to its unique and rich biota. The amount of tourists in Yunnan has grown with 35% since 2007 and in 2010 around 8.2 million people visited Xishuangbanna, creating economic revenue of roughly 8 000 million CNY (1 300 million USD) (NBSC 2013). This makes the tourism industry to a major economical driver in the region (Eng 1998) and being a flagship species, the elephant is one of the main attractions (Wu & Ou 1995). Even though the chances of actually seeing elephants in the wild are very small they are a common feature in Xishuangbanna, both as souvenirs and adornments and can for example be seen depicted as traffic signs, street decorations and statues.

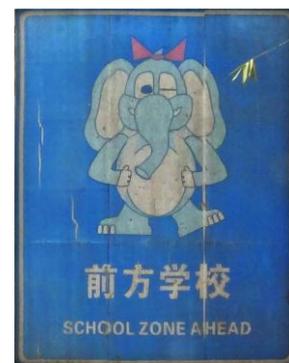


Figure 3. Traffic sign in Mengla County, Xishuangbanna.

The increased interest for nature tourism in China (Li & Han 2001) has led to that many destinations such as The Wild Elephant Valley are projected as nature tourism destinations (Catibog-Sinha & Wen 2008). Nature tourism can propose a threat for wildlife but if it is well managed ecotourism it could also be beneficial (Kruger 2005). The critique against the ecotourism in China has however been quite harsh, disparaging the amount of disturbances, absent of management objectives and lack of local investments (Nepal 2000, Li & Han 2001 Nyaupane *et al.* 2006). Tourism in China is mainly regulated by the government and some large tourism agencies approved by the government which restrict outside influences and alienate local people from the industry (Nyaupane *et al.* 2006, Catibog-Sinha & Wen 2008). The type and number of tourists do also affect local peoples possibilities to be incorporated in the industry, which is easier if it is not a mass tourist destination for people that is not interested in the local culture or life of the people living in the area, which mainly is the case in Yunnan (Nyaupane *et al.* 2006, NBSC 2013). So even if the presence of elephants facilitates tourism revenues it might neither benefit the local communities nor improve their relation to the elephants.

### *Cultural value*

Elephants have been used by people in Asia for over 4 000 years, not only for their ivory and meat but also for warfare and agroforestry (Wu & Ou 1995, Sukumar 2003). Elephants also hold a special cultural value for many of the ethnic minorities in China. They are for example considered to be a sign for good luck in the Dai culture (Wu *et al.* 2001, Yang *et al.* 2004) which is the largest ethnic group in Xishuangbanna, making up 34% of the population (NBSC 2013).

### **When the grass is greener on the other side**

The destruction caused by elephants, mainly by depredation on crops, is the foundation for HECs. The raiding mainly occurs during June-November when the crops rape, with a peek in August (Zhang & Wang 2003, Chen 2008). Elephants mainly feed on banana, sugarcanes, corn, paddy rice and beans (Zhang & Wang 2003) but there are also severe damages on rubber and tea by tramping on saplings (Chen 2008). Usually the elephants arrive in the evening and leave before sunrise (Sukumar 1990, Chen 2008). The risk of crop damage has been shown to be highest in the edge of the forest (Naughton-Treves 1997) and dense farms are more protected (Sukumar 1989a, Naughton-Treves 1998).

Elephants can also be aggressive and are known to have injured or killed people (Zhang & Wang 2003). Between 1991 and 2010 has 32 persons been killed in Yunnan (He *et al.* 2011) with the latest death in July 2013 (XNA 2013). In India 150-200 people are killed every year by elephants (Tisdell & Zhu 1998). The same problem occurs in Africa (Lewis *et al.* 1990, Naughton-Treves 1997, Naughton-Treves 1998) where elephants sometimes are referred to as the “governments’ cattle” (Naughton-Treves 1997, O’Connell-Rodwell *et al.* 2000). People who are aggravated with the management of the elephants have in some occasions un-lawfully killed elephants following a death or bad injury in the village (Zhang *et al.* 2006). Between 1966 and 2005, 120 elephants have been illegally shot in China (He *et al.* 2011), a crime which carries a jail sentence (Zhang *et al.* 2006).

The escalations of HECs are mainly a result of increased elephant densities and expanded agriculture in areas where elephants compete directly with the human population for resources and land (Hough 1988, Thouless & Sakwa 1995).

### *Land-use changes*

In Xishuangbanna, as well as in most parts of Southeast Asia, there has during the last decades been a distinct change in how the landscape is used. Indigenous people use less of their old traditions of land cultivation and more chemicals and modern practises (Wu *et al.* 2001). There used to be more shifting cultivators or “swiddernes” that created gaps in the forest (Zhang & Cao 1995), leading to a higher abundance of early secondary species (Whitmore 1989), which are the preferred food source by elephants (Jin *et al.* 2006).

Most tropical rainforest in China can today only be found within reserves or state forest (Wu & Ou 1995). The management plans for the reserves, ordained by the government, mostly states what is not allowed instead of what should be done (Liu *et al.* 2003, Zhang *et al.* 2006). This means that disturbances such as slash- and burn techniques in most cases are not allowed, creating undisturbed forest with little early successional species (Jin *et al.* 2006). The scarce food supply within the forest and the high amount of available food close to the villages lure the elephants to visit residential areas, where they might feed or trample on crops (Zhang & Cao 1995, Jin *et al.* 2006).

### *Changed feeding strategy*

Crop raiding can be seen as an extension of the elephant's optimal foraging strategy (Sukumar 2006). Many of the cultivated crops that are grown by the villagers in Xishuangbanna have wild counterparts that contain lower levels of nutrients and are less palatable due to the lack of human selection for high nutrient content (Sukumar 1990). Elephants are selective in what they eat and have been observed to select for the most nutritious parts of the crops (Sukumar 1990). In India it has been observed that it mainly is males that feed on cultivations, which could be explained by a "high-risk high-gain"- strategy due to marked sexual dimorphism that occurs in polygynous mammals to enhance reproductive success (Sukumar 1991, Sukumar & Gadgill 1988).

### *Loss of habitat due to increase of rubber plantations*

Due to extensive logging between the 1960s and the 1990s (Jianchu *et al.* 2005) and the vast amount of crop land the forest cover in Xishuangbanna is exceedingly low (Huijun *et al.* 2002). In 1998 was a new land-use policy established in China, the Natural Forest Conservation Program (NFCP), which aims to restore and protect natural forest, diminish erosion and increase timber production (Zhang *et al.* 2000). Nevertheless, since there is no demand to plant native tree species (Zhang *et al.* 2000) there has been a huge transformation of tropical forest to rubber plantations (Jianchu *et al.* 2005, Li *et al.* 2007).

Rubber was introduced in China in 1948 and the first plantations were established in the 1950s (Wu *et al.* 2001). In 1978 China went from plan- to market economy which led to an expansion of the industry to meet the national demand (Li *et al.* 2007).

Rubber is grown below 1000 meter and it is also at these lower altitudes where the elephants live (Li *et al.* 2007). Rubber plantations have improved local economy (Zhang & Cao 1995, Eng 1998) and decreased forest fragmentation (Li *et al.* 2007) but mainly being monocultures they hold considerably fewer species than tropical forest and are an inadequate habitat for several species existing in the tropical forest, such as the elephants (Wu *et al.* 2001). Much of the tropical forest in Yunnan has been degraded due to the increase of rubber plantations which reduce humidity, increase erosion and pollutions due to the use of chemical fertilizers (Wu *et al.* 2001, Leimgruber *et al.* 2003). There is therefore not much land left for the elephants, which are forced to walk through plantations to reach patches of tropical forest, in the process of which they might cause damage to the saplings (Sukumar 2006).

### *Loss of habitat due to agricultural land and infrastructure*

Of the 46 million people living in Yunnan are 1.1 million living in Xishuangbanna and even if the birth rate has decreased the population is still increasing (fig. 4). The few areas of tropical forest in Xishuangbanna lie in a heavily fragmented landscape with a high human density (58 persons per km<sup>2</sup>). The elephants' migration routes might therefore at times intercept with what today has become production zones and residential areas, which increases the risk of elephant predation on crops (Liu *et al.* 2003).

Around 64% of the population in Xishuangbanna live in rural areas and with 70% of the population working in agriculture Yunnan is one of the most important agricultural provinces in China (Yang & Li 2000). In 2010 the annual average per capita net income for people living in the rural areas of Yunnan was 3 952 CNY (643USD) and the per capita net expenditure 3 398 CNY (553USD), making self-sustaining agricultural practices indispensable and a loss of income due to depredation on crops would likely have a severe effect on peoples livelihood (NBSC 2013).

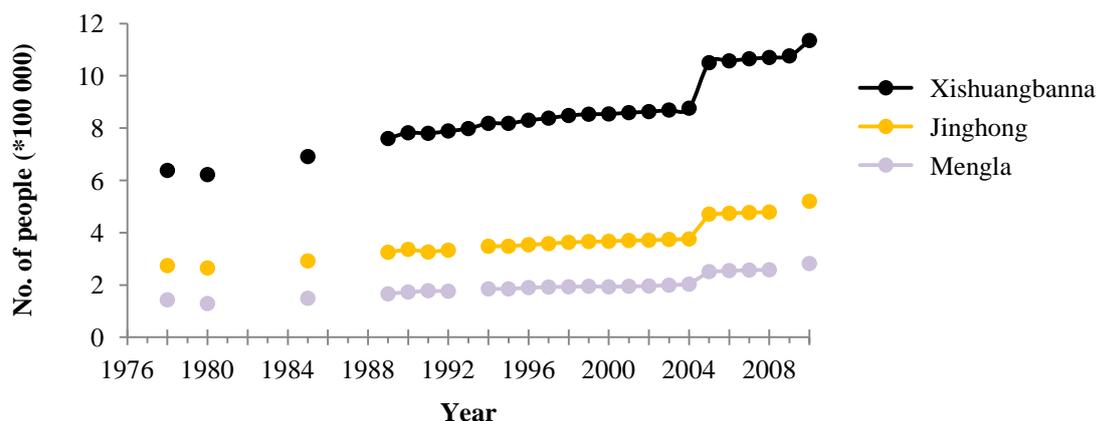


Figure 4. Human population changes in Xishuangbanna from 1978 to 2010 (NBSC 2013).

### How to mitigate HECs?

HECs are regarded to be one of the biggest threats to wild elephants and it is of outmost importance to alleviate the economical losses due to elephant raids to achieve long term viability for the elephant population. In order to reduce crop raiding the villagers have physically or by intimidation been trying to prevent elephants to enter residential areas. This has usually worked for a while but when the elephants realize that no harm will come to them they have simply ignored the barriers built or sounds made by the people (Thouless & Sakwa 1995, Sukumar & Gadgil 1998, Tisdell & Zhu 1998, O'Connell-Rodwell 2000, Zhang & Wang 2003). To build salt ponds and provide food within the reserve has shown to be somewhat successful (Zhang & Wang 2003). The International Found for Animal of Welfare (IFAW) did also launch an Asian elephant program where farmers are given money for learning how to use the land to grow other crops that pose less temptation for elephants, in order to reduce the amount of contact between humans and elephants (IFAW 2013).

When damages created by wild animals cannot be avoided they are instead tried to be mitigated. This is usually done by reducing the population, culling problem animals or by compensation. Since elephants hold a first class protection in China, reducing the population is not an option and the local government is instead bound to reimburse farmers according to The Law of the People's Republic of China on the Protection of Wildlife (1989), article 14:

*“If the protection of wildlife under special state or local protection causes losses to crops or other losses, the local governments shall make compensation for them. Measures for such compensation shall be formulated by the government of provinces, autonomous regions and municipalities directly under the Central Government”.*

There used to be a system in Xishuangbanna, where the local county and prefecture governments remunerated the villagers. The funds were however insufficient, making much of the money set for conservation to go to compensation instead, which still only covered around ten percent of the villagers losses (Tisdell & Zhu 1998). Therefore a new system was introduced on trial 2010, where the government together with China Pacific Insurance Company compensate the villagers. The compensation is given annually and follows a set form based on the amount of destruction (table 1).

Usually the head of the village sends in the complaints from the village. The damage is then assessed in collaboration between the head of the village and a staff worker from both the insurance company and the local government. As a rule this is done once or twice a year. There have been reports in media about how villages get extremely high compensations for damages created by elephants with the new insurance policy (China Daily 2010) but as mentioned, so far no studies exist looking into how the villagers feel about the new policy and how this affects their opinions about the elephant population within XBR.

Table 1. Amount of compensation given in CNY depending on type of damage with the new insurance policy for the years 2010 and 2012.

	2010	2012
If person die		200 000
If person get hurt		100 000
House	10 000	10 000
Rice	400/km <sup>2</sup>	500/km <sup>2</sup>
Corn/Buckwheat	300/km <sup>2</sup>	400/km <sup>2</sup>
Rubber 0-5years	15/plant	10/plant
Rubber >5years	15/plant	20/plant
Tea	2/plant	2/plant
Fruit tree	20/plant	20/plant
Coffee	10/plant	5/plant
Banana	10/plant	10/plant
Sugarcane	700/km <sup>2</sup>	700/km <sup>2</sup>
Bean	250/km <sup>2</sup>	250/km <sup>2</sup>
Peanut	400/km <sup>2</sup>	400/km <sup>2</sup>

## Method

The study was a collaboration between Uppsala and Yunnan University. I was accompanied in field by an English speaking student from Yunnan University and a local guide. The field work was carried out between the 17<sup>th</sup> and 29<sup>th</sup> of March 2013 during which we talked to people from 15 different villages in the Mengyang-, Mengla- and Sangyong sub-reserves of XBR.

## Study area

Xishuangbanna Dai autonomous prefecture (21°09'-22°33'N, 99°58'-101°50'E) is a highland mountain zone with a shift in elevation from 630 to 1300m above the sea level. With the Hengduan Mountains running north-south, 95% of the region is covered by mountains and hills (Li *et al.* 2007). The total area of the prefecture is 19700km<sup>2</sup> of which twelve percent are covered by XBR (Chen 2008). The Lancang River (Mekong River) runs through Xishuangbanna and its many tributaries create a green landscape with rich water resources (Lin *et al.* 2008). Tropical seasonal rain forest, tropical mountain rain forest, evergreen broad-leaved forest and monsoon forest are the main natural forest types found in Xishuangbanna (Wu & Ou 1995).

The climate in Xishuangbanna is semi-humid, lying within a transition zone between sub-tropical to tropical climate, with an annual rainfall of 1100 to 2400mm and temperature ranging between 15.1 and 21.7°C. The humidity and temperatures are highest during the summer (May-October) while the winter (November-April) is dry and foggy (Yang *et al.* 2004). The combination of the unique climate and topography has created a transition zone of flora and fauna from south east Asia and subtropical China (Wu & Ou 1995).

### *Sub-reserves*

In order to cover a large area of Xishuangbanna three sub-reserves within XBR were visited; Mengyang, Mengla and Sangyong. The sub-reserves lie in two different counties, Jinghong and Mengla, and differ in size, type of cultivated land and number of elephants, villages, and minorities. Mengyang is the largest of the sub-reserves (998km<sup>2</sup>), followed by Mengla (927km<sup>2</sup>) and Sangyong (312km<sup>2</sup>, Lin *et al.* 2008). Mengyang sub-reserve also holds the largest population of elephants, and it is in this area that the HEC has been most pronounced

(Chen 2008). Since Mengla and Sangyong are connected through a corridor they are sometimes considered as one reserve and the elephant population might also be migrating between the sub-reserves. The conditions between the two sub-reserves are however somewhat different.



Figure 5. The village of Mang Dan in the Mengla sub-reserve, a typical Dai-village.

### Data collection

Of the 260 villages in connection to XRB, 15 were chosen for visits: seven in Mengyang, four in Mengla and four in Sangyong sub-reserve (fig. 6). The villages were chosen by the guide and were villages that they knew had been experiencing elephant raids. In the Mengyang sub-reserve we did not need an exterior guide since the driver had extensive knowledge about the area. For the Mengla and Sangyong sub-reserve we used two other guides that knew the area and the people in the villages better. This was of great importance since we wanted the consent to talk to the villagers from the head of the village for each village before we started the interviews.

We tried to get an even spread of villages lying both within and on the edge of the reserve for each sub-reserve.

Table 2. Basic facts about each village within the three sub-reserves (based on information given by the villagers).

<b>Sub-reserve /Village</b>	<b>No. of families</b>	<b>No. of people</b>	<b>Location in reserve</b>
<b>Mengyang</b>			
<i>ZhongTian Ba</i>	40	160	Within
<i>Mengmang</i>	80	360	Edge
<i>Xiao Hei Qing</i>	40	180	Edge
<i>15 group</i>	33	149	Edge
<i>Shang Liudui</i>	15	68	Edge
<i>Xiang Yin Qing</i>	30	135	Within
<i>Bai Hua Shan</i>	15	68	Edge
<b>Mengla</b>			
<i>Mangdan</i>	80	360	Within
<i>Manglang</i>	80	360	Within
<i>Sha Ren</i>	40	180	Within
<i>Guang Ming Group 2</i>	60	270	Within
<b>Sangyong</b>			
<i>Do Longha</i>	70-80	315-360	Edge
<i>Jin Zhu Lin</i>	20	90	Within
<i>Hui Yan Long</i>	20	90	Edge
<i>Shang Zhong Liang</i>	60-70	270-315	Outside

Two villages were usually visited each day, one at noon when people were home for lunch and one in the evening when they were back from working in the fields. In Mengyang many villagers were out on the fields collecting tea during the time for our visit which led to fewer answers per village compared to the other sub-reserves. Furthermore did the villages visited in Mengyang usually consist of fewer families compared to the villages in Mengla and Sangyong (table 2). The number of families and people for each village were given to us by the villager that helped us. GPS coordinates were taken for all of the villages.

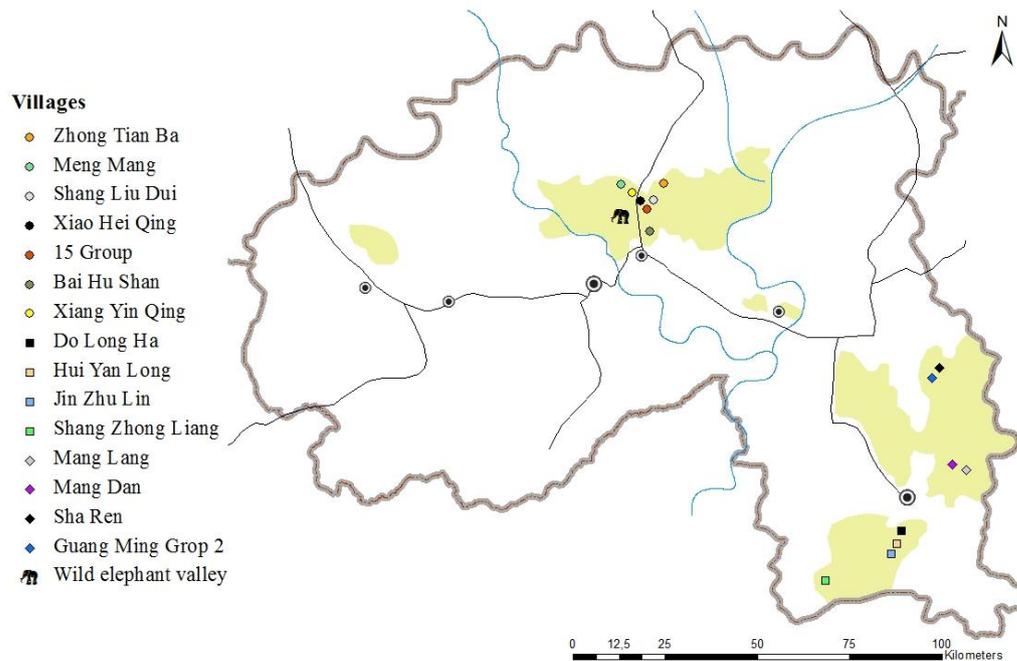


Figure 6. The fifteen villages visited in Mengyang-, Mengla- and Sangyong sub-reserve in XBR.

### Questionnaire

To easier be able to analyse the data I choose to use a questionnaire that was used consistently across all villages. The goal was to use the questionnaire as a way to be able to measure attitudes towards the new insurance policy relative to the old one and people's attitudes to the conservation and protection of the elephants. The questionnaire consisted of some general questions about age, gender and education and an additional six questions about how often they saw signs of or saw the elephants, how often they had got their property damaged, how often they applied for compensation, what they felt about the compensation given (both before and after 2010) and what they thought about the population size and protection of the elephants in Xishuangbanna (Appendix A). The villagers' opinions about the number of elephants and the protection of the elephants were used as a measure of their feelings about the conservation of wild elephants in Xishuangbanna.

Most of the time people were asked to choose between some pre-listed alternatives but for some questions they could answer more freely. Since people in the villages did not speak English the questionnaire was translated into Chinese (mandarin) by the student from Yunnan University. She was also the only one performing the interviews in order to minimize errors by interpretation. We edited some questions after making a test run to make it easier for the villagers to answer. I was attending all the interviews and the villagers stories were translated to me by the student. A couple of times when the villagers could only express themselves in their own language the guide was asked to translate their answers into mandarin.

### *Approaching people*

In the villages people were approached as we saw them, some we talked to on the streets and others in their homes. With us we either had our guide(s) and/or a villager (usually the head of the village or a protector of the reserve). This made it easier to get people to talk to us. For most of the time the guide did not participate during the interview but merely helped with the introduction of the project. All were asked if they wanted to answer the questions and a short presentation of the study was given before we started. Most people were positive to the research and very few declined to participate.

There was no upper age limit for the people we asked but we tried to not ask to young people since they usually had little knowledge about the amount of destruction or how the insurance policy worked. We tried to get an even spread of male and females, but sometimes the females did not want to answer the questions if their husbands were present, which made it a bit harder to get females to participate. In most cases it is therefore only one from each family who has answered the questions.

### **Data analyses**

The data from the questionnaires was used to analyse whether the new insurance policy is working better than the last one (based on people's attitudes), if the compensation given is affecting people's feelings towards the conservation of the elephant and what can be improved from a conservation biology aspect. The sub-reserves having different number of elephants offered me the opportunity to look into whether there is any difference between the reserves in amount of damage and people's attitudes towards the conservation of the elephants, depending on factors such as location within the reserve, amount of contact with the elephants and the amount of destruction.

### *Statistics and maps*

Maps were created in ArcGIS with data from UICN, Mapcruzin data and Natural earth data and I carried out the statistical analyses in Minitab 16. T-tests were used for comparing differences between villages located on the edge of the reserve and in within the reserve, for differences in how often and to what extent villagers experienced destruction and saw or saw signs of elephants before and after the beginning of 2010.

I used paired t-tests to compare differences in attitudes between the same individuals before and after the beginning of 2010.

I used ANOVAs for the data that had a normal distribution and Kruskal-Wallis test for the non-parametric data to compare differences between the villages and sub-reserves when it came to age, years in village, degree of education, presence of elephants, the destruction and peoples' feelings towards the insurance policy and protection of elephants.

Chi-square statistics were used for some of the categorical data in order to compare differences in gender amongst the people we talked to between the reserve and how the opinion about the population size and protection of elephants varied between the sub-reserves.

Variance was estimated by standard deviation (SD).

In order to use the data for statistical analysis some of the answers from the questionnaire were scaled from one to five, one being the lowest/worst and five the highest/best value. The "Do not know"-answers were set as an 6 (table 3). These values were excluded from analyses comparing means.

Throughout the results degrees of freedom are presented in brackets.

Table 3. Scaled value for the different alternative people had to choose between in the questionnaire.

Question	Scale					
	1	2	3	4	5	6
Degree of Education	No education	Primary school	Junior secondary school	Senior secondary school	Junior college/higher education	-
Did the compensation cover the loss?	Not possible	Not at all	Almost	Just	Exceeded	Do not know
Did the compensation make you feel better?	Not possible	Not at all	A little	No change	Better	Do not know
Population size of elephants in XBR.	Decrease a lot	Decrease a little	Good as it is	Increase a little	Increase a lot	Do not know
Should the elephants be protected?	No	Do not know	Yes	-	-	-

## Results

### Villagers in XBR

In total 269 persons answered the questionnaire of which 83 lived in or close to the Mengla sub-reserve and 93 in the Mengyang and Sangyong sub-reserves. Seven of the villages lied within XBR and eight of them on the edge of the reserve. The age data for the ones that answered the questionnaire followed a normal distribution. The average age was  $43 \pm 14$  years, which did not vary significantly between the sub-reserves (ANOVA,  $F_{(2, 268)}=1.03$ ,  $p=0.360$ ) or the villages ( $F_{(14, 268)}=1.26$ ,  $p=0.231$ ). People had on average lived in their village for  $32 \pm 14$  years, although this varied significantly between the sub-reserves (ANOVA,  $F_{(2, 268)}=3.47$ ,  $p=0.032$ ) and the villages ( $F_{(14, 268)}=3.84$ ,  $p<0.001$ ). In Mengyang people had lived in the village for  $29 \pm 13$  while they had lived for  $35 \pm 17$  in Mengla.

There were also a significant difference in the amount of answers by each sex between the sub-reserves, with a higher representation of males from Mengyang and Mengla compared to the Sangyong sub-reserve (Chi-square,  $\chi^2_{(2)}=8.104$ ,  $p=0.017$ ).

People who participated in the study belonged to ten different ethnic minorities, that representation of which varied between the sub-reserves and villages. Within each village most people belonged to the same ethnic minority (Appendix B). Dai were more common in Mengla while there were more Han in Mengyang compared to the other sub-reserves. On average Dai were the most common (34%) followed by Han (23%) (table 4). The representation of ethnic minorities in the study was similar to data from NBSC, which for 2004 state that Dai make up 34% of the population in Xishuangbanna, Han-people 25% and Hani 19% (2013).

The degree of education within the villages was relatively low, where most only had attended primary school. The average degree of education for those who answered was similar to the average for the whole of Yunnan, but with a smaller representation for people with a higher education (NBSC 2013, table 5). There was no significant difference in the degree of education, based on school years, between the sub-reserves (Kruskall-Wallis:  $H_{(2)}=4.00$ ,  $p=0.135$ ) or the villages ( $H_{(14)}=16.7$ ,  $p=0.275$ ).

Table 4. The percentage of people belonging to different ethnic minorities represented in the study per sub-reserve and for the whole study.

Ethnicity	Mengyang	Mengla	Sangyong	All
Han	42	3	24	23
Hani	25	1	5	11
Dai	13	63	29	34
Yi	8	1	1	4
Kino	11	-	-	4
Aini	-	-	38	13
Yao	-	19	-	6
Zhang	-	13	-	4
Lahu	-	-	3	1
Bai	1	-	-	<1

Table 5. The percentage of people in the study with a certain degree of education compared to data from NBSC for the whole of Xishuangbanna (2012).

Degree of education	My data	NBSC
Primary school (6 years)	49	43
Junior secondary school (9 years)	27	27
Senior secondary school (12 years)	4.1	8.4
Junior college and higher education	0.7	5.8
No education	19	15

The results will henceforth be presented following the order of the questions from the questionnaire.

### **Have you ever seen or seen signs of wild elephants around the village?**

The median observed signs (such as footprints and faeces) by the villagers in XBR of elephants were 30 times a year while the median value for seeing wild elephants were 3.5 times a year. The villagers did therefore on average see significantly more signs per year from the elephants than they saw them (T-test:  $T_{(431)}=11$ ,  $df=431$ ,  $p<0.01$ ). Many mentioned that elephants predominantly were seen in August and September, when elephant raids are more common (Appendix B).

There was also a significant difference between the villages in how often people saw signs of (Kruskall-Wallis:  $H_{(14)}=62.5$ ,  $p<0.001$ ) or saw elephants ( $H_{(14)}=99.1$ ,  $p<0.001$ ) as well as how often people saw signs ( $H_{(2)}=6.62$ ,  $p<0.05$ ) or saw elephants between the sub-reserves ( $H_{(2)}=34.0$ ,  $p<0.001$ , fig. 7-8).

The villagers in the 15 group, Bai Hua Shan, Sha Ren and in Shan Zhong Liang saw most signs of elephants with a median value of 300 times a year (fig. 8). Shang Zhong Liang in the Sangyong sub-reserve was also the village where elephants were seen most frequently (median of 200 times a year). Bai Hua Shan, a village close to the Wild Elephant Valley, was the village with the second highest median value (90) for seeing elephants per year (fig. 7).

The median number of signs of elephants and for seeing elephants was highest in Mengyang (300 and 15 times a year) and over all were there least signs and sightings of elephants in Mengla (15 and 1.5).

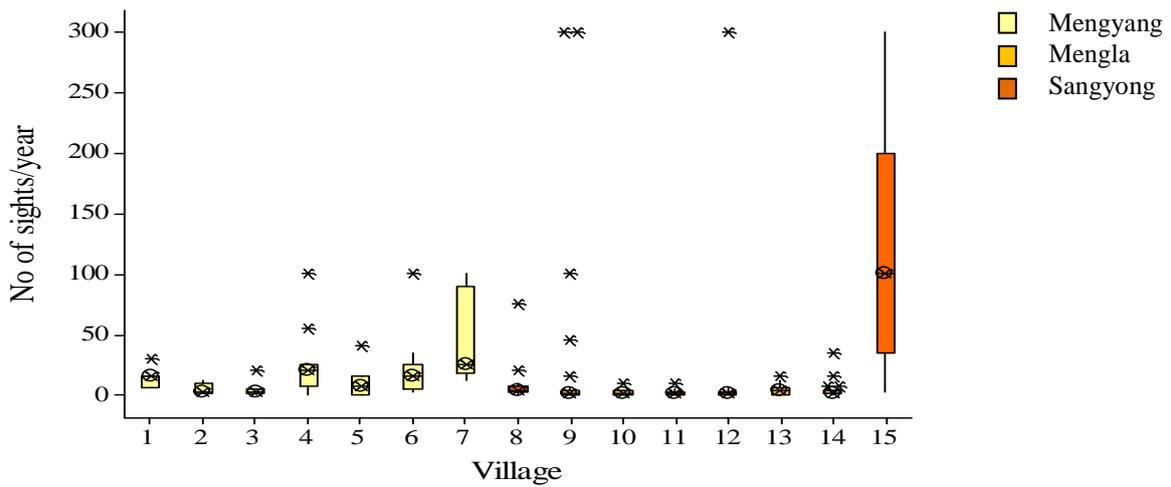


Figure 7. Boxplot showing interquartile range and median for how often the villagers see elephants per year. Outliers are marked with a star.

1. Zhong Tian Ba, 2. Mengmang, 3. Xiao Hei Qing, 4. 15 group, 5. Shang Liu Dui, 6. Xiang Yin Qing, 7. Bai Hua Shan, 8. Do Long Ha 9. Mang Dan, 10. Mang Lang, 11. Jin Zhu Lin, 12. Hui Yan Long, 13. Sha Ren, 14. Guang Ming Group 2, 15. Shang Zhong Liang.

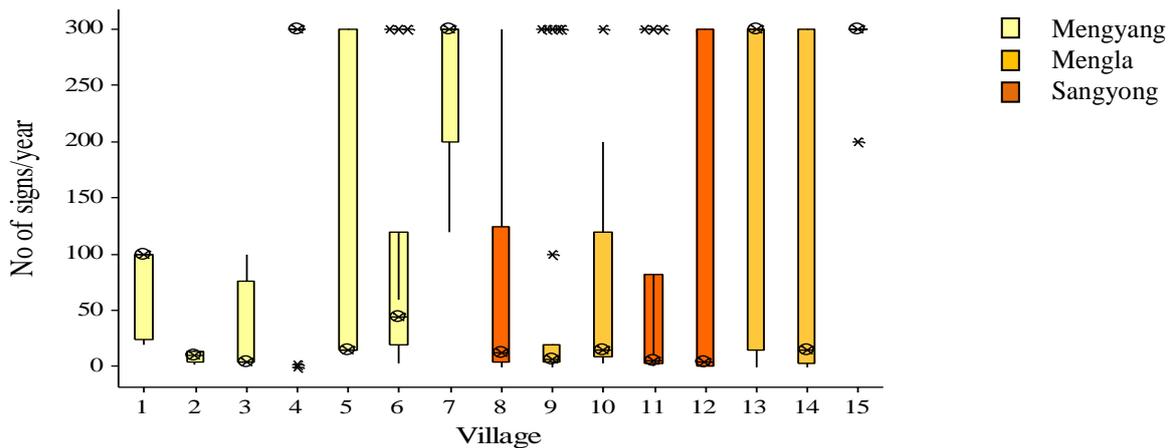


Figure 8. Boxplot showing interquartile range and median for how often the villagers see signs from elephants per year. Outliers are marked with a star.

1. Zhong Tian Ba, 2. Mengmang, 3. Xiao Hei Qing, 4. 15 group, 5. Shang Liu Dui, 6. Xiang Yin Qing, 7. Bai Hua Shan, 8. Do Long Ha 9. Mang Dan, 10. Mang Lang, 11. Jin Zhu Lin, 12. Hui Yan Long, 13. Sha Ren, 14. Guang Ming Group 2, 15. Shang Zhong Liang.

## Have wild elephants caused damage to your property?

*How many times has it happened?*

The villagers in XBR stated that they got their property destroyed by elephants on average  $5.6 \pm 8.3$  times a year before 2010 and  $4.6 \pm 7.7$  times a year after 2009, which showed no significant difference in frequency of destructions before and after the start of year 2010 (Two-sample t-test:  $T=1.21$ ,  $N=220$ ,  $p=0.228$ ).

There was a significant variation between the sub-reserves in how often the villagers experienced destructions, both before 2010 (Kruskall-Wallis,  $H_{(2)}=84.4$ ,  $p<0.001$ ) and after 2009 ( $H_{(2)}=70.0$ ,  $p<0.001$ ). Villagers in Mengyang got their properties destroyed more

frequently by elephants compared to people living in Mengla and Sangyong both before and after the start of year 2010 (fig. 10-11).

There was also a significant difference in the number of destruction per year between the villages before 2010 (Kruskall-Wallis,  $H_{(14)}=130$ ,  $p<0.001$ ) and after 2009 ( $H_{(14)}=140$ ,  $p<0.001$ ). For example were the villagers' properties damaged considerably less in Jin Zhu Lin, Hui Yan Long and Meng Lang compared to Bai Hua Shan, Xiang Yin Qing and Zhong Tian Ba (fig. 10-11).

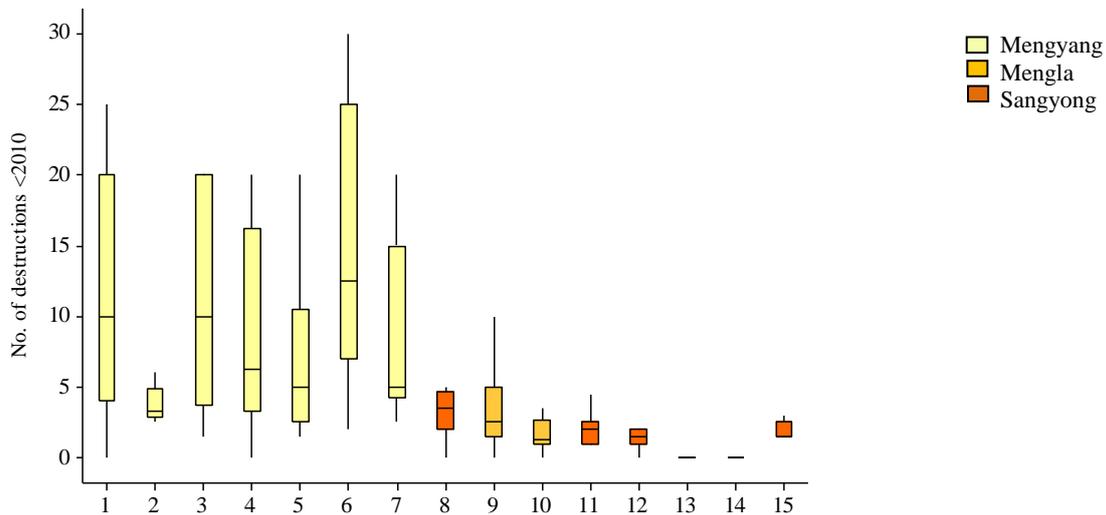


Figure 10. Boxplot showing the interquartile range and median for the number of destructions per year before 2010 for each village within Mengyang, Mengla and Sangyong sub-reserve.

1. Zhong Tian Ba, 2. Mengmang, 3. Xiao Hei Qing, 4. 15 group, 5. Shang Liu Dui, 6. Xiang Yin Qing, 7. Bai Hua Shan, 8. Do Long Ha 9. Mang Dan, 10. Mang Lang, 11. Jin Zhu Lin, 12. Hui Yan Long, 13. Sha Ren, 14. Guang Ming Group 2, 15. Shang Zhong Liang.

The location of the village also affected how often elephants visited the village. People living on the edge of the reserve both saw elephants significantly more frequently ( $T_{(199)}=3.8$ ,  $p<0.01$ ) and saw more signs ( $T_{(230)}=3.1$ ,  $p<0.01$ ) than the ones living within the sub-reserves (table 6). There was no significant difference in how often peoples properties got raided between villages on the edge of the reserve compared to those within the reserve, but the average amount of destructions per year were higher for villages on the edge both before and after 2010 (table 6).



Figure 9. Villager in Zhong Tian Ba, showing elephant footprints and damaged banana plants.

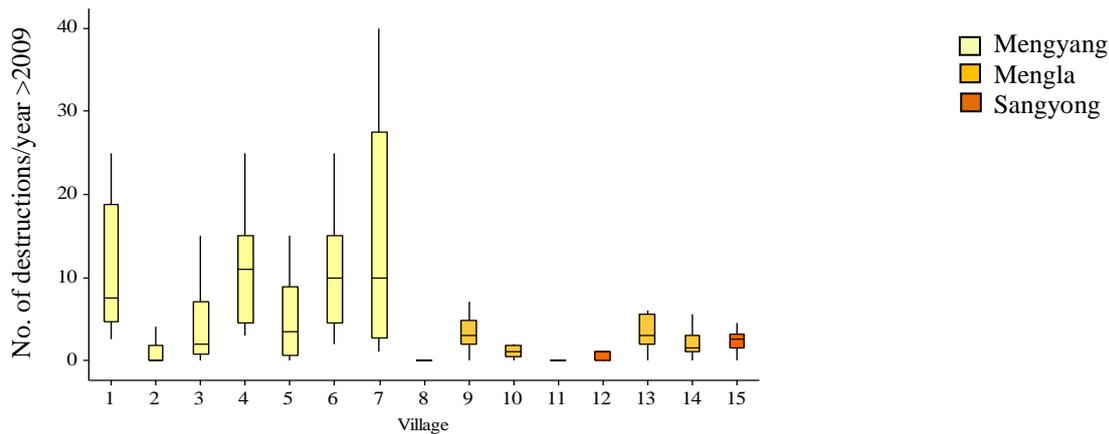


Figure 11. Boxplot showing the interquartail range and median for the number of destructions per year after 2009 for each village within Mengyang, Mengla and Sangyong sub-reserve.

1. Zhong Tian Ba, 2. Mengmang, 3. Xiao Hei Qing, 4. 15 group, 5. Shang Liu Dui, 6. Xiang Yin Qing, 7. Bai Hua Shan, 8. Do Long Ha 9. Mang Dan, 10. Mang Lang, 11. Jin Zhu Lin, 12. Hui Yan Long, 13. Sha Ren, 14. Guang Ming Group 2, 15. Shang Zhong Liang.

Table 6. Difference in mean values for how often people see or see signs from elephants and how often they experience destructions per year between villages on the edge of the sub-reserves and within the sub-reserves. Significant values are marked bold.

	Edge	Within	T	p	df
Average no. of Signs/year	167±140	96±127	3.8	<b>&lt;0.001</b>	199
Average no. of Sightings/year	34±64	12±41	3.1	<b>&lt;0.01</b>	230
Average no. destructions/year<2010	6.6±8.8	4.7±7.6	1.7	0.091	213
Average no. damages/year ≥2010	4.8±9.4	4.5±5.5	0.25	0.801	203

Only five persons (2%) of the ones asked had never got their property damaged. Of these only one had lived in the village for two years and another for three years. Three lived in the Mengla sub-reserve and two in the Sangyong sub-reserve, all in different villages (Appendix B). Several of the villagers mentioned that both the amount of destruction and elephant raids varied greatly between years and around 10% could not estimate how often they had suffer economic losses due to wild elephants.

#### What type of property was damaged?

The main things that elephants damaged were rice, corn and rubber. In 85% of the cases before 2010 that elephants caused destruction were rice damaged, whilst corn and rubber were damaged in 83% and 80% of the cases. Damages on corn and rice became scarcer after 2009, while the frequency of damages on rubber increased. Tea, pumpkins, beans, bananas, sugar and peanuts were the other most common things that got damaged. Demolition of houses or human injuries was rare (Appendix B).

There was dissimilarity between the sub-reserves in how often different types of crops and plants got damaged. Destruction of corn, rice, tea, coffee, sugar and vegetables were most common in Mengyang, both before and after 2010 (fig. 12-13). There had for example 88% of the villagers experienced destruction on corn after 2009, while only 51% and 62% said that they have had any destruction on corn in Mengla and Sangyong during the same time (fig.13). The frequency of destruction on rubber was highest in Sangyong while it was in Mengla that most people reported destruction on bananas and pumpkins (fig. 12-13).

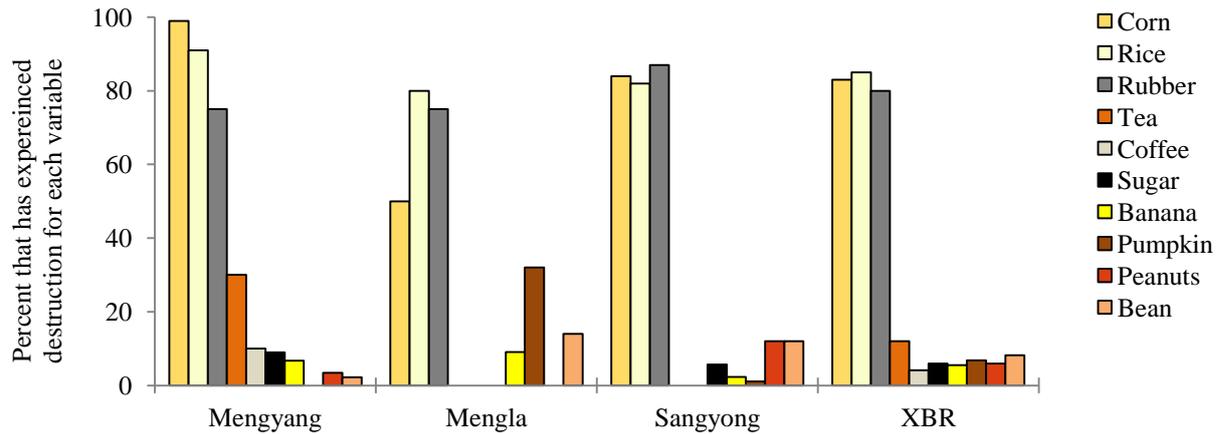


Figure 12. The percentage of people whose property got damaged that have experience destruction on any of the variable before 2010 for each sub-reserve and the total for XBR.

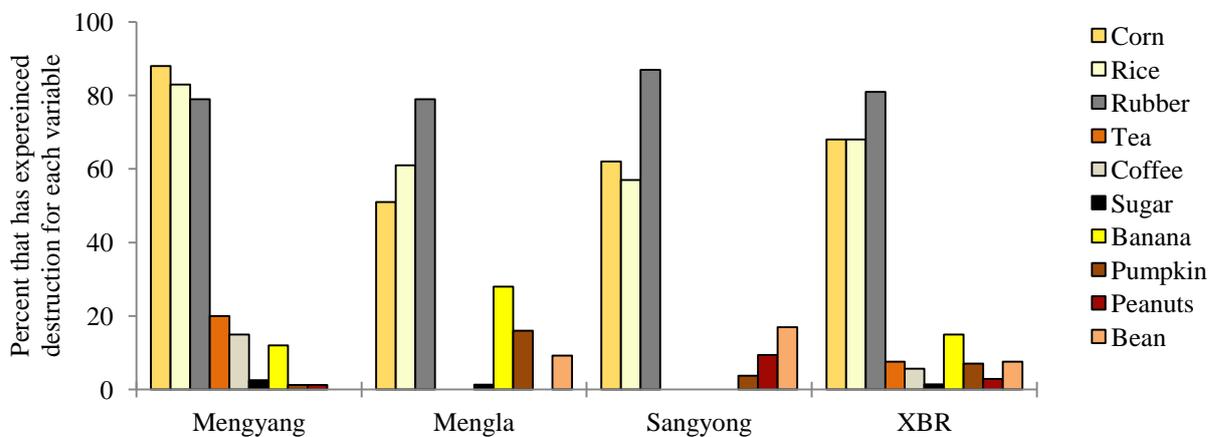


Figure 13. The percentage of people whose property got damaged that have experience destruction on any of the variable during and after 2010 for each sub-reserve and the total for XBR.

### To what extent was the property damaged?

Over all there has been a significant reduction of the average amount of damage on corn (Two-sampled t-test,  $T_{(521)}=3.27$ ,  $p<0.01$ ) and rice ( $T_{(519)}= 3.60$ ,  $p<0.001$ ) after 2009 in XBR (table 7). Also the destruction on tea and coffee seems to have been reduced while destruction on other plants such as rubber, bananas and pumpkins has increased (table 7). The damage caused by elephants did usually destroy most of the crop field or several of the grown plants (Appendix B).

When corn was damaged was on average 62-82% destroyed, shifting with sub-reserve and year. The average amount of rice destroyed was a little smaller ranging from 51-82% (fig. 7).

Table 7. Two sample T-test statistics for the difference in amount of destruction on various crops and plants before 2010 and after 2009. Significant values are marked bold.

Variable	T	Df	p
Corn	3.28	521	<b>0.001</b>
Rice	3.60	519	<b>&lt;0.001</b>
Rubber	-0.56	450	0.577
Tea	0.66	503	0.507
Coffee	0.89	521	0.372
Sugar	0.91	530	0.364
Banana	-1.56	520	0.120
Pumpkin	-1.29	531	0.198
Peanuts	-0.71	527	0.479
Bean	-1.29	527	0.196
Water melon	-1.12	528	0.264
Cotton	-1.39	531	0.165

The extension of which destruction on rice occurred were significantly lower in Mengla compared to Mengyang and Sangyong both before (Kruskall-Wallis,  $H_{(2)}=14.0$ ,  $P<0.001$ ) and after the start of year 2010 ( $H_{(2)}=14.2$ ,  $P<0.001$ , fig. 10). Corn were destroyed to the same extent in all of the sub-reserves before 2010 ( $H_{(2)}=1.22$ ,  $p=0.542$ ) and after 2009 ( $H_{(2)}=0.02$ ,  $p=0.989$ , fig. 14). There was also a significant variation between the sub-reserves in how many rubber plants that on average got destroyed by elephants before 2010 (Kruskall-Wallis,  $H_{(2)}=44.40$ ,  $p<0.001$ , fig. 15). Sangyong was the reserve with most destruction.

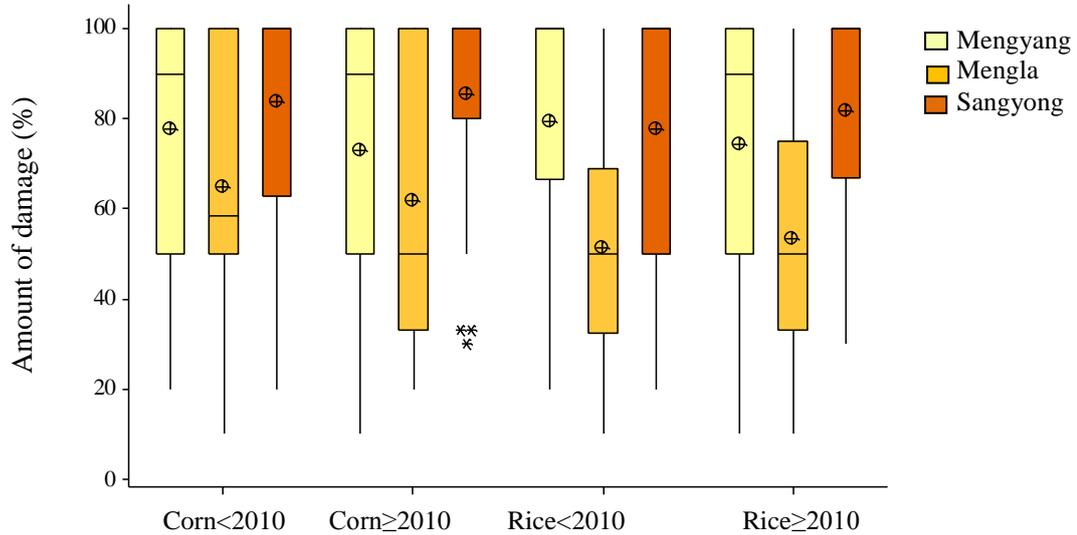


Figure 14. Boxplot showing the interquartile range and mean value symbols for the amount of damage (%) the elephant cause when they destroy corn or rice per reserve for the period before and after 2010. Outliers are marked with a star.

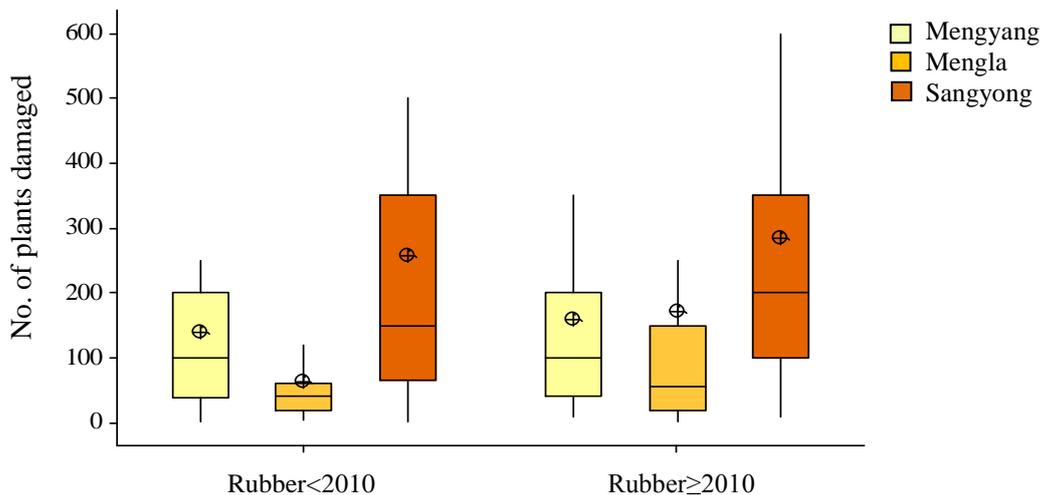


Figure 15. Boxplot over the interquartile range and mean value symbol for the amount of damage (no. of plants) the elephant cause when they trample on rubber plants per reserve for the period before and after 2010.

Before 2010 did the elephants on average damage 259 rubber plants each time they caused damage to the plantations in Sangyong, while on average only 64 rubber plants got damaged in Mengla. Since 2009 has the average number of damaged plants for XBR increased and there is no longer any significant difference in the amount of destroyed plants between the sub-reserves ( $H_{(2)}=0.16$ ,  $p=0.925$ ).

### Did you get any compensation for the damages caused?

Both with the new and the old insurance policy did those that applied for compensation get it in 77% of the cases; this did however vary some between the reserves. In Sangyong did for example only 63% people report that they always got compensation when they applied for it before 2010 and 59% after 2009, compared to in Mengyang where 93% and 83% got it during the same period of time (table 8).

Most people always applied for compensation, only very few had never or sometimes not applied for compensation. The reason given for not applying before 2010 was mainly that it paid to little, while the main reason after the new insurance policy was introduced was that the damage was too small so that there was no point of applying (table 8).

Table 8. Comparison between the sub-reserves for the percentage of people that got paid and applied for compensation with the old (<2010) and the new ( $\geq 2010$ ) insurance policy for damages caused by elephants in Xishuangbanna.

Compensation	Total		Mengyang		Mengla		Sangyong	
	<2010	$\geq 2010$	<2010	$\geq 2010$	<2010	$\geq 2010$	<2010	$\geq 2010$
Always got compensation	77	77	93	83	75	83	63	59
Did not get it sometimes	16	20	5	17	14	11	29	37
Did not apply sometimes	4	1	2	1	-	-	10	1
Never applied	2	1	4	-	-	1	-	4
Do not know	5	3	2	-	6	6	8	2
Reasons for not applying:								
- Pay to little	47	-						
- To little damage	20	40						
- Hard to apply	7	-						

### Did the compensation cover the economic loss (including the loss of income)?

There was a significant difference in how people felt about the compensation given before and after the new insurance policy was introduced (table 9), regarding how much it covered (Paired t-test:  $T=-4.76$ ,  $N=119$ ,  $p < 0.01$ ). Most people still felt that the compensation given after 2009 was too small but that the new insurance policy covered more than the old one. Of the ones that applied for compensation after 2009 did 54% say that the new insurance policy was better than the old one (Appendix B). No one answered that the compensation exceeded or covered the loss (table 9).

The villagers opinions about how well the insurance covers their losses did not vary significantly between the reserves before 2010 (Chi-square,  $\chi^2_{(2)}=3.49$ ,  $p=0.479$ ). Less people in Mengyang thought that the compensation did not at all cover the loss before 2010 and after 2009 compared to Mengla and Sangyong (table 9). No one thought that the compensation cover the loss before 2010 at least 16% of the people in Mengyang thought that the

compensation partly covered the loss after 2009. No one felt the same in Mengla and only 1% in Sangyong said the same (table 9).

Table 9. Data for how the villagers which had applied for compensation felt that the compensation given, both with the old (<2010) and the new ( $\geq$ 2010) insurance policy, covered the damages caused by elephants per each sub-reserve (%).

	Mengyang		Mengla		Sangyong		All	
	<2010	$\geq$ 2010	<2010	$\geq$ 2010	<2010	$\geq$ 2010	<2010	$\geq$ 2010
Comp. exceeded the loss	-	-	-	-	-	-	-	-
Comp. covered the loss	-	-	-	-	-	-	-	-
Comp. partly covered the loss	-	16	-	-	-	1	-	7
Comp. did not at all cover the loss	75	70	86	81	82	89	80	79
Not possible to compensate	6	1	2	-	6	-	5	1
Do not know	19	13	13	19	12	10	15	13

*Did the compensation change how you felt about the loss of income?*

There was a significant difference in how the compensation made people feel before and after 2010 (Paired t-test:  $T=7.25$ ,  $N=125$ ,  $p<0.01$ ) where people thought it was better now. Still only four percent said that the compensation given after 2009 made them feel better about the loss of income (table 10). The main reason for why people did not consider the compensation to be fair is because it paid too little. Many did however feel that it was better with the new insurance policy and mentioned that the money given to them before just barely covered the cost of buying new seeds, but that it at least was better than nothing. Many of the villagers said that they could not do anything but to follow the directions from the government (Appendix B).

Table 10. Data for whether the villagers that had applied for compensation felt that the compensation given, both with the old (<2010) and the new ( $\geq$ 2010) insurance policy, made them feel better per each sub-reserve (%).

	Mengyang		Mengla		Sangyong		All	
	<2010	$\geq$ 2010	<2010	$\geq$ 2010	<2010	$\geq$ 2010	<2010	$\geq$ 2010
Comp. made it feel a lot better	-	-	-	-	-	-	-	-
Comp. made it feel better	1	9	-	-	-	-	<1	4
Comp. barley changed anything	9	46	4	16	3	8	6	28
Comp. made no difference	74	36	80	63	87	43	80	56
Not possible to compensate	2	-	-	-	-	43	1	-
Do not know	13	9	16	21	10	6	13	12

Also when it came to how the compensation made them feel, the villagers in Mengyang thought that the compensation made them feel a bit better compared to the other sub-reserves, both before and after the start of 2010 (table 10). Mengla was the sub-reserve where most people did not consider the system to be good and Sangyong the sub-reserve where most people thought it would not be possible to compensate for the loss compared to Mengyang and Sangyong both before (Kruskall-Wallis,  $H_{(2)}=14.0$ ,  $P<0.001$ ) and after the start of year 2010 ( $H_{(2)}=14.2$ ,  $P<0.001$ , fig. 10).

**Do you think that it is good to let the wild elephant population increase in numbers within XBR?**

Most of the villagers approached in XBR (57%) thought that the wild elephant population within XBR should decrease. Of these 47% thought that it should be decreased a lot and 10% that it should decrease a little. Only 3% felt that the population size was good as it was, 2% thought that it should decrease a little and 27% that it should increase a lot. 10% did not know (table 11).

Table 11. Contingency table over how peoples' opinions (%) about the size of the elephant population within XBR vary between sub-reserve, if the village lies within or on the edge of XBR and gender.

	Mengyang	Mengla	Sangyong	Edge XBR	Within XBR	Females	Males	All
Increase a lot	10	41	31	20	34	19	32	27
Increase some	4	1	1	3	2	5	1	2
Good as it is	3	4	2	3	3	4	2	3
Decrease a little	14	5	12	16	3	7	12	10
Decrease a lot	59	36	45	50	44	58	40	47
Do not know	10	13	20	8	14	7	13	11

**Do you think that the wild elephants should be protected in China?**

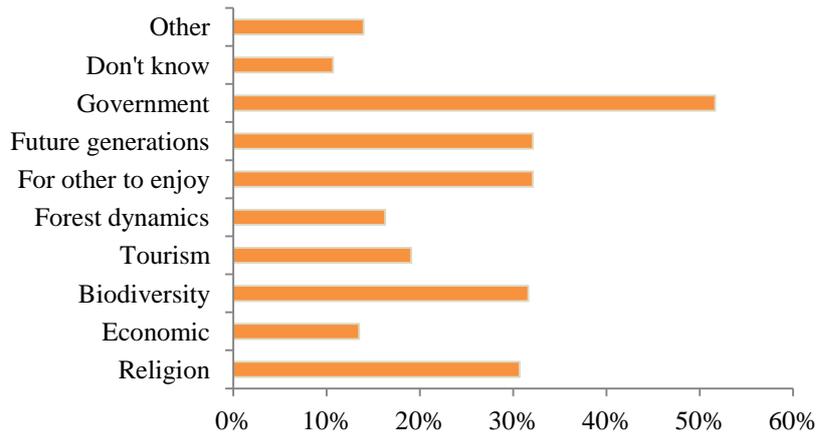
When it came to the protection of elephants, 80% answered that they thought that elephants should be protected in China, 3% did not know and only 17% did not think the elephants should be protected (table 12). Of the villagers that wanted to protect the elephants did however 40% mention that they only wanted to protect the elephant or let the population increase if the elephants would not destroy their properties or if the compensation covered more of their losses. Some also mentioned that they were scared of elephants (Appendix B).

Table 12. Contingency table over how peoples' opinions (%) regarding the protection of elephants in China, vary between sub-reserve, if the village lies within or on the edge of XBR and gender.

	Mengyang	Mengla	Sangyong	Edge XBR	Within XBR	Females	Males	All
Be protected	80	93	68	71	90	69	87	27
Not be protected	12	7	30	4	3	5	2	2
Do not know	8	-	2	25	70	26	11	3

*Why do you think the elephants should be protected?*

52% of the villagers thought that the elephants should be protected because they are protected by the law, enforced by the government. The other most common reasons for approving the protection were for: “future generations”, “other people to enjoy”, “biodiversity” and “religious reasons”. Few (<20%) saw any economic benefits by protecting the elephants, such as tourism (fig. 16), even though some said that “Xishuangbanna would not be Xishuangbanna without the elephants” (Appendix B). Only 16% listed the elephants' role in maintaining the forest dynamics as an important reason for protection (fig. 16).



**Proportion of the ones that thought that the elephants should be protected**

Figure 16. Reasons for why the villagers thought that the wild elephants in XBR should be protected (they could list as many reasons as they wanted).

### Factors affecting peoples' opinions regarding the conservation of elephants

There was a significant difference between the sub-reserves ( $\chi^2_{(2)}=29.62$ ,  $p<0.01$ ) regarding peoples' attitudes towards the number of elephants within XBR, where more people in Mengyang were of the opinion that the population should be decreased compared to the other sub-reserves (table 11). People living within the sub-reserve were significantly more willing to let the elephant population increase in number compared to those living on the edge of the sub-reserves ( $\chi^2_{(5)}=15.86$ ,  $p<0.01$ , table 11), even if they also generally were of the opinion that the population should be decreased. A significantly higher frequency of females also thought that the population should decrease in numbers compared to males ( $\chi^2_{(5)}=12.97$ ,  $p<0.01$ ).

There was also a significant difference between peoples' opinions about the size of the elephant population in XBR relative to the amount of destruction they have experienced, both in the frequency of damages and the amount destroyed corn and rice (table 13).

Table 13. Kruskal-Wallis statistics for variation between peoples' opinions regarding the population size of elephants in XBR depending on a set of variables. Significant results are marked bold.

Kruskal-Wallis test	H	df	p
Education (years)	3.45	5	0.631
No. of destructions <2010	24.92	5	0.000
No. of destructions $\geq$ 2010	21.72	5	0.001
No. of sights	11.30	5	<b>0.046</b>
No. of signs	5.95	5	0.310
Destruction on corn (%/year) <2010	17.45	5	<b>0.004</b>
Destruction on corn (%/year) $\geq$ 2010	33.41	5	<b>0.000</b>
Destruction on rice (%/year) <2010	21.32	5	<b>0.001</b>
Destruction on rice (%/year) $\geq$ 2010	24.33	5	<b>0.000</b>
Destruction on rubber (no/year) <2010	22.72	5	<b>0.000</b>
Destruction on rubber (no/year) $\geq$ 2010	6.61	5	0.291

People who wanted the elephant population to decrease a lot after 2009 had a annual average number of destruction per year of  $6.8 \pm 10$ , which was significantly higher than the average of  $2.7 \pm 3.5$  for those that wanted the population to increase a lot (Kruskall-Wallis,  $H_{(5)}=21.72$ ,  $p=0.000$ , table 13). There was no significant difference in opinions about the population size depending on the villagers age (ANOVA,  $F_{(5, 239)}=0.99$ ,  $p=0.502$ ), number of years they had lived in the village ( $F_{(5, 239)}=0.86$ ,  $p=0.748$ ), education (Kruskall-Wallis,  $H_{(5)}=3.45$ ,  $p=0.631$ ) or the number of times that they had seen signs from the elephants ( $H_{(5)}=5.95$ ,  $p=0.310$ , table 13-14).

Table 14. ANOVA statistics for variation between peoples' opinions regarding the population size of elephants in XBR depending on a set of variables. Significant results are marked bold.

ANOVA	F	df	p
Age	0.99	239	0.502
Years in village	0.86	239	0.748

The opinions whether the elephants should be protected in China did vary significantly between the sub-reserves (Chi-square,  $\chi^2_{(2)}=27.24$ ,  $p<0.01$ ), where the lowest support for the protection of elephants occurred in Sangyong (table 12). The same trend that was seen for the opinions regarding the population size of elephants could be seen for the protection of elephants, where a significant higher frequency of males ( $\chi^2_{(2)}=12.98$ ,  $p<0.01$ ) and people living within XBR ( $\chi^2_{(2)}=15.86$ ,  $p<0.01$ ) were more willing to protect the elephants compared to females and people living on the edge of XBR (table 12).

The opinions about the protection of the elephants was similar to those regarding the population size (table 15-16), where people who have experienced a higher frequency of destructions after 2009 were more reluctant to protect the elephants (Kruskall-Wallis,  $H_{(2)}=21.7$ ,  $p=0.002$ ).

Table 15. Kruskal-Wallis statistics for variation between peoples' opinions regarding the protection of elephants in China depending on a set of variables. Significant results are marked bold.

Kruskall-Wallis test	H	df	p
Education (years)	5.16	2	0.076
No. of destructions <2010	8.39	2	<b>0.015</b>
No. of destructions $\geq$ 2010	12.70	2	<b>0.002</b>
No. of sights	6.66	2	<b>0.036</b>
No. of signs	14.81	2	<b>0.001</b>
Destruction on corn (%/year) <2010	15.78	2	<b>0.000</b>
Destruction on corn (%/year) $\geq$ 2010	32.63	2	<b>0.000</b>
Destruction on rice (%/year) <2010	13.24	2	<b>0.001</b>
Destruction on rice (%/year) $\geq$ 2010	18.99	2	<b>0.000</b>
Destruction on rubber (no/year) <2010	31.02	2	<b>0.000</b>
Destruction on rubber (no/year) $\geq$ 2010	14.41	2	<b>0.001</b>

Table 16. ANOVA statistics for variation between peoples' opinions regarding the protection of elephants in China depending on a set of variables.

ANOVA	F	df	p
Age	0.95	259	0.569
Years in village	0.88	259	0.722

## Discussion

### The people in XBR

The villagers that took part in the study are considered to be a representation of the people in XBR. The age data follows a normal distribution, with a high representation of each gender, and both a representation of ethnic minorities and degree of education that is similar to statistics over Xishuangbanna from NBSC (2013). The lack of people with a higher education in the study might be explained by the fact that they usually do not live in the rural areas of Yunnan but within the cities, hence not in the areas that were in the focus of this study.

The overall high variance amongst the data is expected in a study such as this, dealing with estimations and peoples' feelings and show that peoples' opinions are influenced by several different factors.

### The presence of wild elephants

#### *Seeing signs of elephants close to the village*

Many of the villagers in XBR live close to the wild elephants, perceiving their presence in daily life by seeing signs of elephants, either when working on the plantations or nearby to the village. There is a high variance between the villages in how often they saw signs or saw the elephants, but also as many mentioned between years. In some of the villages people used to see elephants more often before, while in others people reported a higher presence of elephants today compared to previous years. This shows that the presence of elephants within one area is not constant but changes over time and that not all villages within the same sub-reserve experience the same stress of elephant raids. Over all it was least common to see or see traces of elephants in the Mengla sub-reserve, leading me to believe that there is a relationship between the density or number of elephants and their presence in populated areas. The difference in presence of elephants' between the sub-reserves might also partly be explained by the location of the village within the reserve, where residents that live in villages within the reserve saw fewer signs of elephants compared to those who live in villages on the edge of the reserve. All villages in Mengla lie within the reserve.

That people in Xiang Yin Qing and Bai Hua Shan more frequently saw signs of elephants compared to several of the other villages can be explained by their villages' proximity to the Wild Elephant Valley where several feeding stations for the elephants have been built, both to attract more elephants to the park and to provide supplementary food since the resources within the forest are scarce.

#### *Corn and rice are the most common crops destroyed by elephants*

The main cash crops destroyed by elephants are corn and rice, followed by destruction of plants of rubber, tea, bananas and sugar, which coincides with data from previous studies (Sukumar 1990, Zhang *et al.* 2006, Chen 2008). There is some variation between the sub-reserves in what gets damaged. For example have a higher proportion of the villagers experienced damage on corn and rice in Mengyang compared to the other sub-reserves, while it is more common in Sangyong that people are experiencing destruction on rubber plants compared to Mengyang and Mengla.

The difference in destruction between the sub-reserves is most likely explained by differences in predation pressure or trampling on plants by elephants or by the occurrence of plantations and not by a difference in raiding behaviour between the elephant sub-populations. For example are tea plantations more common in the Mengyang sub-reserve compared to the others which could explain why no one reported any damages on tea plantations in Mengla or Sangyong. Pumpkin- and bean plantations were however quite

uncommon in Mengyang, but common in Mengla and Sangyong, which could explain the smaller proportion of people that have experienced destructions on beans and pumpkins in Mengyang compared to the other sub-reserves. Hence it is the data for corn, rice and rubber that is most likely to explain the different frequencies of destruction between the sub-reserves, since these plantations are common within each of them. A more accurate comparison between the sub-reserves would require comprehensive data of agricultural land use for each region.

#### *Extent of destruction on crops and plants*

The average number of times that the villagers experience destructions in XBR has not changed since 2009, showing that the raiding pressure from the elephants has been at least somewhat constant over the last decades. There is however a difference between the sub-reserves where people in Mengyang more often experience destructions compared to the other sub-reserves. Mengyang is also the sub-reserve with the largest sub-population of elephants while Mengla is the sub-reserve with least elephants and number of destructions per year, which indicates that there might be a connection between the amount of damage and number of elephants within the area. Mengla was also the reserve where it was most difficult to find suitable villages to visit since few of them had experienced elephant raids, at least in the past.

The overall destruction on corn and rice in XBR has decreased since 2009, which partly can be explained by the fact that many villagers have reduced the production of corn and rice to avoid elephant raids (Appendix B). In Do Long Ha and Jin Zhu Lin the villagers also mentioned that the elephant raiding had decreased since they started to use pesticides as well as grow rubber and bananas instead of corn (Appendix B). In the village of Meng Mang many referred to the building of the highway as a factor that had reduced the elephant raiding and in Xiao Hei Qing where the reduced destruction on cash crops believed to be the result of that one elephant was illegally shot close to the village in 2011. The destruction has however also increased in some villages, such as in Sha Ren and Guang Ming Group 2, in Mengla, where there were no elephants before 2010.

The degree to which elephants destroy corn, rice and rubber is overall higher in Sangyong compared to the other sub-reserves and consistently lower in Mengla. This shows that there is a great variation in the frequency with which elephants cause damage between the sub-reserves, where there seems to be a higher degree of destruction with increased density of elephants.

#### **The new insurance policy versus the old one**

A majority of the people in XBR regarded the new insurance policy as better than the old one, since it now is easier to apply for compensation and it pays better. Nevertheless no one thought the compensation to be adequate and very few felt that the compensation made them feel better. Many considered the insurance to be especially bad when it came to compensation of rubber plants. The rubber trees hold a value of 10-400 CNY per plant, depending on the size and age of the tree. However the villagers only receive a maximum compensation of 20 CNY per plant, which can lead to a severe loss of income. For people whose livelihood is completely dependent on agriculture these losses are especially severe.

People were in general less pleased with the compensation in Sangyong and Mengla compared to Mengyang, where people on average thought that the compensation both covered more and made them feel better, although very few thought so even in Mengyang. Both with the old and the new system did the villagers receive compensation when they applied for it in most of the cases. If they did not get any money this was mainly because the insurance company could not confirm the destruction due to the fact that staff workers only visit the villages once or twice per year and not after each raid. Many did however not receive

any compensation for 2012, which I was told by my guide from the protective agency was due to a conflict between China Pacific Insurance Company and the government.

This leads to believe that even if the new insurance policy might be an improvement compared to the old one when it comes to the amount of compensation and application handiness further improvements are needed in order to reduce peoples' frustration with the insurance policy.

### **Attitudes towards the conservation of elephants in XBR**

There is a strong acceptance amongst the villagers within and close to XBR for the protection of wild elephants in China even if most do not want the population to increase within XBR, at least not if the elephants continue to pose a threat to their livelihood. The main reason why people believe that they should protect the wild elephants is that they are regulated to do so by law, which also earlier have been seen by He *et al.* (2011). The fact that most people seem to want to protect the elephants mainly because they are told so and not because they see any personal value in doing so could explain why a majority of the people said that they wanted the elephant population to decrease in number but still thought that it should be protected. It also shows the importance of educational communication between residents and staff workers from the forestry bureau.

There is some difference in attitudes between the sub-reserves, where the weakest support for an increase in number of elephants occurs in Mengyang and the lowest support for the protection of elephants occurs in Sangyong. The will to increase the number of elephants and the will to protect them were highest in Mengla which is also the sub-reserve with the lowest density of elephants and amount of destruction.

#### *Variation in attitudes depending on peoples culture, gender, age and education*

Many factors influence peoples' attitudes towards the elephant population in XBR, partly shown by the great variance between the samples. Factors such as age and education did not affect the villagers' feelings towards conservation, which have been seen previously in similar attitude studies (He *et al.* 2011). Nevertheless it does seem to be a vague trend that those with higher education are also more willing to let the elephant population increase in numbers but since there are so few with a higher education that participated in the study it is hard to draw any direct conclusions about how education might affect peoples' opinions regarding the elephants. Males had a significantly higher education than females and did also show a significantly higher acceptance to protect and let the elephants increase in numbers.

There were furthermore differences amongst the ethnic minorities where especially Zhang and Yao showed a strong will to preserve the elephants, followed by Dai and Han. The difference between minorities could be explained by their different beliefs and relationships to the area. For example do the Dai have a long tradition of association to the land and place a high value on elephants (Wu *et al.* 2001, Yang *et al.* 2004). Also in India have cultural heritage been shown to affect peoples' attitudes towards wildlife (Madhusudan 2003).

#### *How compensation affect peoples' attitudes*

The fact that no one considered the compensation to be satisfactory disabled me to look into whether people who were happy with the payment also felt more inclined to protect the wild elephants, which is an argument usually put forward when it comes to human-wildlife conflicts (Messmer *et al.* 1997, O'Connell-Rodwell *et al.* 2000).

#### *How the amount of damage due to elephant raids affect peoples' attitudes*

The opposition for an increased elephant population is as mentioned above lowest in Mengyang, which are the area with the largest sub-population of elephants in China and also

the area with the highest number of destructions per year and with the highest percentage of people that have experienced destruction of corn and rice. The density of elephants is slightly higher in Sangyong compared to Mengyang sub-reserve but in Sangyong the elephants are able to migrate both to the Mengla sub-reserve and into Laos (Chen 2008), which might ease the damage caused on the villagers' fields and partly explain why people in Sangyong do not experience elephant raids as often as in Mengyang. When the elephants do create damages in Sangyong these seem to be more severe compared to the other sub-reserves. Mengla is the sub-reserve with the lowest amount of destruction, both when it comes to the frequency of raids and the damage caused and it is also in Mengla where the support for protecting and increasing the elephant population is highest.

Several of the villagers also specifically said that they would not mind the elephant population to grow if the payment for the damages caused by elephants were improved or if the elephants did not cause so much destruction to their properties. Over all there was an immense frustration amongst the people we talked to, where many expressed a mixture of abhorrence and admiration for the elephants.

Thus the result from my study give further support to the theory that people who experience less economical offsets due to wildlife are more willing to protect it (Damiba & Ables 1993, Messmer *et al.* 1997, Naughton-Treves 1997, Tisdell & Zhu 1998, Nyhus & Tilson 2004, He *et al.* 2011).

### **How does peoples' attitudes affect the protection of the elephants**

There is a pride of having elephants in Xishuangbanna but their occurrence does mainly gain the tourism industry from which the local people get no direct benefits. This and the fact that it is the villagers who get to bear the cost of having elephants in the area have in other places, as well as in Xishuangbanna, been observed to increase peoples anger and the HWC (Messmer *et al.* 1997, Tisdell & Zhu 1998, Madhusudan 2003, Nyhus & Tilson 2004).

As mentioned earlier it is of great importance that the number of wild elephants in China will increase and that they are able to migrate over larger areas, mainly to avoid inbreeding but also to enable them to find enough food within the forest, minimizing the depredation on farmland. Since elephants have a slow reproduction (Sukumar 2006) an increase of the population will take several years, which might be one reason for why the estimated population size of elephants has been the same during the last 20 years in China (Sukumar 1989, Sukumar 2003, Chen 2008). The lack of reliable census data might also explain the poor population estimates (Blake & Hedges 2004). Nevertheless, what can be seen is that there is no rapid increase of elephants in China, making them particularly vulnerable. Even a small reduction of the population might threaten their future survival. Hence it is probable that even a small escalation of HEC and increased poaching of elephants in Xishuangbanna could jeopardise their long term survival. It is therefore of great importance that the people in Xishuangbanna are willing to let the number and distribution of elephants increase. In order to achieve a successful reinforcement of elephants there is a great need to either reduce the damages due to elephant raids or to improve the economical incentives for the villagers to protect the elephants and the forest in which they live.

### **How to improve the support for conservation of elephants in XBR**

#### *Decrease the amount of destruction due to elephant raids*

One of the main reasons for elephant raids is the opposing appeal of crop fields. With reduced habitat and less available food resources within the forest elephants are more likely to feed outside the forest or in the edge, hence in areas with human settlements and crop fields. It has been shown to be very difficult to prevent elephant raiding and at the moment there are no

long term solutions available (Thouless & Sakwa 1995). Villages have even been moved in order to keep elephants from harming properties, but this is a very costly process and does merely offer a short term solution, since the elephants then usually just favour another village instead (Madhusudan 2003, Chen 2008).

Destruction could however be somewhat reduced by agricultural means. For example could the growing of rice and corn be minimized in areas close to the elephants and crop fields could be avoided close to the forest edge, since elephants find these fields more attracting (Naughton-Treves 1997).

Another option could be to cull problem animals, which is a common practice for dealing with unwanted behaviour amongst protected animals (Thouless & Sakwa 1995, O'Connell-Rodwell *et al.* 2000). There has been shown to be a difference in crop raiding behaviour amongst elephants in India where males tends to raid more frequently than females and thereby cause more damage (Sukumar & Gadgil 1988, Sukumar 1991). The same thing could be occurring in China and culling problem animals might decrease the raiding. It has also been shown that elephants tend to avoid areas where other individuals have been killed (Thouless & Sakwa 1995), which could reduce the occurrence of elephants within the area further. In order to avoid inbreeding is it however important that the culling does not lead to a skewed sex ratio (Sukumar 1991). Since the population of elephants already is so small in China and the State forestry administration and local governments are not allowed to kill elephants is this not an solution at the moment, but could offer some ease to the HEC in the future.

#### *Decrease the economical cost for villagers of having elephants within XBR*

Local communities are the ones suffering from elephant raids (Naughton-Treves 1997, 1998) but in order to achieve successful conservation practices it is important that the villagers instead are gaining on the protection of wildlife (Madhusudan 2003). It has been shown that community based conservation where people get the opportunity to be involved in conservation efforts have led to that people are more willing to manage wildlife, a measure which will also reduce the cost for the managers (Lewis *et al.* 1990, O'Connell-Rodwell *et al.* 2000). Increased economical and emotional incentives for protection of wildlife could be achieved in some different ways:

(i) *Compensation.* As shown, the compensation given in Xishuangbanna for damages created by elephants does not encourage the protection of the species but it is possible that higher monetary compensations could increase peoples will to protect wildlife (Messmer *et al.* 1997). There is however little money allocated for conservation in China (Lewis *et al.* 1990) and therefore unlikely that a compensation through the present system will be much higher.

Bulte & Rondeau (2005) did however point out that there is a risk if the compensation is high and it is the local government that carries all the costs. The compensation could then be seen as agricultural subsidies, which could result in an expansion of agricultural activities which in turn might lead to reduced wildlife populations. It has therefore been suggested that insurance policies where local communities have to sign up and pay a fee for entering might be more successful (Madhusudan 2003, Bulte & Rondeau 2005) since it creates a commitment from the locals to prevent damages from occurring (Mishra *et al.* 2003).

(ii) *Tourism.* Many researchers have pointed out the importance of including local people when managing wildlife resources and to make sure the villagers are profiting by doing so (Lewis *et al.* 1990, O'Connell-Rodwell *et al.* 2000), which for example could be accomplished trough ecotourism. The increased market for nature tourism in China is often described as ecotourism but does seldom meet the conditions for what usually is considered to be ecotourism. For example local people get extremely little, if anything, of the 8000 million

CNY (1300 million USD) that is generated via tourism every year in Xishuangbanna. Only little less than 20% of the people we talked to recognized tourism as a reason for protecting the elephants and even less considered there to be any economical motive to protect them. This signifies that elephants represent no economical asset for the villagers.

(iii) *Secondary funding*. One part of ecotourism is to engage people in nature protection and raise their awareness about conservation practices; this has sometimes made tourists more willing to donate money for conservation (Kruger 2005), money that in part could be used to pay the villagers for their losses. In this way might tourism not only benefit the communities through direct economical offsets but also generate external funding for conservation practices within XBR. Another proposal that has been raised by Tisdell & Zhu (1998) is that the agencies that earn money on the presence of wildlife should contribute to the economical compensation given to the villagers for their loss of income.

Xishuangbanna is considered to be a part of the worlds' biodiversity hotspots (Myers 1988, Myers *et al.* 2000), making nature conservation in the area a worldwide interest. Biodiversity hotspots were defined as "areas featuring exceptional concentrations of endemic species and experiencing exceptional loss of habitat" by Myers *et al.* (2000). Elephants are often considered to be an umbrella species, since the protection of elephants and their habitat will gain many other species, both due to the fact that elephants require large unfragmented areas (Leimgruber *et al.* 2003) and to their ability to moderate the landscape, creating gaps and disturbances, which may increase the biodiversity. By protecting the elephants it might therefore be possible to protect much of the hotspot area.

It has been shown that people in urban areas sometimes are willing to contribute to the protection and management of wild animals, especially large, charismatic species (flagship species) such as the elephant. Bandara & Tisdell (2004) did for example show that people in urban areas in Sri Lanka were willing to provide monetary support for preserving the elephants that fully covered all the economical losses created by them. Such generosity does of course depend on peoples' economical situation, the population size of elephants and thereby the damage caused by them, but it might be a way to generate more money to cover the economical offsets villagers are enduring in China today.

## Conclusion

It is of great importance that the wild elephant population in Xishuangbanna is allowed to increase in number but by increasing the population size is there a great risk of intensifying the HEC in the region. I saw the weakest support for protection of elephants in Sangyong and Mengyang sub-reserves which are the areas with the highest density of elephants and degree of destructions due to elephant raids. Similar observations of the relationship between support for protection and economical offsets have been made in previous studies, both in Asia (Zhang & Wang 2003, Zhang *et al.* 2006, He *et al.* 2011) and Africa (Lewis *et al.* 1990, Naughton-Treves 1997, Naughton-Treves 1998).

A larger part of the villagers damages in XBR are reimbursed by the new insurance policy compared to the old one but the villagers' economical losses are still extensive. Even if several of the villagers thought that it was nice that they at least got some compensation none believed the compensation to be adequate. The will to protect the elephants in Xishuangbanna is still very high but there is a risk of intensifying the HEC if the elephant population is allowed to increase in numbers since higher densities of elephants seems to cause more destruction and aggravation amongst the villagers. To avoid an escalation of the HEC in Xishuangbanna is it therefore important to minimize the local communities' economical losses and to incorporate the villagers in conservation practices (Lewis *et al.* 1990, Naughton-Treves 1997, Wainwright & Wehremeyer 1998, O'Connell-Rodwell *et al.* 2000). Elephants

need not only to be recognised as ecological engineers but also as an economic and cultural asset, available not only for the large companies but most importantly for the small village communities, in order to achieve a long term, successful management of the Asian elephants, one of the Earths' last extant mega herbivores.

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