Mammal distribution in Cleopatra's Needle Critical habitat

A research using camera traps on mammal distribution

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COMMISSIONED BY CENTRE FOR SUSTAINABILIY PH. AND VAN HALL LARENSTEIN

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Glossary

Barangay/Barrio	Smallest administrative division in the Philippines
CITES	Conservation on International Trade in Endangered Species
CNCH	Cleopatra's Needle Critical Habitat
ELAC	Environmental Legal Assistance Center
EOO/Extent of occurrence	The shortest imaginable boundary that can be drawn in between all known sites of occurrence.
NTFP	Non-Timber Forest Product
IUCN	International Union of Conservation for Nature
PPC	Puerto Princesa City
Sitio	Village

Abstract

This is the report of a research that was conducted on the mammal distribution in CNCH. The research was conducted with the following research question *Is there a difference in distribution of endangered and vulnerable mammal species between the slightly disturbed primary forests and the highly disturbed agricultural fields in CNCH?*

In order to get an answer to the research question the following sub questions need to be answered:

- *What vulnerable and endangered mammal species are present at CNCH?*
- *What are the habitat preferences of the species of interest?*
- *What will be a good place to set up camera traps in order to get good imagery and the highest probability of mammal sightings?*
- *What information can the indigenous people provide and how can this information be utilized?*

In the problem analysis this research states the importance of protecting the rainforest areas of Palawan, since they harbor a wide variety of rare and endemic species. Since a great part of the Philippines has been deforested, the Primary forests of Palawan have become a last sanctuary for many mammals. This research will have an extra focus on the endangered and vulnerable mammal species, namely the Palawan pangolin, Binturong, Philippines porcupine and Palawan bearded pig.

In order to find out if there is a difference in mammal distribution among the two levels of disturbance 6 camera traps will placed for 4 weeks in order to capture footage of mammals. The location of these camera traps was decided by literature study and by consulting members of the Batak community present in that area. 3 camera's will be placed in the slightly disturbed primary forest and 3 will be placed in the highly disturbed agricultural fields.

The recorded species richness among mammals was higher in the slightly disturbed primary forest. The difference in mammal diversity was less significant but still higher in the slightly disturbed primary forest. The area closest to the Batak village yielded the lowest result. The agricultural fields further away from the village still got a decent amount of mammal sightings. All species of concern, except the Palawan pangolin, were sighted, and thus are at least present in the area. Their abundancy was low however, except for the Philippine porcupine which turned out to be one of the mammals that was captured the most on the camera traps.

Furthermore this report highlights the factors that could have influenced the results of this research. It suggests further topics of research to add to the information that this research provides or to make the results of this research more viable.

Contents

1. Introduction

Palawan is the least densely populated island of the Philippines. Compared to the other islands of the country it has a relative high amount of natural area and is home to countless endemic species. One of these natural areas is Cleopatra's Needle Critical Habitat. It is a natural area surrounding a mountain named Cleopatra's Needle. This area harbors a wide variety of wildlife, including a lot of endemic and endangered species.

1.1 Problem analysis

Between 1990 and 2005 the Philippines lost a third of its natural forest. Now a total of 7,162,000 ha of the country (24%) is covered in forests of which only 829,000 ha (2.8%) is primary forest (Butler, 2014). Study showed that the deforestation rate of the Philippines is so alarming that, if no further reforestation actions are taken, the country will have no forest left in the year 2036 (Tacio, 2013). The Philippine island of Palawan was spared from this great deforestation disaster that occurred all over the Philippines (Breijnen & Hoevenaars, 2015). Thanks to this it still has a high amount of primary forests and is dubbed "the last ecological frontier" of the Philippines. In figure 1 a picture is shown which shows the change in forest cover over the last 100 years in the Philippines.

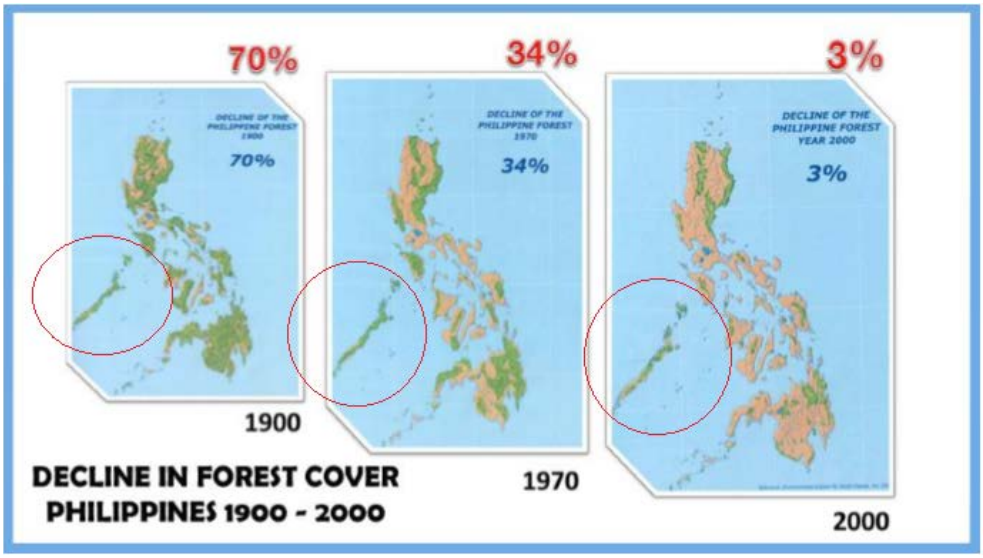


Figure 1 Decline of forest cover in the Philippines: Palawan is marked by the red circle (Breijnen & Hoevenaars, 2015)

In order to strengthen conservation efforts and improve the protection of the area and the species that live in it, more information is needed. Since many of the species that live in CNCH are often lesser known and endemic to the island of Palawan, there is a big information deficit and thus there is a high need on research on these species. Some mammal species in CNCH already hold endangered and vulnerable IUCN status and their numbers are even more depleting due to poaching and the high deforestation rate. One of these species is the Palawan pangolin (Manis culionensis), which is considered to be at the brink of extinction. Other species of concern that decline at an alarming rate are the bearcat (Arctictis binturong), the Philippine porcupine (Hystrix pumila) and the Palawan bearded pig (Sus ahoenobarbus). For more information on the species of concern and why there is a need to protect them see chapter 1.4.

1.2 Research question

This research report will focus on the mammal species of CNCH. It will strive to find out if the mammal distribution is affected by the human activity in the area by comparing mammal abundancy in highly disturbed areas and slightly disturbed areas. The research will be conducted with the following research question*: Is there a difference in distribution of endangered and vulnerable mammal species between the slightly disturbed primary forests and the highly disturbed agricultural fields in CNCH?*

In order to get an answer to the research question four sub questions have been formulated. Two of these questions are theoretical questions formulated to answer the main questions.

- *What vulnerable and endangered mammal species are present at CNCH?*
- *What are the habitat preferences of the species of interest?*

The following two questions are methodical questions, formulated in order to ensure the quality of the data:

- *What will be a good place to set up camera traps in order to get good imagery and the highest probability of mammal sightings?*
- *What information can the local stakeholders provide and how can this information be utilized?*

The objective of this research is to achieve more insight on the distribution and abundancy of mammals in CNCH. This report will show if the presence and abundancy of (endangered and vulnerable) mammal species in the agricultural fields is lower, equal or higher than in the primary forests. Lastly, the information provided by this research will aid *Centre for Sustainability Ph.* with writing the management plan for CNCH.

The research question of this research was changed during the process. In first instance the research was solely dedicated to the Palawan pangolin. However, due to its rarity and vigilance it would be very hard to spot. Several sources showed that the time span was too short to getter enough relevant information and local people also questioned the probability of success in finding the pangolin. After half of the data was collected without any pangolin traces, the research was adjusted with a broader perspective. Instead of just focusing on the pangolin, the research now focusses on all vulnerable/endangered mammal species present in CNCH.

1.3 Area description

Located north from Puerto Princesa City and south from the famous Subterranean River National Park is the area preserve of Cleopatra's Needle Critical Habitat (see appendix 1 and 2 for the location of CNCH). CNCH is a 100,000 acres primary forest and holds a wide variety of different species (Global Wildlife Conservaton, 2017). It has a lot of Palawan's endemic animals and even some species that are endemic to CNCH. In appendix 3 is a list of all mammal species occurring in CNCH and their IUCN status. In total about 85 percent of the birds and mammals endemic to Palawan live in CNCH (Global Wildlife Conservation, 2016). CNCH is also home to the Philippines last 200 members of the Batak tribe. The Batak are originally from Papua New Guinea and thought to be the first inhabitants of the Philippines (Rainforest Trust, 2016). They live in small villages in CNCH, where they own small pieces of agricultural land and harvest NTFP products like honey, bushmeat and tree resin.

Centre for Sustainability (CS), the company that is commissioning this research, has been striving for the declaration for CNCH as a critical habitat. In cooperation with Palawan Council for Sustainable Development, City Environment and Natural Resources Office of Puerto Princesa and the Batak tribe they

succeeded to do so. This does not mean that the area is now free from any thread. Measures to protect the area from illegal occupation, logging, forest conversion to agriculture and settlements, mineral exploration and extraction, and other damaging human activities still need to be implemented. Even with appropriate measures, these threads will only cease to exist if poverty in the area will start to dwindle. An absence of livelihoods is the main reason for pillage of resources (Fabro, 2016).

CNCH is divided over several barangay, namely Tagabinet, San Rafael, Tanabag, Concepcion, Binduyan, Langogan, and New Pangganan. The part of CNCH were the research will be conducted is in the Concepcion barangay. This location is chosen since most of mammals occur in this area, one of the Batak villages that has good relations with CS and could aid with the research is located here, and during the last camera trapping research preformed in CNCH this was the only barangay where a pangolin was sighted.

1.4 Species of concern

Even though CNCH is known to be a biodiversity hotspot, some of its species are declining at an alarming rate. Almost one quarter of the mammal species living in the area holds an endangered or vulnerable status. The pangolin, the Palawan bearded pig, the binturong and the Philippine porcupine are for these reason and extra focus of this research. This does not mean that other mammal species are neglected. They also will be included, but are in general less of a concern than the more vulnerable species.

1.4.1 The pangolin

A pangolin, also sometimes referred to as scaly anteater, is a mammal with large keratin scales that cover their body and make up 15% of its body weight. It has huge scythe like claws which it uses to break open termite hills or dead wood in order to find food. They have long snouts and a tongue even longer than its body which it uses to gobble up ants and termites. Unlike most mammals their tongue is attached to their ribcage and not to their mouth (Bradford, 2016). Pangolins are highly poached animals. They have a hard time recovering from their losses due to their low reproduction rate. A pangolin usually gets one cub per lit and has one lit per year. They are also particularly picky about their food (they will only eat particular ant and termite species). This together with high amount of poaching makes it that the risk of extinction is quite high for the pangolin (Wu, Liu, Zhang, & Ma, 2004).

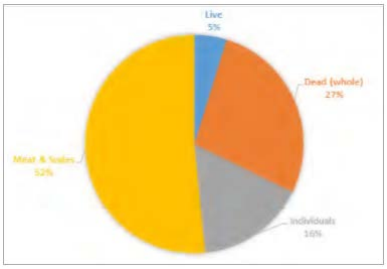


Figure 2: Pangolin trafficking volume. N = 667, Blue = Live animal, Red = Dead, Grey = individuals, Yellow = Meat and Scales (Emerson & Gomez, 2018)

The Philippine pangolin, or the Palawan pangolin (Manis culionensis) is the species of pangolin that lives in CNCH. It is mainly found in primary forests and lowland grasslands (Lagrada, Schoppe, & Challender, 2014). There is no exact number known about their wild population, but estimations have been made that in 2012 there were about 0.05 pangolins per km2 in primary forest and 0.01 in mixed forest/bushland. There have been significantly more sighting in the North and the center of the island compared to the south (IUCN SSC Pangolin Specialist Group, 2016). Local hunters noted that compared to the past, now more effort has to be spend to hunt down Pangolin (Lagrada L. , 2012), which indicates that their population has been dropping.

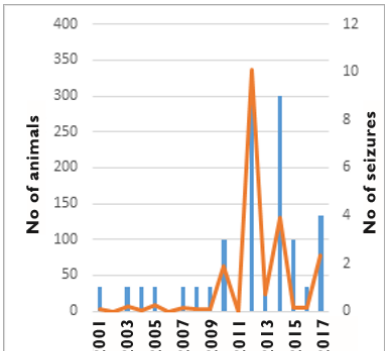


Figure 3: Number of seizures in Philippines 2001-2017 (Emerson & Gomez, 2018)

The pangolin is under heavy pressure and is believed to be the most poached animal in the world (Shutter, 2014). They are mainly poached for their meat and their scales. Their scales fetch a high price on the black market due to their unique pattern and the fact that some people believe that they hold unique healing properties (Abdullah, 2008). Based on reported pangolin captures, a total of 116,990 to 233,980 pangolins where hunted between 2011 and 2013. However experts believe that this number is just a mere 10% of the total amount of pangolin that where trafficked in illegal wildlife trade (WWF, 2018). In the Philippines a total of 667 of pangolin trade seizures have been measured between 2001 and 2017 (Emerson & Gomez, 2018). In figure 2 is shown in what form the pangolin where traded. In figure 3 the quantity of the seizures is shown. Figure 4 shows the key locations of the seizures. Most seizures took place in or near Palawan (PPC, El Nido, Coron, Tay Tay) or Manilla. These places are not surprising since Palawan is the only place in the Philippines where pangolin live and Manilla being by far the biggest city with 24 million citizens. Their meat is sold and eaten as a luxurious delicacy, mainly in China and Vietnam. In figure 5 is shown how much each of the actors in the wildlife trade earns from a pangolin. The pangolin are being poached in such high numbers that they hold an endangered to critically endangered status in the wild (Wu, Liu, Zhang, & Ma, 2004). In 2016 countries agreed to put a stop to all legal wildlife trade in pangolin. An international agreement announced to stop the trade in pangolin in order to conserve their population, as they would know be protected under the CITES agreement (WWF, 2016).

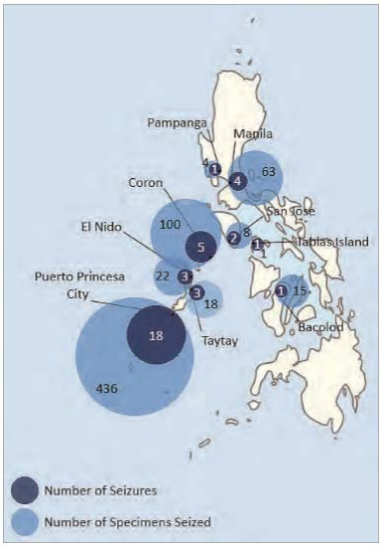


Figure 4: Key locations of pangolin seizures (Emerson & Gomez, 2018)

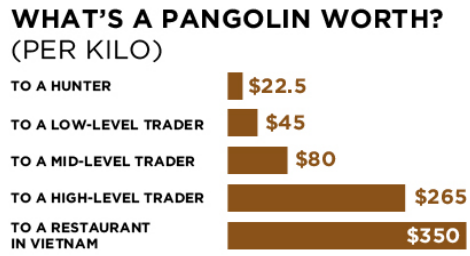


Figure 5: What is a pangolin worth? (Traffic; South Africa; IUCN, 2014)

1.4.2 The Palawan Bearded Pig

The Palawan bearded pig (Sus ahoenobarbus) is a species endemic to Palawan. It lives on the main island of Palawan and some islands adjacent to it (Meijaard & Widmann, 2017). Previously thought to be a subspecies of the Bornean bearded pig (Sus barbatus) but now thought to be its own separate species (Lucchini, Meijaard, Diong, Groves, & Randi, 2005). The Palawan bearded pig is locally hunted for food. Most of the hunting is done for personal consumption, however there is also a substantial amount in the Palawan bushmeat trade. There has been an increase of middlemen and collectors that want to purchase wildlife products. Rural restaurants, as well as restaurants in the islands capital Puerto Princesa City, sell the meat of the Palawan bearded pig (Meijaard & Widmann, 2017). It was previously listed as vulnerable but has now a near threatened status. This is due to that its extent of occurrence (EOO) exceeds the IUCN criteria. However, its population is decreasing as well (Meijaard & Widmann, 2017). This species is protected by Philippine wildlife protection legislation. However, implementation of this is sometimes of poor quality, as well is the enforcement of designated protected areas. Recommendations in protecting this species thus include: better enforcement of legislation, and new protected areas in key environment with improved management by local authorities (Meijaard & Widmann, 2017).

1.4.3 Binturong

The binturong (Arctictis binturong), also sometimes referred to as bearcat, is the largest living member of the Viverridae family (Hunter, 2011). It has a vulnerable IUCN status in the wild due to a declining rate over 30% for over the last 18 years (Willcox, et al., 2016). The subspecies of Arcticus binturong whitei is the species of binturong that lives in the Philippines and is endemic to the island of Palawan (Cosson, et al., 2007). They are mainly found in primary and secondary lowland forests up to 400 m above sea level (Rabor, 1986). However, life in the secondary forests is hard for the binturong. It lives mainly in the canopies where it can find most of its food (eggs, fruits, nuts, insects), and thus it is really reliant on the canopy structure that primary forests offer. Conversion from primary to secondary forests is thus a great threat for the binturong (Bittel, 2016). The major threads that the binturong faces include habitat loss, degradation and defragmentation. The latter one especially poses a thread in areas where this species is heavily hunted. It is hunted for bushmeat and for traditional medicine. Because of its cute appearance it is also sold in illegal wildlife trade to be kept as a pet. Habitat loss due to logging is an increasing threat (Willcox, et al., 2016). The ELAC are involved with applying and governing the wildlife laws concerning the binturong (Willcox, et al., 2016).

1.4.4 Philippine Porcupine

The Philippine porcupine (Hystrix pumila), also known as Palawan porcupine or Indonesian porcupine is a rodent species with large pointy spines on the back. It is locally known as Durian because of its resemblance to the pointy durian fruit. As many other species it is endemic to the Palawan faunal region. It was previously listed as least concern, but is now listed as vulnerable due to a strong decline of over 30% (Heaney, et al., 2008). Even though it has a vulnerable status, it is locally hunted as a source of bushmeat. The local tribes in CNCH hunt it for its bushmeat as well. Since their status as indigenous tribe they are allowed to hunt this species by law as long as it is only for own consumption and in sustainable numbers. Another thread for the porcupine is forest clearance (Esselstyn, Widmann, & Heany, 2004).

1.4.5 Other mammals

CNCH is also home to a wide variety of other mammal species, some of which also endemic to the Palawan faunal region. So is the Philippine long-tailed macaque, the Palawan pencil-tailed tree mouse, the Palawan Stink badger, the Palawan spiny rat, the Palawan leopard cat, and the Palawan tree shrew. Next to the endemic mammals the forest of CNCH is also home to 3 different civet species and the short-tailed mongoose. Furthermore 2 different squirrel species are present in CNCH. Notably a high percentage of the mammal species in CNCH are nocturnal.

Even though it is present in CNCH and has a vulnerable status, the Asian small-clawed otter (Aonyx cinereal) is not included in this research, since it is not present in the particular research area. This research will not include flying fox and bat species, since they are highly unlikely to be captured on camera traps.

2. Methodology

In order to find an answer to the research question two different methods will be used. Firstly a social research using a questionnaire will be conducted among the members of the Batak tribe. Secondly, camera traps will be set up in the research area. The social research will have two purposes, to find out what the Batak people know about mammal distribution among the two levels of disturbance and to find out what will be good place to set up the camera traps. The camera traps will be used to collect field data on the animals that are present in the research area.

2.1 Local Expertise

There are two indigenous tribes in Cleopatra's Needle Critical Habitat, the Batak and the Tagbanua. Due to their connections with Centre for Sustainability, their more convenient location, and their past experiences with research it is chosen to mainly cooperate with the Batak tribe for this research. They have a lot of local expertise and played an important role in this research. Before setting up the camera traps, the people from the Batak community were consulted on where they thought would be the best places to put the camera traps. Involving local tribes in the research is a great way to attain local knowledge. However, when consulting indigenous tribes and involving them in the research, it is important to keep the cultural differences in account. Researchers have a responsibility to cause no harm, however in the past research caused distress for indigenous people due to inappropriate research methods. In the past social research with indigenous tribes often tended to be of political or colonizing nature. It often included classifying and labelling indigenous people in order to manage them. Even though most of these research methods have ceased it has led to distrust towards researchers (Cochran, et al., 2008). When cooperating with indigenous communities it is important to balance the academic values of the research and the values of the community (Cochran, et al., 2008). The Batak community already has experience in research using camera trapping techniques, so they are familiar with the concept. A structured interview using a questionnaire is chosen as method to conduct the social research. This decision was made since the communication is done through an interpreter, which would make a semi-structured interview hard to execute. The questionnaire was prepared to mainly target the local people who are familiar with the forest (like hunters and NTFP collectors). Due to tribe customs, village chief's family members that were present at the time of the interview were included in the interviews. The questions in the questionnaire are of quantitative nature. Quantitative research questions are used when the relation of the theory to the research is of deductive nature (Bryman, 2015). Deductive social research, sometimes revered to as top-down approach, works from general to more specific. It is used in order to confirm a theory or hypothesis (Torchin, 2006). In this case being the difference in pangolin diversity at the time that the questionnaire was created.

When executing a social research with the indigenous tribes, it is also important to be aware of how the questions are formulated. The same question can be implied differently in other cultures. An example of this can be found in question 3 of the questionnaire (The English version of the questionnaire can be found in appendix 4, and the Tagalog version as used in the field is in appendix 5). This questions comes accompanied by a paper showing images of all mammals that live in the area. The interviewee will be asked if he or she has seen this animal. In earlier stages of the research this question was formulated differently, namely: "what animals have you seen in the forest?". Due to local religion, the Batak people often believe to see spirits and other mythical creatures of which their existence cannot be proven. Having these creatures in the interview results will complicate the data and it will cost a lot of time to track down which creatures are supernatural and which are genuine mammals. The questions about the mammal

sightings they personally experienced in the forest where added since the results will provide more insight on the abundance of mammals in the forest and/or the shyness of the species towards humans. A large part of the questionnaire is solely dedicated to gain more information on the pangolin. This is due to the fact that at the moment of the interviews the main topic of the research was pangolins and not vulnerable mammals in general. These are question about the seasonal activity of a pangolin and their possible affinity with slash and burn areas. Furthermore, there are questions about the interviewees their personal relation to the forest. These will provide information on why they are going into the forest and for what reason. These questions are included to put the results of their sightings in better perspective. If a person makes daily visits in the forest it is reasonable to assume that they have a higher amount of animal sightings. Lastly questions are asked about how they view the current state of the forest. This information is used to confirm how the members of the Batak tribe view the problems stated in problem analysis. Since most members of the Batak community cannot speak English this questionnaire was translated to Tagalog by one of the employees of Centre for Sustainability, who also aided with conducting the interviews. In chapter 3.1 the results of the interviews are presented and their role in the decision making is explained.

2.2 camera trapping

A total of six camera traps were used to record mammal footage in highly disturbed agricultural fields and the slightly disturbed primary forests. The slightly disturbed primary forest refers to the forest surrounding the Batak village land inward (in the opposite direction there are small houses, shelters and eventually a highway). This area is referred to as slightly disturbed, since there is almost no human disturbance in this forest. Occasionally the people from the village come to this part of the forest to hunt and to collect honey. Furthermore, since Palawan is small island, human influence can be seen in the forest even without humans ever being there. Occasional alien plant life (mainly eucalyptus) can be seen in the forest. Five Bushnell Trophy Cams and one Browning Trail Camera were used for the camera trapping. Two different models of Bushnell Trophy Cams were available for this research: Two times Model #119537C, which can take photographs and videos simultaneously and three times Model #119436C, which can take either photographs or videos. Model BTC-5 of the Browning Trail Camera was available which could take either videos or pictures as well. The cameras that could take either videos or pictures were set to take pictures, since the quality of the pictures the camera takes is higher than the quality of the videos. The cameras use a passive infrared motion sensor to detect heat within the detection cone of the infrared sensor, triggering the camera. A five-second trigger time was used between trigger events. The cameras functioned for 24-hour cycles using built-in infrared LEDs to capture low light images, such as those at night, and color flash to capture daytime images. All cameras were set to take 30-second videos. Once the locations of the camera traps were decided and the cameras were all set up, a GPS was used to save coordinates of the location. This was used to relocate the camera's later on, and could provide to be helpful in future research to set up cameras in the same location. The cameras are attached to large tree trunks or other object. While attaching the camera it is made sure that the cameras were attached is such a way that nothing was blocking their view. For medium recording medium-sized mammals (30-50cm) the cameras should be placed 20-30cm above the ground and a distance of 2 to 3 meters from the chosen recording site (Meek, Ballard, & Fleming, 2012). Once the cameras were attached, they needed to be tested to see if they were making clear images. A person would trigger the sensor and the SD card was removed to view the pictures on a digital camera. If the picture is of good quality the SD card will be returned and a last check will be done to make sure the camera takes 30 second videos with a 5 second trigger time or is set to taking pictures (Marler, 2017). The cameras were named according to

their disturbance level (ex. Highly disturbed, slightly disturbed) and it were numbered (ex. [disturbance-level] camera 1). A total of 6 camera traps were used. 3 of them were put on the highly disturbed agricultural fields and the other 3 in the slightly disturbed primary forest. The camera traps were located near mammal trails, in order to increase the possibility of useful imagery. Aspects that could attract pangolin are taken into account (aspects like decaying wood, ant activity), as well as habitat criteria as described in chapter 1.4 for the species of interest. In order to keep the results fair the distribution of these aspects are kept as equal as possible among the 2 different levels of disturbance. Three camera traps were placed in the disturbed areas. One was placed on a slash and burn site (approximately 1km from the village), one on a taro field (also approximately 1km from the village), and one on a cassava/banana field (right next to the village). Another three camera traps were placed in the less disturbed primary forest. One was placed halfway up the mountain, one on top of the mountain ridge and one will be placed closer to a water source. All of the locations in the primary forest are further away from the village then the cameras located in the disturbed areas. Note that the primary forest is less disturbed, since it is occasionally visited by people from the village, mainly to hunt or collect honey. A local Batak guide accompanied the field work. The guide was an experienced hunter and knew the location of many mammal trails. A detailed description of the field characteristics of the cameras location was noted. This included forest type, tree species, animal signs, and any other remarkable aspects of the area. In appendix 6 the camera location details are shown. The cameras will record footage for a period of 5 weeks. The cameras were checked halfway to refresh the batteries and change the memory cards. Due to a limited budget, it was not possible to purchase a second batch of batteries. As a result, halfway the research the batteries had to be returned. They were being charged overnight and returned the next day.

Materials that were used for the field work are: Camera traps, A photo camera to take pictures of the location, a GPS, and a notebook and pen.

2.3 Data analysis

Once all camera footage has been retrieved and all species on the footage are identified, the data will be analyzed. This will be done by several calculations and indices that will provide more insight on what the data actually can tell about species abundance and biodiversity of each area.

For this research there is four types of analyses that will be conducted on the data that is collected. Their aim and method are explained down below:

RAI

- **Aim:** The RAI (relative abundance indices) is a calculation aimed to estimate the abundancy of species based on the amount of camera sighting with respect to the amount of camera trapping days.
- **Method:** The RAI will be calculated for each species in each level of disturbance, meaning that all detections per species and per level of disturbance is summed for all camera traps over all days, multiplied by 100, and divided by the total number of camera trap nights.
- **Kind of data:** The data that will be used in order to compute the RAI is all the camera footage of mammals collected at each site.
- **Conclusions:** Since it is an estimation, it is not reliable draw conclusions from the RAI estimation alone. The RAI becomes most valuable when it is compared with previous studies at the same

site or other parts of the region.
(Jenks, et al., 2011)

Sørensen's similarity index

- **Aim:** The Sørensen's similarity index will be used to calculate the amount of similarity in mammal species distribution between the slightly disturbed primary forest and the highly disturbed agricultural fields. This comparison in similairity of species is called the β-diversity (beta diversity).
- **Method:** The formula used to calculate the β-diversity (beta diversity) is: $\beta = 2c / S1 + S2$
- **Kind of data:** The data used for this formula is footage of mammals in the two levels of disturbance. The C in this formula is the amount of species that occurs in both areas. S1 is the total amount of species measured in the first area. S2 the amount of species measured in the second area.
- **Conclusions:** This formula should always in a result between 0 and 1. When the result is 0 it means that there are no similar species between the two areas. If the result is 1 it means that exactly the same species occur.
(Kerkhoff, 2010)

Shannon-Wiener and Simpson index

- **Aim:** These two indices are used to measure biodiversity. These indices do not only account species richness but also their relative contribution to each area.
- **Method:** The formula used to calculate the Shannon-Wiener index is: $H' = -\Sigma\, p_i \ln(p_i)$. For the Simpson index it is: $D = 1/\Sigma\, p^2_i$.
- **Kind of data:** The data used for this formula is footage of mammals per site. The p_i in both of these equations stands for the total recorded amount of 1 species divided by the total amount of all recorded species.
- **Conclusions:** The result of these formulas should tell something about the biodiversity of each area. The H' and D values should typically range from 0 to 5 for a healthy level of diversity.
(Kerkhoff, 2010)

T-test

- **Aim:** the t-test is a statistical hypothesis test. It used to tell if two sets of data are significantly different from one another. In this research the t-test will be used to tell if there is a significant difference in the data from the slightly disturbed primary forests and the highly disturbed agricultural lands.
- **Method:** The formula for a t-test is $t = Z/s$. Z and S in this formula are functions of the data.
- **Kind of data:** The t-test will be used on the data of mammal abundancy and mammal biodiversity of each level of disturbance.
- **Conclusions:** A result above 0.05 means that it is enough to prove a significant difference.

3. Results

The first results that could be retrieved were the results of the interviews conducted with the tribe members. These interviews where mainly used to answer the sub questions of this research. After 4 weeks of camera trapping the images were retrieved and analyzed. Appendix 3 can be used as a reference since it concludes a full list of mammal species occurring in CNCH.

3.1 Results Interviews

The questions for the interviews are shown in appendix 4. In appendix 7 the most relevant results of the interviews are shown. At the time that the interviews were conducted the research was planned to have a different research questions so some questions seem a little of topic, and there is a higher focus on the pangolin overall. The first relevant result is the one of the pangolin (or other mammal) traces in their agricultural fields. Most villagers were sure that the pangolin visited the fields. There were different answers for the reason why they do so. Some villagers believed it was for eating ash (there was no literature found to back this up) whilst others believed it was to feed on crops and ants (which seems more likely). In the end most villagers agreed that there was mammal activity on the agricultural fields, but more so in the forest. They believed the absolute mammal hotspot of the area was high upon the mountain ridge in the primary forest. They suggested to place the camera trap near mammal trails and near dead or decaying wood which can attract mammals. Another interesting result was the pangolin sightings. The villagers that did see a pangolin in real live were on average way older than the villagers that did not. Unfortunately, a question about the interviewees age was not included in the questionnaire and thus there is no data to back this up, but there could be a possible relation. Likewise, most of the sightings occurred a long time ago. Sightings of the vulnerable mammal species still occur frequently, even though they occur less than they used to. Not to surprisingly there is also a clear correlation between the amount of animal sightings and the amount of times that villagers go in the forest. The villagers that go in the forest the most had the highest amount of animal sightings on average.

3.2 The camera traps

In this chapter the results are of the camera traps are presented. A table shows the species captured on camera and how often they were captured on camera. A column chart is also shown for all camera trap results in order to better visualize the results. For pictures of the camera traps in their trapping sites see appendix 8. In appendix 9 some examples are shown to get an idea of what captured images look like. Next to mammals a wide variety of other animals, like monitor lizards, forest chickens and peacocks, where captured. Since this research focusses solely on mammals these were not included in the results.

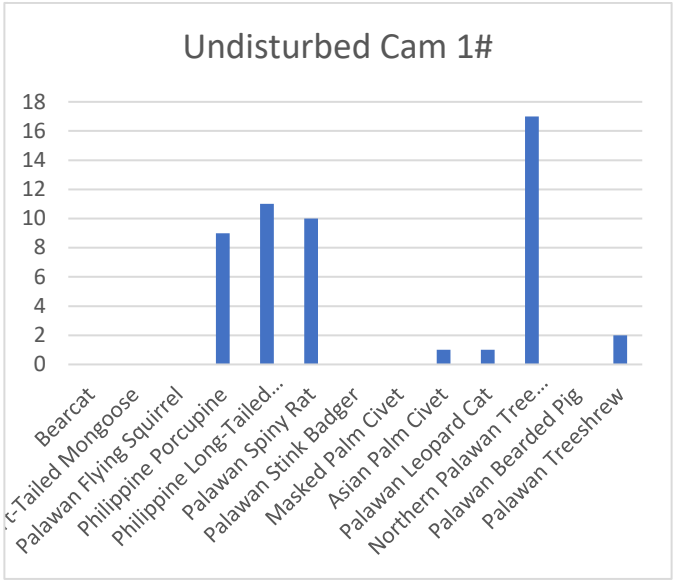
3.2.1 Undisturbed forest cam #1

Undisturbed forest cam #1 is by far the camera that yielded the greatest results. It worked from 19-Apr-2018 till 27-Apr-2018. The second period of camera trapping was from 03-May-2018 until 17-May-2018. In total the camera recorded for 22 trap nights. In table 1 is shown what species where caught on camera in this site, as well as its RAI calculation. Graph 1 also shows the occurrence of mammal species on this site but in a more graphic view.

Table 1: species captured with undisturbed cam 1#

Undisturbed Cam 1#	Count	RAI
Bearcat	0	0
Short-Tailed Mongoose	0	0
Palawan Flying Squirrel	0	0
Philippine Porcupine	9	40.90909
Philippine Long-Tailed Macaque	11	50
Palawan Spiny Rat	10	45.45455
Palawan Stink Badger	0	0
Masked Palm Civet	0	0
Asian Palm Civet	1	4.545455
Palawan Leopard Cat	1	4.545455
Northern Palawan Tree Squirrel	17	77.27273
Palawan Bearded Pig	0	0
Palawan Tree shrew	2	9.090909

Graph 1: Column chart of sighting by undisturbed cam 1#



A lot of Northern Palawan tree squirrels (Sundasciurus juvencus) were captured on this site. Next to this the Philippine long tailed macaque (Macaca fascicularis philippinensis) and the Palawan spiny rat (Maxomys panglima) were also quite abundant on this site. Out of the vulnerable animals of interest, there have been 9 sightings of Philippine porcupine (Hystrix pumila). Other sightings of interest include the Palawan leopard cat (Prionailurus bengalensis heaneyi), Asian palm civet (Paradoxurus hermaphroditus) and the Palawan tree shrew (Tupaia palawanensis), the latter one being unique to this site.

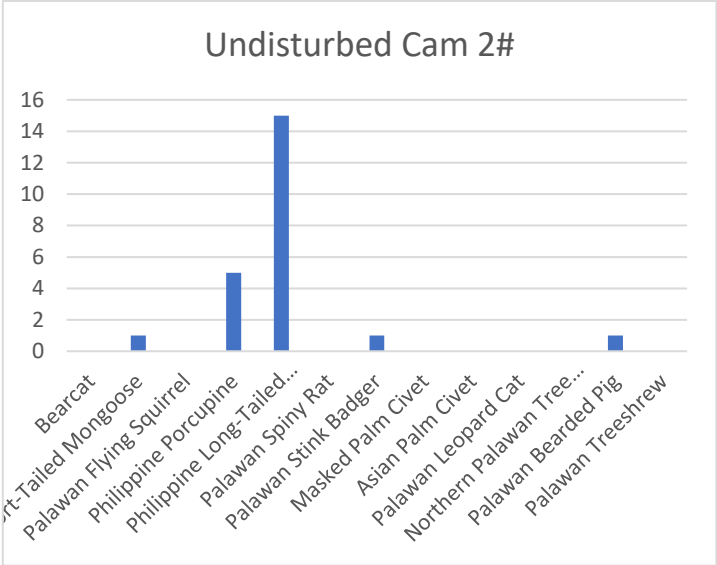
3.2.2 Undisturbed forest cam 2#

Undisturbed forest cam 2# was located at the top of mountain underneath an overhanging log. There were no malfunctions noted with this camera during the research period, which means it had a total of 27 trapping nights. It worked continuously from 19-Apr-2018 to 17-May-2018 apart from the night of battery charging from 2nd of May till the 3rd. In table 2 is shown what species where caught on camera in this site, as well as its RAI calculation. Graph 2 also shows the occurrence of mammal species on this site but in a more graphic view.

Table 2 Camera sighting undisturbed cam 2#

Undisturbed Cam 2#	Count	RAI
Bearcat	0	0
Short-Tailed Mongoose	1	3.703704
Palawan Flying Squirrel	0	0
Philippine Porcupine	5	18.51852
Philippine Long-Tailed Macaque	15	55.55556
Palawan Spiny Rat	0	0
Palawan Stink Badger	1	3.703704
Masked Palm Civet	0	0
Asian Palm Civet	0	0
Palawan Leopard Cat	0	0
Northern Palawan Tree Squirrel	0	0
Palawan Bearded Pig	1	3.703704
Palawan Tree shrew	0	0

Graph 2 Column chart of sightings undisturbed cam 2#



Most notably is that there are no sightings of the otherwise really common northern Palawan tree squirrel or Palawan spiny rat. This site also had a high amount of long tailed macaque sightings and also has 5 sightings of the Philippine porcupine. Furthermore this is the only sight that recorded the Palawan bearded pig (Sus ahoenobarbus). The recording of it concerned a piglet, so there is a high possibility that the were more bearded pigs around. Additionally this was also the only sight to record images of the Palawan stink badger (Mydaus marchei) and the short-tailed mongoose (Herpestes brachyurus).

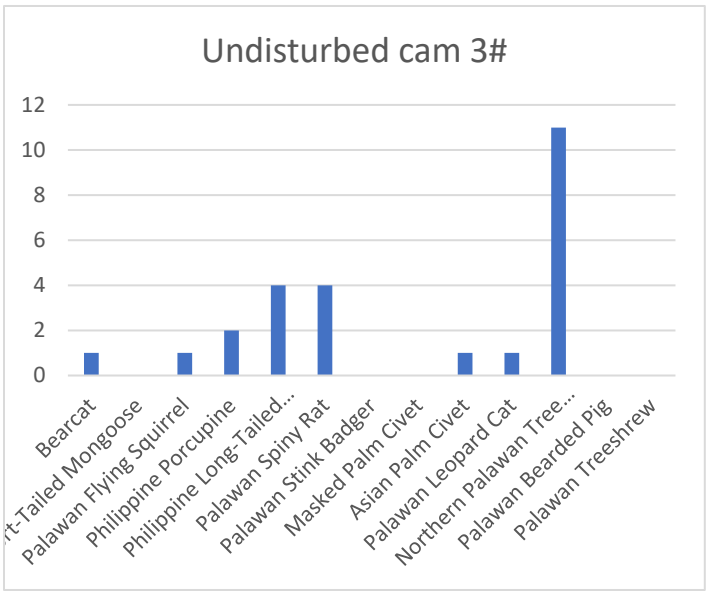
3.2.3 Undisturbed forest cam 3#

Undisturbed forest cam 3# was located next to a mammal trail between two higher rocky ridges. Seasonally there would be a creek in this location. This camera was free from malfunctions as well and thus worked continuously from 19-Apr-2018 to 17-May-2018 apart from the night of battery charging from 2nd of May till the 3rd, with a total of 27 trapping nights. In table 3 is shown what species where caught on camera in this site, as well as its RAI calculation. Graph 3 also shows the occurrence of mammal species on this site but in a more graphic view.

Table 3 Sighting on undisturbed Cam 3#

Undisturbed Cam 3#	Count	RAI
Bearcat	1	3.703704
Short-Tailed Mongoose	0	0
Palawan Flying Squirrel	1	3.703704
Philippine Porcupine	2	7.407407
Philippine Long-Tailed Macaque	4	14.81481
Palawan Spiny Rat	4	14.81481
Palawan Stink Badger	0	0
Masked Palm Civet	0	0
Asian Palm Civet	1	3.703704
Palawan Leopard Cat	1	3.703704
Northern Palawan Tree Squirrel	11	40.74074
Palawan Bearded Pig	0	0
Palawan Tree shrew	0	0

Graph 3 Column chart of sighting undisturbed cam 3#



This place was the only place to capture imagery of the vulnerable binturong (Arctictis binturong whitei). Once again there were Philippine porcupine sightings in this location, 2 in total. It captured imagery from the common three species, northern Palawan tree squirrel, Philippine long-tailed macaque and Palawan spiny rat. However for the latter two in lower quantities than on most other sites. This camera was also the only one to capture imagery of the Palawan flying squirrel (Hylopetes nigripes). Furthermore it also captured pictures of the Palawan leopard cat and Asian palm civet.

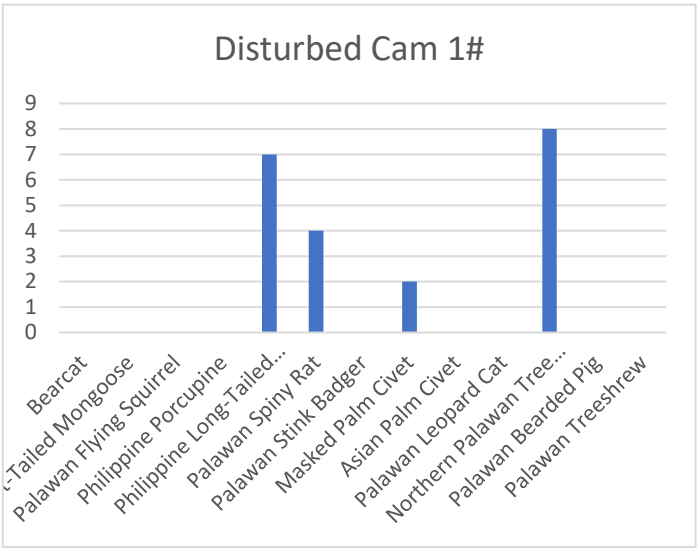
3.2.4 Disturbed area cam #1

This camera was located on the edge of slash and burn field located approximately 1km away from the village. This camera did not record any animals for the first halve of the research period. During the second halve however, it recorded plenty of animals. It has 27 trapping nights. This area was of particular interest, since some of the community members mentioned in the interviews that they have seen signs of Palawan pangolin (Manis culionensis) visiting the slash and burn sites. In table 4 is shown what species where caught on camera in this site, as well as its RAI calculation. Graph 4 also shows the occurrence of mammal species on this site but in a more graphic view.

Table 4 Sightings of Disturbed Cam 1#

Disturbed Cam 1#	Count	RAI
Bearcat	0	0
Short-Tailed Mongoose	0	0
Palawan Flying Squirrel	0	0
Philippine Porcupine	0	0
Philippine Long-Tailed Macaque	7	25.92593
Palawan Spiny Rat	4	14.81481
Palawan Stink Badger	0	0
Masked Palm Civet	2	7.407407
Asian Palm Civet	0	0
Palawan Leopard Cat	0	0
Northern Palawan Tree Squirrel	8	29.62963
Palawan Bearded Pig	0	0
Palawan Treeshrew	0	0

Graph 4 Column Chart of sightings Disturbed Cam 1#



This site recorded none of the vulnerable mammal species. Even though this site recorded a lot of animal sightings it did not record that high amount of different mammal species. A lot of Philippine long-tailed macaque, northern Palawan tree squirrel and Palawan spiny rat. Furthermore there were two sightings of masked palm civet (Paguma larvata). No sightings or further traces of Palawan pangolin.

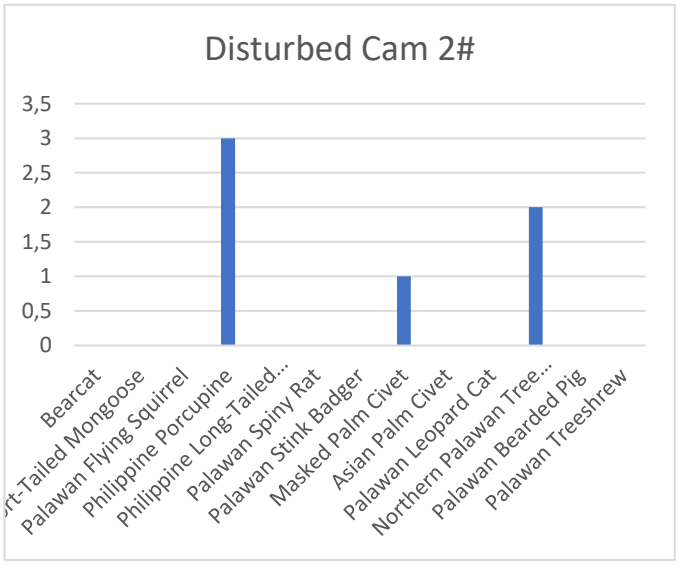
3.2.5 Disturbed area cam 2#

This camera was located in a taro field, also approximately 1 km from the Batak village. When collecting the camera footage on 17-May-2018 this camera was missing. This means that for this site there are only sighting for 19-Apr-2018 till 02-May-2018. In table 5 is shown what species where caught on camera in this site, as well as its RAI calculation. Graph 5 also shows the occurrence of mammal species on this site but in a more graphic view.

Table 5 Sightings by Disturbed area cam 2#

Disturbed Cam 2#	Count	RAI
Bearcat	0	0
Short-Tailed Mongoose	0	0
Palawan Flying Squirrel	0	0
Philippine Porcupine	3	21.42857
Philippine Long-Tailed Macaque	0	0
Palawan Spiny Rat	0	0
Palawan Stink Badger	0	0
Masked Palm Civet	1	7.142857
Asian Palm Civet	0	0
Palawan Leopard Cat	0	0
Northern Palawan Tree Squirrel	2	14.28571
Palawan Bearded Pig	0	0
Palawan Treeshrew	0	0

Graph 5 Column graph for sighting undisturbed area 2#



The species with the highest occurrence for this site was actually one of the species listed as vulnerable namely the Philippine porcupine. Other mammals that were recorded on this site are the masked palm civet and the northern Palawan tree squirrel.

3.2.6 Disturbed area cam 3#

This camera was located right next to the Batak village and was placed on a piece of dead wood on a field with mixed cultivation of cassava and banana plants. This camera recorded only one sighting over the whole research period and had no known malfunctions. This sighting concerned a Philippine porcupine. In table 6 this sighting is shown together with the RAI.

Table 6 Sightings for Disturbed area cam 3#

Disturbed Cam 3#	Count	RAI
Philippine Porcupine	1	3.703704

3.3 Alpha diversity, Beta diversity and abundancy

The α-diversity (alpha diversity) is the number of species of organism present in a certain area. This is also referred to as species richness. In this particular case only the species richness for mammals is measured for each area. The areas being the disturbed agricultural fields and the slightly disturbed primary forests. A total of 12 different mammal species were measured in the primary forest. 5 different mammal species were measured in the more disturbed areas.

The β-diversity (beta diversity) was calculated using the Sørensen's similarity index, which uses the following formula:

$\beta = 2c / S1 + S2$

C in this formula is the amount of species that occurs in both areas. S1 is the total amount of species measured in the first area. S2 the amount of species measured in the second area. When the result is 0 it means that there are no similar species between the two areas. If the result is 1 it means that exactly the same species occur. For this research a total of 4 similar mammal species were measured between the 2 areas. Which gives the following formula:

$\beta = 8 / 12 + 5 = 0.5$

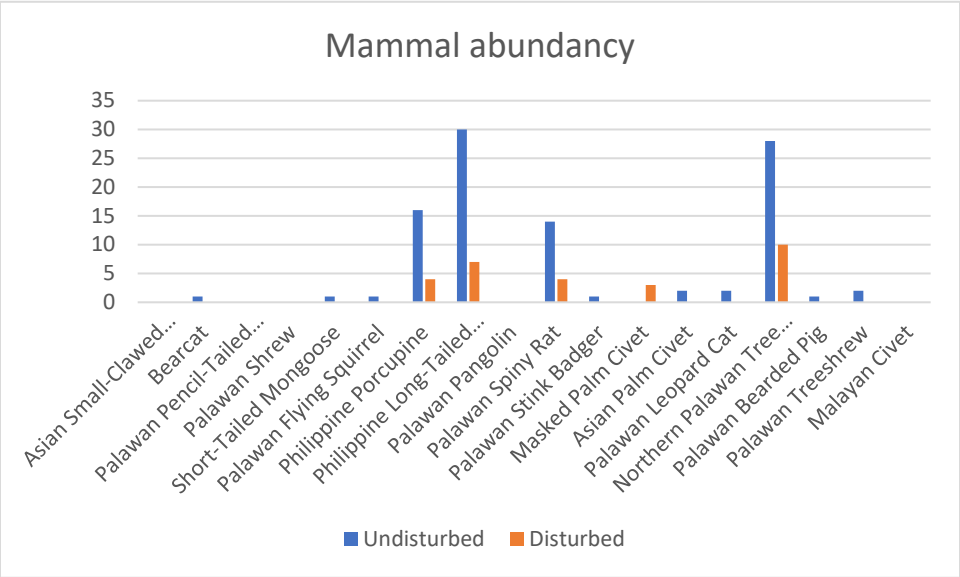
A table that shows the total amount of species and their abundancy is shown in table 7. A more graphic view is show in graph 6. The total species richness of disturbed is 5 mammal species, for disturbed it is 12, making the species richness ratio 5 to 12.

Table 7 Mammal abundancy between the 2 levels of disturbance

	Undisturbed	Disturbed
Asian Small-Clawed Otter	0	0
Bearcat	1	0
Palawan Pencil-Tailed Tree Mouse	0	0
Palawan Shrew	0	0
Short-Tailed Mongoose	1	0
Palawan Flying Squirrel	1	0
Philippine Porcupine	16	4
Philippine Long-Tailed Macaque	30	7
Palawan Pangolin	0	0
Palawan Spiny Rat	14	4
Palawan Stink Badger	1	0
Masked Palm Civet	0	3
Asian Palm Civet	2	0
Palawan Leopard Cat	2	0
Northern Palawan Tree Squirrel	28	10
Palawan Bearded Pig	1	0
Palawan Treeshrew	2	0
Malayan Civet	0	0

Note that these table do not give the most honest representation since the has been more camera malfunctions in the disturbed areas. However this will give an idea on the mammal abundance between the two areas. Performing a t-test of these results with assuming unequal variances, results in a p value of 0.05758. This means that this data is not enough to prove a significant difference.

Graph 6 Column chart of mammal abundancy



3.4 Biodiversity index

Two of the most frequent used indices to measure biodiversity are the Shannon-Wiener index and the Simpson index. These indices do not only account species richness but also their relative contribution to each area. They are measured by the following equations:

Shannon-Wiener Index: $H' = -\Sigma\, p_i \ln(p_i)$

Simpson Index: $D = 1/\Sigma\, p^2_i$

The p_i value represent the fractional abundance for each species on each camera site. A table presenting the fractional abundance is presented in table 8

Table 8 Fractional abundance of mammal species

Species:	Cam# UndistCam 1	UndistCam2	UndistCam3	DistuCam1	DistuCam2	DistuCam3
Asian Small-Clawed Otter			0	0	0	0
Bearcat			0.04	0	0	0
Palawan Pencil-Tailed Tree Mouse			0	0	0	0
Palawan Shrew			0	0	0	0
Short-Tailed Mongoose		0.043478261	0	0	0	0
Palawan Flying Squirrel			0.04	0	0	0
Philippine Porcupine	0.176470588	0.217391304	0.08	0	0.5	1
Philippine Long-Tailed Macaque	0.215686275	0.652173913	0.16	0.333333333	0	0
Palawan Pangolin			0	0	0	0
Palawan Spiny Rat	0.196078431		0.16	0.19047619	0	0
Palawan Stink Badger		0.043478261	0	0	0	0
Masked Palm Civet			0	0.095238095	0.166666667	0
Asian Palm Civet	0.019607843		0.04	0	0	0
Palawan Leopard Cat	0.019607843		0.04	0	0	0
Northern Palawan Tree Squirrel	0.333333333		0.44	0.380952381	0.333333333	0
Palawan Bearded Pig		0.043478261	0	0	0	0
Palawan Treeshrew	0.039215686		0	0	0	0
Malayan Civet			0	0	0	0

The results of each equation are presented in table 9. Since the Shannon-Wiener and Simpson equation only measures diversity in relation to other records at the same site, it can still be comparable with results from other sites even though absolute numbers (possibly due to less trapping days) are different from one another.

Equation:	Cam# UndistCam 1	UndistCam2	UndistCam3	DistuCam1	DistuCam2	DistuCam3
Shannon-Wiener	1.603813057	1.019496713	1.664735935	1.273647429	1.011404265	0
Simpson	4.35678392	2.090909091	3.93081761	3.418604651	2.571428571	1

Table 9 Shannon-Wiener and Simpsons index

Since there is only one sighting on the site of disturbed camera 3#, the results for this site does not mean much. Notable is, for the other sites, that difference between disturbed and undisturbed is less big compared to the numbers of species richness. According to the Simpsons equation, disturbed camera 1 and disturbed camera 2 both have a higher species diversity than undisturbed camera 2. Also notable is the fact according to the Shannon-Wiener equation the site of undisturbed camera 3# is the most diverse, whilst according to the Simpsons equation the site of undisturbed camera 1# is the one that yielded the highest result.

To get a better idea about the diversity in vulnerable mammal species in both levels of disturbance the same equations are performed only including the vulnerable species. In table 10 the results of these equations are shown.

	Dist	Undist
Shannon-Wiener	0.425848	0
Sorenson	1.255814	1

Table 10 Shannon-Wiener and Simpsons index for vulnerable species.

4. Conclusion

For the duration of one month, six camera traps have been recording in order to find out if there is a difference in mammal distribution between the slightly disturbed primary forests and the highly disturbed agricultural fields in CNCH. These cameras yielded very varying results. One of the mammal species of particular interest for this research was the Philippine pangolin (Manis culionensis). During the interview that was carried out with the members of the Batak tribe it became clear that even for people living in the same area, observation of the Philippine pangolin was rare and hardly ever occurred. Most people who have seen the pangolin were older community members and it happened many years ago. People still did see signs of the pangolin around, especially on the slash and burn fields. The camera traps unfortunately did not record any pangolin. Out of the other mammal species of particular interest, the Philippine porcupine (Hystrix pumila) had a surprisingly high amount of sightings for species that is listened as vulnerable. It was the third most occurring mammal species, only the northern Palawan tree squirrel (Sundasciurus juvencus) and the Philippine long-tailed macaque (Macaca fascicularis philippinensis) had more sightings. It occurred on every site except for disturbed area 1# which was the slash and burn field. It was the most occurring species on taro field, possibly because it feeds on the crops. Even though this animal was not recorded on one of the disturbed sites and has more sightings on the primary forest sites, it cannot be concluded that species is more abundant in the primary forest. This because there is a larger data deficient on the disturbed sites due to the missing of one camera, and there still was a decent amount of sightings on the disturbed areas. What can be concluded is that it at least occurs on both level of disturbance. The other two species of particular interest, the binturong (Arcticus binturong whitei) and Palawan bearded pig (Sus ahoenobarbus), both only occurred one time on camera. Both of these sightings were in the primary forest. Even though the end result is once again higher for the slightly disturbed primary forest there is nothing that can be concluded from a single sighting apart from the fact that they do occur in this area. The Shannon-Wiener and Simpson index on the vulnerable species shows the diversity in the species of interest on the two levels of disturbance. The highly disturbed agricultural field only recorded one vulnerable species (Philippine porcupine) so it got the lowest value possible for both equation. For the slightly disturbed primary forest the diversity is remarkably lower when only the vulnerable species are included. Still it is significantly higher then the highly disturbed agricultural fields.

The results of the social research backs up the findings in field. Most mammals were recorded in the primary forest and the highest amount of sightings was in the location that was appointed by most interviewees as highest diversity hotspot. One notably difference was that the Palawan bearded pig was regularly sighted by the tribes people, but only had one camera sighting. This has likely to do with the fact that many of interviewees were hunters. In the end all mammal species, apart from the Palawan pangolin, that were present in the area were captured on camera.

The total species richness for the mammal species recorded in this research was way higher in the slightly disturbed forest with a 12 to 5 ratio. The abundancy of the species was even higher. Every mammal species had a higher amount of sightings in the primary forest than in the agricultural fields. The only exception for this was the masked palm civet (Paguma larvata), which had a higher occurrence in the agricultural fields and was not recorded at all in the primary forest. Even though there was a clear difference in abundancy values, the p-value of the t-test was over 5 percent which means that it cannot be concluded as a significant difference. The different equations for diversity used in this research also yielded different results. According to the Shannon-Wiener equation the site of undisturbed camera 3# is the most diverse,

whilst according to the Simpsons equation the site of undisturbed camera 1# is the one with highest diversity. Most notably however is the fact that the difference in results is less big than when the two different levels of disturbance are compared in species richness. In both equations disturbed camera 1# and 2# yielded similar or even higher results than undisturbed camera 2#. The Sørensen's similarity index resulted in a 0.5, meaning that there is definitely an overlap in species, but each area still holds it unique species (especially the primary forests, since only one unique species has been recorded for the agricultural fields). Only one of the vulnerable species was recorded in both areas being the Philippine porcupine. Notable that the four species similar to both areas (Philippine porcupine, Philippine macaque, Palawan spiny rat, and Northern Palawan three squirrel) are all opportunistic feeders and could very well be on the agricultural fields looking for crops to feed on.

The field that had the obvious least amount of sightings was the site of disturbed camera 3#. It only recorded one Philippine porcupine. An explanation for this low result could be the location of the field being right next to the Batak village, whereas the other two highly disturbed sites which did record a higher amount of mammals where significantly further away from the village. Another reasoning could be that the crops that are grown on this field (cassava and banana) has nothing to offer for mammals species, whilst the crops grown on the other fields (taro and rice) attract more mammal activity.

Another notable fact is the sudden increase in animal activity in the slash and burn field. Even though there were no real signs of camera malfunction the sudden increase in animal activity is so big compared to the first halve of the research, that it seems possible that a malfunction could have occurred. Another reason for the sudden increase of animal activity could be the planting of the rice.

5. Reflection

In a research there are many factors that could influence the result of the research. In this chapter the factors that could have influenced the results will be illustrated, furthermore suggestions for further research are given to more safely conclude findings by this research or for more information on CNCH that this research could not provide.

5.1 Discussion

The research did not go without any setbacks. One if the biggest setbacks was camera malfunctions or data deficiency. Undisturbed camera 1 yielded the most results. Even though it could not do its full extent of camera trapping. This is due to a waving leave in front of the sensor during its first period of camera trapping. It triggered the censor to continuously make pictures and videos, which drained the batteries rapidly. This means that it worked from 19-Apr-2018 till 27-Apr-2018. Until the 3th of may when the batteries were refreshed. After that it recorded continuously until the research period was over. Another case is the slash and burn field. The first half of the research it recorded absolutely nothing, whilst in the second half it yielded big results. The big difference in recordings could suggest that there could have been a malfunction for the first period. It did record footage of the camera being set up, but after that there was no footage at all. Almost simultaneously with the refreshing of the batteries the people from the Batak village also planted rice in this field, which could have attracted more animals to this field. This could be another explanation on why there was sudden increase in recording. If accounting that the camera did not malfunctioned there should have been 27 trapping nights for this site as well. In order to safely draw conclusions it is of great importance to know if this camera did malfunction or not. If it did malfunction it would mean that the abundancy of the measured mammal species is estimated to be twice as big, however since there were no clear signs of malfunction it cannot be conclude that it did. Furthermore the disappearing of disturbed camera 2 created a dent of missing data. It was noticed that the camera was gone on may the 17th. The lock with which this camera was attached to a tree trunk was still there and showed cutting marks. After informing the village chief about the incident the camera was returned a week after. It turned out 3 children from the village took it. However the SD card was still missing and was never returned.

Another important thing to keep in mind is the amount of sightings and RAI estimates. The RAI estimates is a very broad estimation of wildlife population based on camera sightings and can only become of worth when compared to other RAI estimates. There is no way to conclude that actual mammal population in the study area are close to the RAI estimates. Furthermore there are animal species that are very camera happy, whilst other animals species are more camera shy. Animals that are camera happy are often curious towards the camera trap and show up more often. Animals that are camera shy are more afraid of the unfamiliar camera trap and tend to stay away from them. The camera traps also carry a human scent. Shyness from humans is also different per animal species and thus can influence the amounts of animal recorded.

The camera locations were distributed as the following: 3 in primary forest and 3 on agricultural fields. However, apart from this each location has unique properties, examples being the crops that are grown, being close to water or the elevation of the location. Different results in abundancy could also be due to one of these factors instead of simply just due to highly disturbed or slightly disturbed. The location of the cameras is also partly bias due to the dependency on the Batak guide for navigating through the area. The time span for the research was so limited there was no time to get personally familiar with the area, thus

the preferred site features and location were discussed with the local guide. Due to this there was no full control in specifying the location sites and it was partly decided by the guide.

Involving the local people is a great approach when researching in an unfamiliar area. However, this does come with its own set of challenges. Firstly there is a language barrier. The Batak people cannot do not speak English and only speak Tagalog or their own Batak language. For this reason an employee of Center for Sustainability, who could speak both English and Tagalog, accompanied the field work. However, there is always a possibility that minor translation errors were made during the questionnaire and the interview. The fact that at the time that the interviews were conducted the research was still handling a different research question more focused on pangolin, makes it that the questions from the questionnaire and interviews could have been more focused towards the topic of endangered and vulnerable mammals. When conducting interviews with people there is also a big reliability on the peoples honesty. For this research it is assumed that interviewees spoke the truth. However, it is always a possibility that people exaggerated their answers or gave the answers they assumed were the most pleasing for the research.

Animal identification is the most tricky part in a camera trapping research. Some of images that were recorded by the cameras where so unclear (for example it only showed a tine part of tail) that they could not be identified. An animal would not be identified if there would was not any characteristic visible on which you could conclude the animal species. It is also challenging to tell if a sighting of an animal concerns a new individual or the same animal walking the same trail twice. If there were not any characteristics one which individual could be recognized, other aspects would be measured as well. These aspect include date and time of occurrence, time in between sightings and direction of the animal. If there was nothing to conclude that this concerns the same individual it was listed as a separate individual. However, it is possible that some animals that are listed as separate individuals could be the same individual or vice versa. The lighting on the cameras for the pictures taken at nights was really bright. This is also an aspect that made animal identification more difficult.

Another great influencer of this research is chance. Animals could be walking just outside the view of the camera. Or they could be present all year round but just moved to another area. In contrary it could also happen that one camera could capture a huge group of animals whilst they are normally rare or hardly occur in the area.

Lastly, this research was conducted in a very limited time span and with limited resources. More data means safer conclusions. If the research was conducted for a longer time and/or with more camera traps it could have yielded different results. There are also species that occur more often during a specific season. Having a timespan not covering all season can give misleading results on seasonal species.

5.2 Suggestions for further research

In order to add to the information and data found by this research and to learn more about CNCH and its wildlife further research is highly suggested.

This research had a rather small scope focusing only on mammal species. Similar researches focusing on other species could help to get to know more about CNCH. This research also did not cover the whole CNCH area, other mammal research in different parts CNCH could be great to add to the information or as a comparison. Since the critical status of the Philippine pangolin, a similar research solely focusing on the pangolin could also provide viable information. However since its appearance is so rare, a research

focusing only on the pangolin should take at least one year to get some viable information. A previous research in CNCH which took 6 months only recorded one individual.

Next to a comparison between slightly disturbed and highly disturbed areas, a similar research could be conducted on a comparison between vegetation type, or distance to a village/highway. This research has a lot of variables that could have been an influence on the results. Doing a follow up research on these variables (example given; vegetation type, distance to highway) will provide valuable insight on how much influence these variables were on the results.

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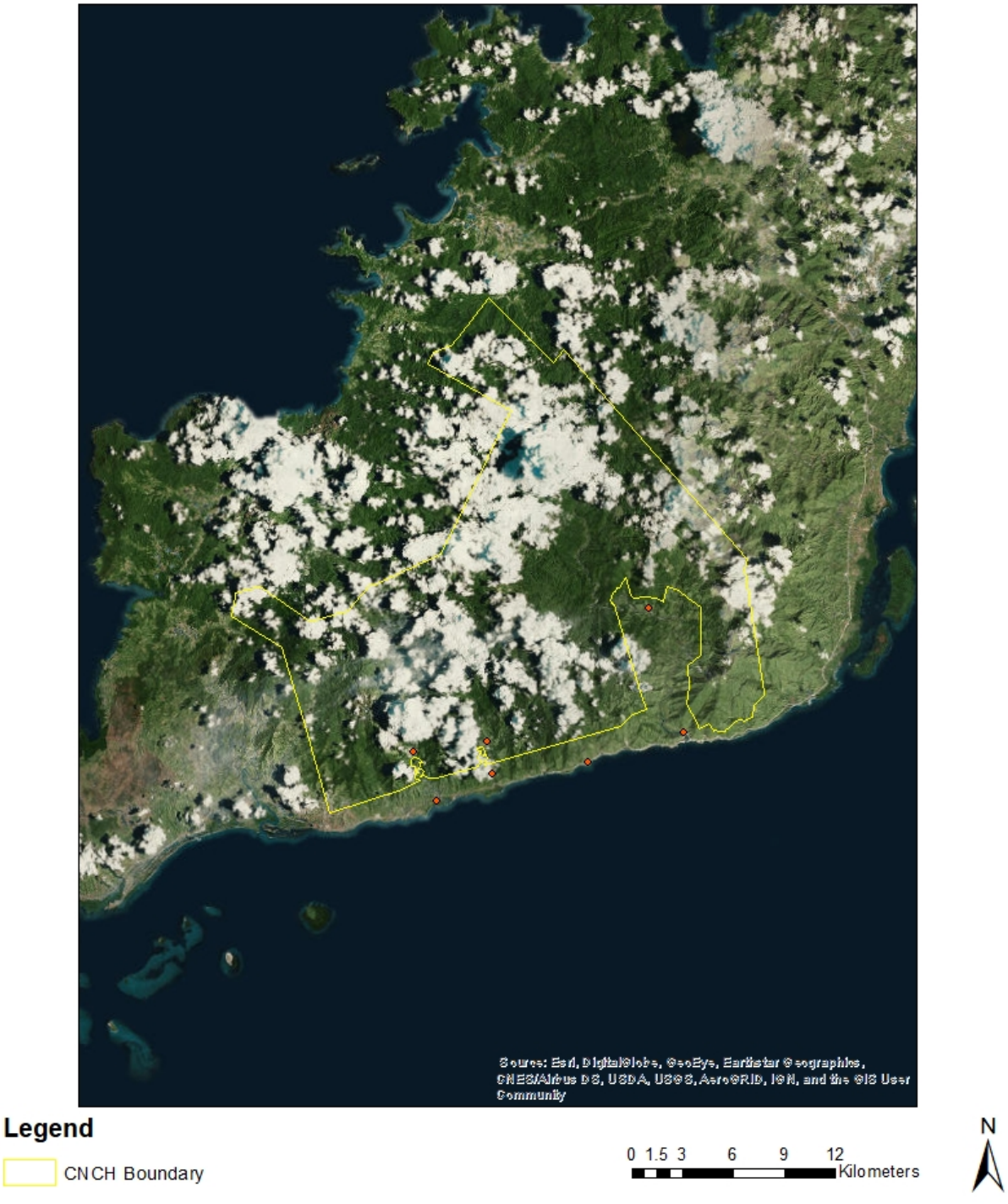
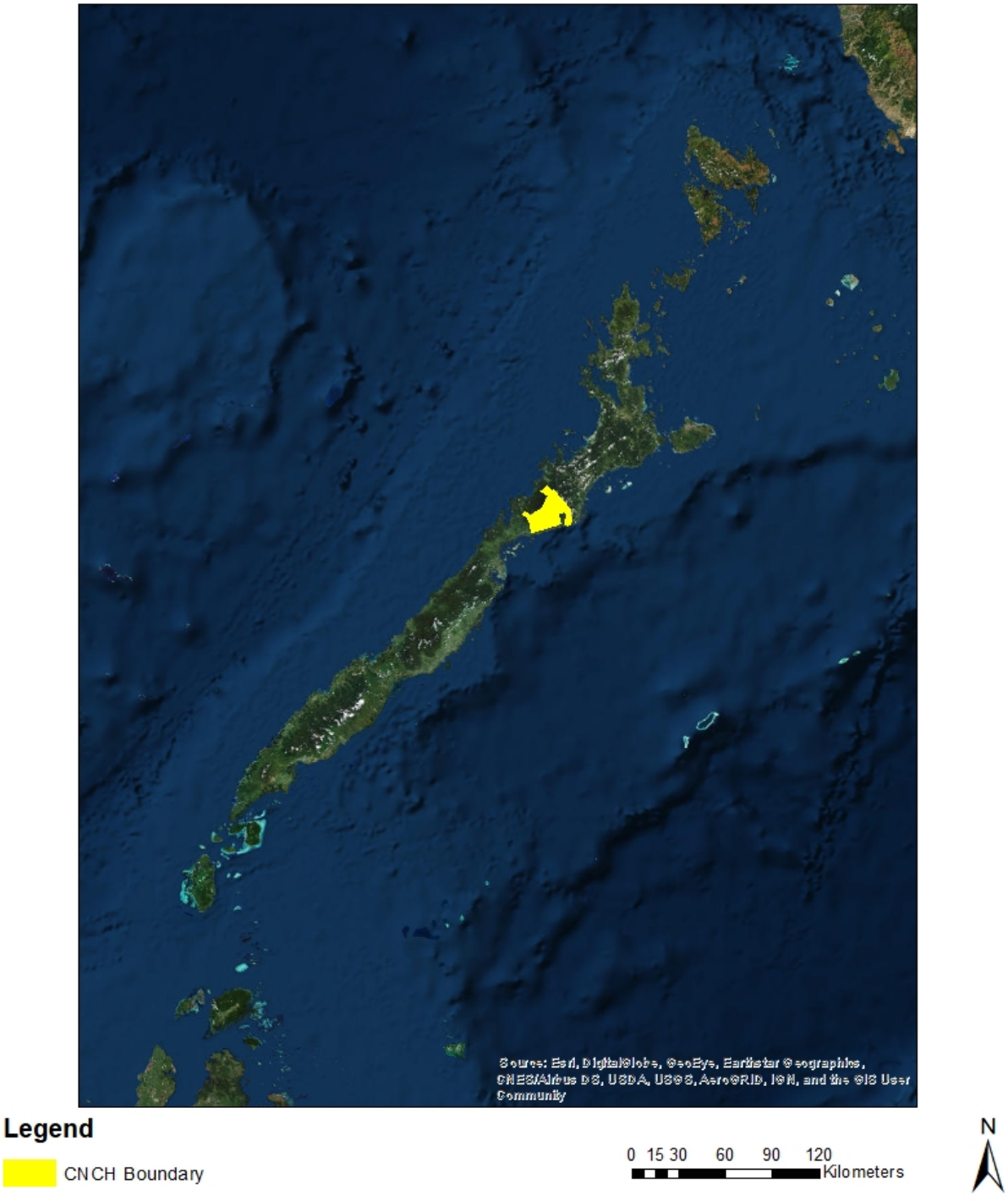
Appendix 1: CNCH boundary



Appendix 2: CNCH location in Palawan



Appendix 3: List of species occurring in CNCH

Mammals CNCH				
ID	**Species_Sceintific**	**Species_English**	**IUCN_Status**	**Endemicy**
1	Aonyx cinerea	Asian Small-Clawed Otter	Vulnerable	Palawan
2	Arctictis binturong	Bearcat	Vulnerable	Palawan
3	Chiropodomys calamianensis	Palawan Pencil-Tailed Tree Mouse	Data deficient	Palawan
4	Crocidura palawanensis	Palawan Shrew	Least concern	Palawan
5	Herpestes brachyurus	Short-Tailed Mongoose	Least concern	
6	Hylopetes nigripes	Palawan Flying Squirrel	Near threatened	
7	Hystrix pumila	Philippine Porcupine	Vulnerable	Palawan
8	Macaca fascicularis ssp. Philippensis	Philippine Long-Tailed Macaque	Near threatened	Palawan
9	Manis culionensis	Palawan Pangolin	Endangered	Palawan
10	Maxomys panglima	Palawan Spiny Rat	Least concern	Palawan
11	Mydaus marchei	Palawan Stink Badger	Least concern	Palawan
12	Paguma larvata	Masked Palm Civet	Least concern	
13	Paradoxurus hermaphroditus	Asian Palm Civet	Least concern	
14	Prionailurus bengalensis ssp. Heaneyi	Palawan Leopard Cat	Not yet assessed	Palawan
15	Sundasciurus juvencus	Northern Palawan Tree Squirrel	Least concern	
16	Sus ahoenobarbus	Palawan Bearded Pig	Vulnerable	Palawan
17	Tupaia palawanensis	Palawan Treeshrew	Least concern	Palawan
18	Viverra tangalunga	Malayan Civet	Least concern	

Appendix 4: English questionnaire IP's

1. How often do you leave the Sitio to make a half-day's walk or more into the forest?

2. Since you can remember, has the forest changed? Are there more or less trees? And the river, has it more or less water? And the amount of Animals?

3. Which of the following animals have you seen in the forest?

4. What animals have you hunted in the forest?

5. How often do you see Balintong (Pangolin) in the forest? And do you see more in dry season or wet season, or is it the same?

6. Did you see any Balintong in your agricultural fields/ slash and burn sights?

7. Could you guide us to 10 places you think our cameras would be able to record as many mammals as possible? (refer to map) If there's a place that would likely record Balintong (Pangolin), could you please guide us there?

8. What about each site makes you think it would be a good place for us to record mammal.

Appendix 5: Tagalog questionnaire IP's

Mga katanungan

Pangalan _____

1. Gaano Kadalas kayong bumibisita sa gubat? At anong dahilan.

Kasagutan: _____

2. Sa inyong pagkakaalala, mayrong bang naganap na mga pagbabago sa kagubatan?

Kasagutan: _____

3. Sa inyong palagay bumaba ba ang bilang ng mga punong kahoy?

Kasagutan: _____

4. Sa inyong palagay Nagbago ba ang lebel ng tubig sa mga ilog?

Kasagutan: _____

5. Sa inyong palagay may pagbabago ba sa bilang ng mga hayop?

Kasagutan: _____

6. Alin sa mga sumusunod na larawan ang inyong nakita sa kagubatan?

Kasagutan: _____

7. Anong mga hayop ang inyong hinuhuli sa kagubatan?

Kasagutan: _____

8. Kagaano nyo kadalas makita ang balintong(Pangolin) Sa gubat?

Kasagutan: _____

9. Sa anong panahon sila madals makita Balintong?

Kasagutan: _____

10. Mayroon bang mga balintong sa inyong mga kaingin? Paano nyo nasabing mayroong prisensya ng balintong?

Kasagutan: _____

11. Saan maaring ilagay ang mga kamera traps para makita.

Kasagutan: _____

Appendix 6: Camera site details

Camera traps											
ID	**Camera**	**Disturbance level**	**Type**	**Vegetation type**	**Mammal trail**	**Dead wood**	**Mammal traces**	**Remarks**	**WayPoint**	**X-coordinate**	**Y-coordinate**	**Elevation**
1	Highly disturbed Camera 1	Highly disturbed	Slash/burn	Bamboo forest	Yes	No	Cat dung, Other dung	Very steep hill	169	119.02256	10.02655	
2	Highly disturbed camera 2	Highly disturbed	Crop field	Bushland/forest	Yes	Yes	Porcupine dung	Taro crop field	170	119.02256	10.02389	74
3	Highly disturbed camera 3	Highly disturbed	Crop field	Bushland	Yes	Yes		Cassava and banana field	171	119.01706	10.02729	83
4	Slightly disturbed camera 4	Slightly disturbed	Mountain ridge	Forest	Yes	Yes			174	119.02197	10.03509	
5	Slightly disturbed camera 5	Slightly disturbed	Mountain ridge	Forest	Yes	Yes			176	119.02281	10.03521	345
6	Slightly disturbed camera 6	Slightly disturbed	Mountain ridge	Forest	Yes	No	Boar tracks	Close to water/drinking place	179	119.02520	10.03651	382

Appendix 7: Results interviews IP's

Name Villager	Go in the Forest	Change Animals	How often met Pangolin	Remarks Sightings	Which Season Most Pangolin	Slash/Burn	Recommendation CT
Martim Gupo	3x a Week	Not sure	Rarely		All year	Heard about it	Mountain ridge trail
Noel Bagarang	Daily	Same	Rarely		Summer	Eating ash	Bamboo forest
Merly Mauricio	Daily	Less animals	Never			Traces	Forest, Trees
Francis Eustaquio	Occasionally	Less animals	Rarely		All year	Unsure	Mountain ridge trail, Decomposed trees
Ilbimb Gupo	Daily	Less animals	Once	During Nighttime		Heard about it	Mountain ridge
Winsislaw Rameres	Daily	Less animals	Rarely			Traces	Mountain ridge trail
Jocelyne Gupo	2x a Month	Less animals	Never			Eating ants	Mountain ridge trail
Rosemay Sican	2x a Month	Less animals	Never			Eating ash	Mountain, High trees
Aneklito Bulontong Jr.	Daily	Less animals	Rarely			No	Deep Forest
Mary Jane Ramares	Rarely	Less animals	Never				Mountain ridge
Lucito Gupo	Daily	Less animals	Rarely				Mountain
Bisaya Gupo	Never	Less animals	Never	Only poached ones			
Binbinido Mucal Jr.	5x a Week	Less animals	Never		Dry Season	Traces	Mountain ridge trails
Analya B Gupo	Daily	Less animals	Once	During Nighttime		Traces	The Forest
Arlan Villairs	3x a Week		Rarely		All Year	Eating ants	Anywhere
Rica Gupo	Daily	Less animals	Once	Very Long time ago		Traces	Dead Trees

Appendix 8: Camera trapping sites

Disturbed camera #1

Disturbed camera #2

Disturbed camera #3

Undisturbed camera #1

Undisturbed camera #2

Undisturbed camera #3

Appendix 9: examples camera trapping results.

Masked palm civet (disturbed area cam #2)

Philippine long-tailed macaque (disturbed area cam #1)

Northern Palawan tree-squirrel (disturbed area cam #1

Binturong (undisturbed forest cam #3)

Palawan bearded pig piglet (Undisturbed forest cam #2)

Palawan leopard cat (undisturbed forest cam #1)