A Manual for Human-Elephant Conflict Monitoring

WILDLIFE CONSERVATION SOCIETY

Lao PDR Program

ອົງການ ອະນຸລັກ ສັດປ່າ

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Cover Illustrations: Asian elephant (*Elephas maximus)* near Ban Thalang, Nakai District, Khammouane Province. Photo: Khamkhoune Khounboline (DoF/WCS/ IUCN). Background of forest cover in Lao PDR. Photo: Stuart Chape (IUCN).

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Foreword

The Nakai Elephant Program implemented by the Wildlife Conservation Society (WCS), in conjunction with the Nam Theun Power Company (NTPC), studied Human Elephant Conflict (HEC) on the Nakai Plateau, Lao PDR, between 2004 and 2009. The methods and techniques described in this manual were used by the by both WCS staff and Nakai District Agriculture and Forestry Officers (DAFO) to document HEC in the area. This manual represents the second edition of a HEC training manual produced by the Nakai Elephant Program (see Hedges 2004, 1st edition).

Purpose of this booklet

The purpose of this booklet is to act as a training manual for Government of Lao PDR (GoL) staff, and others, who want to accurately and systematically monitor Human Elephant Conflict (HEC). It describes methods and techniques, consistent with MIKE protocols, by which HEC can be systematically recorded. The manual is designed to provide a practical guide for developing capacity needed to effectively monitor HEC incidents. As such the manual includes a basic overview of the status of elephants in Lao PDR, information about HEC and its origins, descriptions of technologies and equipment used for HEC monitoring, and proposes a monitoring protocol to be used for monitoring HEC. Since some of the techniques and technologies proposed for HEC monitoring in the manual may be new to some GoL staff, each technique is described in detail. No training manual or booklet can replace trainings delivered by experienced HEC numerators and as such we recommend the best use of this booklet is made in conjunction with training sessions facilitated by people who have extensive field experience monitoring HEC.

Introduction

The Lao PDR is often described as 'Lan Xang' (Land of a Million Elephants) and continues to have a rich culture and history in which the Asian Elephant (*Elephas maximus)* play a prominent role. For Lao people the Asian elephant is regarded as a symbol of the power and potential of the forest, and rightly so considering it is one of the largest land creatures on the planet. Statues and carvings of this magnificent animal adorn temples and houses throughout the country. The Asian elephant also still features in spiritual and cultural ceremonies and festivals held throughout Lao PDR (Figure 1A and 1B).

Figure 1. Asian elephants participating in cultural activities, Lao PDR ©AMcWilliam 2009.

For many of hundreds of years the elephant has helped humans to explore and exploit wild landscapes. Before cars and roads the elephant was a form of transport for royalty and explorers alike. The Asian elephant, somewhat ironically, is extensively used in logging operations to transport cut timber and supplies over terrain that is impassable for many vehicles (Figure 2A). As new technologies emerge these logging elephants are less and less required for these kinds of operations and are increasingly used in the tourism sector. Even today elephants in Lao PDR continue to carry travelers from around the world through the forests providing a unique vantage point. Researchers, naturalists, and scientists also continue to use the elephant as a means of exploring and carrying equipment (Figure 2B).

Figure 2. Asian elephants perform a demonstration of logging skills at the Lao Elephant Festival, Hongsa 2007 (left). Asian elephants assist in forest surveys, Xekong 2009 (right).

The worldwide population of Asian elephants is distributed throughout 13 range States from India to Vietnam and is "estimated" to be somewhere between 30,000 and 50,000 individuals. This is a large range and in reality it is little more than a best guess given that quantifiable and reliable estimates from the 13 range States is often lacking. Asian elephants are still widely distributed across Lao PDR (Duckworth et al. 1999, FAO 2002) and the country has what is probably the largest and most important Asian elephant population in Indochina (Duckworth and Hedges 1998) (Figure 3).

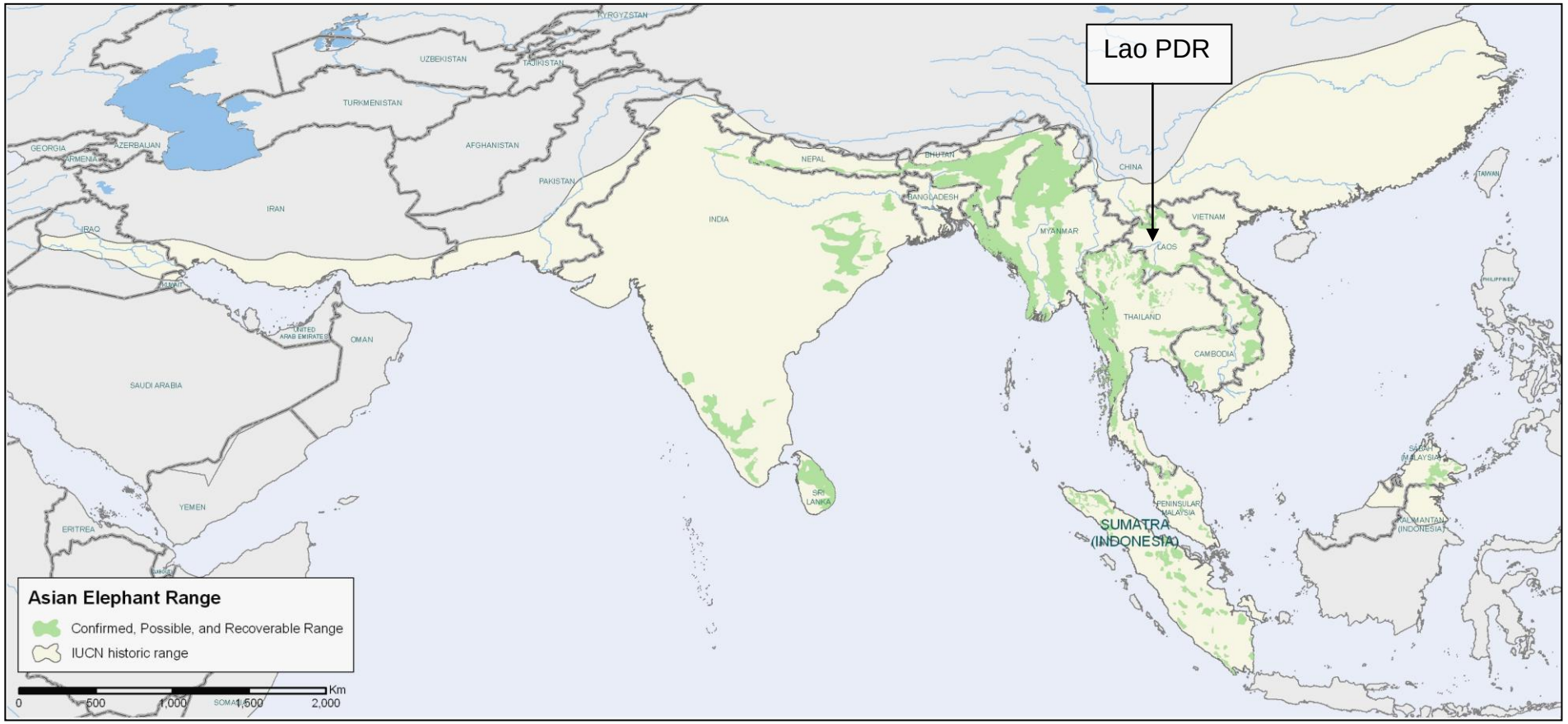


Figure 4 Asian elephant range. The green areas indicate the confirmed, possible and recoverable range of Asian elephants in the 13 range states. Source: WCS 2010.

The national population of Lao PDR contains both wild and captive elephants. Estimates of the total wild elephant population range from 2000-3000 (Venevongphet 1988), a maximum of 1202 (Khounboline 2002), to 602 individuals[1]. Individual wild elephant populations in Lao PDR tend to be relatively small containing between 5 – 200 individual animals and exist in National Protected Areas (NPA), adjoining Provincial Protected Areas and corridors (Duckworth and Hedges 1998), and also in areas not currently covered in the system of protected areas[2].

The largest and probably most viable elephant populations in Laos occur in 1) Sayaboury Province west of the Mekong, including Nam Phoui NPA, and 2) the Nakai Nam Theun area, including the Nakai-Nam Theun NPA, the Nam Kading NPA, the fringes of the Phou Hin Poun NBCA, and the Nam Theun and Nam Kading corridors linking the three areas. A recent comprehensive survey of the elephant population in the Nakai Plateau area conducted by the Wildlife Conservation Society and the Nam Theun Power Company, using two different survey methods, provided an estimate of 132 (95% CI=[120,149]) elephants (WCS 2007). Other populations in the country are believed to be smaller and some are probably fragmented (genetically isolated from other populations), although all remain potentially important for elephant conservation. Previous surveys have documented the presence of elephant populations in and around at least 18 of the 20 legally established National Protected Areas, which cover 14% of the land area (Duckworth and Hedges 1998, Southammakoth and Phanthavong 2003).

The population of captive elephants is estimated to be approximately 500 individuals (Elefant Asia, pers comms). Figure 5 shows an age pyramid for captive elephants in Lao PDR based on registration information collated by Elefant Asia.

[1] Figures presented at the Asian Elephant National Action Plan development workshop August 2008 conducted by WWF Laos.
[2] Figures presented at the Asian Elephant National Action Plan development workshop August 2008 conducted by WWF Laos.

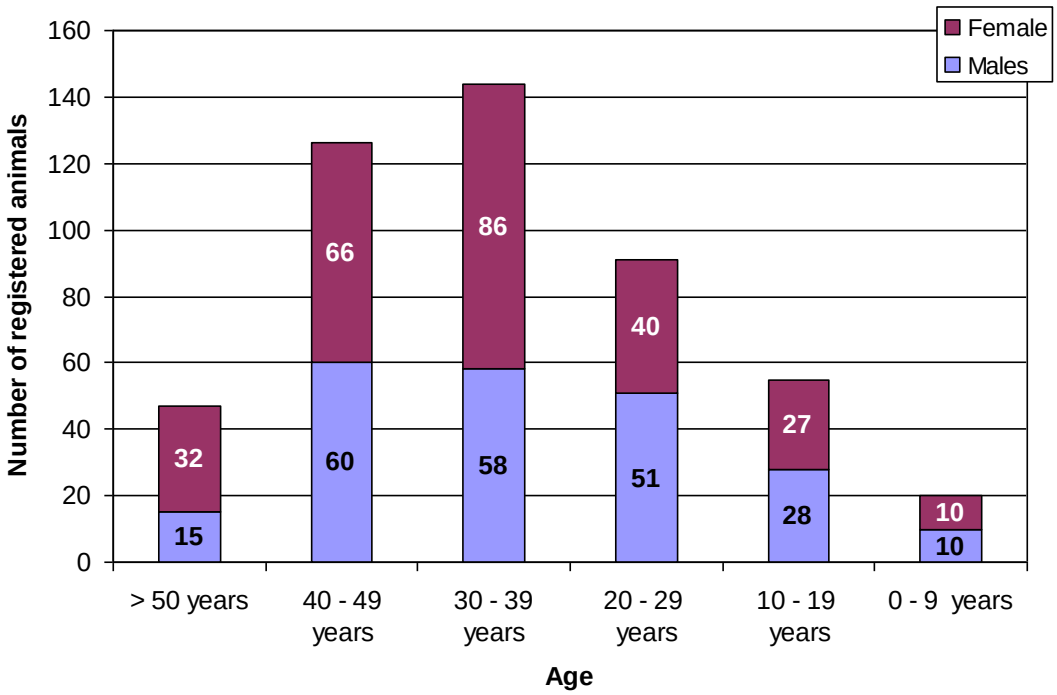


Figure 5. Age pyramid for Lao PDR captive Asian elephant population based on registered animals. Source: Elefant Asia 2009.

Overall the number of Asian elephants in the Lao PDR, and worldwide, is much reduced from historic levels and the species is classified as 'endangered' (IUCN 2010) with a population trend of decreasing. This means that Asian elephant faces a very high risk of extinction in the wild in the near future. The population estimates for Lao PDR between 1988 and 2009, despite being best guesses in many cases, are based on the best available information at the time and certainly reflect this overall worldwide trend of a rapidly decreasing population of Asian elephants.

For example, below is a figure and table which contrast different population estimates for different areas of Lao PDR from 2002 and 2009. Figure 6 is taken from the National Programme for Integrating Elephant Management and Rural Livelihood Improvement (FAO 2002). The most conservative population estimates from this figure provide an overall national population estimate of **732** Asian elephants. Table 1 was presented at the Asian Elephant National Action Plan Development Meeting hosted by WWF and DFRC during August 2009 and provides an overall national population estimate of **602** Asian elephants.

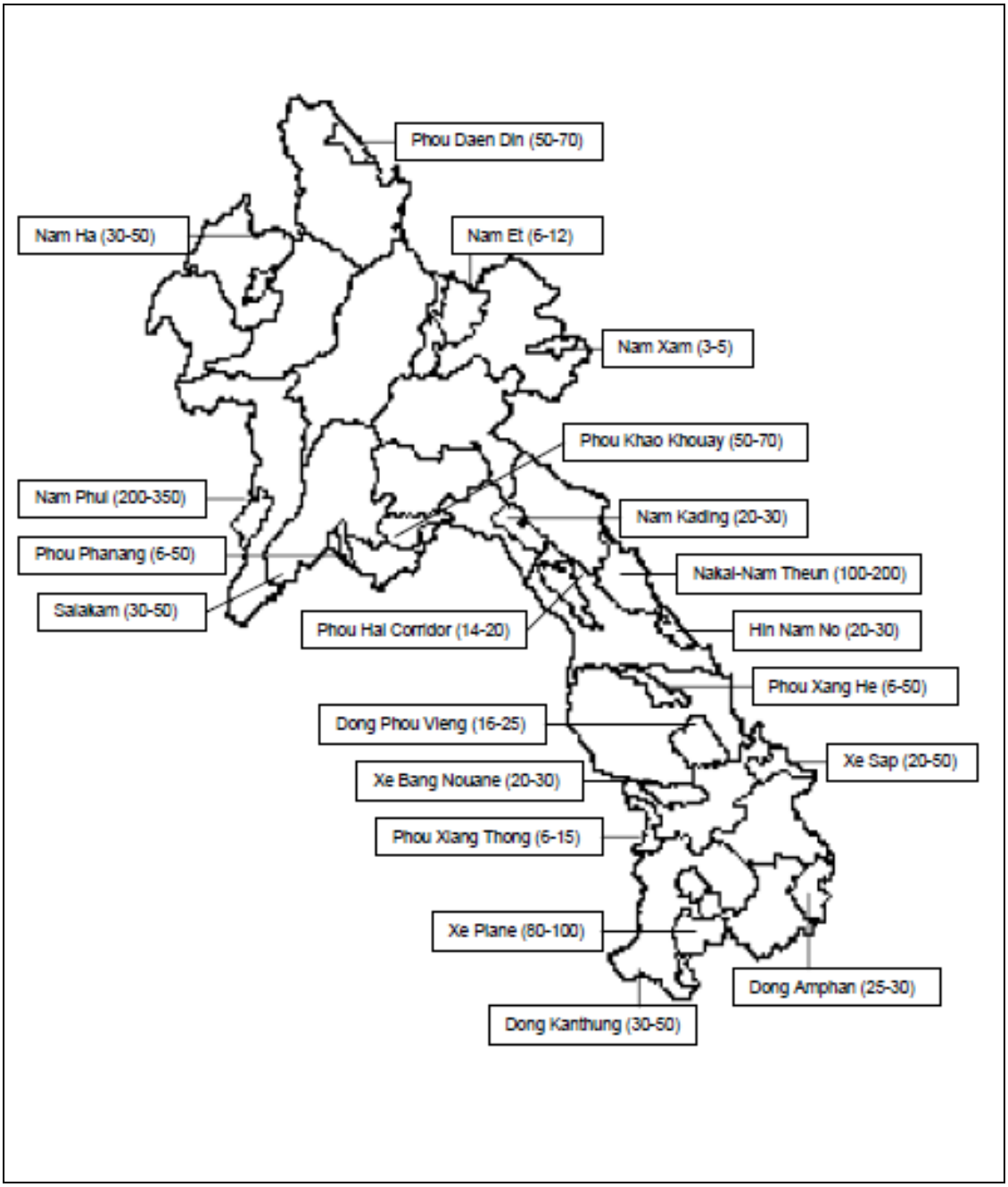


Figure 6. Distribution of estimated Asian elephant population in Lao PDR. Locations and population estimates from Khounboline (2002) and FAO (2002)

Table 1. Estimated Asian elephant population sizes in known elephant habitats, population trends, poaching intensity, human elephant conflict threat, and habitat conversion threat, Lao PDR. Source WWF 2009. Note the population estimate for the Nakai Nam Theun habitat is the only population for which surveys have been conducted according to internationally recognized standards (MIKE).

No	Name of elephant habitat	Province	Estimated population size (2009) WWF	Population trend	Poaching intensity	Human elephant conflict threat	Habitat conversion threat
1	Say Phou Louag	Bolikhamxai	10	declining	low	yes	no
2	Ban Na	Bolikhamxai	30	declining	high	yes	yes
3	Boualapha	Khammoun	20	declining	no	yes	yes
5	Dong Amphan	Attapeu	30	stable	low	yes	yes
6	Dong Khanthung	Champasak	20	declining	low	yes	yes
7	Dong Phou Vieng	Savannakhet	25	declining	high	yes	no
9	Nonggouy	Bolikhamxai	5	declining	medium	yes	yes
10	Phou Khao Khouay	Bolikhamxai	15	declining	medium	yes	no
11	Nakai Nam Theun	Khammoune	132	stable	medium	yes	yes
12	Nam Et	Houa Phanh	10	declining	low	yes	yes
13	Nam Ha	Louang Namtha	20	declining	medium	yes	yes
14	Nam Kading	Bolikhamxai	15	stable	no	yes	no
15	Nam Pouy	Xayabouly	100	declining	high	yes	yes
16	Sanakham	Vientiane	10	declining	high	yes	yes
17	Nam Xam	Houa Phanh	5	declining	no	yes	no
18	Phou Dending	Phonsaly	50	declining	low	yes	no
19	Phou Loun	Attapeu	10	stable	no	yes	no
20	Phou Thun	Xe Kong	30	declining	medium	yes	yes
22	Phou Xan He	Savannakhet	10	stable	high	yes	no
23	Phou Xieng Thong	Salavannh	10	declining	no	no	no
24	Xe Ban Nouan	Salavannh	10	stable	no	no	no
25	Xe Pian	Champasak	5	declining	high	no	no
26	Xe Xap	Xe kong	30	stable	no	no	no
	TOTAL		**602**				

The main threats faced by elephants in the Lao PDR are illegal poaching for ivory and other trade products, and being killed as a direct result of Human Elephant Conflict (crop raiding or human deaths). A more detailed list of threats to, and challenges for conserving, Asian elephants in Lao PDR will be presented in the Asian Elephant National Action Plan due to be released soon.

Recent cases of elephant poaching in Xayaboury Province (2008) and Phou Khao Khouay National Protected Area (2009, and historical records of elephant killings, highlight that the practice of killing elephants for trade products is an ongoing threat in Lao PDR (Table 2). As elephant habitat is converted to land for agriculture, logging, hydropower and mining projects, and infrastructure development elephants are compressed into increasingly smaller areas of suitable habitat. Often these areas adjoin places where people live and as a result there is an increase in Human-elephant Conflict (HEC) as human and elephants compete for resources.

Table 2. Incidents of killings of Asian elephants in Lao PDR 1990-2009. Source, WWF 2009.

Province	District	NPA	Number	Incident type	Year
Khammouane	Nakai	Nakai Nam Theun	15	ivory	1990
Khammouane	Nakai	Nakai Nam Theun	10	ivory	1996
Vientiane	Phou Panang	Phou Panang	1	conflict	1996
Attapeu	Xaysetha	Dongampham	3	ivory	1990
Houaphan	Nam Xam	Nam Xam	4	ivory	1990
Houaphan	Nam Et	Nam Et	5	ivory	1985
Khammouane	Hin Nam No	Hin Nam No	2	ivory	1994
Xekong	Kalum	Xe Sap	1	ivory	1999
Bolikhamxay	Tapabad	Nakai Nam Theun	1	conflict	2000
Xaygnabouly	Nam Pouy	Nam Pouy	15	ivory	2001
Khammouane	Nakai	Nakai Nam Theun	1	conflict	2003
Xaygnabouly	Nam Pouy	Nam Pouy	1	ivory	2003
Bolikhamxay	Thapabad	Phou Khao Khouay	2	conflict	2004
Vientiane	Phou Panang	Phou Panang	1	ivory	2004
Xekong	Thateng	Phou Thum PPA	1	ivory	2004
Bolikhamxay	Thapabad	Phou Khao Khouay	1	ivory	2004
Bolikhamxay	Thapabad	Phou Khao Khouay	3	ivory	2005
Louang Namtha	Sine	Nam Ha	1	conflict	2005
Attapeu	Xangxay	Dong Ampham	1	ivory	2006
Savannakhet	Nong	Dong Phou Vieng	1	ivory	2006
Savannakhet	Nong	Dong Phou Vieng	1	conflict	2006
Vientiane Capital	Sangthong	Phou Panang	1	ivory	2006
Vientiane province	Sanakham	Kodkhaodor	5	ivory	2006
Louang Namtha	Sine	Nam Ha	1	conflict	2006
Bolikhamxay	Bolikhan		2	ivory	2007
Salavanh	Kongxedong	Phou Xieng Thong	1	trade	2007
Salavanh	Phou Xieng Thong	Phou Xieng Thong	1	trade	2007
Xaygnabouly	Pieng	Nam Pouy	2	trade	2008
Savannakhet	Palang	Phou Xang He	4	trade	2008
Vientian/Bilikhaxai	Thapabad	Phou Khao Khouay	5	trade	2009
Vientiane Capital	Sang thong	Phou Panang	1	trade	2009

Incidents of conflict between elephants and humans, such as crop raiding and sometimes deaths of humans or elephants, are on the increase in Lao PDR (FAO 2002). Overall, very little quantitative information is available on elephant numbers, distribution, origins of human elephant conflict, the real costs of these conflicts, or economic impacts of HEC at local, district, provincial and national levels (FAO 2002). This makes it difficult to formulate government policies and develop management practices to deal with HEC situations.

What is human elephant conflict (HEC)?

The IUCN/ SSC African Elephant Specialist group defines human elephant conflict (HEC) as;

"any human elephant interaction which results in negative effects on human social, economic or cultural life, on elephant conservation, or on the environment".

HEC can be further categorized as either **direct or indirect** according to how it impacts upon people.

Direct HEC includes the following situations;

Crop Damage- crop damage is the most prevalent form of HEC in Lao PDR. Elephants commonly damage rice, both dry upland and wet irrigated rice (Figure 7A). Other crops that are often targeted during elephant raids include banana, coconut, cassava, corn, sugarcane and pineapple (Figure 7B). During HEC monitoring in the Nakai area between 2007 and 2009 a total of 17 different crop types were damaged and destroyed by elephants. Groups of elephants can destroy large areas of a single crop in a single night. One example of this was a raid during a single night in Nakai when a small group of elephants (most likely 2 individuals) destroyed 93 banana trees.

Figure 7. A. Rice crop damaged and eaten by elephants. B. Banana trees destroyed by elephants. Both images from the Nakai Plateau area. ©Alex McWilliam WCS/ 2008.

Human death and Injury- Elephants have both injured and killed people in Lao PDR in recent years. For example in the Nakai area between 2000 and 2002 three people were killed during encounters with elephants in forested areas near Thalang village. During the 2002 incident a person was also seriously injured.

Elephant death and injury- Many of the elephants in Lao that are killed by humans are either as a result of wildlife poaching to obtain products for trade, such as tusks, trunk, feet, tail and skin, or in retaliation for crop raiding. Some recent examples are;

May and August 2008 – a total of 5 male elephants (two wild and three domesticated) killed in Xayaboury province (Figure 8). The tusks from all males were removed and some others had their tails removed.

Figure 8. Two elephants illegally killed in Nam Pouy National Protected Area, Xayaboury province during 2008 (PAFO 2008).

March 2009 – a total of 5 elephants, both male and female, reported killed in Phou Khao Khouay. Details about all the deceased animals are not known, although, two animals had their tusks, tail, trunk, and teeth removed.

2000 – a female elephant killed at Ban Na village in Bolikhamxay province while he was defending planted sugarcane. The villager involved received a heavy fine and also a jail sentence (FAO 2002).

Legal status of Asian Elephants in Lao PDR

Under the Lao PDR Wildlife and Aquatic Law (2008) all wildlife belongs to the nation which is represented by the state. According to this law the Asian elephant is listed as a Category 1 protected species. As such it is illegal to hunt, kill, capture, buy, sell, elephants or elephant parts and products within Lao PDR. Lao is also a signatory to the Convention of International Trade in Endangered Species (CITES). CITES controls, and in some cases prohibits, the international movement of wild plants and animals, alive or dead, whole or parts there of ("specimens" of species). For Lao PDR this treaty includes Asian elephants.

Damage to property- Elephants may also cause damage to property such as fencing, field huts, and irrigation systems (Figure 9). In the Nakai area this type of damage is prevalent in the dry season.

Figure 9. A villager from Thongkhong village, Nhommolath district, points to a house destroyed by elephants.

Indirect HEC may not directly impact livelihood but can still have a negative effect upon people's lives. An example of this is people not going to the forest to collect NTFP's or firewood because they are afraid of encountering elephants. During the major cropping wet season famers may guard their rice fields due to the threat of elephants raids and as such forgo opportunities to participate in other livelihood or village activities. In Nakai some farmers no longer plant crops such as banana and pineapple because these crops have repeatedly been raided by elephants in the past. Often these indirect costs of HEC are very difficult to monitor and quantify in term of monetary cost. Nonetheless, they do impact people's livelihoods and should be considered in management practices.

There are many other animal and insect species that damage farmer's crops, for example buffalo, wild pigs, birds, rats and mice, and grasshoppers. On a provincial scale the overall amount of yield loss caused by elephants may be small when compared to other species such as rats or insects. Despite this the yield loss to an individual farmer from a single crop raid by an elephant group can be considerable. Many farmers in Lao PDR are subsistence farmers and a single raid can severely affect a family's food security in the near future.

Why monitor HEC?

It is not possible to address the problem of HEC very effectively by management actions in any area without information about what it is elephants are damaging and where and when these damage incidents occur. If management authorities follow

standardized monitoring procedures for all HEC incidents, the data collected will be of consistent quality and therefore be reliable enough for summary and analysis. This will mean that two things can be achieved: (1) comparisons between different areas experiencing elephant problems will be valid and (2) management decisions on 'problem elephants' can be made on the basis of good data and do not have to rely on guesswork.

Accurately documenting HEC in the Lao PDR will not only help to better develop government policy aimed at reducing HEC but also assist government departments responsible for wildlife management to make well informed decisions regarding this very important and endangered species.

There area three general aspects that we need to know about in order to effectively manage HEC. These are;

- distribution *(where they are happening?)*
- frequency *(when they are happening?)*
- severity *(what is being damaged and how badly?)*

Elephant ecology

The Asian elephant (*Elephas maximus*) is a completely different species to the African elephant (*Loxodintia africana*). Although smaller than the African elephant a large male Asian elephant can weigh up to 4500kg and stand 3m tall whereas a large African elephants can weigh up to 7000kg and stand 4m tall. Asian elephants can be easily distinguished from the African cousins by their smaller ears and their back is slightly rounded or flat, unlike the concave backs of African elephants. Asian elephants also have a single finger on the lip of their trunk whereas the African species has two fingers. See box 1 for more details on Asian elephant ecology.

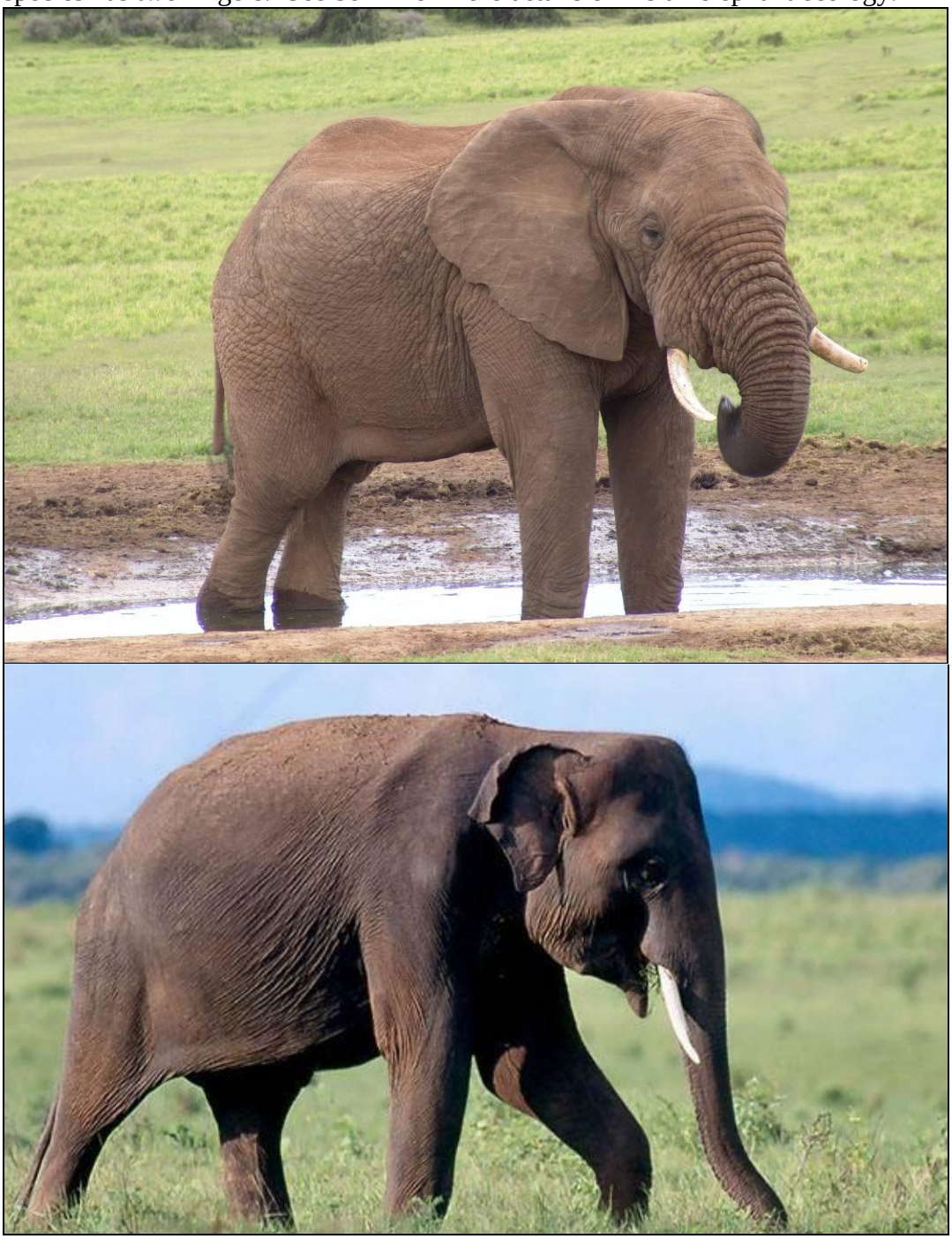
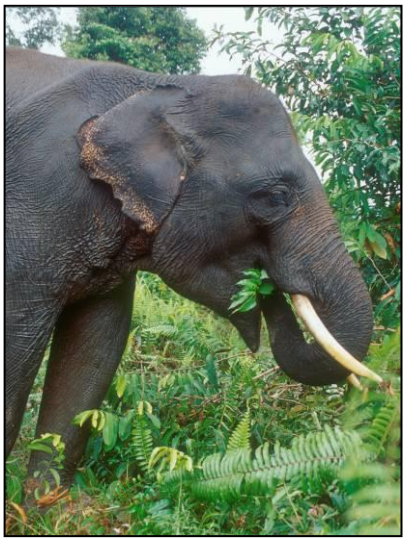


Figure 10. African elephant (*Loxodontia africana*) above and Asian elephant (*Elephas maximus)* below. Note the smaller ears and a more rounded back on the Asian elephant.

Box 1. Asian Elephant (*Elephas maximus*)



Distribution: Asian Elephants occur in 13 countries across South and Southeast Asia, with the largest population in India.
Adult weight: 2700-4500 kg
Food: Elephants can eat up to 250 kg per day. Elephants are herbivores and generalist feeders, consuming a large number of plant species. They spend most of their time foraging for food such as grasses and other leaves, bamboo, vines, bark, and roots. One study in India found that Asian Elephants ate 112 different kinds of plants
Minerals: Asian Elephants also eat soil from natural mineral licks which contain sodium salts and other minerals to supplement their diet
Water: An adult elephant can drink up to 150 liters of water a day
Behavior: Cows will form groups of up to 20 relatives led by the oldest female who coordinates the groups search for food and water. Males may travel alone or in small groups when they are younger.
Reproduction and life cycle: Asian Elephants become sexually mature at about 15 years of age. Female elephants are pregnant for 18–22 months. When an elephant calf is born it usually weighs about 100kg. Female elephants will stay with their herd for their entire lives but male elephant will leave the herd when they are about 7–8 years old. Females can give birth to a calf once every 3–4 years if they live in high quality habitat. Asian Elephants can live to be 70 years old.
Sense of smell: Asian Elephant have an extremely good sense of smell and can detect scents up to several kilometers away
Hearing: Asian Elephants can hear very well and use their large ears to amplify sounds. They are able to communicate with each other using infrasound. Amazingly, the frequencies of these sounds are so low that humans cannot hear them and elephants can communicate over distances of up to 10km using them. Elephants also use their large ears to lose heat and so keep themselves cool.
Sight: Elephants actually have fairly poor sight but make up for it with excellent hearing, sense of smell, and touch.
Trunk: An elephant trunk is a union of its nose and upper lip and contains over 100,000 muscles. It is extremely useful to an elephant and can be used to pick up a small nut just as easily pull down a tree. Elephants do not drink water with their trunk but suck water into it that they then squirt into their mouth. Trunks are used in eating, drinking, smelling and breathing, touching, vocalizing, washing, dust-bathing, and fighting.
Tusks: Male Asian Elephants have tusks; females only have small tushes which rarely protrude beyond their lips. These tusks and tushes are made of ivory, and elephants are often killed illegally to obtain their tusks which command high prices in illegal international markets.

Crop raiding behavior

Although exceptions will always occur, the following generalizations can be made about crop-raiding situations and behaviour by elephants:

- even in extensive elephant habitats, when part of a group's or individual's (in the case of adult males) home range is converted to agriculture, the elephants recognize the converted areas as an abundant and nutritious food source, and raiding them may become part of their foraging strategy. Essentially, cropping turns what may have been a seasonal or "average" environment for elephants into a very attractive one.

- although difficult to quantify, a proximate cause of much crop-raiding behaviour may be destruction or degradation of adjacent elephant habitats, resulting in a paucity of natural food resources in forest areas. Other related factors may be harassment by poachers, disturbance resulting from human activities in elephant habitats (e.g., logging), direct displacement by development activities (e.g., dam and reservoir construction), and disruption of seasonal migration routes.

- where individual forest/habitat patches in fragmented landscapes are too small to support elephant populations, fields containing highly nutritious crops are a powerful attraction to elephants. Long, narrow forest patches within a primarily agricultural matrix (or conversely long, narrow agricultural patches within a forest matrix) result in an extensive boundary between cultivation and elephant habitat, resulting in increased crop depredation. In the worst case scenario, elephants may become isolated in patches of forest and be able to obtain their food only from surrounding crops.

- elephants damage crops in a way that varies greatly from location to location, and also over time. There are few spatial trends, making it difficult to predict where conflict will take place. For example, one village may be heavily damaged by elephants while the next village may receive no damage at all.

- some commonly grown crops (e.g., rice, cassava, coconut, sugarcane, pineapples, bananas, corn) are particularly palatable and hence vulnerable to damage by elephants. Conversely, other crops of potentially similar economic value (e.g., tea, coffee, chilli peppers) are unpalatable and unlikely to be raided by elephants.

- normally only a small proportion of any given elephant population engages in crop raiding behaviour. When crop-raiding does occur all sex and age groups may be involved, although adult males tend to raid with greater frequency and persistence.

- elephants most often raid crops and damage property at night

- often there is an increase in elephant crop raiding during September to December each year as the main crop, rice, is becoming mature and ready for harvest

Figure 11. Cropping areas adjoining known elephant habitat provide excellent raiding opportunities. Thongkhong village, Nhommolath District, Lao PDR.

HEC Monitoring

An effective HEC monitoring system relies on many components to ensure that each incident is reported, responded to, and data is collected by monitoring teams according to a standardized protocol.

Establishing an informant network

Before any standardized HEC monitoring can begin enumerator's first need to be notified that a HEC incident occurs. Often HEC can occur in a number of villages distributed over a large area and it is not possible to place enumerators in all of these villages. Therefore often notification of HEC incidents will come from the villagers themselves. Thus it is very important to develop a relationship with each village in the area in which HEC is occurring in order to receive reports from them.

Meet with the Headman and village executive members at villages and tell them about the intention to monitor HEC in the area. Have a general meeting with village community to inform them of who the HEC enumerators will be, how the enumerators will monitor HEC incidents after they occur, and most importantly why it is essential to collect this information. During these meetings you should also inform people exactly how they can contact monitoring teams following a HEC incident and encourage them to report as soon as possible. The sooner a HEC incident is reported the more accurate the information provided about the event is likely to be. Also it will

be easier to asses crop and property damage if it is soon after the event. For example, if farmers report a HEC incident involving extensive damage to rice crops many weeks after the incident occurred then it will likely be very difficult to accurately quantify the damage.

Meet with representatives from other projects and/or government departments working in the area and cover all of the above and request them to pass on any information they receive from villages regarding elephant movements or HEC. If these projects and government departments are aware that HEC data is being collected in the area then they can be an additional source of HEC reports.

In addition to a villager, and other, informant networks it is advisable if HEC monitoring teams visit villages in the affected area at least once per month, or, as often as is deemed necessary in the area.

Reporting HEC incidents

It is very important to have a clear and defined system as to how villagers can report incidents to HEC monitoring teams.

Every situation is different and HEC monitoring team leaders will need to develop a system that is appropriate for the area in which they work.

In the Nakai Plateau area WCS developed 4 means by which villagers can report HEC incidents.

1. Regular monthly visits to villages known to experience HEC and once per week for villagers identified as HEC 'hotspots'
2. When villages travel to the regional center where staff are based they report directly to the team
3. Villagers report incidents via telephone if the area has mobile phone reception.
4. Villages that have access to a VHF radio can report using this
5. Villagers can inform officials or staff of other government agencies that visit villages and those officials then report directly to the HEC monitoring team.

It is a good idea to have posters in each village to remind villagers to report HEC incidents. The best places to display these posters is in areas where people from the village often gather, such as at the Headman's house, the village office, or the village school. It is recommended that these posters by as simple as possible and visually appealing. Laminating the posters to make them weather resistant is also advisable. An example poster that was used in the Nakai area is presented in Appendix 1.

Responding to a HEC incident

HEC monitors should visit the site of an incident as soon as possible after the incident occurs. Ideally, the assessment of crop damage should take place the day after the incident occurred.

This is for a number of reasons;

1. Farmers will see the HEC monitoring teams are active in their work
2. Conditions at the site of the incident may change very quickly.
   Some example of this are
   a) Often elephants will return to a crop raiding site on consecutive nights or within the same week. As such if the HEC monitoring team arrives one week after the indents occurred and elephants have crop raided more than one time in the same field it can be very difficult to tell which area was damaged on which day/night.
   b) Farmers may be in the process of harvesting crops. If the HEC monitoring team delays their visit to the site of an incident it may be difficult to distinguish which area was damaged by elephants when crops around the area have already been harvested
   c) If a rice crop is damaged early during the growing season farmers may choose to replant the area following an elephant raid. This can make it difficult to determine where the damaged area was.
   d) Farmers will better remember the exact details of the incident

The key to any data collection is consistency and an attention to detail. A HEC monitoring protocol is designed to help maintain consistency and ensure that all the details of a HEC incident are recorded.

The HEC monitoring team

How many HEC monitoring teams are required in your area will depend on how large the area is and how many staff can perform the task. In the Nakai area we had two monitoring teams of two people each. These teams monitored HEC regularly in 17 villages and surrounding areas.

It is recommended that each HEC monitoring team consist of two people. Having two people in each team is safer if the team has to travel a long distance to a HEC incident site. The two team members can also measure cropping areas quicker and more efficiently, and confer about qualitative data such the quality of crops. It is important that all HEC monitoring teams follow the same monitoring protocol and receive training about how to conduct HEC monitoring.

Techniques and technologies

The HEC monitoring data form

There are many different types of HEC incident. The datasheet presented in this manual was designed for HEC monitoring in the Nakai area. The form is sufficient for most types of HEC, although, if an elephant dies or is killed, or a person is injured or killed by an elephant, then a more detailed report of the incident is usually required. The Monitoring of Illegal Killing of Elephants program, or MIKE, developed by the International Union for the Conservation of Nature (IUCN) has specific forms for these types of incidents, see http://www.cites.org/eng/prog/MIKE/index.shtml.

General Protocol

The general idea is to interview the farmer about details of the incident and, inspect and measure the area where the HEC incident occurred.

Steps to be completed for each incident;

1. Conduct interview with farmer/s
2. Record location data using a GPS
3. Measure and sketch HEC incident area
4. Draw scale map of the incident and calculate areas
5. Add incident data to data management system

Once a HEC report is received the team should travel to the affected village as soon as possible. Upon arriving at a village the HEC team should notify the Nai Ban of their arrival and that they would like to speak with the farmer/s that have been affected by HEC

Upon meeting the affected farmer/s the team should;

a. introduce themselves and where they are from
b. explain that they would like to interview the farmer/s about the incident
c. explain to the farmer/s that the HEC monitoring team would like to inspect and measure the area were the HEC incident occurred

It is best if the farmer/s can accompany you to the field so as to show the HEC team exactly where the HEC incident occurred. Farmers are often busy with tending to crops or other activities. To minimize the amount of time the farmer/s spend with the HEC team conduct the interview first and then ask the farmer to show you the entire area of the affected crop and the area which has been damaged by elephants.

It should be made clear that data are not being collected in order to pay the farmer compensation for the crop damage. If permission is refused, the team should attempt to politely persuade the farmer, but if he/she still refuses they should accept this. No money should be offered to farmers as compensation for crop losses.

If permission is refused, if there is no time to measure the damage, or if the damage occurred too long ago and so it is no longer possible to measure the damage accurately, the HEC teams should complete the following sections of the datasheet:

- Location, date, and other general information about incident
- Problem animals
- Problem Animal Control
- Other comments
- Date crop planted

If farmers were successful in driving elephants away from a field and no damage occurred it is VERY important to record this. In such cases, the HEC teams must complete the following sections of the datasheet:

- Location, date, and other general information about incident
- Problem animals
- Problem Animal Control
- Other comments
- Date crop planted

HEC incident assessment report

(Be careful to mark every question with an answer.)

Location and date

Location (GPS data for site where damage occurred):_____E, _____N

District:_____ Date damage occurred:_____

Village:_____ Date of complaint:_____

Farmer (owner of the field):_____ Date assessed:_____

Reported to the HEC team by:_____

HEC team assessors:_____

Crop damage (you must make a sketch map on the back of this sheet. Use a new report sheet and make a new map for every field with damage)

Crop type	Stage (seedling, intermediate, mature)	Date planted	Quality of crop (poor, average, good)	Total area of crop (m^2)	Area damaged (m^2)	Eaten or damaged or both?	Intensity of damage (low, medium, high)

Other damage

Damage to any property (e.g. fences, huts) or injuries/deaths (give details):_____

Problem Animals

Elephants seen? (circle one): Yes No → If yes, by whom?_____

Number of animals? (If seen):_____

Tracks seen? (circle one): Yes No → If yes, by whom?_____

Sex of elephant (circle one): All males All females Mixed Unknown

Calves present? Yes No Unknown → If yes, seen or tracks?_____

Time of entry?_____

Time of exit?_____

Problem Animal Control (PAC)

Was PAC used at the time of the incident? (Circle one) Yes No

What methods were used?_____

Number of people?_____ Time PAC started?_____

Names of people? _____ Time PAC finished?_____

Reaction of elephants: (give details and be specific)

Other comments (continue on back of sheet if necessary):

How to fill in the crop damage assessment datasheet

Most of the datasheet is self-explanatory. The following guidelines should however be read before using the datasheet.

Location, date, and other general information about incident section

- **"Location** (GPS data for site where damage occurred)**"**: It is very important that you remember to record the GPS location data! The GPS location for the HEC incident should be taken at the actual site where the incident occurred. Not at the farmers field hut, not nearby the incident, not at the village but at the site of the incident.
- **"Farmer"**: Write the name of the owner of the field as well as the farmer's name if these are different.
- **"Village"**: This is the name of the village where the farmer lives.
- **"District":** The name of the district that contains the village.
- **"HEC team members":** Write down the names of all the people in the HEC team that assessed the incident.
- **"Damage reported to HEC team by":** You should write the name of the person who reported the incident to the HEC team. This may be a different person to the farmer, e.g. it may be the village headman.
- **"Damage to property or injuries/deaths (give details)":** This is where you record details of damage to buildings, equipment, injuries to farmers, etc. Continue on the back of the sheet if necessary.
- **"Crops grown (ask the farmer)":** Ask the farmer to tell you all crops grown in the fields affected by the elephant raid.
- **"Crops damaged (ask the farmer)":** With the farmer/s the team should investigate the crop damage to determine which plants/ crops were damaged.
- **"Date incident occurred":** This is the date that that the elephants raided (or attempted to raid) the farmer's crops, damaged his property, etc.
- **"Date incident reported":** This is the date that the incident was reported to the HEC team.
- **"Date incident assessed":** This is the date the HEC team visited the site of the incident.

Crop damage section

- **"Crop type"**: Write all crop affected by the crop raiding incident, **using a new line for each affected crop** present in the field. **(Use a separate sheet for every field.)** Continue to write on the back of the sheet if necessary.
- **"Crop's average growth stage (seedling, intermediate, mature)"**: The HEC team should assess visually the average growth stage of the crop plants **in the total field area that is planted with that crop**. The definitions are given below:
  - **"Seedling"** is when the crop is at an early stage of growth;
  - **"Intermediate"** is when the crop is established but does not yet have fruits (although it may have flowers);
  - **"Mature"** is when the crop is producing fruits (although they do not have to be ripe to qualify as mature).

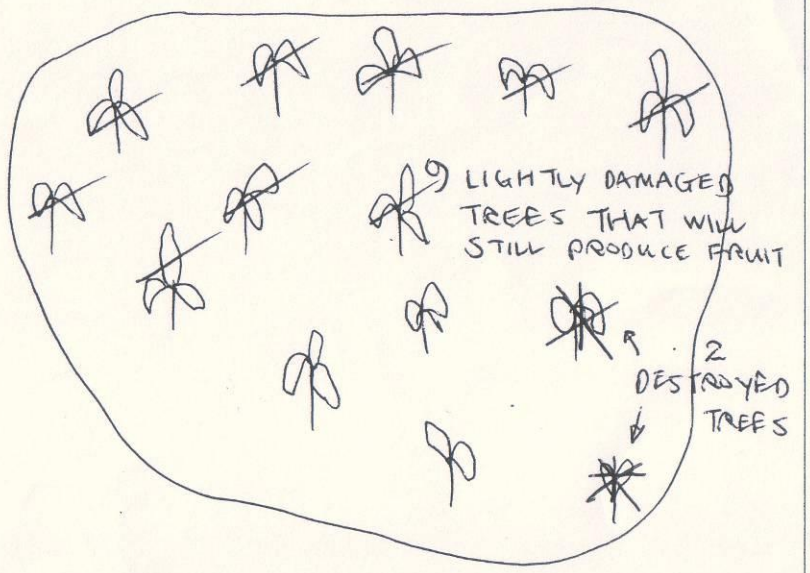
- **"Date planted"**: If the farmer knows the month, then record that, otherwise record how the farmer describes the time when they planted the crop (e.g. "three full moons ago").
- **"Average quality of crop"**: The HEC team should assess visually the average quality of the crop plants in the total field area planted with that crop. The definitions are given below:
  - "Poor" if the crop is of obvious low quality;
  - "Average" if the crop is in reasonable condition;
  - "Good" if the crop is obviously high quality.

  This is up to the judgement of the HEC team members. Team members should come to a consensus as to the quality of the crop.
- **"Total area (m²) or number of stems of crop"**: Remember this is not necessarily the area of the field if, for example, more than one crop is grown in the field. See "Determining areas covered by crops and areas damaged by elephants" below for information about measuring crop areas.
- **"Area (m²) or number of stems damaged"**: See "Determining areas covered by crops and areas damaged by elephants" below for information about measuring damaged areas.
- **"Eaten or damaged or both?"**: When inspecting the crop team members should decide whether elephants have 'eaten' or 'damaged' sections of the crop. If elephants have both damaged portions of the crop, for example by walking on it, and eaten other portions then the team should write 'both'.
- **"Intensity of damage"**: The HEC team should assess visually the average intensity of damage for the crop plants in the damaged areas (Figure 12). The definitions are given below:
  - "Low" if the crop plants are slightly damaged (e.g. torn leaves and bent stems, but may recover to produce fruits / be suitable for harvest);
  - "Medium" if less than 50% of the crop plants are uprooted or damaged so badly that they will never produce fruit / be suitable for harvest;
  - "High" if 50% or more of the crops are uprooted or damaged so badly that they will never produce fruit or be suitable for harvest

Figure 12. Examples of assessing the intensity of crops

(a) The small areas of rice that were damaged by elephants were nonetheless almost completely destroyed so the intensity of damage is high because it is a measure of the damage done within the damaged areas <u>not</u> the whole field.

(b) Of the 14 banana trees in the field, 2 were completely destroyed by elephants and 9 were slightly damaged, so the intensity of damage is "medium" (because 2 out of 11 affected trees are damaged so badly that they will never be suitable for harvesting and 2 out of 11 is <50%).



Other damage ***section***

In this section write down any details of damage done to property (eg buckets), structures (eg field huts) or persons. Be as specific as possible.

Problem animals ***section***

- **"Animals seen? Yes/No If yes, by whom?"**: Write down the name of any person who reports they saw the elephants.
- **"Tracks seen? Yes/No If yes, by whom?"**: Again write down the name of any person who reports seeing tracks.
- **"Number of animals if known"**: Self-explanatory; if unknown, write "unknown". Farmers often try to estimate the size of groups by looking at the track the next morning. This is not an accurate way of determining how many elephants there were. The answer in this situation is unknown. You can write that the farmer "estimates" there were, for example 3 elephants, in the Other Comments section at the bottom of the datasheet.
- **"Sex of animals"**: All males/all females/mixed/unknown": Self-explanatory.
- **"Calves present? Yes/No/Unknown If yes, seen or tracks?"**: Self-explanatory.
- **"Time of entry"**: If the farmer does not have a watch, then ask the time of day, e.g. "evening", "after dark", etc.
- **"Time of exit"**: If the farmer does not have a watch, then ask the time of day, e.g. "evening", "after dark", etc.

Problem Animal Control (PAC) ***section***

- **"Was PAC in use at time of incident?"**: Ask the farmers whether they attempted to keep elephants out of their fields or attempted to chase them out once they had entered.
- **"Methods":** If PAC was in use, what methods were used? Write these here, e.g. "burning chillies and banging bamboo tubes".
- **"Number of people?"**: Write down how many people were involved in the PAC.
- **"Names of people":** Write the names of people who were involved in PAC.
- **"Time PAC started":** If the farmer does not have a watch, then ask the time of day, e.g. "evening", "after dark", etc.
- **"Time PAC finished":** If the farmer does not have a watch, then ask the time of day, e.g. "evening", "after dark", etc.
- **"Reaction of elephants":** For example, did the elephants run away or did they get angry and chase people? Write further details on the back of the datasheet of necessary.

Other comments *(continue on back of sheet if necessary)*

Use the back of the sheet to record any additional information about the incident, or any information that you cannot fit into a particular section of the datasheet. It is very important that team members record as much detail about the incident as possible.

General guidelines

Do not forget to check that all data have been collected before you leave a crop field or other HEC location!

Determining crop areas and areas damaged by elephants

Dealing with multiple-crop fields1:
Fields that contain more than one crop growing in separate (discrete) areas.
Remember we are only interested in crops damaged by elephants. So, for example, if a field has been planted with rice in its western half and maize in its eastern half, and only the maize has been damaged by elephants, then the team should only map the area planted with maize.

Dealing with multiple-crop fields 2:
Small numbers of crop plants growing (inter-planted) within an area planted with another crop.
(e.g. a rice field that contains 3 cassava plants and 2 chilli plants as well as rice). If it is easy to count these other plants then count them and make a note of how many of each type is present. Remember we are only interested in assessing crops damaged by elephants, so if these plants were undamaged, then there is no need to record their planting date, growth stage, etc.

Dealing with multiple-crop fields, 3:
Fields containing significant (= uncountable) numbers of two or more crops inter-planted.
In such cases, measure the area of the field and estimate the proportion of the area covered by each crop type. In such cases it is likely that all crops will be damaged if a crop-raid occurred, and so it is necessary to record data on planting dates, growth stage, quality, etc. for all crop types present.

Elephant trails through crops
If elephants have created a trail through a crop this usually means that the crop they have walked through has been damaged. For elephant trails through crops, just measure the length and average width of the trail. Take care to make sure the Hipchain thread follows the trail when you walk along a curving trail. You can do this by looping the thread around a stem or branch. If you do not do this, the Hipchain thread will follow the shortest distance between the start and end of the trail rather than following the actual route of the trail.

Measure the width of elephant trails to the nearest 0.5 m (so, 0.1 to 0.4 m = 0.5 m; 0.6 m to 0.9 m = 1.0 m).

Be careful not to damage crops when measuring fields!

If crops can be counted (e.g. banana trees, sugar cane plants) then count them unless there are too many to count, in which case measure the areas covered by these plants.
Interview techniques

It is best to conduct the interview in an area that is comfortable for the farmer/s (Figure 13). In the shade or at the farmers' field hut is a good place. All HEC team members should be present at the interview. The team member not conducting the interview should make notes in their own work diary about the incident and be present to clarify answers provided by the farmer or to answer any questions the farmer may have.

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An appropriate interview technique is to show sympathy for the farmer you are interviewing. Make it clear that you understand elephants are a problem for them.

Do not waste farmers' time. For example, when you are asking them to show you the perimeter of their fields do not map the field with compass and Hipchain while walking with the farmer. Instead, ask the farmer to quickly identify the boundaries of his/her cropping area. Make a simple sketch map showing the corners of the field, then let the farmer get on with his/her work while you go back and map the field accurately using the compass and Hipchain.

Do not interrupt the farmers' stories when, for example, they are describing a crop-raiding incident because the story may contain valuable details. Also do not prompt answers from the farmer, let them describe the incident in their own words.

Think about whether the farmers' stories make sense. If the stories do not make sense, for example, a farmer says the incident happened during a dark rainy night but he saw two adult female elephants, a calf, and an adult male, do not respond in a manner that might offend him. Instead, say something like, "I am confused, could you explain again please?" (i.e. make it seem as if it is <u>you</u> that is confused not the farmer). Often the explanation will be simple, for example, the farmer saw the elephants in an adjacent field after it had got light the following morning, or a neighbour saw the elephants. The explanation may give you additional information.

Figure 13. A HEC monitoring team member interviews a farmer at Khonkhen village about a HEC incident that occurred in his field the night before.

Global Positioning System (GPS)

The GPS unit is used to collect location information for each HEC incident. This data is crucial in order to make spatial analysis HEC in the area.

Background

The Global Positioning System (GPS) is a worldwide system of 26 satellites that orbit the earth. A GPS receiver is the unit that finds these satellites and is what people use in the field (commonly call a 'GPS'). When turned on the GPS receiver searches for the satellites orbiting around the earth. To get an accurate location of where you are the GPS receiver needs to locate at least 3 satellites ('2D NAV') and then it calculates the distance from you to each of these satellites. GPS receivers can also provide an estimate of altitude (meters above sea level, or m.a.s.l). In order to provide an altitude reading the GPS receiver must locate at least 4 satellites ('3D NAV').

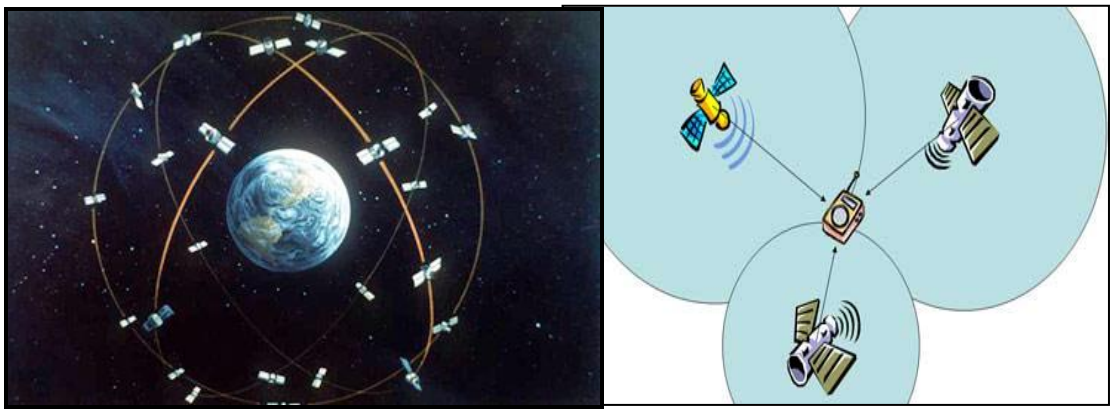


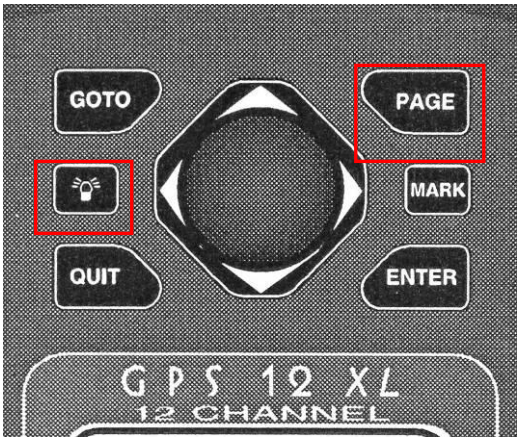
Figure 14. The system of satellites orbiting the earth which make the GPS system possible (left). A HEC monitor using a GPS receiver in the field (right)

A GPS receiver is a very valuable tool in the field and it has many uses, although, for the purposes of HEC monitoring using a GPS is very simple. You will note that on the HEC incident assessment form you only need to record the location of the HEC incident.

How to record the GPS location for HEC monitoring

There are many models of GPS receiver available. Many GPS receivers have similar capabilities, although, like mobile phones each brand of GPS receiver is operated slightly differently. For the purposes of this manual we will provide some basic instructions about how to use a GARMIN 12XL GPS receiver (right) to record the location of a HEC incident. If you are using a different brand of GPS then you may find that these instructions still apply as many GPS receivers have a similar user interface.

On the GPS receiver there are a number of key pads. For the GARMIN 12XL the key pads are displayed below.



For HEC monitoring the keypads you need to use are  and 

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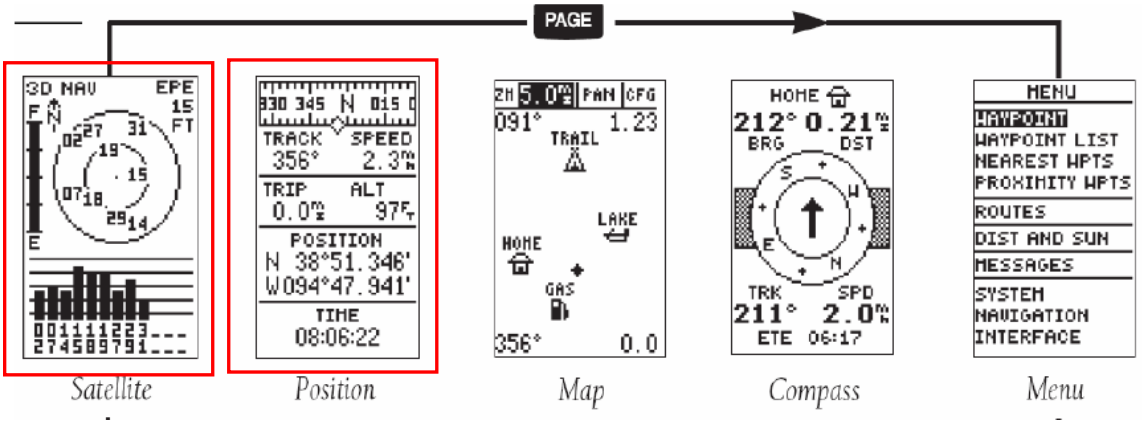
 - This keypad turns the GPS unit On and Off. Press the keypad and hold it down for a few seconds to turn the GPS receiver on. This action also turns the GOS receiver off.

- This keypad navigates between the different primary pages. To change to a different primary page then press the 'page' keypad once each time to move to a different page.

The GARMIN XL has 5 primary pages.

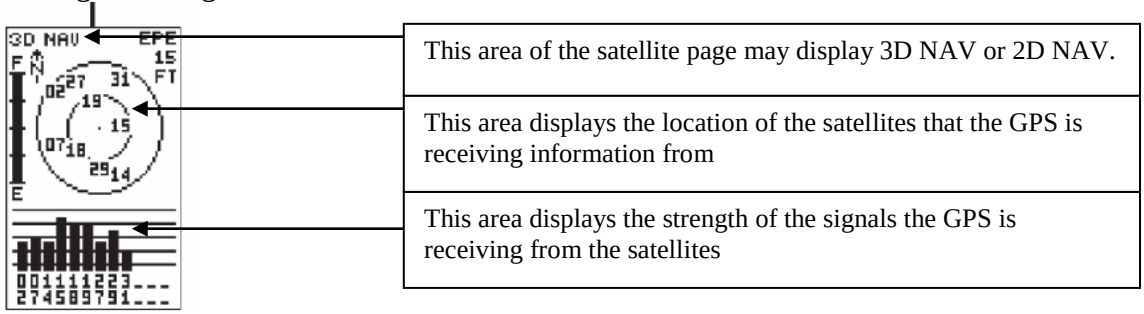
1. Satellite page
2. Position page
3. Map page
4. Compass page
5. Menu page

The primary pages for the GARMIN 12XL are displayed below.

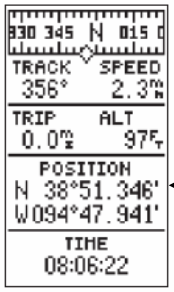


The pages needed for HEC monitoring are the 'satellite' and 'position' pages (highlighted in red above).

The satellite page shows the accuracy of the location reading, satellite positions and their signal strength.



The position page displays information about the location where you are using the GPS receiver. There is a lot of information, although, for HEC monitoring the most important is the 'POSITION'.



This area displays the position of the GPS receiver. i.e. where you are.

The position can be recorded in either latitude/longitude (lat/long) or Universal Transverse Mercator (UTM).

Your GPS should be set to UTM. This makes it easier to search for GPS recordings on a maps.

Steps for using the GPS receiver to record a position of a HEC incident

1. Stand in the area where the HEC incident occurred
2. Press  for a few seconds to turn the GPS receiver on.
3. Press  to navigate to the SATELLITE page, if it is not already displayed.
4. Wait for the GPS receiver to locate a number of satellites (2D NAV or 3D NAV). This may take a few minutes. If you are located in thick forest or under some trees you may have to move a little so the GPS can get a reading form the satellites above.
5. Once the GPS receiver has found enough satellites to locate an accurate position press  to go to the LOCATION page
6. Read the location on the screen and record it on the HEC monitoring form.

Creating sketch maps using a hip chain and compass

To accurately calculate how much crop area was eaten or damaged by elephants during a crop raiding incident we need to create scale maps. Creating scale maps in the field is not practical. The best way is to create a sketch map of the crop area using a hipchain and compass. We can then use this sketch map to create an accurate scale map later.

First we will look some of the equipment needed to draw sketch maps of crop areas and how to use this equipment.

Hipchain

A hipchain is a piece of equipment that measures distance (Figure 15).

Figure 15. A hipchain and a measuring tape.

If your HEC team does not have a hipchain it can easily be substituted for a tape measure (preferably 50m or 100m).

A hipchain is essentially a box that contains a spool of fine string and a counter. As the string is spooled out the counter records what length of string has been used. The counter displays distance in meters (m).

For example 0024.4 = 24.4m and 0263.8 = 263.8m.

The metal dial on the front of the hipchain can be rotated to reset the counter to 0000 (Figure 16). This should be done before each new measurement is taken.

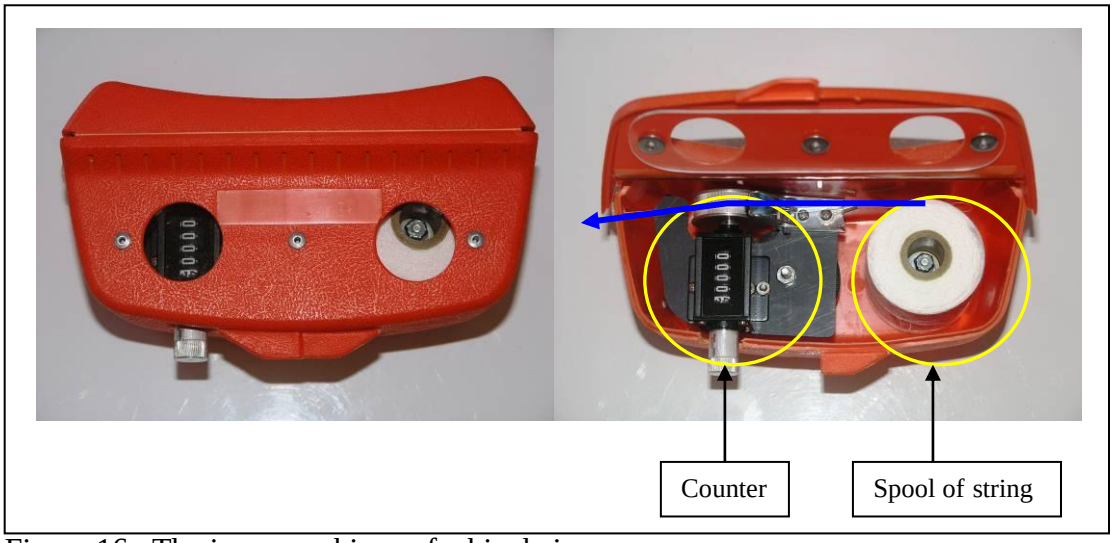


Figure 16. The inner workings of a hipchain.

Steps for using a hipchain to record a length

1. At a corner tie the string of the hipchain to anchor point. E.g. a fence post, tree branch etc.
2. Reset the counter to 00000.
3. Walk to the next corner or designated point
4. Record the length displayed on the counter.

Remember to reset the counter each time you take a new measurement

Figure 17. HEC monitoring team members use a hipchain to measure a distance between two points.

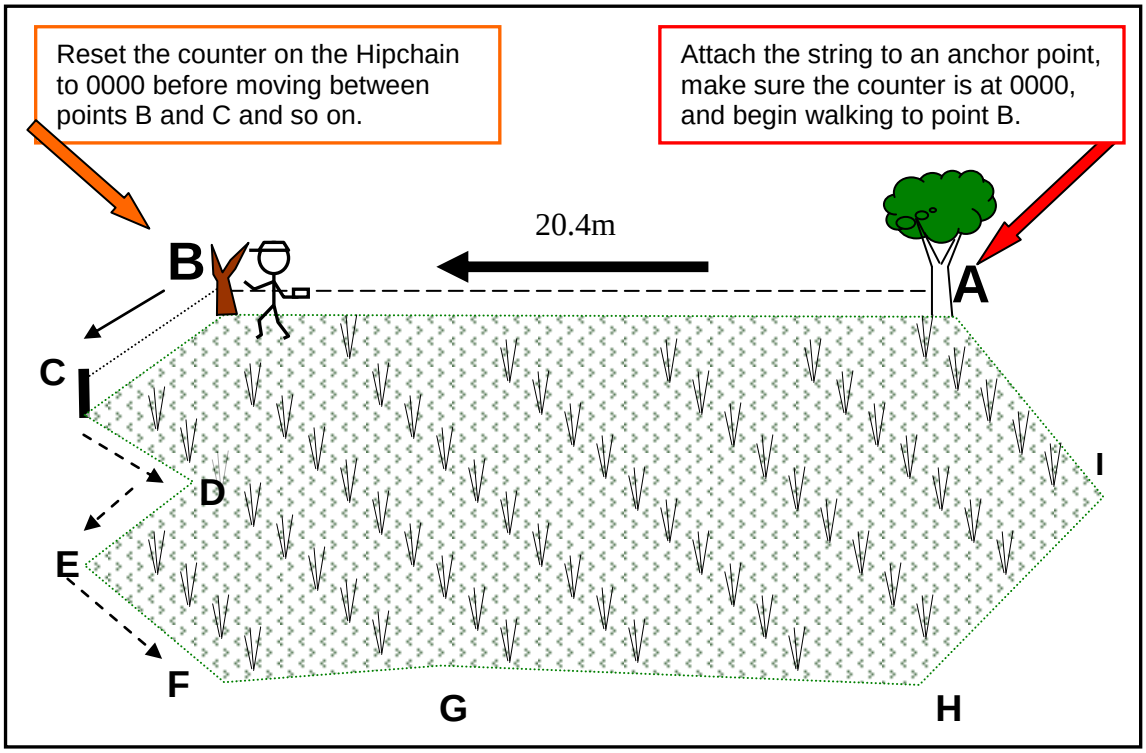


Figure 18. How to use a hip chain to measure distances in a field area.

Sighting Compass

What is a compass?

A compass is an instrument used to measure direction. If you look at a compass you will see that it is divided into four main direction, north, south, east and west. The needle of the compass, which usually has a red tip, always points to north (Figure 19). The compass also has a moveable dial that surrounds the needle (Figure 19). This dial usually has a series of numbers on it (Figure 19). These numbers represent degrees and are used to represent directions.

Figure 19. Two different kinds of compass. Note that the red needle of both compasses points to north. Also note the moveable dial with numbers. The compass on the left is a sighting compass.

The compass is divided into three hundred and sixty degrees (360°). North is 0° or 360°, East is 90°, South is 180° and West is 270° (Figure 20).

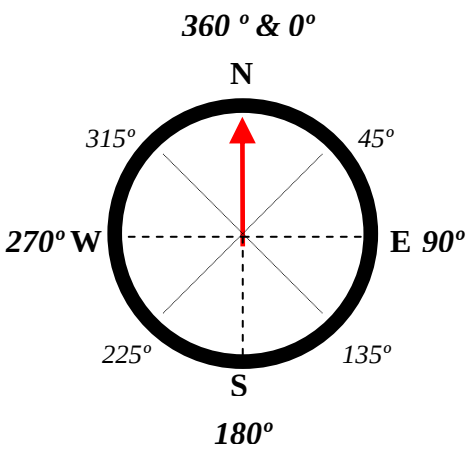


Figure 20. a) The points of a compass and their equivalent bearings. b) A compass with degrees marked on the moveable dial. Note that this compass has the degrees marked in multiples of 10. Therefore 4 = 40°, 16 = 160°, and 30 = 300°.

What is a sighting compass?

A sighting compass is a type of compass that allows you to calculate the bearing of a line between two points (Figure 19, 20, 21).

Figure 21. A HEC monitoring team member uses a sighting compass to measure a bearing

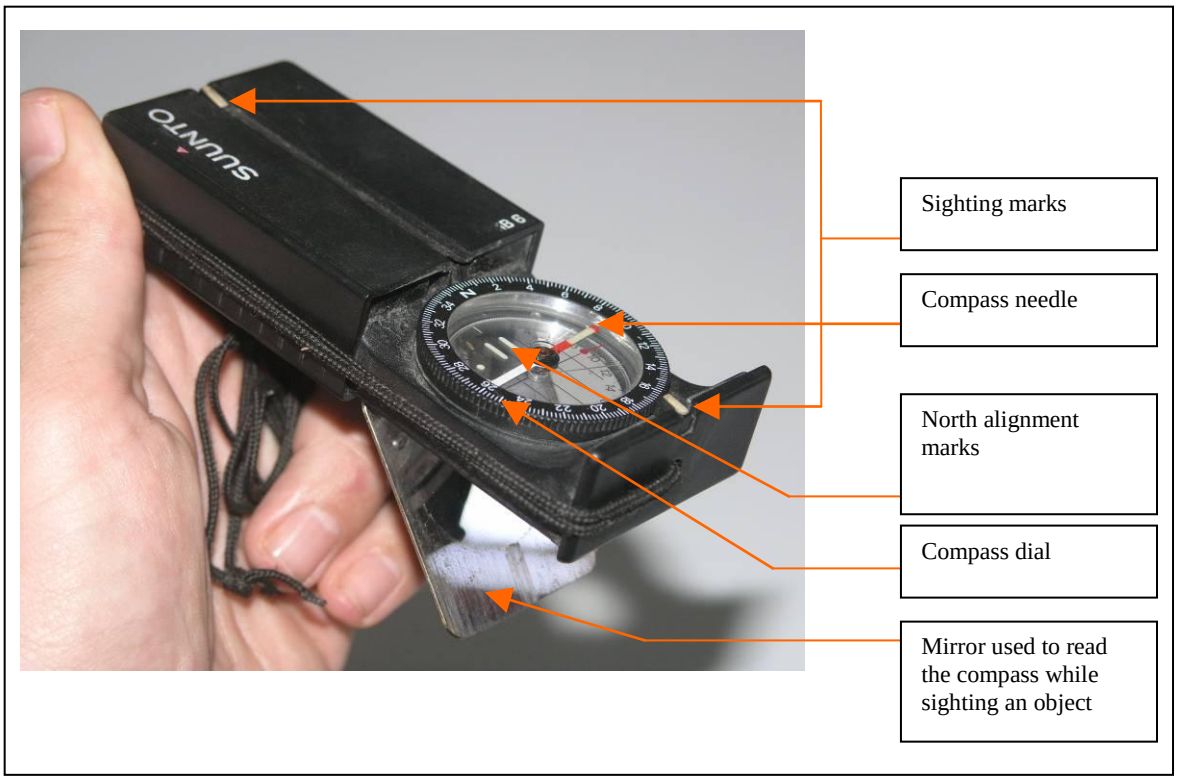
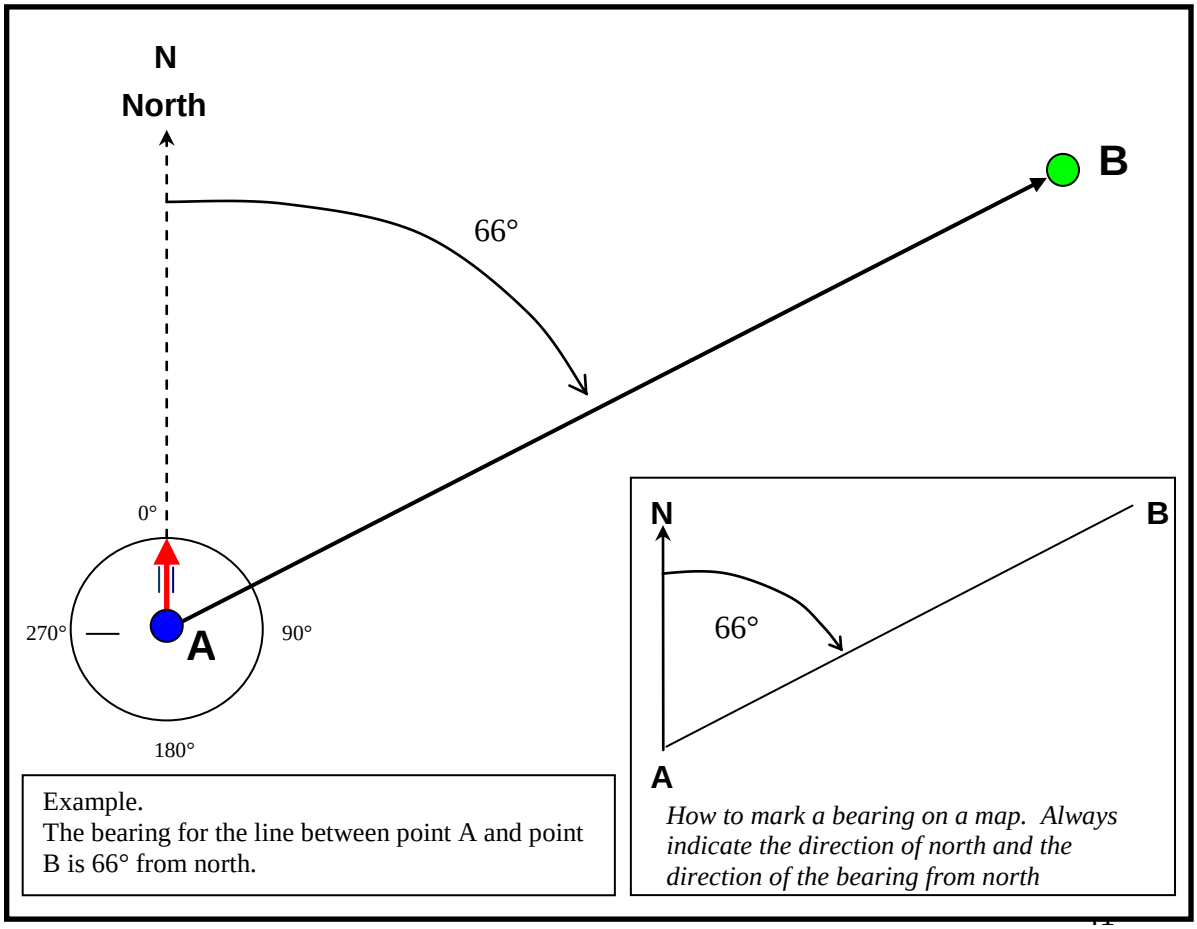


Figure 22. Components of a sighting compass.

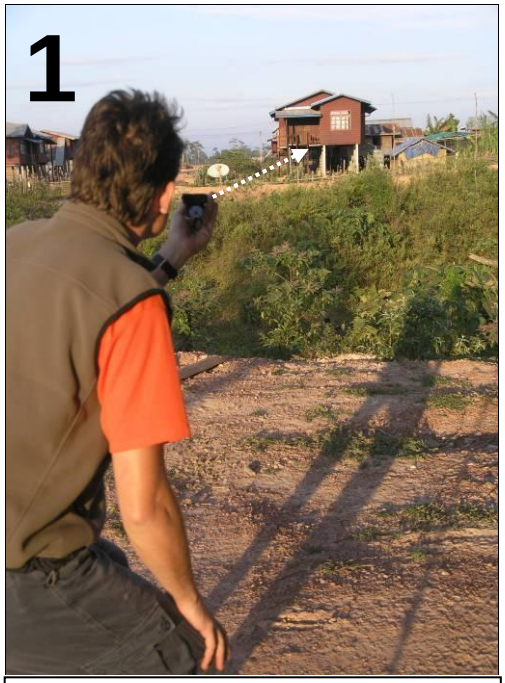
What is a bearing?

A bearing is a direction between two points. The bearing is always measured from north and is always recorded in degrees.

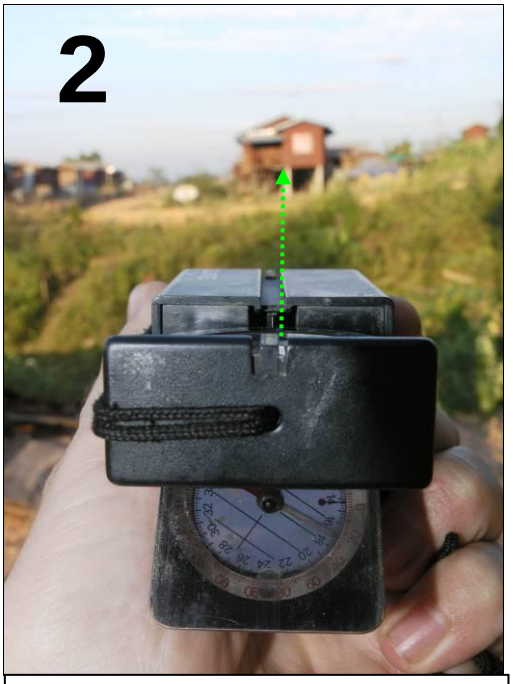


How to use a sighting compass to record a bearing between two points

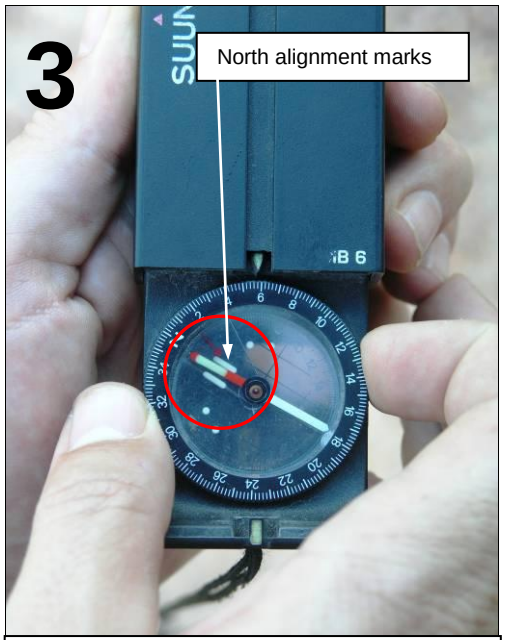
Example: You want to measure the bearing between you and a house in your village.



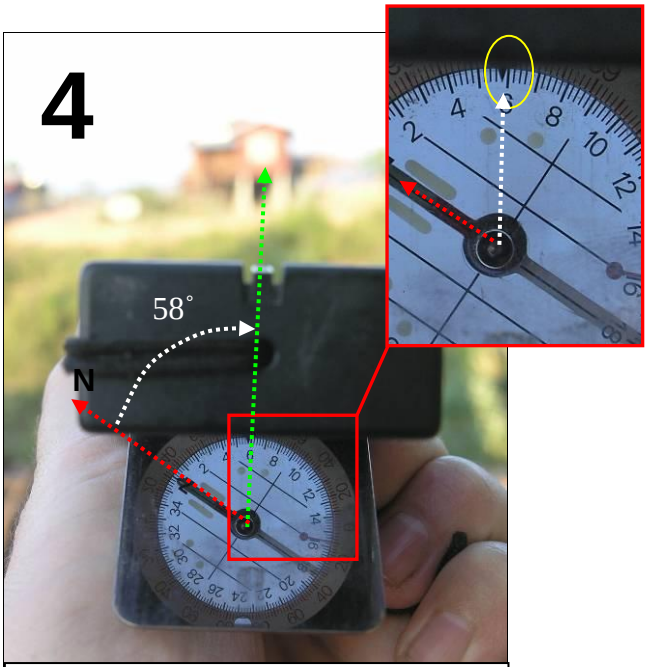
Take the sighting compass and align it with the object to which you want to find the bearing. In this case the house.



Using the sighting marks accurately aim the compass at the object.



With your compass pointed directly at the object (in this case the house) turn the dial so that the north alignment marks are either side of the red needle. Remember the red needle always points to north.



With your compass aligned with the object (the house) using the sighting line on the compass, and with north correctly aligned, read the bearing. In this case 58°, i.e. 58° from north is the bearing to the house from your position.

Measuring a damaged field and drawing a sketch map

Using a hipchain and a sighting compass you can draw a relatively accurate sketch map of field areas that have been the subject of a HEC crop raiding incident.

By having two people in each HEC monitoring team it is easier to measure fields and areas of crop damage. When creating a sketch map of the field and the damaged areas one team member can draw the sketch map and record bearings while the other team member operates the hipchain.

Materials

Sketch paper (preferably A4)
Folder
Pencil
Eraser
Ruler
Sighting compass
Hipchain

Steps for measuring a field

1) Upon arriving at the field you should ask the farmer involved where the boundaries of the field are. Get the farmer to show you around the boundary of the field. Quite often many farmers' fields adjoin each other and are not defined by a clear boundary line or fence. Many times farmers use trees within the field or on the perimeter of the field to distinguish the boundary between one farmers' crop and another.
2) Start in a corner of the field. Any corner is ok.
3) Orient your page so that it best suits the shape of the field you are measuring.
4) Write the name of the farmer, the village and the date the incident occurred on the top of your sketch map page.
5) With your piece of paper horizontal, place the compass on your sketch map page and draw the approximate directions of north, south, east and west. This will help you keep your sketch map as accurate as possible
6) In one corner of the field tie off the hipchain string. Or use your partner to hold the hip chain string at the start point
7) You should mark this corner of the field on your sketch map using a triangle symbol. This will help you later to remember where you started from.
8) Team member #2 (operating the hipchain) should then walk to the next corner of the field and wait there, noting the distance recorded on the hipchain. A field may not have defined corners so it will up to the team to decide where the best place to make the next measurement and bearing will be. Often it is difficult for team member #1 to see where the corner of the field is. This makes it very difficult to take an accurate bearing with the sighting compass. If team member #2 waits at the corner this gives team member #1 something to aim at when using the sighting compass.
9) Team member #1 should calculate the bearing between the two points using the sighting compass and draw the line on the sketch map at the correct angle and

distance. It is important that the map be as accurate as possible. Try to keep the lines and bearings approximately to scale.

10) On the sketch map record the length of the line in meters and the bearing from north in degrees. Make sure that you write neatly, numbers should be understandable and clearly correspond to the respective measurement.
11) Team member #1 goes to join team member #2
12) Together team member should decide where the next corner of the field is and use the hipchain and compass to record the distance and bearing using the methods described above.
13) Continue to map the boundary of the field until you have returned to your starting point, marked on your map by a triangle symbol
14) Check to make sure that you have recorded all the distances and bearings on the map.

Remember; first measure the distance between the two points and then record the bearing

<u>Steps for measuring elephant damaged area</u>

The procedure for measuring the damaged area is exactly the same. Decide on a starting point and use the hipchain to measure distances and the sighting compass to measure bearings. Note these on the sketch map.

Many times the starting point for measuring the damaged area is not in one of the corners of the field. It may be on one of the boundary lines of the field (see Figure 23). You <u>must</u> record how far this point is from a known point on your map (see figure 23).

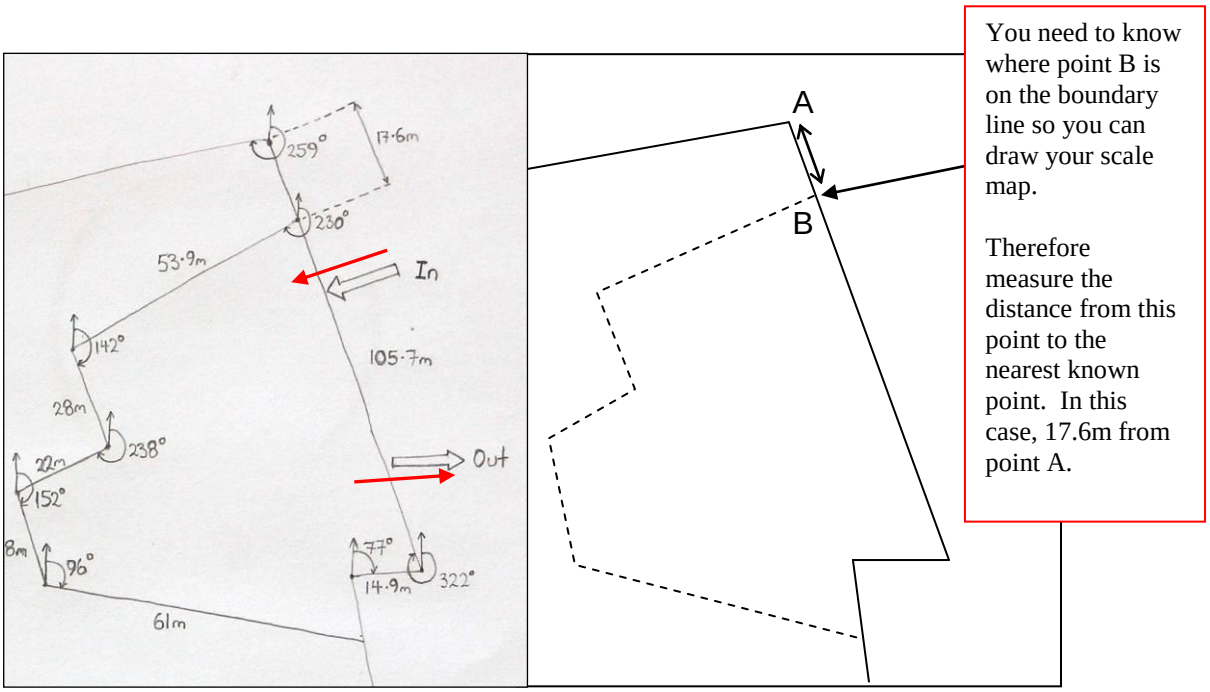


Figure 23. Indicating the elephant damaged area on your sketch map.

On your map you should also indicate using arrows where elephants entered and exited the field if this can be determined from field observations (Figure 23).

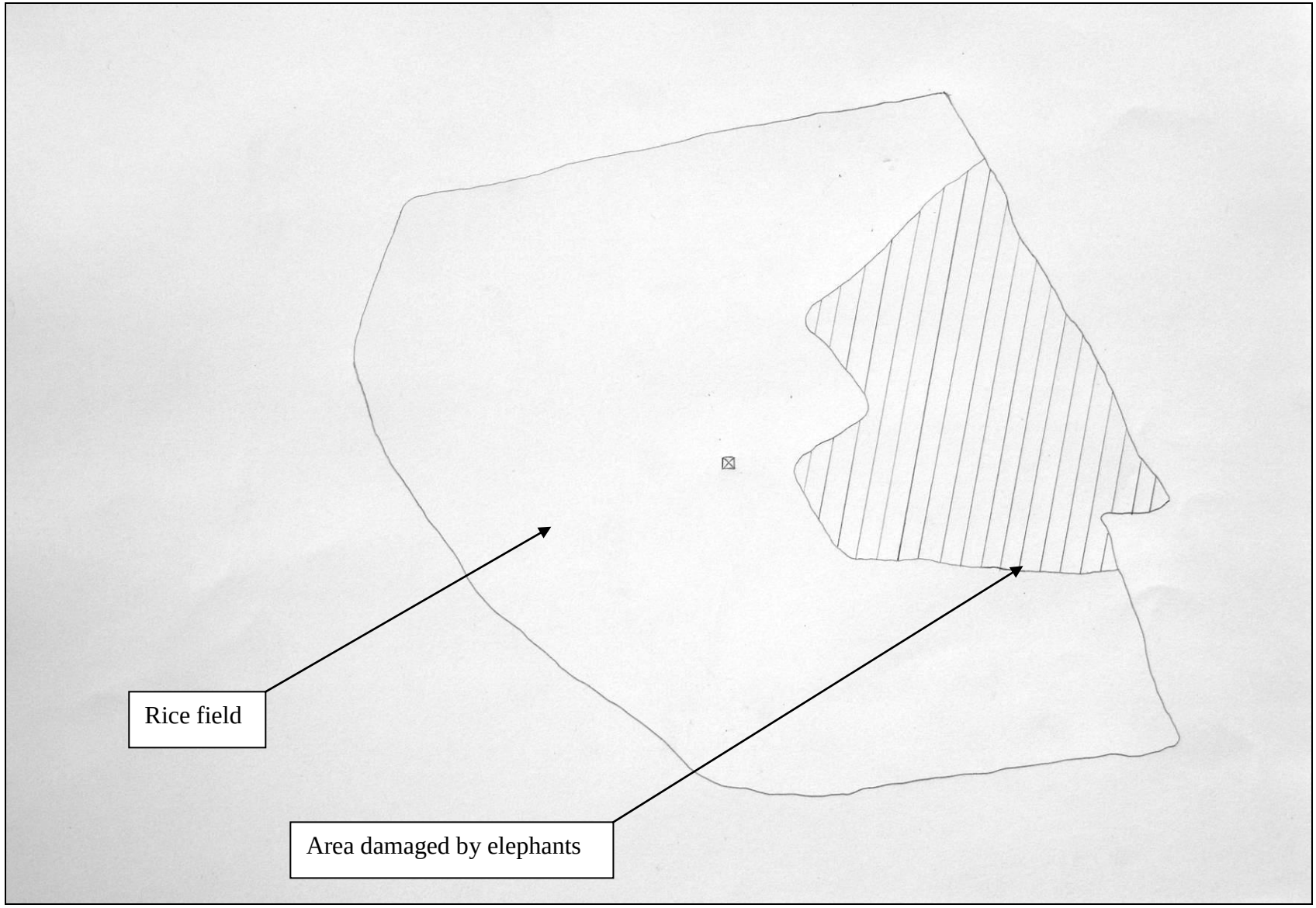


Figure 24. An example of a crop area that has been damaged by elephants

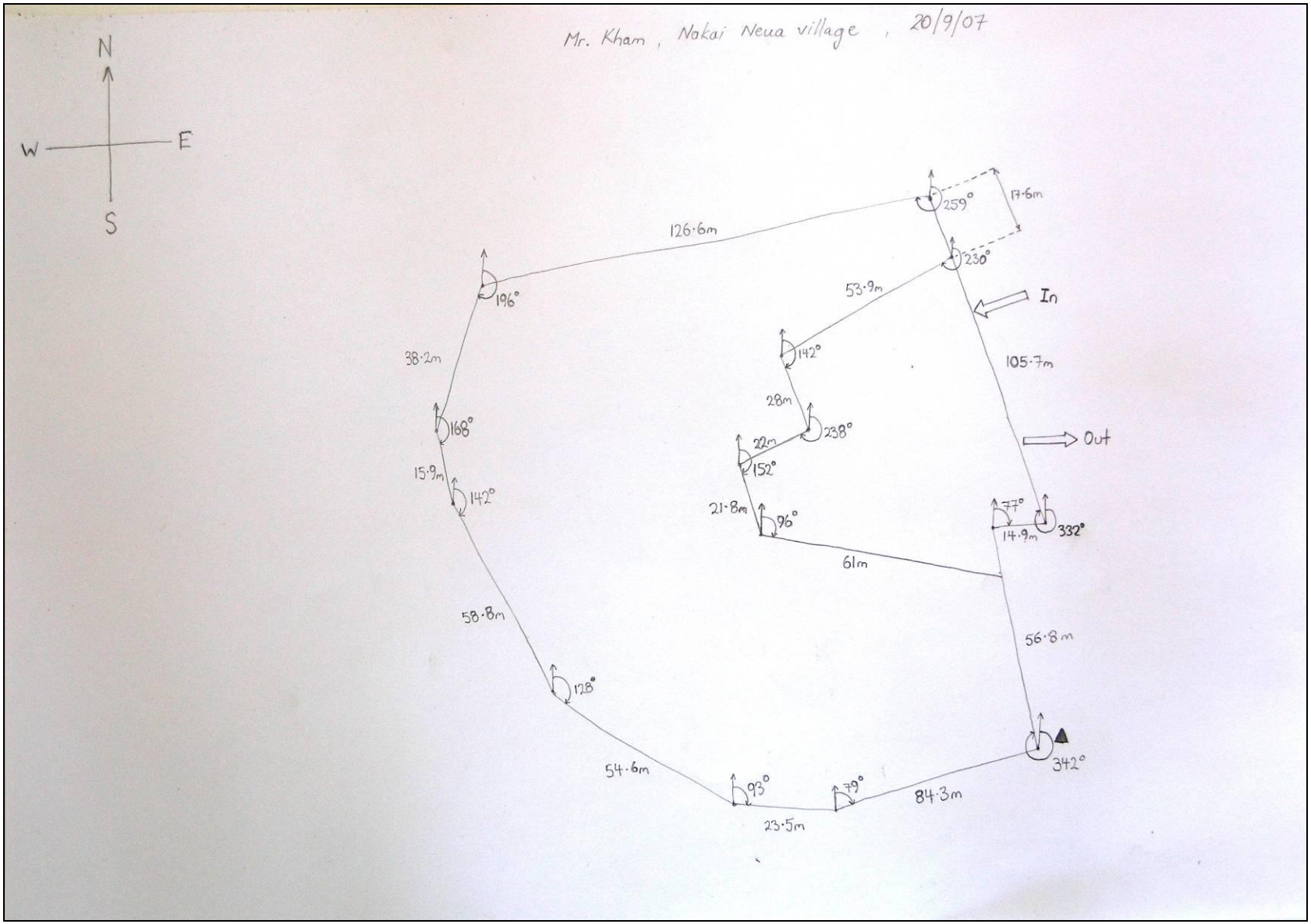


Figure 25. A completed sketch map of the field and damaged area.

Creating scale maps of a HEC crop raiding incident and calculating areas

In the crop section of the HEC incident assessment form (see Page 26) it is necessary to report the total area of the crop and the area of crop damaged in the field. This is not done by an estimate from the farmer or an estimate by member of the HEC team. We can accurately calculate the total area of a crop and the area damaged by drawing a scale map using the sketch map that has been created in the field.

What is scale?

The scale of a map is the ratio of a single unit of distance on the map to the equivalent distance on the ground. All maps should have a scale. You may have seen a topographic map before and on it the scale represented as, for example, 1:25,000. This means that for every 1cm on the map this represents 25000cm's on the ground, or, 250m. Another example is 1:100,000 and this means that for every 1cm on the map this equal 1000m on the ground.

For the purposes of drawing maps for HEC incidents the scale will quite often be a lot larger. For example 1:1000 i.e. 1cm on the map equals 1000cm on the ground or 10m. Deciding on the appropriate scale for your map is very important and one of the first steps in drawing a scale map

Materials

1mm graph paper
Clutch pencil
Eraser (you'll need this a lot)
360 degree protractor
Ruler 30cm (with mm marked)
Calculator

What is a 360° protractor?

A 360° protractor is a tool for measuring angles and you can see that it displays all the bearings/ degrees of a compass.

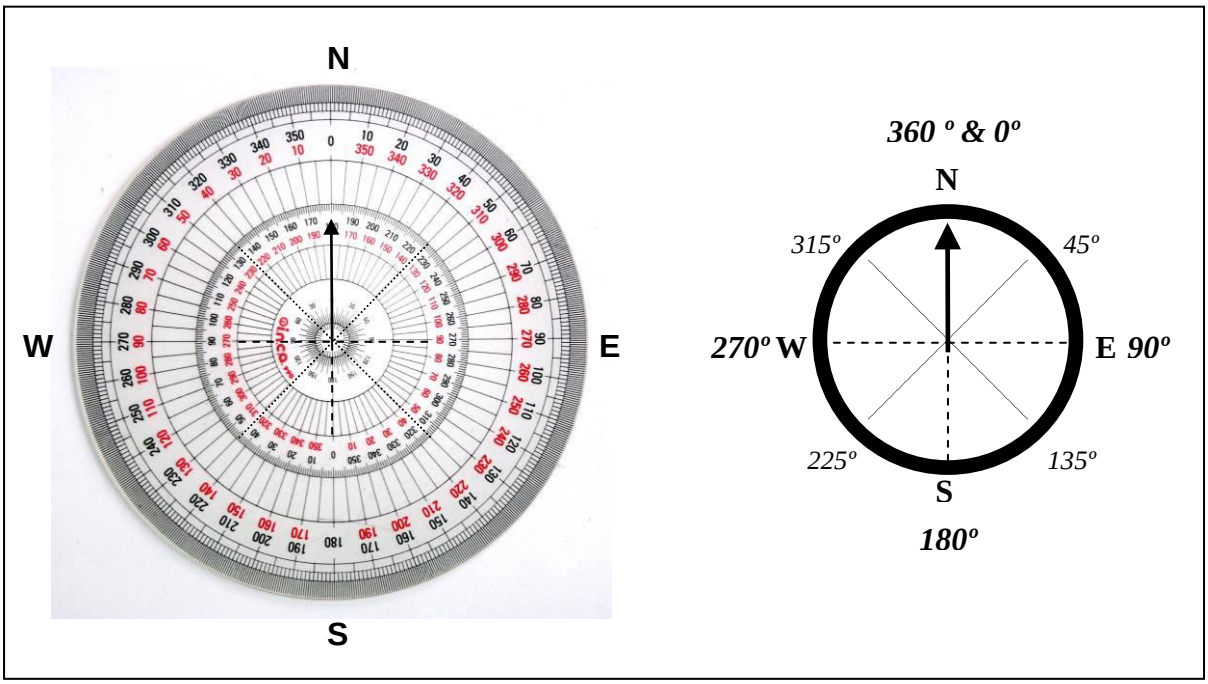


Figure 26. A 360° protractor and a representation of the corresponding angles on a compass

Before drawing the scale map of a HEC incident you first need to decide on a few important things.

Exercise: If you have access to the materials mentioned on page 47 then use the explanations below and follow the steps to successfully draw a scale map.

Step 1. Direction of north and page orientation

Looking at the sketch map you have made of the field you must first decide on the orientation of your page and the direction of north for your scale map. On a map north is always represented as pointing towards the top of the page.

To understand this look at the examples provided below.

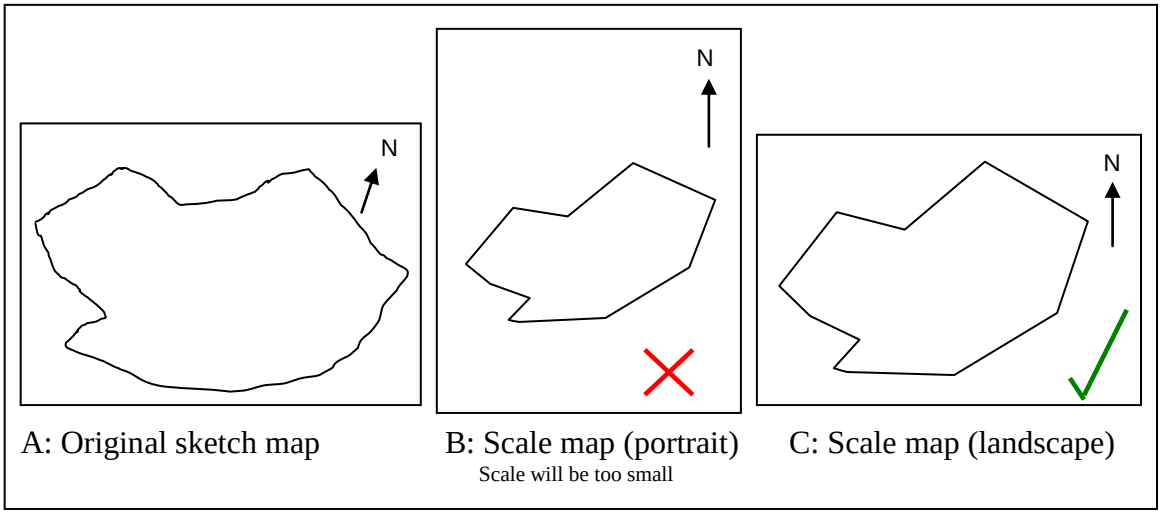


Figure 27. Correct orientation of the page depends on the shape of the field you have measured. North should always point to the top of the page.
You can see that if we use the portrait orientation for the paper then the scale map will be much smaller. In this case it is better to use the landscape orientation for the paper. The map will be larger and therefore our calculation of the areas involved will be more accurate.
You should indicate the direction of north on your map (see example above and below)

Step 2. Scale

Deciding on the correct scale for your map is very important. If the scale is too small then you map will be very small and this makes calculations of the areas less accurate (Figure 28). If the scale is too large then you may find that the map goes off the page at some point (Figure 28). The correct scale will produce a map that fills as much of the page as possible allowing the most accurate calculation of areas.

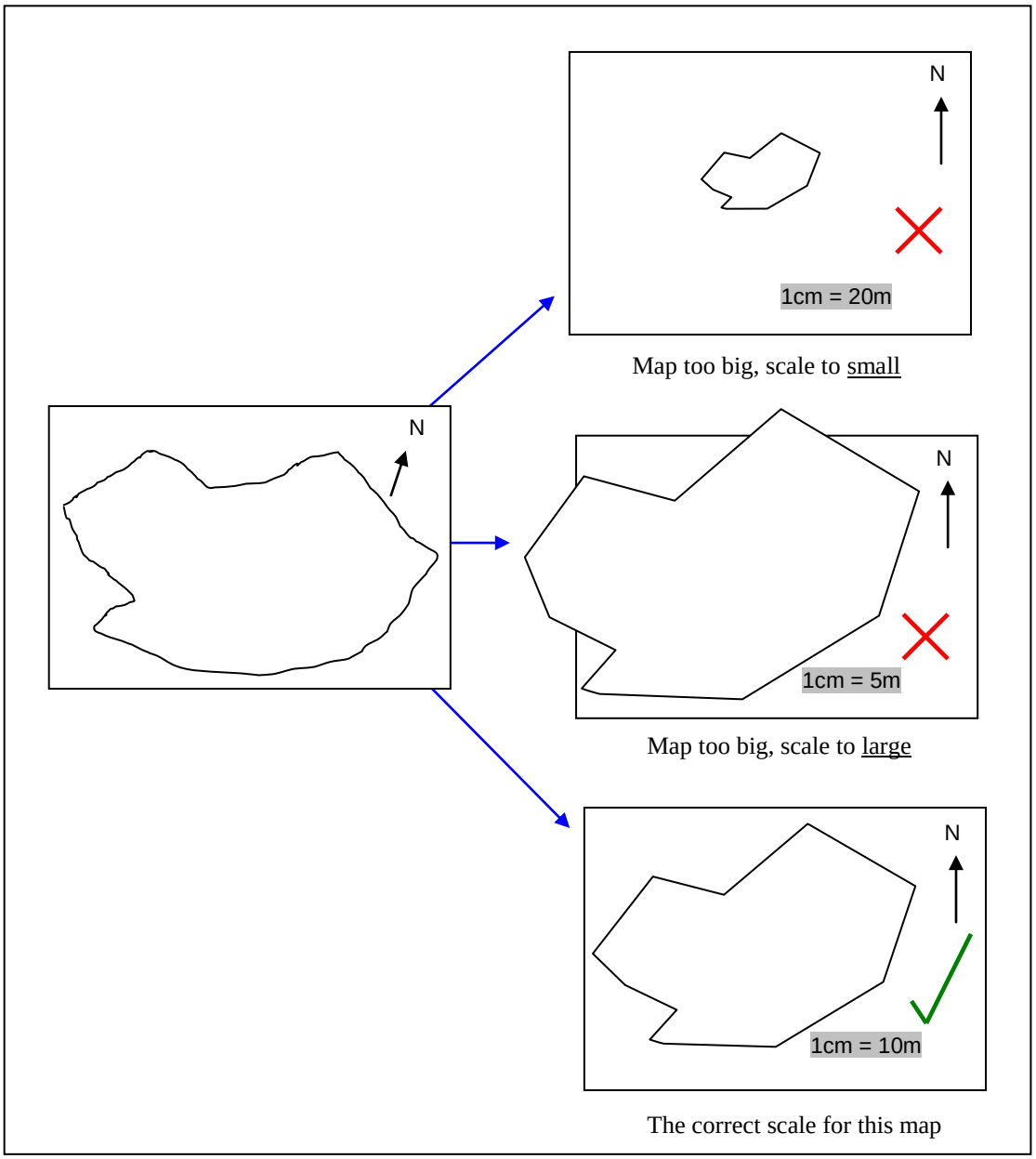
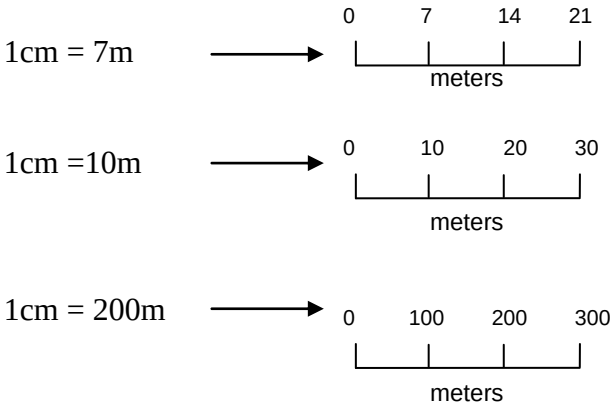


Figure 28. Different scales will give you different size maps for the area.
You should indicate the scale of your map by using a scale bar. See page 62 and look for the scale bar on the map.

For example:



Step 3. Incident details

At the top of the sheet of graph paper write the;

- name of the farmer
- the village where the incident occurred
- date the incident occurred

Do not the date when the incident was reported or recorded!

Step 4. Draw the scale map of the crop boundary

Look at the example sketch map (Figure 25 and below). It is best to start your scale drawing at the point where you began to measure the area in the field. This is indicated on the sketch map by the triangle symbol (Figure 29).

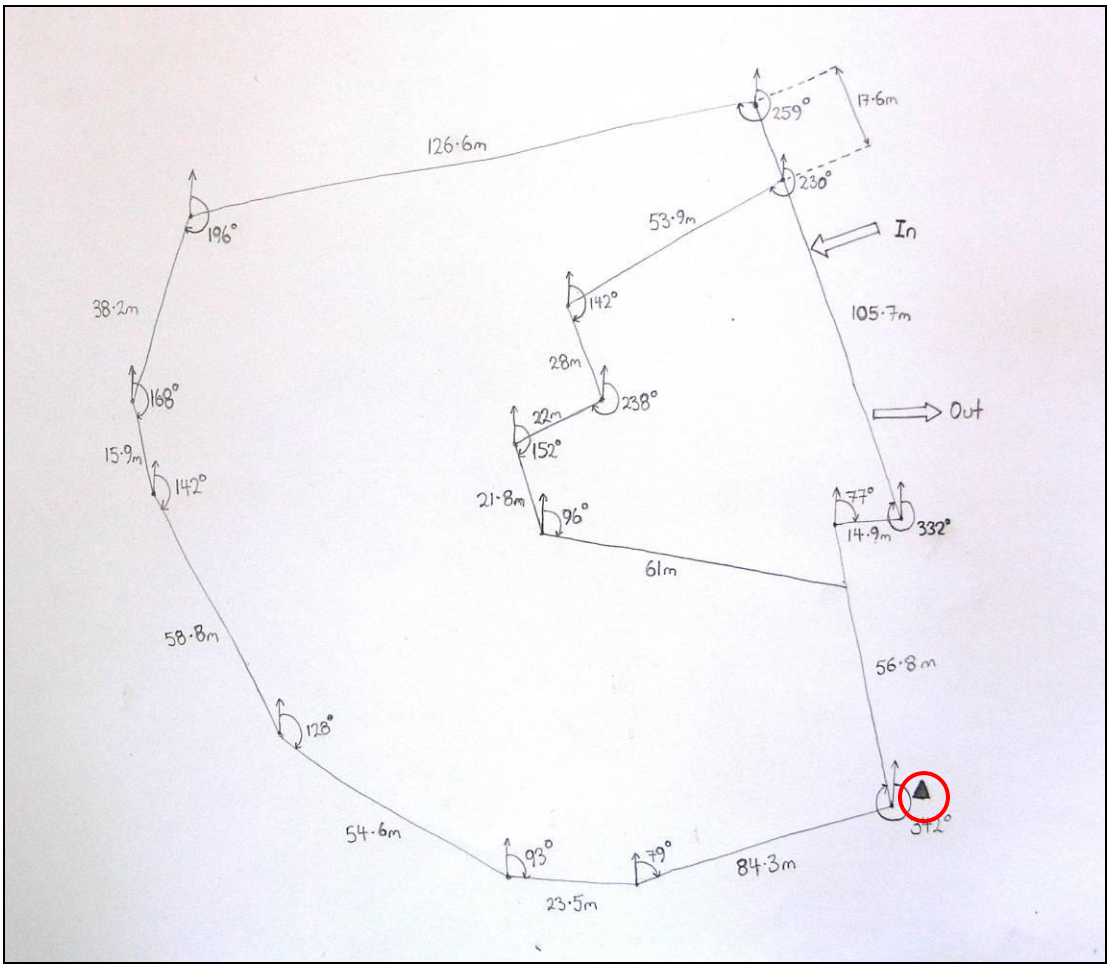


Figure 29. Sketch map of crop area and portion damaged by elephants. This is an example of a sketch map drawn in the field. The red circle indicates the starting point of the sketch map marked with a triangle.

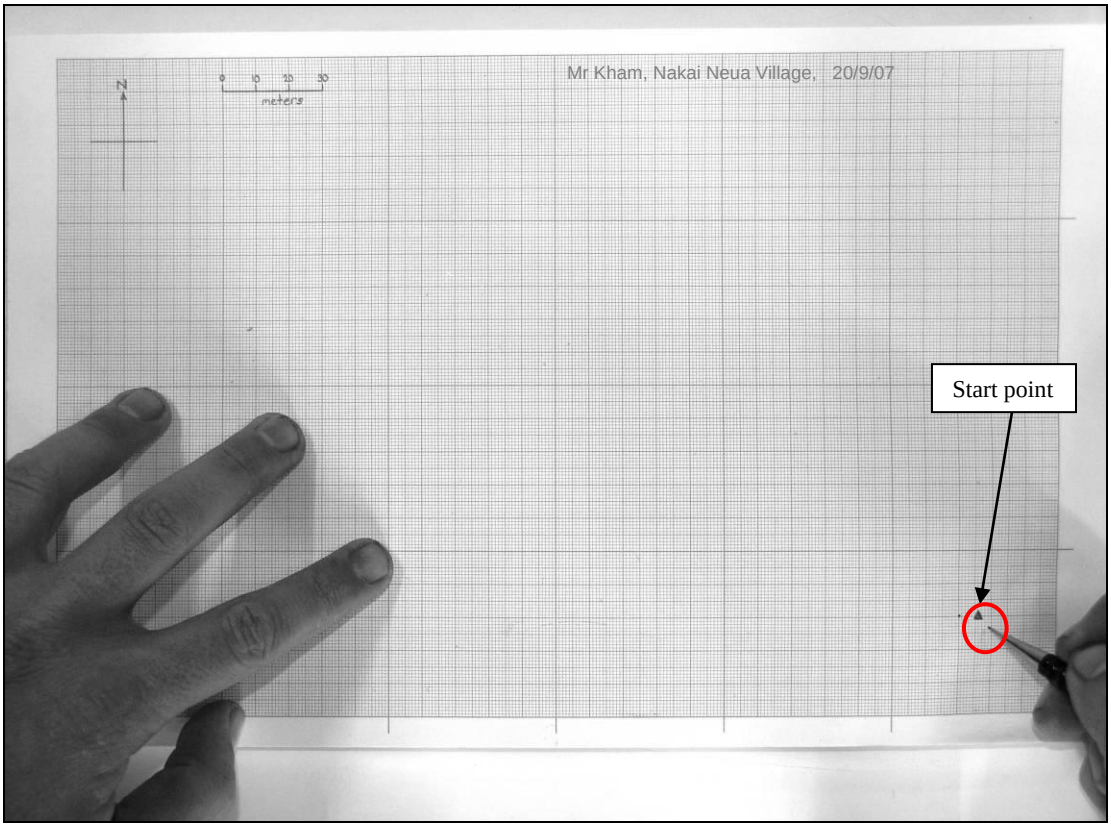


Figure 30. Note that the direction of north, scale bar, farmers name, village and date the incident occurred are already on the map at the top of the page.

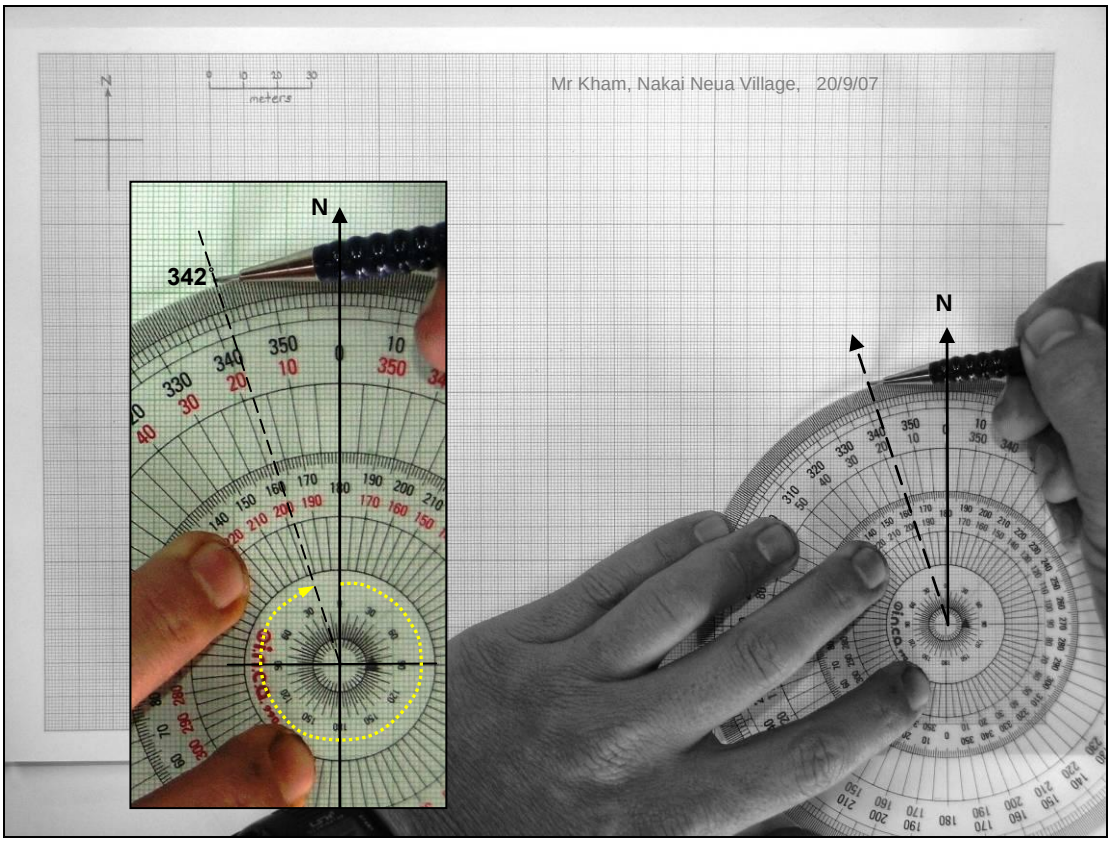


Figure 31. After accurately aligning the protractor with the direction of north mark the first bearing of 342° from north.

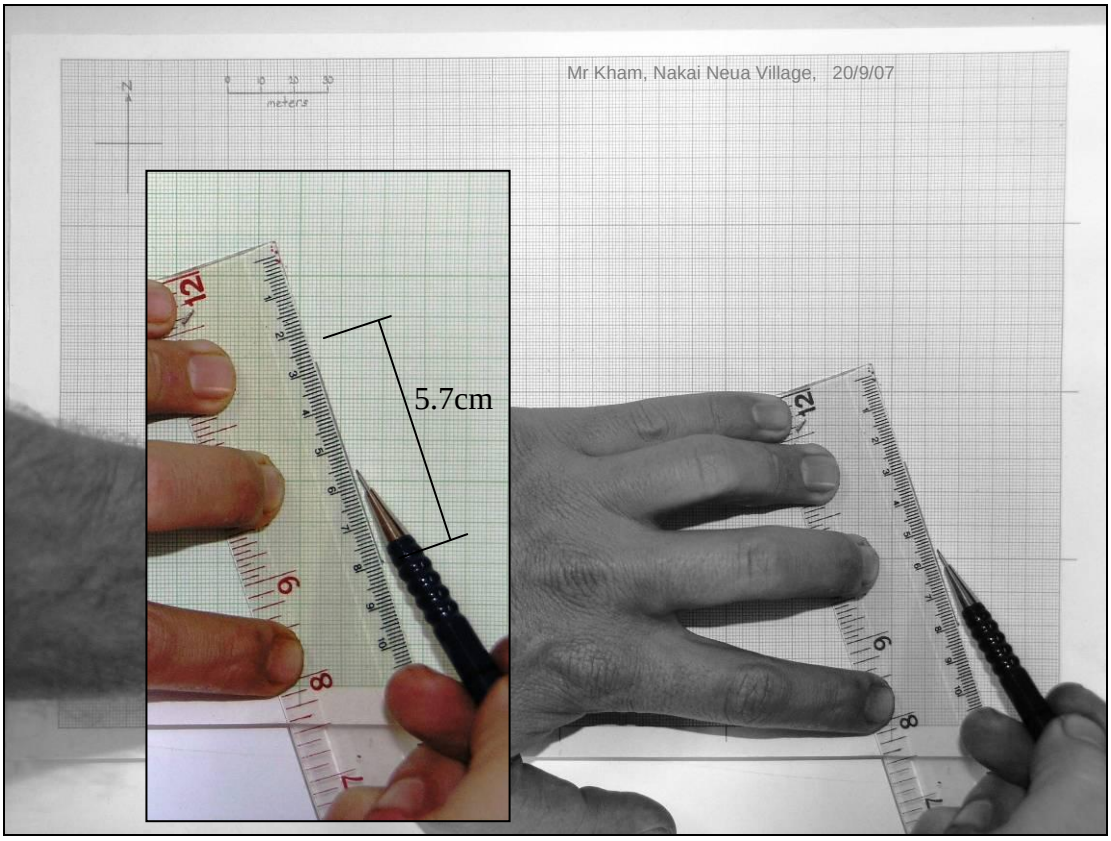


Figure 32. Draw each line from you sketch map to scale. In this case 57m, with a scale of 1cm=10m, equals a line 5.7cm long.

Notice that on the sketch map distance measurements have been recorded in tenths of a meter (e.g. 56.8m). For the purposes of drawing the scale map we convert these measurements to meters only. For example, for measurements 56.0m-56.4m = 56m and 56.5-56.9 = 57m). In this case the measurement will become 57m.

This makes it easier to draw you map. For example, if the measurement is 14.25m and your scale is 1cm = 10m, then you must draw a line 1.425cm long. Since many rulers only have millimeters marked on them it very difficult to draw a line to this accuracy. Therefore the measurement is drawn as 1.4cm to represent 14.0m (since 14.25m becomes 14.0m). Another example is if the measurement is 106.7m, for the purposes of scale mapping this will become 107m, and if your scale is 1cm=5m then you line will be 21.4cm long.

Aligning your ruler with the start point and your mark at 342°, draw the line to represent 57m. In this case the line will be 5.7cm long because your scale is 1cm = 10m (Figure 32).

Now, place the protractor at the end of this line, align it with north and mark the next bearing from your sketch map, 77° from north (Figure 33).

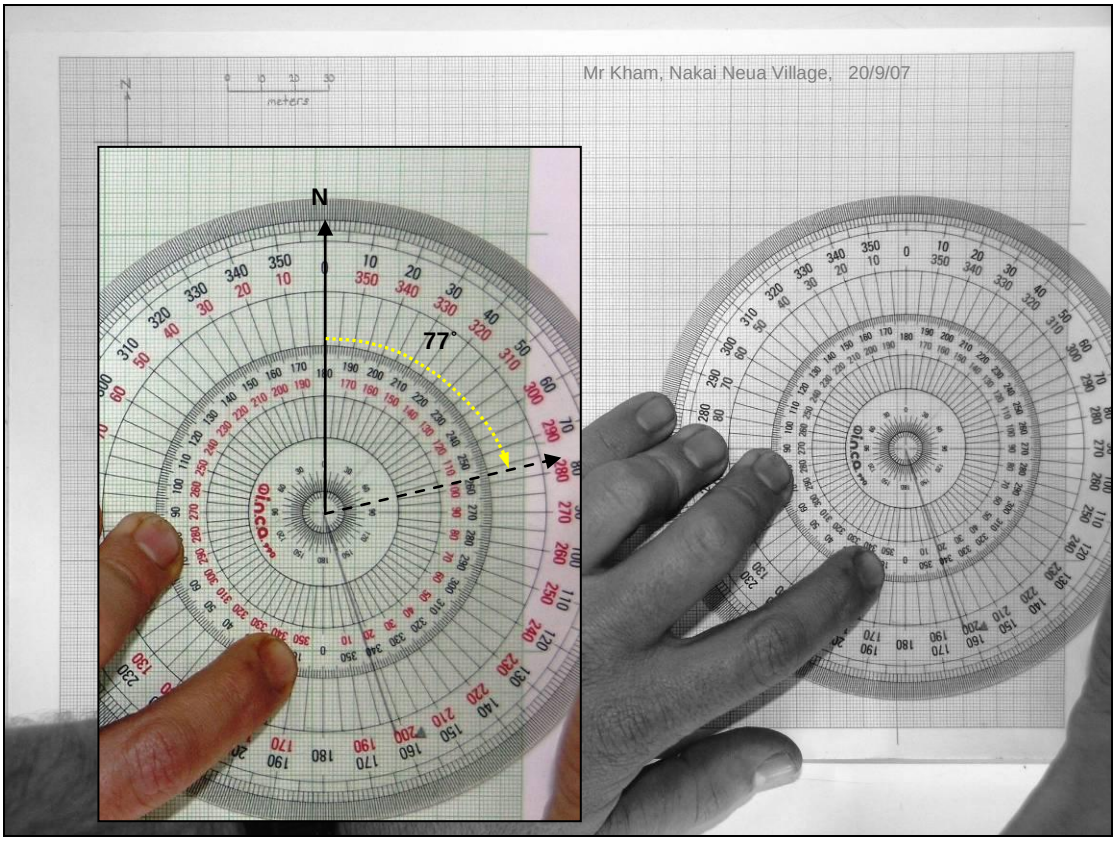


Figure 33. After accurately aligning the protractor with the direction of north mark the first bearing of 77° from north.

Once you have marked the bearing you can draw the next distance measurement. In this case 14.9m becomes 15.0m and is drawn as 1.5cm long (remember the scale for this map is 1cm=10m, therefore 1.5cm=15m).

Continue to map the boundary of the crop area until the last measurement and your map should look like the one presented below (Figure 34).

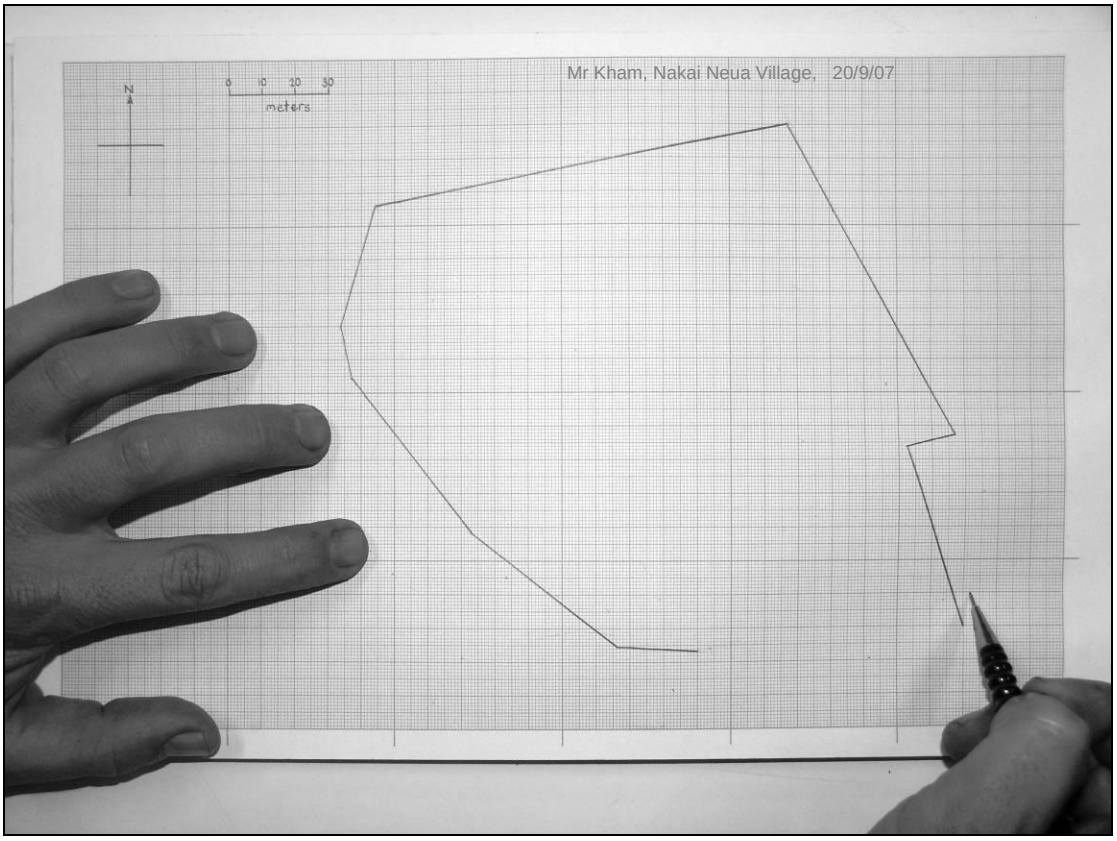


Figure 34. Following the process of marking bearing and drawing in distance measurements up until your last line your scale map should look like this

You will notice that when you mark the bearing and distance measurement for the last line it will not join exactly with the start point (as indicated in Figure 34). This is unavoidable when drawing this kind of scale map because there is a certain amount of error when recording bearings in the field and also because distance measurements are rounded up or down to the nearest meter. If the end point is less than 1cm away from the start point then this is acceptable. You should then proceed to draw the last line to join with the start point (Figure ?).

If the distance between the two points is greater that 1cm then you should check the bearings and distances you have already drawn.

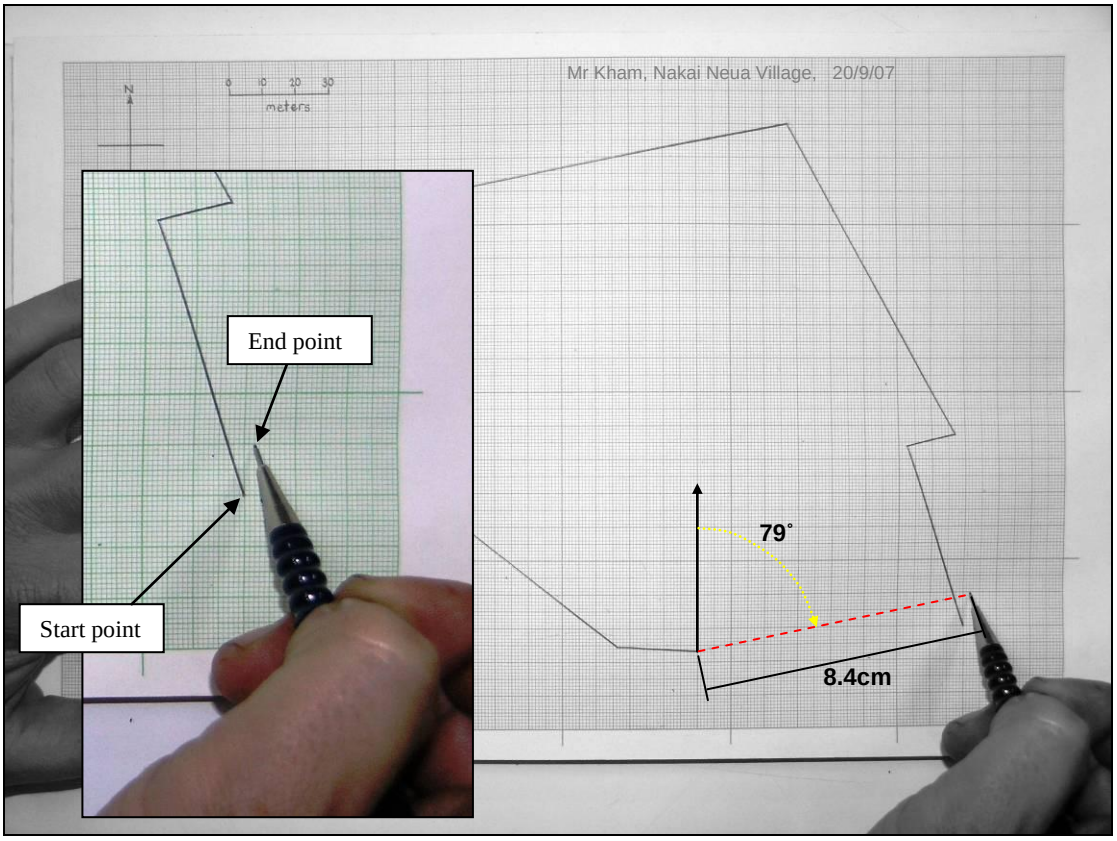


Figure 35. Notice that using the last bearing and distance measurement from the sketch map that the starting point and the end point do not meet exactly.

In this case the start point and the end point are with 1cm of each other so it is acceptable to make the last line meet with the starting point (Figure 36).

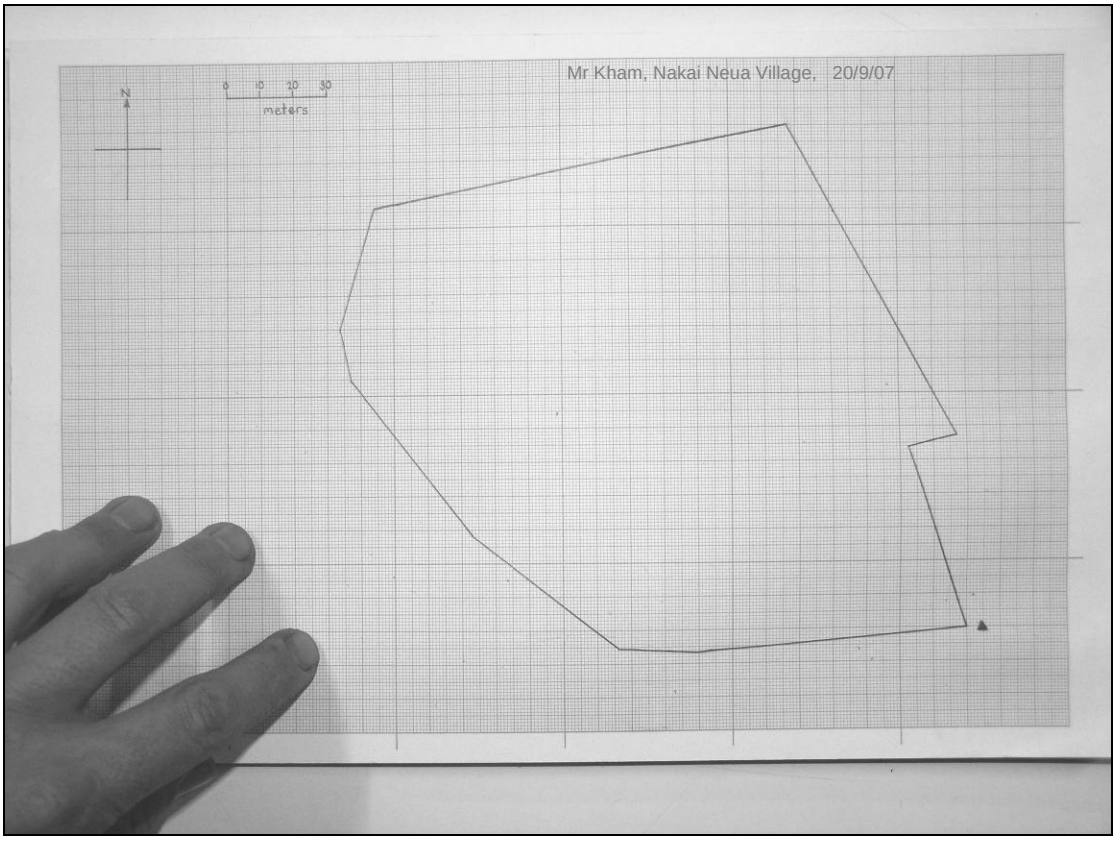


Figure 36. The completed scale map of the crop boundary.

Following the steps above and the measurements from you sketch map you should not draw in the crop area damaged by elephants. Once you have also drawn in the crop damage area your map should look like this (Figure 37, below).

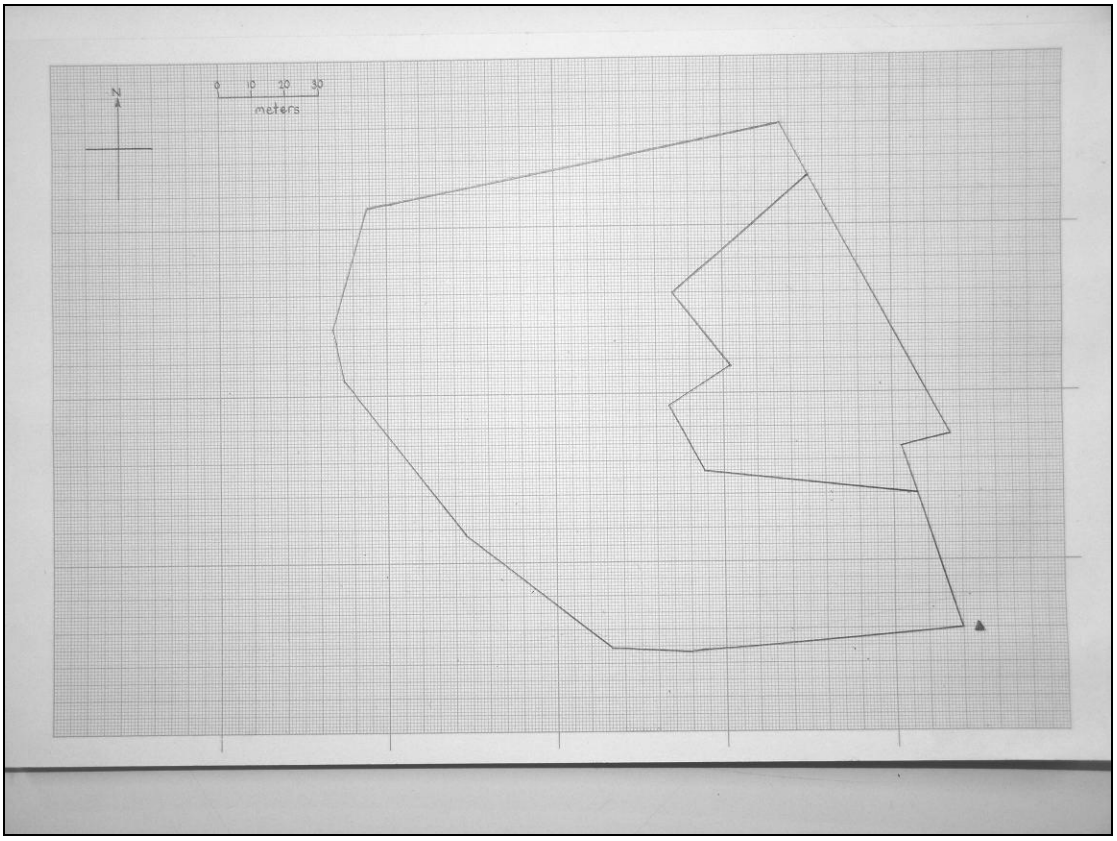


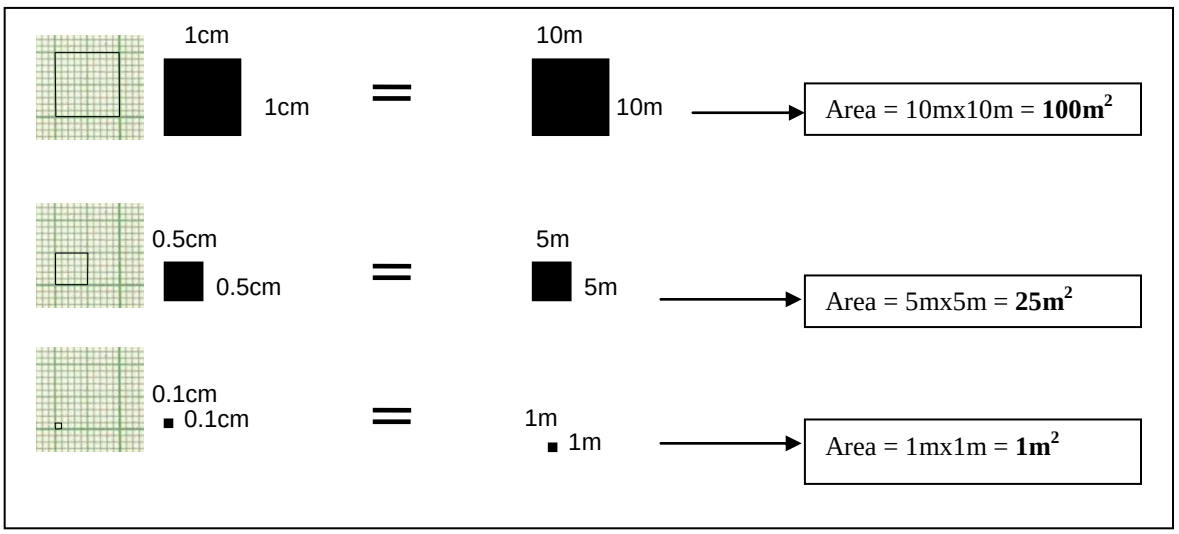
Figure 37. The scale map with both the crop boundary and the damaged area completed.

You now need to calculate the area of both the entire field and the damaged area. This will allow you to calculate the percentage of the crop damages. You will notice on the HEC incident assessment sheet that these areas are required.

How to calculate areas using the scale map?

You have drawn your map on 1mm graph paper that also has line markings for 5mm (0.5cm) and 10mm (1cm). We can easily use this to calculate areas.

If our scale is 1cm = 10m then:



To calculate areas all we need to do is count the number of each size square inside each area.

Note: it is a good idea to indicate the areas on your map as shown below (Figure 38).

You should use the available space around your map to show all your calculations (see image below)

There should be three sections:

<u>Area 1.</u> Undamaged area (m^2)

_____x 100 m^2 = _____ m^2
_____x 25 m^2 = _____ m^2
_____x 1 m^2 = _____ m^2
Total = _____ m^2

<u>Area 2.</u> Damaged area (m^2)

_____x 100 m^2 = _____ m^2
_____x 25 m^2 = _____ m^2
_____x 1 m^2 = _____ m^2
Total = _____ m^2

<u>Area 3.</u> Total area(m^2)

= Area 1 + Area 2
=_____ m^2

<u>Calculate the undamaged area</u>

Do this by counting the number of 1x1cm squares, then counting the 0.5x0.5 squares and then counting the 0.1x0.1cm squares (see Figures 38, 38, 40) Remember each 1x1cm square on the scale map equals 100m^2, each 0.5x0.5cm square equals 25m^2, and each 0.1x0.1cm square equals 1m^2.

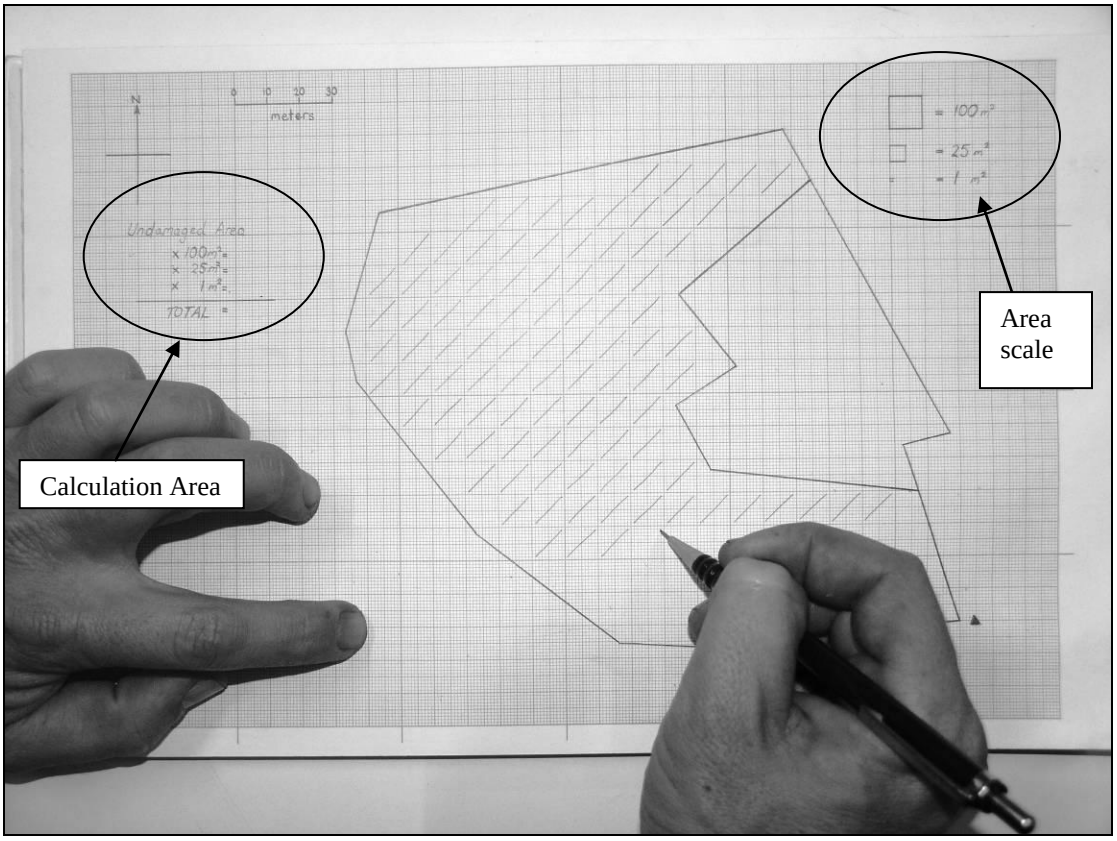


Figure 38. Mark the 1cm squares as you count them by drawing a diagonal line through them. You must only count whole squares.

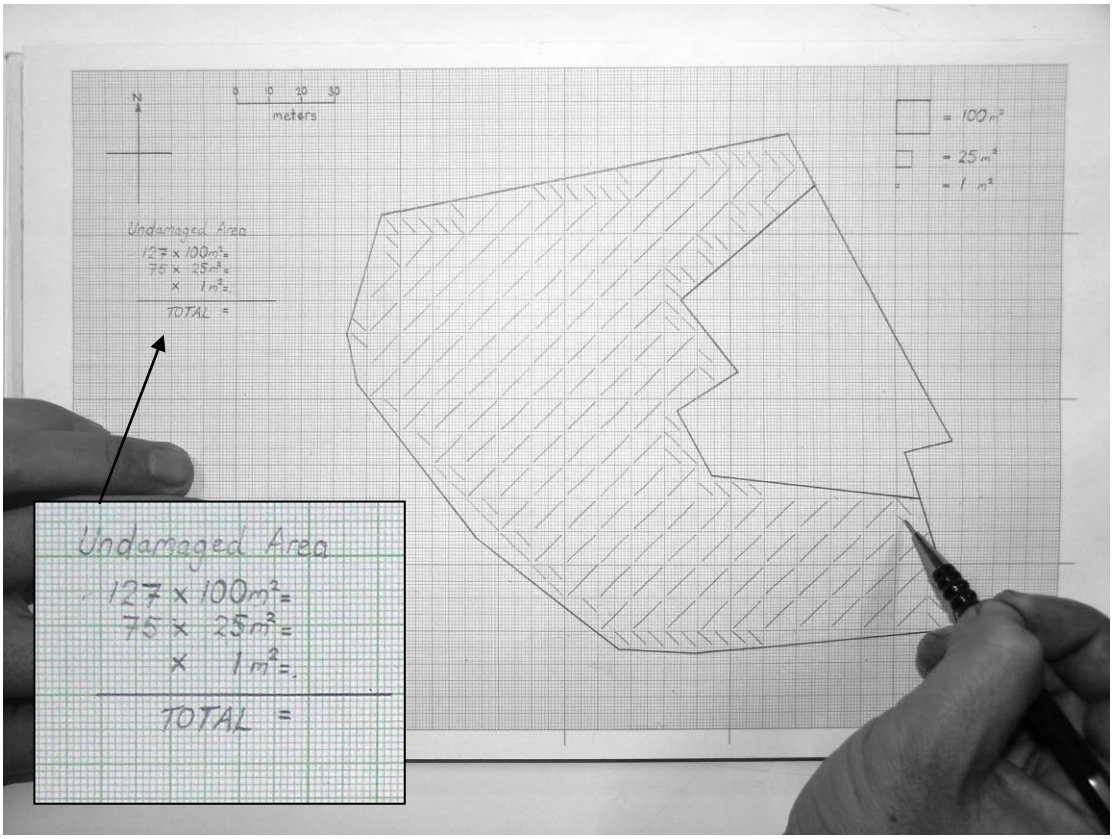


Figure 39. Mark the 0.5cm squares as you count by marking them with an opposing diagonal line. Record the number in the calculation area on the left. Again, only count whole squares

Now count all the 0.1cm squares. This seems like a very repetitive process and can be time consuming but it is important to concentrate and count the squares correctly. The best way to do this is to start at the top left of the area on your map and count all the squares within a 1cm band and then mark this number in the margin of your map under a column marked 1 (Figure 40). Later you can then sum these values using a calculator.

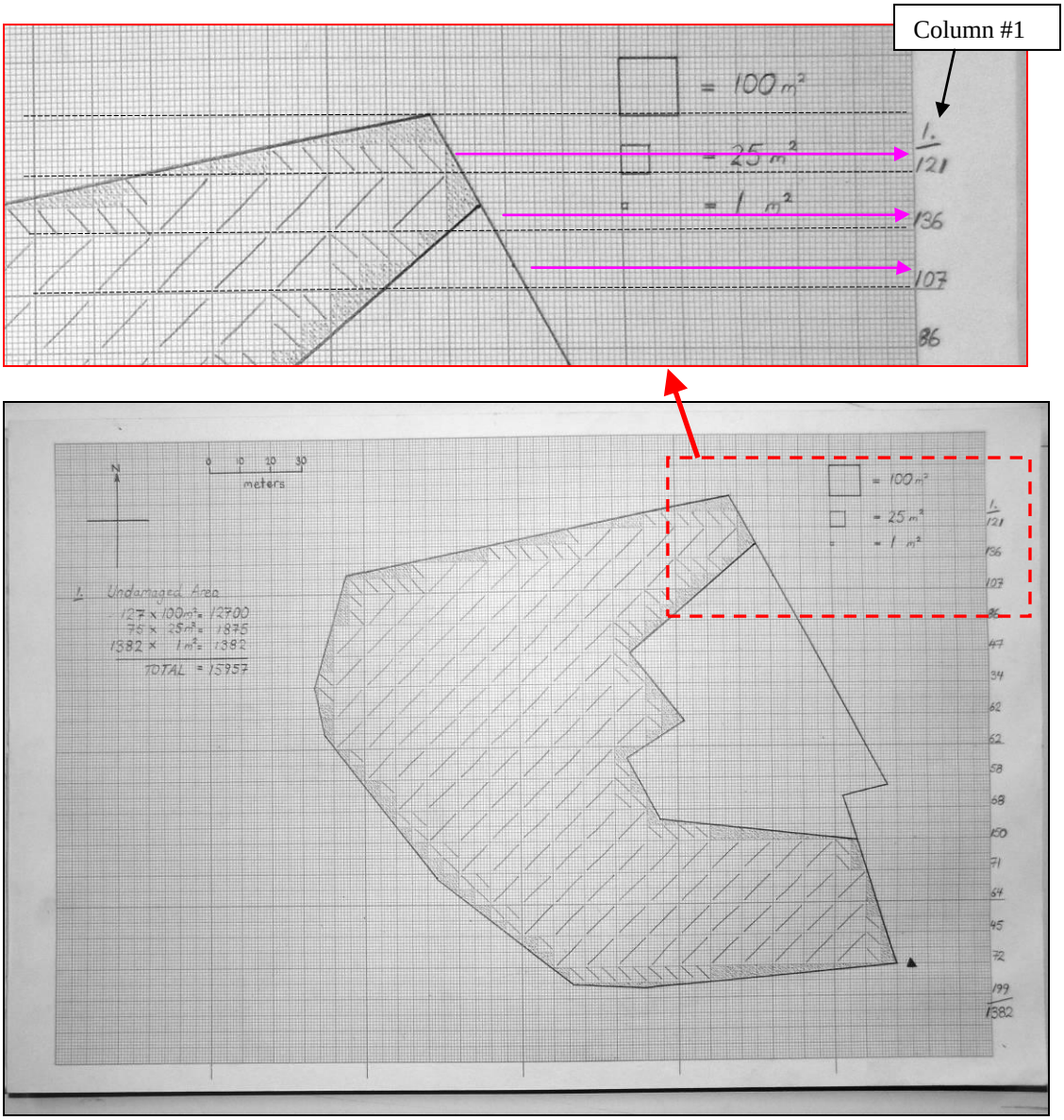


Figure 40 A method to calculate the number of 0.1x0.1cm squares.

Now that you have calculated the undamaged area you should proceed to calculating the damaged area using the same method (Figure 41)

After calculating both the undamaged and damaged areas the total area of the crop can be calculated by adding these figures. In this case; 5957m^2 + 4562m^2 = 20159m^2.

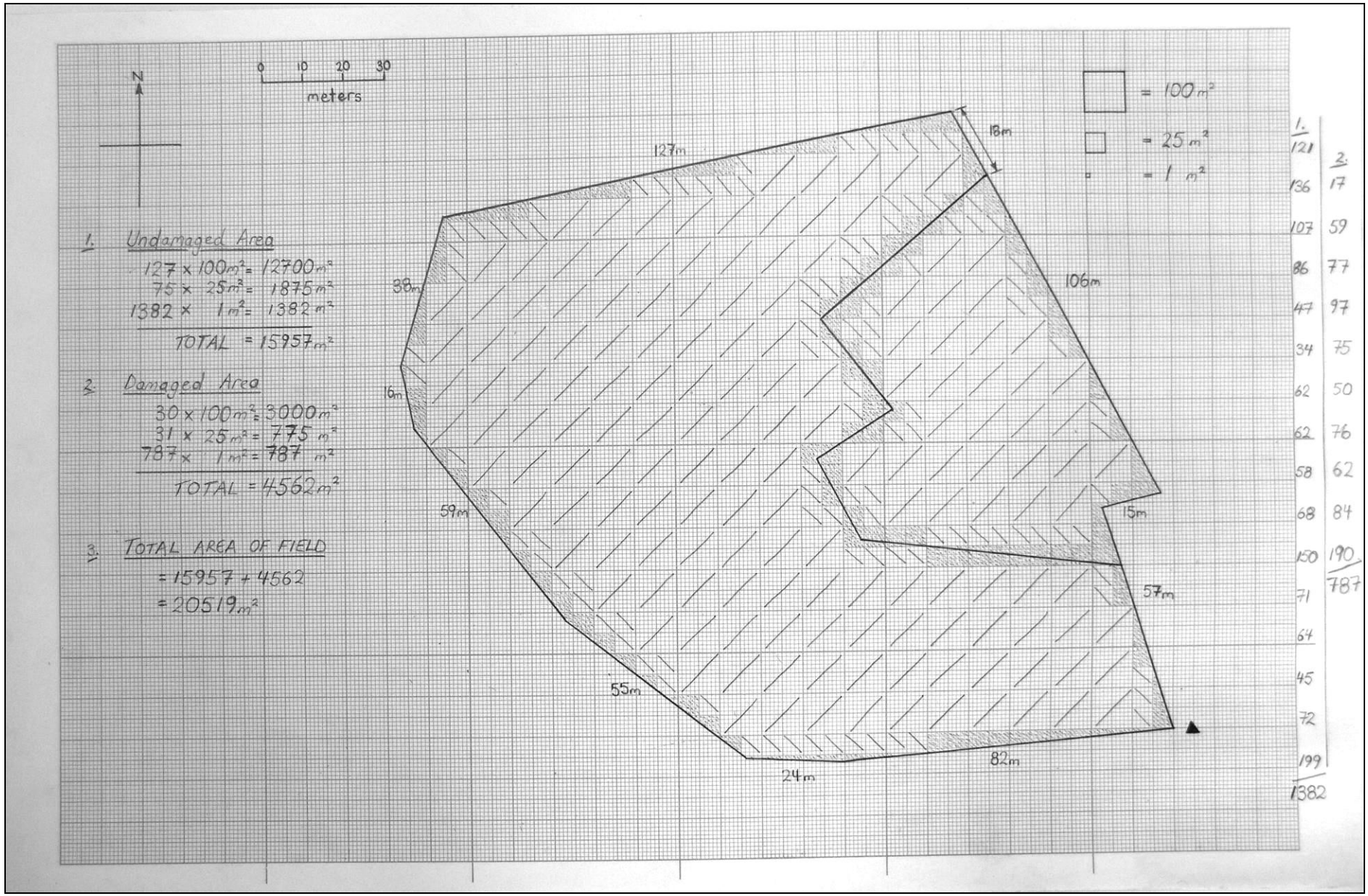


Figure 41. A completed scale map of damaged crop areas.

Make sure that you staple the scale map and the sketch map to the HEC incident assessment datasheet.

Data management

All HEC data that is collected should be stored in a digital database for further analysis. What design the database should be will depend on the authority or organisation managing the data. Included with this booklet is a CD that has an example database, in both Lao and English, that could be used to manage HEC data. There is both a Microsoft Access database and a Excel spreadsheet.

Reporting

What type of report is produced to illustrate the results of HEC monitoring is again up to the authority or organisation managing HEC data. Basic reports that provide a good summary of HEC data are not difficult to produce and give wildlife managers accurate data with which to make management decisions. Some suggestions are to produce sections that answer questions, such as those below, using texts, tables, charts and maps.

1) HEC incidents by month – how many HEC incidents occurred per month?
2) HEC incidents by village – how many HEC incidents occurred in each village in the monitoring area?
3) HEC incidents by major and minor cropping season – how many HEC incidents occurred in each of the major and minor cropping seasons? These seasons will vary depending on where the HEC is occurring. For example, in the Nakai area many farmers planted the dominant crop, upland non irrigated rice, only once a year between June and December. This conveniently divided the year into two six month periods which were contrasted in analysis.
4) HEC incidents by target – what crops/ property/ etc were most damaged by elephants?

Reporting should also include GIS maps which show the spatial and temporal distribution of HEC incidents. These can be created using the GPS data collected for each incidents.

For an example of in-depth HEC monitoring reporting see the Nakai Elephant Programme, Phase 1 and Phase 1.5 reports at:

http://www.namtheun2.com using the link to Documents and Environmental Studies.

Copies of this report are also available from the Wildlife Conservation Society, Lao PDR Programme, Vientiane, Lao PDR. Further reports from Phase 2 of the Nakai Elephant Programme should be available during 2010.

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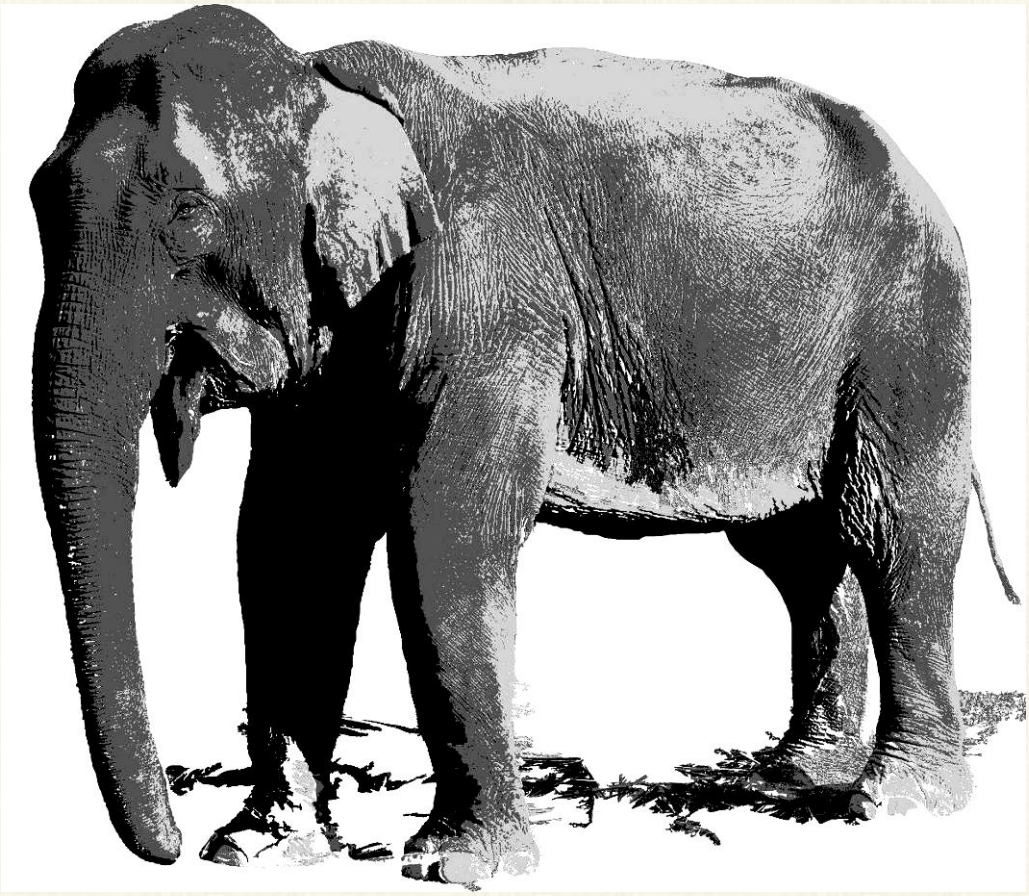
Appendix 1 – Example HEC monitoring information poster that was posted in all project area villages during Phase 2 of the Nakai Elephant Program.

Nakai Elephant Conservation Project

Elephants are important in Nakai!



HEC in your village?
Have you seen elephants near your village?

Please contact the Nakai Elephant Project

Phothakone Luangyotha- 020 297 65 65 (Wildlife Conservation Society)
Somphong- 020 215 99 77 (DAFO)
Vilayhong- 020 677 99 99 (DAFO)

If you cannot call by telephone then please contact NTPC using the Two Way Radio in your village and ask them to call one of the telephone numbers above

WILDLIFE CONSERVATION SOCIETY Lao PDR Program
ອົງການ ອະນຸລັກ ສັດປ່າ

NTPC