Lao People's Democratic Republic
Peace Independence Democracy Unity Prosperity

NATIONAL TIGER ACTION PLAN FOR LAO PDR 2010 - 2020

Ministry of Agriculture and Forsetry
Department of Forestry
Division of Forest Resource Conservation
Government of Lao PDR

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Tiger photo captured by infra-red camera trap in
the Nam Et-Phou Louy National Protected Area, Houaphan Province
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In collaboration with the

Wildlife Conservation Society – Lao PDR

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LIST OF ACRONYMS

CBD	–	Convention on Biodiversity
CITES	–	Convention on International Trade in Endangered Species
CTD	–	Camera trap day
DAFO	–	District Agriculture and Forestry Office
DAP	–	Dong Ampham NPA
DHS	–	Dong Huasao NPA
DKT	–	Dong Khanthung
DPV	-	Dong Phouvieng NPA
GOL	–	Government of Lao PDR
HNN	–	Hin Nam Nor NPA
IP	–	Independent photos
KML	–	Khammuoan Limestone NPA
LLV	–	Lavin-Laveung PPA
LNTA	–	Lao National Tourism Administration
NEPL	–	Nam Et-Phou Loeuy NPA
NHA	–	Nam Ha NPA
NKD	–	Nam Kading NPA
NKG	–	Nam Kong PPA
NKN	–	Nam Kan NPA
NNT	–	Nakai-Nam Theun NPA
NPA	–	National Protected Area
NPU	–	Nam Phoun (Poui) NPA
NXM	–	Nam Xam NPA
PAFO	–	Provincial Agriculture and Forestry Office
PCV	–	Phou Chomvoy PPA
PDD	–	Phou Dendin NPA
PKK	–	Phou Khao Khouay NPA
PKT PNPA	–	Phou Kathong Proposed NPA
PPA	–	Provincial Protected Area
PPN	–	Phou Phanang NPA
PXH	–	Phou Xanghe NPA
PXT	–	Phou Xiengthong NPA
TCL	–	Tiger Conservation Landscape
TPZ	–	Totally protected zone
XBN	–	Xe Bangnouan NPA
XKP	–	Xe Khamphor
XPN	–	Xe Piane NPA
XSP	–	Xe Sap NPA

GLOSSARY OF TERMS

Totally Protected Zone (TPZ). Core breeding area for tigers and other wildlife where human activity is prohibited

Controlled Use Zone (or Managed Zone). Area where sustainable use of natural resources by local communities for subsistence is allowed

Corridor. Habitat connectivity within and between protected areas that allow movement or dispersal of tigers and prey within/between TCLs

Convention on Trade of Endangered Species (CITES). An international agreement between governments to ensure that international trade in specimens of wild plants and animals does not threathen their survival

Convention on Biological Diversity (CBD). An international treaty to sustain the diversity of life on Earth

MIST (Monitoring Enforcement System). A database tool used to track effectiveness of law enforcement efforts, threats, and trend of illegal activities .

Category 1 Species (2007 Wildlife Law). Species that are considered to be rare, highly threatened to extinction, high economic value, significant to socioeconomic development, environment protection, scientific research. Hunting is totally prohibited.

Category 2 Species (2007 Wildlife Law). Speicies that are significant to socio-economic developemtn, envirornment protection, local livelihood and scietific research. Hunting outside the TPZ for subsistence is occassionally allowed, but not for trade.

Category 3 Species (2007 Wildlife Law). Species that are common in nature and have a high reproductive rate. They are also highly significant to socioeconomic development, environmental protection, and scientific research. Hunting for subsistence is occassionally allowed, but not for trade.

Tiger prey. Any wildifespecies, often ungulates, that arehunted by tigers for food

National Protected Area (NPA). National Conservation Forest set aside for the purpose of conserving the nature, preserving fauna and flora, forest ecosystem and other valuable sites of natural, historical, cultural, tourism, environmental, educational and scientific importance.

Provincial Protected Area (PPA). Provincial Conservation Forest set asidefor the purpose of conserving the nature, preserving fauna and flora, forest ecosystem and other valuable sites of natural, historical, cultural, tourism, environmental, educational and scientific importance.

Priority Source Site. An area embedded within a Tiger Conservation Landscape (TCL) that currently has confirmed or likely reports of tiger in a designated protected area, which also has the potential to serve as a Totally Protected Zone (TPZ) within a designated Protected Area

Tiger Conservation Landscape: area where there is sufficient habitat for at least five tigers and where tigers have been confirmed for the last 10 years

LIST OF CONTRIBUTING AGENCIES

- CITES Scientific Authority, Science and Technology Agency, Prime Minister's Office
- Department of Customs, Ministry of Finance
- Department of Forest Inspection, MAF
- Department of Livestock and Fisheries, MAF
- Department of Planning and Investment, Ministry of Planning and Investment
- Department of Planning, MAF
- Division of Forest Resources Conservation, Department of Forestry, MAF
- Faculty of Forestry, National University
- Faculty of Science, National University
- Forest Inventory, Department of Forestry, MAF
- Houaphan Provincial Agriculture and Forestry Office (PAFO)
- International Union for Conservation of Nature – Lao PDR Country Program (IUCN Lao PDR)
- Lao Biodiversity Association
- Luang Pprabang Provincial Agriculture and Forestry Office (PAFO)
- Ministry of Agriculture and Forestry (MAF)
- Muang ThongTiger Farm
- National Protected Areas - 23 representatives
- Phou Bia Mining Company
- The Wildlife Conservation Society-Lao Program (WCS-Lao PDR)
- The World Bank – Lao PDR
- Viengkham District Agriculture and Forestry Office (DAFO), Luang Pprabang province
- Viengthong District Agriculture and Forestry Office (DAFO), Houaphan province
- World Wide Fund for Nature- Lao PDR Program (WWF-Laos)

MINISTER'S MESSAGE

Lao's People Democratic Republic (hereafter Lao PDR), is rich in natural resources. Most notable is that much of the land is still covered by forest – which we literally describe as "green gold". Given its distinctive location at the heart of Indochina, the country contains a wide variety of habitats that support a diversity of fauna and flora, and some of them are rare and endemic to Lao PDR.
The tiger is one of the ecologically important species found in the forest ecosystem of Lao PDR. In the past, tigers were widely distributed in forests throughout the country, and their presence served as an indicator of healthy forests with abundant wildlife populations. Today, tigers across Lao PDR are endangered and on the brink of extinction due to several factors, but the most serious of these are poaching and habitat loss. The potential loss of tiger populations in Lao PDR is an ominous signal that Lao biodiversity, including the nation's forests and wildlife, is also in decline and in danger of being lost.

Can we imagine what a shame it would be if our forests no longer contain tigers? Isn't this the same as if our rivers no longer contain fish?. At first, we may think the simple answers to these questions are that the forest is dispensable, although we also know that thousands of Lao citizens have depended upon on these forests for centuries. Therefore, we, in this generation, need to act now to not let the stripes - that are so powerful, magnificent, and valuable to the forest ecosystem of Lao PDR - become extinct. In national development strategies, the government of Lao PDR emphasizes that the maintenance of healthy and productive forest ecosystems and the sustainable use of natural resources are key to achieving the nation's goals for sustainable economic growth and poverty eradication, and to raise the country out from its least-developed nation status by 2020. These principles are based on the fact that more than 80% of nation's citizens still live in rural areas and depend on biological resources for daily subsistence.

It is a great honor for the government of Lao PDR to work together with all citizens and organizations, including government agencies, the private sector, NGOs, scientists, and local communities to save an endangered species, and also to support management for sustainable use of natural resources to secure the future of the country through sustainable development. Along with this National Tiger Action Plan (NTAP), other important instruments that are already in place to support the NTAP include the national Wildlife Law, the Forestry Law, and several national strategies, including the Biodiversity Strategy and Action Plan, and the Forest Strategy to 2020. However, these instruments mean nothing if they are not implemented effectively. Thus, support and cooperation from all agencies is essential if we are to be successful. The government of Lao PDR is committed to the goal of securing wild tigers and their habitat for future generations. With the development of this National Tiger Action Plan we have taken the first step, and by working together we will achieve our goal for the benefit of our future generations.

Minister of Agriculture and Forestry

MESSAGE FROM THE DIRECTOR OF THE DEPARTMENT OF FORESTRY

Tiger, a flagship of the Asian forest ecosystem, is facing an extremely high risk of extinction in the wild. The global population has currently dropped below 3,500 individuals and occupies only 7% of their historical range. There is a growing concern among conservation communities as well as governments that tigers will be gone within the next few years. In response, the global communities, including Lao PDR, have worked together hand in hand to identify appropriate measures to address the problems, and establish targets to increase tiger numbers. If a powerful and magnificent animal like tiger becomes extinct in the wild, nobody knows what will be happen to this world. However, what we do know at present is that the world is now facing more frequent and extreme natural disasters due to climate change.

Over the past decades, the government of Lao PDR has taken important steps to conserve forests, wildlife and aquatic animals, which is treated as a national property because they provide a wide range of options for national economic activities and growth as well as local livelihoods. In 1993, the National Protected Area (NPA) system was legally established through the Prime Minister's degree No. 164, and there are 21 designated NPAs with a total area of 3.31 million ha, covering 14% of the country's total land area. Other protected areas include 57 provincial protected areas with an area of 932,000 ha (4% of total land area), and 144 district protected areas with an area of 500,000 ha (2% of total land area). This is considered as one of best protected area systems in Asia. After establishment of the NPA system, a series of regulations regarding wildlife protection and PA management were issued to guide how protected areas should be administered. In 2006, the government issued the first Forestry Law, followed by Wildlife Law in 2008. Moreover, the country is a signatory to several international treaties, most notable is the Convention on Biodiversity in 1996, and the Convention on International Trade of Endangered Species (CITES) in 2004.

The National Tiger Action Plan was developed in line with the national strategies for biodiversity and forestry to 2020, emphasizing protection of wildlife and its habitat, particularly tigers, and maintenance of connectivity amongst forest patches throughout the country. The Department of Forestry is a leading government agency with the mandate to ensure that forest resources and biodiversity are managed sustainably and contribute substantially to national development. I, director of the Forestry Department, call for support from all Lao citizens, to work together to ensure that all objectives and measurements identified in this plan are implemented successfully.

Director of Forestry Department

PREFACE

The Division of Forest Resources Conservation is a leading government agency, directly responsible for cooperation and coordination with concerned agencies to secure the management of national protected areas and conservation of aquatic animals and wildlife throughout the country. The tiger is a critically endangered species and legally designated in the list of Category I protected species in the National Wildlife Law. It is a top priority species in need of urgent conservation because it plays a key role in the natural forest ecosystem that contributes significantly to sustainable social, economic, and environmental benefits.

The National Tiger Action Plan was developed according to national principles outlined in the National Biodiversity Strategy to 2020, National Forestry Strategy to 2020, and National Growth and Poverty Eradication Strategy in order to identify appropriate management interventions that support integrated conservation and development to meet national development goals. The Plan was developed in consultation with various stakeholders including both national and local agencies as well as international NGOs who have worked in Lao PDR for many years. All the data on tigers was compiled from the field and interviews using internationally accepted approaches to use as baseline data for designing management objectives. All management interventions in this plan represent inputs or ideas of Lao people in association with national policies. I believe the National Tiger Action Plan will become an important tool to provide guidelines in conserving wildlife and its habitat, particularly tiger populations, and this plan will be successful if we continue working
together to ensure that all activities are implemented.

Buaphan Phanthavong
Director of Division of Forest Resources Conservation
Department of Forestry

ACKNOWLEDGMENTS

We would like to express our sincere thanks to all participants of the National Tiger Action Plan workshop, held in the Department of Forestry from November 31st to December 1st 2010, for their active participation in a series of discussions and for sharing their experience and comments. Outputs from this workshop were compiled and led to development of the National Tiger Action Plan for Lao PDR.

This Tiger Action Plan was made possible by the generous financial support of the Global Tiger Initiative, World Bank, and other in-kind support from the Department of Forestry, Division of Forest Resource Conservation, and the Wildlife Conservation Society-Lao Program. Permission for holding the Tiger Action Plan workshop was granted by the Ministry of Agriculture and Forestry.

Many thanks to those who took part in the facilitation and compilation of the results of discussions held during the workshop, including staff from WCS-Lao PDR and DFRC. Logistic preparation for the workshop was coordinated by staff of the Division of Forest Resource Conservation.

Data on the current status of tigers across the country was compiled from standardized interviews with several wildlife conservation workers including NPA staff, foresters in District Agriculture and Forestry offices, and international NGO staff who are currently involved in field activities in various NPAs. Many thanks to all involved for sharing their knowledge and experience, and for their valuable time to answer our questions by phone.

EXECUTIVE SUMMARY

Within the last 100 years, tigers have rapidly declined in numbers and distribution across their range. Less than 3,500 animals now live in the wild, and occupy only 7% of their historical range across Asia24. Tigers remain today in small isolated and fragmented patches of forest across 14 range countries. However, those small and isolated populations that survive at present are continuingly declining due to direct killing for their body parts, depletion of prey due to overhunting, persecution by angry farmers, and habitat loss and fragmentation.

In Lao PDR, tigers once occurred in most forested areas across the country, but today tigers have disappeared from most places of the country due to the direct killing of tigers, unsustainable over-harvesting of their prey, and loss of habitat. In the last five years, tigers have only been confirmed by camera trap photos and genetic analysis of scats from one location in the country, the Nam Et-Phou Louey National Protected Area, while the persistence of tigers in other parts of the country is provisional from reports of animal signs but the certainty of tiger presence remains unknown.

Despite this decline, the country still contains extensive habitat in several tiger conservation landscapes that could potentially harbor abundant prey populations, which could support viable tiger populations. Unfortunately, the status of the tiger and their prey populations in most of those landscapes remains uncertain. The paucity of information may be due to the fact that tigers have received little conservation attention in the past due to a lack of national capacity and financial support to monitor and manage tiger populations. However, the existing data compiled from field surveys during 1990s, recent research and monitoring in a few national protected areas and anecdotal reports from others suggest that wild tigers may still occur in many parts of Lao PDR, but at very low numbers.

Tigers are adaptable to a wide range of habitats. They can live wherever there is sufficient prey. So, despite the low abundance of tigers in the country at the present time, there are enormous opportunities to make the recovery and conservation of wild tiger populations possible in the Lao PDR. This recovery is possible because; i) the current human population is relatively low (22 people/km2) compared to neighboring tiger range countries, ii) over 47% of land is forested, of which 14% is established as 21 national protected areas that may serve as core source populations for tigers in the wider landscape, iii) major prey species still exist in most NPAs and landscapes, and iv) there are national policies that promote integration between biodiversity conservation and sustainable development, as well as the dissemination of national laws addressing
wildlife protection.

At least eight Tiger Conservation Landscapes (TCLs) were identified throughout the country, and classified into four different classes. Class 1 TCLs have habitat to support at least 100 tigers, evidence of breeding, minimal-moderate levels of threat, and conservation measures are in place. The Class 1 TCLs cover a total area of 45,976 km2, one is in the north east (25,978km2) and another is in the far-south of Laos (19,997 km2). Class 2 TCLs have sufficient habitat for 50 tigers, moderate levels of threat, and a basis for conservation that needs to be improved. A central TCL covers 36,318 km2, and approximately 2,527 km2 in the farsouthwest of the country. Two other classes of TCLs, Class 3 and Potential, have habitat to support some tigers, but have moderate-high levels of threats, and minimal conservation investment. Together, these TCLs cover approximately 40,460 km2.

The primary objective of this National Tiger Action Plan (TAP) is to establish a focused strategy that lays out specific actions to be taken over the next 10 years (2010-2020) toward an overarching vision of securing healthy functioning forest ecosystems where viable tiger populations thrive forever. The overall goal for this plan is to elevate the existing tiger numbers to the level of viable breeding populations at source site, Nam Et-Phou Louey NPA, ensure connectivity between all TCLs, and obtain baseline data on tiger populations for all TCLs in Lao PDR by 2020. The plan was developed in line with existing national policies and legislative structure relevant to wildlife conservation. This framework includes the National Growth and Poverty Eradication Strategy, the National Forest Strategy, National Biodiversity Strategy and Action Plan, and the National Socio-Economic Development Plan, and National Wildlife Law of Lao PDR

The plan identifies seven objectives necessary toward achieving the goal, these include;

1. Increase public awareness and support for the recovery and conservation of wild tigers and their habitats
2. Identify and demarcate totally protected zones (TPZs) in protected areas and corridors for connectivity between TPZs in tiger conservation landscapes.
3. Increase and make effective the enforcement of national regulations and international conventions to stop killing of tigers and to regulate illegal harvest and trade of tiger prey.
4. Increase national cross-sectoral cooperation for the recovery and conservation of wild tigers and their habitats
5. Increase international cooperation to reduce the illegal trade of tiger and prey to neighboring countries
6. Monitor and reduce human-tiger conflict in tiger conservation landscapes
7. Strengthen Protected Area organization, capacity and sustainable financing to effectively implement management activities to reduce threats to tigers and prey at priority source sites in Class 1 and 2 tiger conservation landscapes

The plan describes in detail the actions to be taken at different administrative levels in order to achieve each objective. At priority source sites, actions will mainly aim at reducing direct and indirect threats at sites that harbor tiger populations. At the landscape level, activities will aim at reducing threats occurring beyond the boundary of priority source site (i.e. protected area), which are spread across the landscape. At the national level, actions will focus on national policy or legislation, institutional capacity building, cross-sectoral cooperation and coordination, as well as technical and financial support. The success of this Tiger Action Plan will be possible with cooperation and involvement of all concerned stakeholders and agencies.

This plan will be implemented using an adaptive management approach, where monitoring is used to measure the impact of the interventions on the status of wild tigers, their prey and the threats they face. This approach allows lessons to be learned, and new knowledge and methods to adapt the design and implementation of interventions based on monitoring results. The success of this plan will be assessed by monitoring a measurable indicator of our conservation target, which is tiger occupancy across landscapes and the tiger population size or density in priority areas. The indicator of success will be assessed using sound science-based approaches. For example, capture-recapture analysis using tiger photos from camera traps or fecal DNA from tiger scat. In addition, tiger prey occupancy will be also used to determine the distribution and proportion of the habitat that is occupied prey species. An increase in the measurable indicator of tiger and prey abundance and distribution indicates the efficacy of conservation actions. To measure the achievement and effectiveness of conservation actions towards the objectives, we will use MIST (Management Information System) to evaluate if the conservation actions being implemented are effective at reducing key threats to wild tigers, their prey and habitats.

PART 1

STATUS OF TIGERS AND THEIR CONSERVATION IN LAO PDR

1. TIGER NATURAL HISTORY AND SIGNIFICANCE

1.1 Why conserve tigers?

Tiger is the largest mammalian predator in Asian tropical ecological systems. In their role as top predator, tigers serve as a flagship of Lao ecosystems. The presence of viable populations of top predators is indicative of the integrity of entire ecosystem; if lost it may generate the disruption of food web that affects the structure of ecological community1,2. This means when tigers are removed, prey populations can explode leading to the decline of plant communities on which many species depend. Therefore, protection of the tiger symbolizes the protection of the nation's forest and biodiversity that is important to human well-being in the forms of "ecological services" provided by a healthy ecosystem.

Biodiversity, in addition to providing for food, fuel, shelter, medicine and livelihoods, provides the critical 'ecosystem services' on which socioeconomic development depends. These services include air and water purification, soil conservation, disease control, and reduced vulnerability to natural disasters such as floods, droughts, landslides and pest epidemics3. Biodiversity loss exacerbates poverty, and likewise, poverty is a major threat to biodiversity. So poverty reduction will only be achieved with the maintenance of the nation's biodiversity.

Unfortunately, tigers are in rapid decline throughout the forests of Laos; to reverse the declining trend of tigers is an obligation of Lao citizens. The Law on Aquatics and Wildlife states clearly that tigers are protected so hunting and trading in tigers/tiger parts is banned. As a signatory to the international Convention on International Trade in Endangered Species (CITES), the government of Lao PDR is committed to work with the international community to prevent the illegal trade of tigers.

1.2 Status of tigers at global, regional and national level

Tigers (Panthera tigris), once widely distributed across Asia, today have rapidly declined in number and distribution (Figure 1). They are listed globally as "critically endangered" throughout their range4. They are restricted to small and isolated remnant forest patches covering only 7% of their historical range and their population status is uncertain across this distributional range (Figure 2). Of the eight tiger subspecies, three of them have been driven to extinction. They include the Caspian (P.t. virgata), the Bali (P.t. balica), and the Javan (P.t. sondaica). The Indochinese tiger (P.t. corbetti), was once widely distributed across Indochina, namely Laos, Vietnam, Cambodia, Thailand, Malaysia and Myanmar. The most well-known factors driving the decline of the current tiger population worldwide include direct poaching of tigers for commercial trade, depletion of prey due to over-hunting by humans, and habitat loss and fragmentation resulting from human land-use practices, and tigerhuman conflict.

1.3 Natural history

1.3.1 Description

Tiger is the world's largest cat and is a specialized predator that preys on ungulates – any animal with hooves such as bovids (wild cattle), deer, pigs and serow. Tigers have black stripes with the background coloration of reddish orange to reddish ochre and white under parts. The pelage of tropical tigers seems to be darker than those that occur in temperate habitat. The largest adult tigers weighing up to 300 kg are recorded in Far East Russia with the smallest adult tigers weighing about 140 kg in peninsular Malaysia and Indonesia. Tigers are greatly adaptable to a wide range of habitat types, even in altered landscape. The only prerequisites for survival of tigers are sufficient prey, plant cover, and water. Tigers live wherever there is an adequate supply of prey, and preferably large prey
species7,8.

1.3.2 Reproductive capability

A tigress comes into heat at intervals of around 3 to 9 weeks, and is receptive for about 3 to 6 days within that period. Gestation is short, only 103 days, and a litter usually has a range of 2 to 5 cubs. In nature, a tigress produces a new litter only after her young have

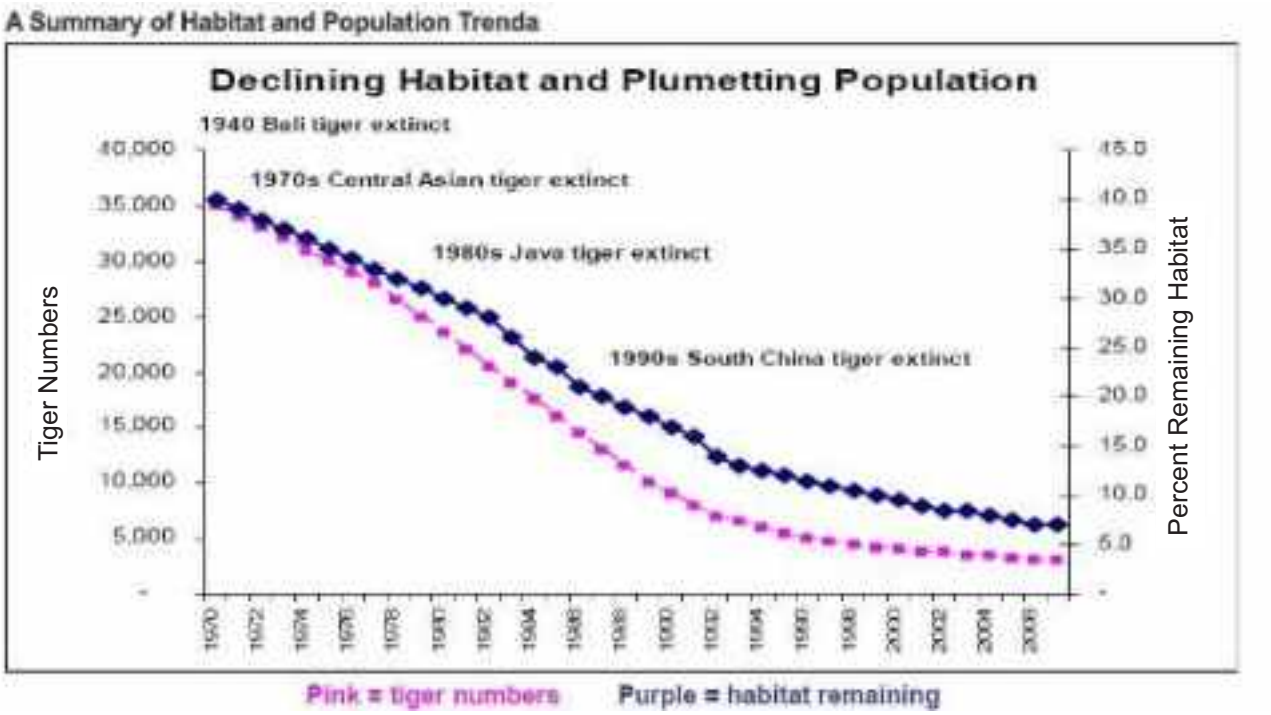

Figure 1. Trend in population status of tigers and habitat throughout its range (Source: Damania et al. 2008, www.wds.worldbank.org)

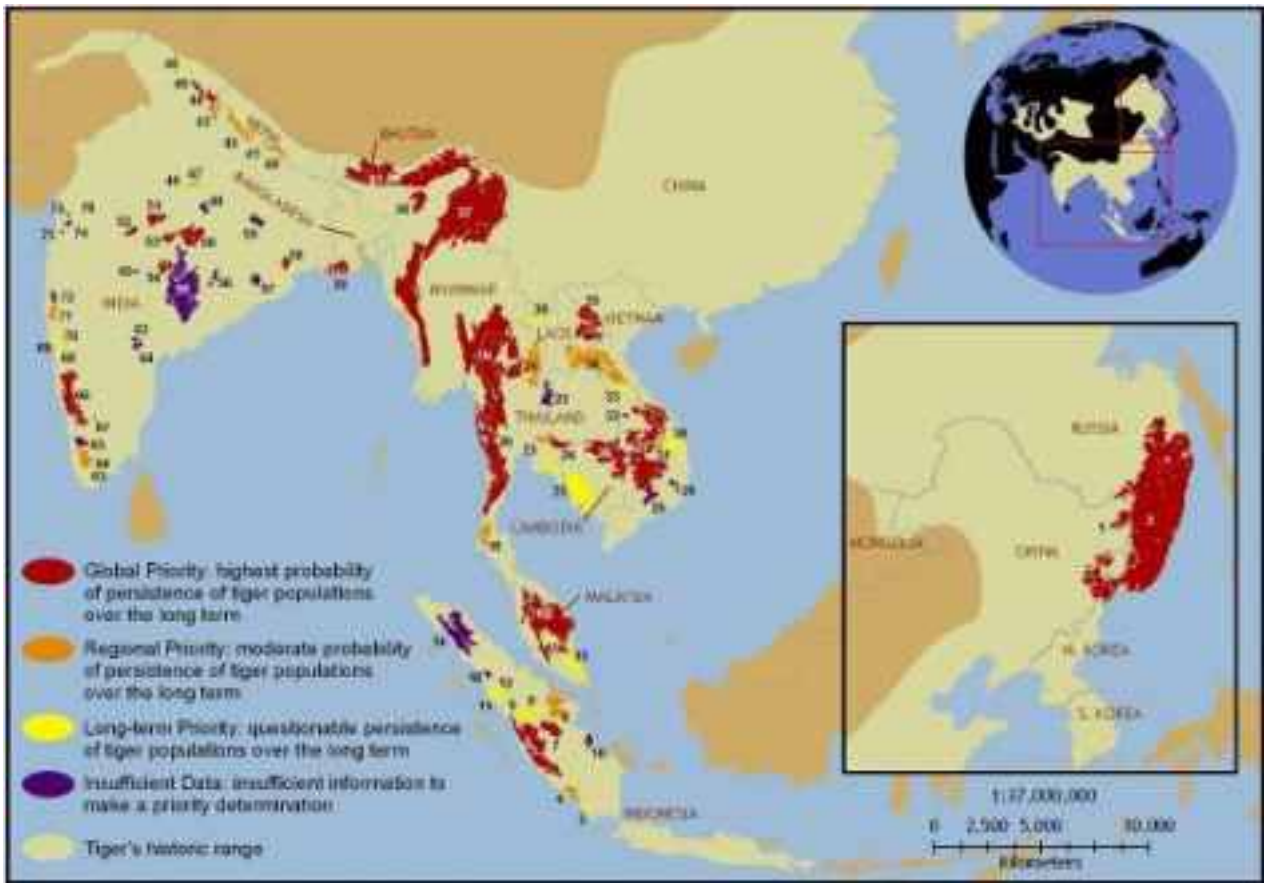

Figure 2. Map showing historical and current geographical distribution of tigers, and priority areas for tiger conservation. (Source: Dinerstein et al. 2006, www.savethetigerfund.org)

all dispersed, usually after 18-20 months. However, if a litter was lost after birth, the interval between litters is only 7-8 months. Females breed relatively early at about 3 years of age, whereas males breed at about 4 years of age. Reproductive lifespan is about 6 years for females and only 3 years for males in nature. Based on their high fecundity, tigers are able to recover rapidly from substantial losses in many places as long as the habitat and prey population remain intact9.

1.3.3 Feeding ecology

Tigers are a top predator in the ecosystem so almost any terrestrial vertebrates are potential prey for this animal. However, in order to survive and reproduce tigers need large prey to meet their energetic requirements10. Large ungulates, such as cervids (deer), make up nearly 75% of the biomass contribution to tiger diets in most parts of tiger range9. So, the depletion of large prey species is a critical threat to the long-term persistence of tigers10. A tigress consumes 5-6 kg of meat per day on average, which translates to 1,760 to 2,112 kg per year. If a mother with cubs, it would need 50% more food9. So to survive, an individual tiger needs to feed on a deer-sized prey approximately every week, consuming about 50 animals per year (Figure 3). Tigers crop about 10% of available prey base, which generally corresponds to the rate at which the prey population grows. Therefore, a total prey population of 500 deer-sized animals is needed to produce the 50 deer that a single tiger must consume annually to survive 12 (Figure 3).

In Laos, large prey (i.e. bovids and cervids) have been heavily hunted; muntjac and wild pig are now probably the key prey13. In the present situation, tigers are likely approaching to a hypothetical 'muntjac-only scenario', where small prey (<25kg) make up the majority of the tiger diet (Sunquist 1999). If this is the case, a tigress needs to kill one 20-kg muntjac every 2-3 days or 183-365 muntjacs/year. If feeding on wild pig only, an average male (120kg) and female (100kg), a tiger would consume annually at least 87 and 104 wild pigs respectively. Thus, the muntjac and wild pig population at a site would need to be several times larger than this to produce sufficient prey for a single individual tiger.

Figure 3. Tiger needs to feed on a deer-sized prey approximately every week, consuming about 50 animals per year. Tigers crop about 10% of available prey base, which generally correspond to the rate at which the prey population grows. Therefore, a prey population of 500 deer-sized animals is needed to support a single tiger (Source: Karanth and Nichols 2002)

1.3.4 Home range and territory

Tigers are solitary outside of the mating season, and when young are fully dependent on their mothers14. In order to meet their requisites or ecological requirements (i.e. food, water, and cover) tigers roam a large area that encompasses a wide range of habitat types or ecosystems. A male's home range is greater than the female, overlapping with several
female territories (Figure 4). However, the size of territories or home range of tigers varies greatly with prey density. For example, a typical home range size for resident breeding females in prime areas in Nepal and India ranges in size from 10 to 15 km2 where they support prey densities of around 25-50 ungulates per km2 14,15, whereas in the Russian Far East that supports prey densities less than 5 ungulates per km2, female tigers have territories that range in size from 200 to 400 km2 16.

Tigers move around within their home ranges for three main reasons; hunting, maintaining social communication with other tigers and avoiding the enemy they fear – i.e. man. Daily movement distance varies considerably with prey abundance. If prey is abundant, they move over short distances as probabilities of encountering prey are high. For example, in Chitawan National Park in Nepal, tigers move only 2-11 km as prey densities are high with 68 ungulates/km2 15,17. If prey is scarce, tigers may travel for several kilometers. This is likely the case for tigers in much of Laos today. In these cases, tigers may travel far beyond the protected area boundaries, which can lead to tiger-human conflict, mainly due to

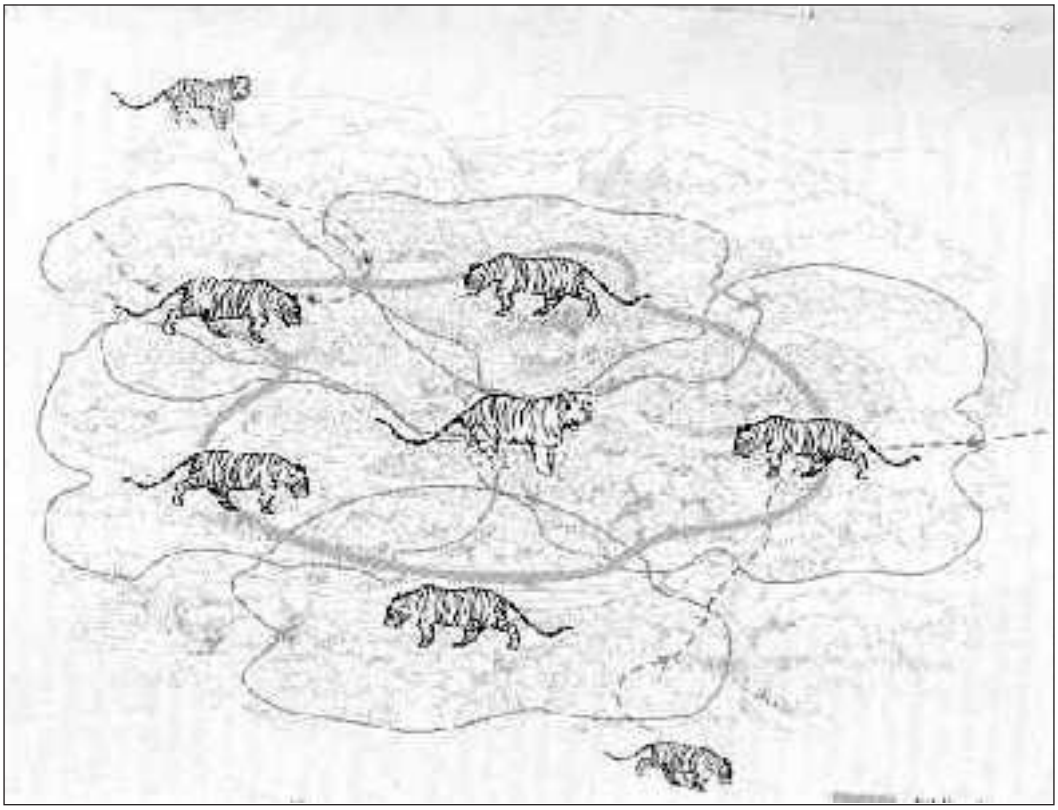

Figure 4. A male's home range is greater than the female, overlapping with several female territories (Source: Karanth and Nichols 2002).

tiger depredation of livestock or direct confrontation with humans18. If problems occur, tigers are often killed by humans in a revenge of loss of their property.

1.3.5 Population density and prey

Prey abundance is a critical determinant of tiger numbers. Tiger population densities are strongly correlated with prey densities. For example, in Kaziranga National Park in India with high prey densities of 68 animals per km2, and associated biomass of 5,200 kg per km2, tiger density is 17 tigers per 100 km2 19. At Sikhote Alin Zapovednik Reserve in Russia where ungulate biomass is lower than 500 kg per km2, tiger density is less than 1 tiger per 100 km2. The situation in Russia is similar to tropical habitats such as Lao PDR where large prey has been heavily hunted out. For example, in Malaysia tiger density ranged from 1.1 to 1.9 tigers/km2 with the estimated prey biomass of 270 to 430 kg/km2 20. In the Nam Et-Phou Louey National Protected Area in Laos, the estimated density of tigers was 0.2 to 0.7 tigers/100 km2 and the crude estimate of prey was about 3.25 ungulates/km2, of which muntjac and wild pig were the most common while detections of sambar and gaur were much lower13.

2. TRENDS IN TIGER DISTRIBUTION AND POPULATIONS IN LAO PDR

2.1 Past records (to 2005)

2.1.1 Sources of data and methods for past records

Historical records of tigers before 2005 were mainly derived from existing reports for the following periods of time:

1988-1993. Salter 199321 analyzed village questionnaire data on wildlife distribution gathered between 1988-1993.

1932-1998. Duckworth and Hedges 199822 assessed the status of tigers in Laos by reviewing five sources of data, which included published papers from 1932 to 1998, wildlife survey reports, reports of other surveys, media articles and personal communication.

1991-1998. Duckworth, Khounboline and Salter 199923.provided a baseline on the status of tigers in Laos by summarizing data compiled from field surveys for large mammals for periods exceeding a

week during 1991-1998 in 32 different areas of the country.

2003-2004. Johnson, Vongkhamheng et al., 200613 used camera traps set in five 100 km2 sampling blocks across NEPL NPA from 2003 to 2004. Each 100 km2 sampling block divided into 25 4-km2 grid cells, in which a pair of cameras was placed to photograph both sides of individual tigers in optimal locations. Cameras were mounted on trees at 45 cm and set to operate for 24 hours per day and left in the forest for over 30 days. The software program "CAPTURE" was used to generate tiger density estimate as tigers could be identified to individual tigers by their distinct stripes. As prey could not be identified to individuals by their markings, index of prey abundance was used, i.e. number of photos per 100 camera trap days (CTD). CTD was calculated from the time the camera was mounted until the date of the final photo for a total effort of 3,588 total CTD.

1995-2005. Dinerstein et al. 20066 delineated tiger conservation landscapes based on tiger records from 1995-2005, current forest cover, and human influence.

2.1.2 Results from past records (see Appendix 4 showing locations of NPAs in Lao PDR)

1988-1993. Salter21 reported tigers present in 87% of interviews (n=328) spread across 18 NPAs of Laos.

1932-1998. Duckworth and Hedges22 mapped 64 tiger records spread over the country, of which only 21 were confirmed records based on sightings or remains of tigers. Based on tiger data and habitat availability

they suggested only five areas that showed particular potential for harboring viable tiger populations. These areas were:

i) Northern Laos including three non-contiguous areas: Nam Et-Phou Louey NPAs, Nam Kan NPA and Nam Phoun NPA
ii) Central Laos in the Nam Theun basin including the contiguous area between Nakai-Nam Theun (including Nakai Plateau), Nam Kading, Khammouan Limestone and Hin Namno NPAs.
iii) Southern Laos including the contiguous area on the slopes of the Bolaven Plateau between Xe Pian, Dong Hua Sao and Don Ampham NPAs, Xe Khampho and Nam Kong PPAs and the Xe Kong basin.

1991-1998. Duckworth et al. (1999) 23 reported tiger as present in 18 of 32 areas surveyed during 1991-1998, however it was thought that their population densities were at low numbers . These areas were:

i) Northern Laos from five of the 11 areas surveyed, which were Nam Et-Phou Louey, Nam Ha, Nam Phoun, and Nam Theun Extension
ii) Central Laos from five of the seven areas surveyed, which were Nakai-Nam Theun including Nakai Plateau and the Nam Theun Corridor, Hin Nam Nor and Phou Xang He, and
iii) Southern Laos from eight of the 14 areas surveyed, which were Xe Bang Nouan, Dakchung Plateau, Phou Xieng Thong, Don Amphan, Nam Kong, Dong Huasao, Xe Piane and Dong Khanthung.

Provisional records were noted for another six areas including Nam Xam, Phou Khao Khoay and Nam Kading NPAs in northern Laos and Xe Sap, Phou Khathong and Bolaven Plateau in southern Laos.

2003-2004. The camera trap surveys in NEPL NPA 13 found that the NPA supported a small viable tiger population with an estimated density of 0.2 to 0.7 tigers per 100 km2 and a population estimate ranging from a minimum of 7 to as many as 23 tigers in the sampled area. An index of prey abundance ranged from 0.08 independent photos (IP) per 100 CTD for gaur, 0.25 IP per 100 CTD for sambar, 0.27 IP per 100 CTD for serow, 0.40 IP per 100 CTD for wild pig, and 2.77 IP per 100 CTD for muntjacs.

1995-2005. Dinerstein et al. (2006) 6 mapped approximately 175 tiger point locations recorded from 1995-2005 in Laos, which included no records of evidence of breeding (see map Appendix 1).

From these records combined with recent land cover and human influence data, the following areas of priority for tiger conservation and surveys in Laos were identified:

Class 1 Landscapes(1)(see maps Appendices 2 and 4):

(TCL#35) Northeastern Laos including areas within and adjoining the Nam Et-Phou Loeuy and Nam Xam NPAs, and extending into northern Vietnam.

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(1) Class 1 landscapes have habitat to support at least 100 tigers, evidence of breeding, minimalmoderate levels of threat, and conservation measures are in place. [24]

(TCL#27) Southern Laos including the areas within and adjoining Dong Huasao, Xe Piene, Dong Amphan, Xe Sap and Dong Phouvieng NPAs and the Xe Khampho, Bolvan Southwest and Phou Khathong PPAs. This area adjoins contiguous habitat in central Vietnam and northeastern Cambodia.

Class 2 Landscapes(2) (see maps Appendices 2 and 4):

(TCL#34) Central Laos in the Nam Theun basin including the areas within and adjoining Nakai-Nam Theun, Nam Kading, and Phou Khao Khouay, Khammuoan Limestone NPAs and Phou Chom Voy PPA and the Nam
Chouan and Nam Ngeum Watershed Management Areas.

(TCL#26) Dong Khanthung PPA with adjoining areas in northern Cambodia and southwestern Thailand.

Class 3 and Potential Landscapes(3) (see maps Appendices 2, 3 and 4)
(TCL#33) Areas within and adjoining Hin Nam Nor NPA

- Also areas west of Phou Xang He NPA including the following PPAs: Phou Sor to the northwest, Xenoy-Xaba to the northeast, and Laving-Laveung to the east.

(TCL#36) Areas within and adjoining the Nam Ha and Nam Kan NPAs Areas within and adjoining Nam Phoun and Phou Phanang NPAs Areas within Phou Den Din NPA Areas within and adjoining Xe Bangnouan and Phou Xiengthong NPAs

2.2 Current records (2005-present)

2.2.1 Sources of data for current records

Current records of tigers in Lao PDR, after 2005, are compiled from two sources:

I) Results of field research projects and,

[2] Class 2 landscapes have sufficient habitat for 50 tigers, moderate levels of threat, and a basis for conservation that needs to be improved.[24]

[3] Class 3 landscapes have habitat to support some tigers, but with moderate-high levels of threat, and minimal conservation investment. In this document, potential landscapes include both "survey priority landscapes" that are large areas of potential habitat under low human impact where tiger status is unknown (or that have not been surveyed since 1995) and "restoration landscapes" that are similarly large areas of potential habitat under low human impact but where survey efforts since 1995 have not revealed evidence of tigers.[24]

ii) Standardized interviews conducted in September 2009 with local wildlife conservation workers including protected area staff, foresters, and/or NGO staff who have worked or have experience in particular areas for at least two years. Pre-prepared data forms were faxed or e-mailed to those concerned people and then followed up by phone calls. The data form included questions about the evidence of:

- tiger signs/sightings with a detailed description of the evidence, location and date,
- tiger human conflict with a description of the human killing or type of livestock killed, description of the evidence for each case, and date,
- threats to tigers including direct killing and date, presence of hunting of prey or habitat loss and description.
- The likelihood that reports represented actual tiger presence were ranked as follows:

Confirmed: tigers were photographed by camera traps or identified by DNA analysis of scats.

Likely: report of tiger killed; track width equal to or greater than 10cm or pad width equal to or greater than 7.5cm.

Possible: report of depredation of adult buffalo or a human killed Uncertain: report of tracks less than 10cm wide or pad less than 7.5cm wide; report of a tiger sighting; report of other signs or depredation of a cow.

2.2.2 Current records: methods and results

Class 1 Landscapes (see map Appendix 4)

(TCL#35) Nam Et-Phou Louey - 25,978 km2

Camera trapping for tigers and prey was conducted from 2004-2006 in 300 km2 of the NPA13 followed by camera trapping for tigers over 800 km2 of the NPA from 2006-2007 (WCS unpublished data). A total of eight individual tigers were detected with camera traps in NEPL NPA from 2003- 2007.

From 2006 to present, DNA extraction from large carnivore scats has been used to estimate a minimum number of tigers in the NPA. Nine individual tigers have been detected from analysis of 124 scats from 2006-2009. One tiger was seen in the NPA by enforcement staff in July 2009. From January-June 2008, prey occupancy surveys were conducted in the NPA core zone49. The 2600 km2 area was divided into 3.25 km2 sub-grids based on biological information on home range of large ungulates. Teams walked approximately 3-6 km within each sub-grid to record presence/absence of ungulate signs every 300 meters. The survey found an estimated prey abundance of 3.25 ungulates per km2 in the core zone, of which muntjac and wild pig were the most common, with much less detection of serow, sambar and gaur.

From January – June 2009, standardized surveys of local experts across 100-300km2 grids and modern occupancy modeling was used to estimate the current occurrence and distribution of tigers and prey in a 30,000 km2 landscape around the NEPL NPA (C. Vongkhamheng, unpublished data). The survey recorded reports of tiger presence within the past year in 70% of the grids across the 30,000 km2 landscape. Most detections occurred inside and adjoining NPAs (NEPL and NXM). Habitat occupancy estimates ranged from 70% for gaur (SE = 0.05), 96% for Sambar deer (SE = 0.02) and up to 100% occupancy for muntjac, wild pig and serow. The probability of occurrence for muntjac, wild pig, and serow were more widely distributed than for gaur and sambar across the landscape.

(TCL#27) Southern Laos - 19,996 km2

Questionnaire surveys for tigers and prey were conducted in 35 villages across Xe Pian NPA using grid-based sampling approach, by dividing the NPA into 14-300km2 grid cells25. Approximately 70% of the 14 grid cells surveyed were reportedly occupied by tigers in the past five years. Of those, 25% of respondents (n=105) reported sightings of tigers, and 53% of respondents reported signs of tigers.

Tracks (13x14 cm) were reported in Dong Huasao on November 2006 and January 2007 (Table 1). Tracks (13x15 cm) were reported from July 2007 in the vicinity of Ban Angor. Tracks and scrapes were found in Phoulan (UTM 691786 1765413) and at Houy Kata (UTM 688826 1766165), Ta Oy district in Xe Sap NPA. Tracks of an adult tiger with cubs were reported in Dong Ampham NPA near Xekhaman hydropower on 7 September 2009 and another report from Huay Chingling in April 2009 (Table 1).

Class 2 Landscapes (see map Appendix 4)

(TCL#34) Central Laos – 36,317 km2

Nam Kading NPA: From 2007-2009, ground dwelling mammals were monitored at a total of 200 camera trap points at a spacing of one camera point per 2 km2 across 400 km2 of the 1,600 km2 NK NPA for a total effort of 6,357 camera trap days. The surveys detected no tigers (WCS / IEWMP; in prep.). Although large cat tracks are reported by NPA staff, it remains uncertain if these are from tiger. Prey including gaur, sambar, serow, wild pig and muntjac were recorded by camera traps but overall abundance is low.

Nakai-Nam Theun NPA: From 2006-2008, ground dwelling mammals were monitored at a total of 300 camera trap points at a spacing of one camera point per 2 km2 across 600 km2 (three blocks of 200 km2 each) in the 3,532 km2 NNT NPA for a total effort of 11,870 camera trap days32, 48. The cameras recorded no tigers and a relatively low level of large prey.

Khammouane Limestone NPA: Tracks (10x11 cm) and cattle depredation by tiger were recorded on 3 August, 2006 by NPA staff (Table 1).

Nam Ngeum watershed management area: Tracks of tiger were reported from southern Xiengkhuang province, at Phoun, Xaisomboun and Thathom districts in 2009 during the NEPL NPA landscape survey (J. Vongkhamheng pers. com.)

(TCL#26) Dong Khanthung – 2,526 km2

No reports have been received from this area since 2005.

Class 3 Landscapes (see map Appendix 4)

(TCL#33) Areas within and adjoining Hin Nam Nor NPA –7,477 km2

Tracks (10x12 cm) and a buffalo carcass suspected of being killed by tiger were found on 25 August 2009 in the vicinity of Ban Nong Buao or near Phou Chuang (17o30′09″ N 105o54′33″ E) (Table 1). The area is located in the corridor between Hin Nam Nor and Nakai Nam Theun NPAs. Also a track (13x15 cm) was reported by NPA staff on 7 September 2009 in the vicinity of Ban Napao.

Areas west and north of Phou Xanghe NPA including Dong Phousor and Xenoi-Xeba, and Lavin-Laveun: Tracks (~11x12 cm) were recorded on May 2005 in the

vicinity of Ban Doune, and a buffalo kill was reported during the dry season of 2007 in Phou Xenghe NPA (Table 1). Other reports of tracks were received from Lavin-Laveun PPA in 2009 near Xepone district

(TCL#36) Areas within and adjoining the Nam Ha and Nam Kan NPAs – 7,315 km2

Nam Ha NPA: Felid tracks were encountered by NPA staff, one (9x10 cm) on 16 August 2009 in the vicinity of Ban Nam Muay, Sing district, and another (10x11 cm) was reported in August 2008 in the vicinity of Ban Hatlieng, Luang Namtha district. Two cows were reportedly killed by tiger in these two villages in June 2007 and October 2008, respectively (Table 1). One large buffalo was reportedly killed by tiger in 2007 near UTM 755787, 2306957 in Luang Namtha district.

Nam Kan NPA: Tracks (10x11 cm) were found on 14 February 2007 by NPA staff in the vicinity of Ban Toop Phouvieng district (Table 1). Other recent reports of large cat tracks are from Chomsy, Nam Laem, Nam Touk, Nam Lin (Table 1).

Potential Landscapes (see map Appendix 4)

(TCL #32) Areas within and adjoining the Xe Bang Nouan and Phou Xiengthong NPAs – 6,948 km2

Tracks (12x13 cm) were recorded on June 2007 in the vicinity of Ban Naxan and Nalan, Vapi district, Saravan province (Table 1). A buffalo and a cow were reportedly killed by tiger on December 2008. Tracks (11x12 cm) were recorded at Phou Xiengthong NPA on June 2007. A report of tiger depredation of a buffalo and cow in the vicinity of Ban Thongphathongxai, Khong district, Saravan province occurred in December 2008.

Areas within and adjoining Nam Phoun and Phou Phanang NPAs – 14,139 km2

Tracks (11x12 cm) were recorded on 27 September 2008 in Navan village, Phieng district (Table 1). Also, a buffalo and cow were reportedly killed by tiger in the same area in the same year. No tigers are reported at present in Phou Phanang NPA.

Areas within Phou Den Din NPA – 4,581 km2

Tracks (10x11 cm) were recorded on 1 June 2008 in the vicinity of Ban Hath Hin (Table 1).

2.3 Trends in tigers across Laos

Although tigers reportedly still occur in several landscapes at present, since 2005 tigers are confirmed from only one protected area (NEPL NPA) with likely evidence of their presence reported from thirteen other protected areas (Table 1). In the remaining areas, the presence of tiger is uncertain or absent. Given this information, tiger abundance appears be declining throughout Laos and they may now be extirpated in some areas based on the following evidence:

Rarity of sightings of tigers in the forest. Out of 35 interviews with people working in landscapes in Laos, there were only 8 reports of sightings of tigers since 2005.

Rarity of camera-trap photos of tigers in key areas surveyed since 2005. In Nakai Nam Theun NPA where sightings of tigers were once regularly reported by field workers during 1990s23, no tigers have been photographed since 2006 despite extensive camera trap surveys (11,870 CTD). Likewise, in Nam Et-Phou Louey NPA, camera trap surveys for tigers over a three-year period from 2005- 2007 photographed only four different individuals over 5,979 CTD of survey effort (WCS unpublished survey data).

Although tigers are protected by law, direct poaching of tigers has reportedly occurred in several protected areas throughout Laos since 2003 (Table 2). The number of tigers reported killed, as shown in Table 2, are only those that local authorities have strong evidence of. The number of actual kills across the country is uncertain. This is a concern given that scientific studies show clearly that a small population of about 30 individual tigers may become extinct within 15 years with only a 2% kill rate a year. Only a larger population of over 70 tigers could potentially sustain a loss of 10% a year or more5. So, based on the known number of tiger killed in each NPA or landscape, and if the trend still continues, it appears that tigers in Laos are presently vulnerable to extirpation.

3. THREATS TO TIGERS IN LAO PDR

3.1 Direct killing of tigers

3.1.1 Poaching of tigers for trade

Although tigers are a legally protected species in Laos, they are poached with a variety of methods including snares, poison, and explosives across Laos. This is because of the high demand for tiger parts in

Table 1. Reports of tigers since 2005 from protected areas across Laos based on photographs (PHO) or DNA analysis of scat samples (DNA) or from interviews (n=35) reporting observations or reports of tracks (TG,TL) or other sign (SN), sightings (RS), evidence of large livestock depredation (BD, CD), of tigers killed (TK) or humans killed (HK).

No	TCL	Name of Protected Area	2005 to present2 (level of confidence)					Sources
			Prior to 2005[1]	Confirmed	Likely	Possible	Uncertain	
I.		**Class 1 Landscapes**						
1.	**35**	Nam Et-Phou Louey NPA	X	PHO,DNA	TK,TG	BD	TL,RS,SN,CD	NPA staff/WCS staff, camera traps, scat DNA
2.	35	Nam Xam NPA	?	-	TK	-	-	NPA staff/village survey
3	27	Dong Phouvieng NPA		-	-	-	-	NPA staff
4	27	Xe Sap NPA	?	-	TK	-	SN,CD	NPA staff, IUCN staff
5	27	Dong Huasao NPA	X	-	TG	BD	CD	NPA staff, village reports
6	27	Dong Ampham NPA	X	-	TG	HK	RS	NPA staff/WWF staff
7	27	Xe Piane NPA	X	-	-	-	TL,RS,SN	NPA staff/WWF report
8	27	Nam Kong PPA	X	-	-	-	SN	IUCN staff
9	27	HHW/Xe Khamphor		-	-	-	SN	IUCN staff
10	27	Dak Cheung plateau	X	-	-	-	-	
11	27	Phou Kathong PNBCA	?	-	-	-	-	
II.		**Class 2 Landscapes**						
12	34	Phou Khao Khouay NPA	?	-	-	-	-	NPA staff
13	34	Nam Kading NPA	?	-	-	-	TL,SN	NPA staff/camera traps
14	34	Nakai-Nam Theun NPA	X	-	TG	BD	RS,SN	NPA staff/camera traps
15	34	Khammouan Limestone \NPA	?	-	-	-	TL,SN	NPA staff
16	34	Phou Chomvoy PPA		-	-	-	-	
17	34	Upper Nam Ngem		-	-	-	SN	WCS staff

No	TCL	Name of Protected Area	2005 to present[2] (level of confidence)					Sources
			Prior to 2005[1]	Confirmed	Likely	Possible	Uncertain	
		Watershed						
18	34	Upper Nam Chouan Watershed		-	-	-	SN	WCS staff
19	34	Special Zone (Xaysomboun)		-	-	-	SN	WCS staff
20	26	Dong Khanthoung	X	-	-	-	-	
III.		**Class 3 Landscapes**						
21	36	Nam Ha NPA	X	-	TK,TG	BD	RS,CD	NPA staff
22	36	Nam Kan NPA	X	-	TK,TG	BD, HK	CD	NPA/DAFO staff
23	33	Hin Nam Nor NPA	X	-	TG	BD	RS	NPA /IUCN staff
24	33	Phou Xanghe NPA	X	-	TG	BD	TL,SN	NPA staff
25	33	Lavin-Laveun PPA		-	-	-	SN	Outhai (pers. com)
IV.		**Potential Landscapes**						
26	32	Xe Bangnouan NPA	X	-	TG,TK	BD	CD	NPA staff
27	32	Phou Xiengthong NPA	X	-	TG	BD	CD	NPA staff
28	-	Nam Phoun (Poui) NPA	X	-	TG,TK	BD	TL,CD	NPA, DAFO staff
29	-	Phou Phanang NPA	?	-	-	-	-	NPA staff
30	-	Phou Dendin NPA	?	-	TK	-	TL,CD	NPA staff

[1]Records prior to 2005 from Duckworth & Hedges (1998): ? - tiger presence based on provisional report, x - tiger presence based on signs, sighting

[2]Degree of confidence of tiger report from 2005 to present:
Confirmed: tigers were photographed by camera traps(PHO) or identified by DNA analysis of scats(DNA)
Likely: report of tiger killed(TK); tracks >10 cm wide or pad >7.5 cm wide(TG)
Possible: report of depredation of adult buffalo(BD) or a human killed (HK)
Uncertain: reports of cat tracks <10cm wide, pad<7.5cm wide(TL); report of sighting(RS); report of signs(SN) or cow depredation(CD)

Table 2. Reports of tiger poaching from NPAs since 2003.

No	NPAs	# tiger killed	Date(s)	Source
1	Phou Den Din	2	Apr-06/July-07	NPA staff
2	Nam Ha	3	Dec-05/Apr-07	NPA staff
3	Nam Et-Phou Louey	17	Jan-03 to Oct-09	NPA staff
4	Nam Xam	1	Mar-08	NPA staff
5	Nam Phui	1	9-May-05	DAFO of Phieng district
6	Xe Bang Nouan	1	Dec-08	DAFO of Khong district
7	Xe Sap	1	Dec-08	DAFO of Ta Oy district
8	Nam Kan	2	Jun-05/Nov-05	NPA staff

international markets for traditional medicines associated with the weak protected area management in Laos. The current estimated price of a tiger ranges from US$ 10,000 up to US$ 70,000 5,28. In NEPL, tiger bones sold for up to US$ 11,528 in 200413. Tiger parts, such as skins, teeth, bones and others, were one of the most-traded wildlife items in recorded in Lao PDR during the 1990s[26].

Since 2003, poaching of tigers for trade is reported in several NPAs (Table 2). For example, more than 15 tigers have been killed since 2003 in Nam Et-Phou Louey, two tigers were reportedly killed near Bor Keo-Luang Nam Tha provincial boundary in June 2005, two were killed in Nam Ha NPA on October 2007, and one tiger killed in Nam Xam in April 2008.

A tiger farm was established in Laos in 2002, with the first 20 breeding individuals originating from Taiwan. Now, the farmer claims there are 254 individual tigers in the farm and they will be ready for export in the near future27. Although the direct impacts of this tiger farm on wild tigers in Laos is uncertain, the potential threat to wild tigers caused by tiger farms is very high. It is well-known worldwide that the legalizing trade in farmed tiger products allows smugglers to exploit the loophole and take opportunities to sell wild tiger products. This problem occurs because there is no way to distinguish between parts of tigers from the farm and those from the wild, which makes law enforcement difficult.

From an economic perspective, the price of a wild tiger ranges from US$10,000 to US$70,000 in international markets28, and approximately US$11,528 on local markets in northern Laos13. The high price is because customers perceive wild products to be more effective than the farmed ones and thus prefer the wild products over the farmed29. In a simple cost analysis of wild versus farmed tigers parts, the cost of raising a tiger to adulthood in captivity is at least US$ 4,000 (range from US$ 4000 to US$ 10,000) and as little as US$15-25 for a bullet to poach a wild tiger. Despite the cost of transportation and an occasional loss due to confiscation by authorities, it is a lucrative trade. This discrepancy provides substantial economic incentive for poachers and smugglers to undercut farmers in any legal markets despite the risks associated with being caught and penalized30. In short, tiger farms don't support wild tiger conservation even though farmers often claim that farms are a solution to wild tiger conservation arguing that the legally-supplied captive-bred tiger parts and products in markets would undercut the illegal supply from tiger poachers. Some argue that tiger farmers have no interest in wild tiger conservation. If wild tigers do go extinct, farm investors stand to gain an economic advantage as they can control the supply of tiger parts for the global market30.

3.1.2 Killing of tigers as the result of human-tiger conflict

Livestock depredation. Killing of tigers in revenge due to livestock loss has been recorded in many rural areas throughout Laos. About 43.8% of village interviews across Laos during 1988 to 1993 (n=317) reported livestock depredation by tigers, but the proportion of reports truly referring to tigers is unclear23. For example, one tiger was shot in Phou Khoun on the Luangphrabang/Vientiane province border in December 1998. Another was shot in Nam Et-Phou Louey on 18 December 1997 with the permission from Viengthong district authorities.

Of particular concern at the present time, given the high price of tiger parts and the associated negative attitude of humans toward tigers, is that when livestock are killed and tigers are suspected, tigers are targeted by the villagers, resulting in opportunistic killing of more tigers rather than taking revenge. For example, in the Nam Et-Phou Louey NPA, a systematic investigation of human-tiger conflict from 2003-2004 found that tiger poaching was closely tied to cattle grazing with farmers opportunistically using livestock to bait tigers more so than retaliation for livestock attacks13. Contrary to previous predictions that livestock loss was a widespread problem, the study found depredation affected only 12% of NPA villages and a small fraction of the total herd. Given the opportunity to report attacks in return for possible compensation, farmers lagged in both reporting and removing livestock to villages. NEPL farmers were willing to accept livestock loss and encouraged grazing in tiger habitat as it provided opportunities for tiger poaching to offset livestock loss, which was driven by the increasing lucrative trade in tiger bones.

Man-eating. Although tigers have had a bad reputation as man-eaters in many parts of Laos, very few cases have been reported across the country in recent years. For instance, there are only two cases reported prior to 200523 and another other two cases reported after 2005 (WCS unpubl. data). Actually, humans are not the primary or preferred food source for tigers. The occurrence of a human attack is usually in self-defense or protecting their infants, and those man-eaters are usually old, sick or injured8. If an incidence occurs, tigers are typically killed in revenge. An example of a recent incident occurred in August 2005 in Meung district, Bokeo province is the following report: "It started when a group of three men went fishing near Hua Nam Kha village. They heard a wild pig screaming and went to investigate, and saw it was a tiger. The tiger ran off when it saw the men. One of the men had a gun, so the other two waited while one man went after it with the intention to shoot it. He didn't come back and it was getting dark. They went back to the village and led a big search party next morning with many people. They found his gun and then him. All that was left was the head and one leg. There were two sets of paw prints, one animal bigger than the other. They carried the bits back to the temple in Meung township."

3.2 Prey depletion

Hunting of ungulates (i.e. gaur, sambar, serow, wild pig and muntjac) for subsistence has long been practiced by rural residents in Laos. However, the picture began to change when the government of Laos introduced the "new economic mechanism (NEM)" during the late 1980s. Since the opening of free markets and the associated increase in the prices of wildlife on both domestic and international markets, hunting of wildlife for subsistence has become more commercially oriented. Various parts of ungulates including horns, antlers, gall bladders, meat and others were commonly traded domestically, and with Thailand, China, and Vietnam31,26. In recent years, wild meats are still sold in markets and restaurants in several townships across the country despite the fact that it contradicts the National Law on Aquatics and Wildlife.

The decline of ungulate populations in Laos is clearly evident from results of research in protected areas. For example, in Nam Et-Phou Louey NPA, a 2008 study found an ungulate abundance index of approximately 3.25 animals/km2 49. Large prey (>100kg) are extremely low at only 0.02 and 0.31 animal/km2 for gaur and sambar, respectively, whereas muntjac and wild pig are more abundant at 1.38 and 1.36 animals/km2, respectively (C. Vongkhamheng, unpublished data). The results suggest that wild pig and muntjac are probably the principle prey available for tigers in Laos at the present time. Similarly, in Nakai Nam Theun and Nam Kading, the large prey abundance is very low and only muntjac and wild pig are found in moderate abundance32.

3.3 Habitat loss and fragmentation

In Lao PDR, habitat loss and fragmentation is a less urgent threat to tigers than the two major threats of tiger poaching and prey depletion. This is based on the fact that Laos still has over 40% of suitable forest cover and a low human population of about 22 people/km2 at present as compared to neighboring countries (263 people/km2 for Vietnam, 128 people/km2 for Thailand, 80 people/km2 for Cambodia).

However, given the current trend of rapidly increasing human population and associated increases in rates of resource use, habitat loss and fragmentation will become a much more serious problem in the near future if there is poor land-use planning and management. This is because almost two thirds of country is geographically mountainous. Flat land suitable for permanent agricultural fields is found only in Mekong valley on the western side of the country and over 75% of the population is living in rural areas. Forest clearance for shifting cultivation by subsistence farmers is widespread in the upland areas.

Moreover, logging (legal and illegal), cash crop plantations along with the rapid increase in mining and hydropower development as well as transportation corridors across the country is contributing to habitat loss and fragmentation. Land use planning is needed to assure that appropriate habitat with sufficient protection is maintained to allow tigers to safely move within and between tiger conservation landscapes. If corridors are not maintained to connect source populations of tiger, the result will be smaller isolated populations that are genetically depauperate and face an even higher likelihood of human-tiger conflict. This will ultimately lead to extirpation of tigers from these fragments and threaten the long-term survival of tigers across Laos.

4. LEGISLATIVE PROTECTION OF TIGERS IN LAO PDR

The Lao PDR's Constitution (1991) states that "all organizations and citizens must protect the environment and the natural resources including: land, underground minerals, forests, fauna, water sources and the atmosphere" (Article 17)45. Legislative protection of tigers has long been taken into account by the government's decrees and regulations addressing tiger conservation (Table 3). More recently, the law on aquatic and terrestrial wildlife states that tigers and their larger prey species (gaur, banteng, sambar, serow) are listed as protected44. On the 3rd of April, 2007 the Prime Minister also signed an urgent agreement No. 25/PM, to increase effectiveness of forest management throughout the country. This agreement states how the nation's economic development is linked to the country's environmental status. Additionally, Lao is a signatory to several international conventions that support tiger conservation. These conventions enable the government to address problems affecting tiger conservation beyond the national jurisdiction, including the Convention on Biological Diversity (1994) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora since 200443.

5. OPPORTUNITIES AND CONSTRAINTS FOR TIGER CONSERVATION IN LAO PDR

5.1 Opportunities for tiger conservation

Given the high resilience of tigers in the environment

Table 3. Principle legal instruments addressing tiger protection in Lao PDR.

Legal instruments	Key provision
National Legal Framework	
Decree of the Council of Ministers No. 185/CCM, in relation to the Prohibition of Wildlife trade, 21 October 1986	Prohibits export of all wildlife
Decree of the Council of Ministers No. 47/CCM, on the State Tax System, 26 June 1989	- Lists types of natural resources, including various species of wildlife, aquatic animals and parts thereof and their associated resource tax rates and special fees; 67 species or species group of wildlife are listed - Subsistence level users of natural resources are exempted from resource taxes - 1996 New Tax Law does not mention natural resource tax
Decree of the Council of Ministers No. 118/CCM, on the Management and Protection of Aquatic Animals, Wildlife and on Hunting, and Fishing, 5 October 1989	- Defines wildlife as state property with mandate to MAF to manage it (including through awareness programs) and local people to use it pursuant to regulation. - Allows import/export of wildlife with special authorization - Prohibits hunting and breeding of protected or endangered species, except where human life is endangered - Prohibit hunting by means of mass destruction (explosives, poisons, etc.)
Decree of the Prime Minister No.	- Established national protected areas and states

Legal instruments	Key provision
164, 29 October 1993.	that hunting and fishing inside them is illegal - Explosives, chemicals, poisons and other substances harmful to wildlife are banned in NPAs - Measures (warn, fine) for anyone who disobeys the decree, confiscates illegal items
Order 54/MAF on the Customary Right and the Use of Forest Resources, 7 March 1996; followed by recommendations 377/MAF on the Customary Use of Forest Resources	- Secures legal rights for local people to use forest resources for subsistence, including hunting and fishing of non-protected species - Customary rights may be recognized by signed agreement or by law, and local people shall be compensated for loss of customary means of livelihood
Decree 1074 of the Ministry of Agriculture and Forestry, 11 September 1996	- Prohibits wildlife trade - Prohibits hunting of protected species including tiger and "such as Asian elephant, Banteng, Saola, Douc Langur, etc." - Prohibit hunting during a breeding season, and by dangerous methods, and/or by the use of weapons in NPAs and towns - Bans wildlife trade, except for research and conservation - Bans exporting wildlife used for food - Responsibility for PAFO to co-ordinate with other agencies to collect and register weapons used for hunting
Forestry Law, October 1996 and updated 24 December 2007.	- Grants state ownership of and authority to manage wildlife - Prohibits possession of wildlife without permission - Mandates state to define two categories of protected wildlife - Prohibits hunting during a breeding season and/or by means of mass destruction - Prohibits hunting of and trade in prohibited species, with certain exceptions - States that all guns and hunting equipment must be registered with certificates - Article 46, Part 5, establishes by law Wildlife Day on 13th July annually - Zoning NPAs to core (totally protected), managed (controlled use), and corridor zones
MAF Regulation No 0360 (2003) on management of NPAs, Aquatic Animals and Wildlife	- Provides guidelines on establishment and zoning of NPAs - Defines restricted activities on aquatic animals and wildlife - States duties of state agencies and funding support
Provincial and District regulation on management of PA, Wildlife, and Aquatic Animals (e.g. NEPL NPA Regulation 2008)	- Zoning of NPA into core, managed, and corridor zones and specify clearly activities in those areas - Prohibit hunting of all wildlife and aquatic animals in the core zone - prohibit trade in wildlife - Guns must be registered with special licenses
Wildlife and Aquatics Law, 24	- Update lists of protected (Category 1) and

Legal instruments	Key provision
December 2007	tmanaged (Category 2 and Category 3) species with tiger and large prey listed as Category 1 species that cannot be harvested anywhere in the country at any time. - State activities, management, and development on wildlife and aquatic animals
Prime Minister' agreement No.25/PM regarding forest management, 3rd April, 2007	- Assigned at least 15 staff in each NPA - Provide basic equipment and financial support for NPA management
International Commitments and Obligations	
United Nations Convention on Biodiversity (signed in 1996)	- Requires State Parties to prepare Biodiversity Strategies and Action Plan. - Laos has agreed; • To develop a national strategy for conservation and sustainable use of the nation's biological diversity • To develop regulatory provisions for protecting threatened species and populations • To integrate conservation and sustainable use of biological resources into national decisionmaking • To conduct an Environment Assessment (EA) of proposed development projects with a view to minimize harmful effects • To take measures for an equitable sharing of the results of research and development in genetic resources
ASEAN Agreement on the Conservation of Nature and Natural Resources (1985)	- Parties have agreed on development planning, the sustainable use of species, conservation of genetic diversity, endangered species, forest resources, soil, water, air and processes of environmental degradation and pollution. - Promotes joint and individual state action for the conservation of the natural resources in the ASEAN region.
Convention on International Trade in the Endangered Species of Fauna and Flora (signed in 2004).	- Provides international umbrella for management and control of trade in endangered fauna and flora. Tiger is listed as CITES Appendix 1 species for which all international trade is prohibited.

(adaptable to a wide range of habitat types, climates, and prey base) plus high fecundity (reproduction), there are several opportunities that allow for rapid recovery of tigers in Lao PDR even though tiger populations are at very low numbers at the present time.

Low human population

Laos has a low human population density (22 persons per km2) as compared with other tiger range states in Indochina (263 people/km2 for Vietnam, 128 people/km2 for Thailand, 80 people/km2 in Cambodia). Tigers require large home ranges to meet their ecological needs so availability of adequate space results in low human-tiger conflict.

High forest cover

The country has over 40% forest cover, which provides large extensive habitat that could support viable populations of tigers and prey.

Well developed protected area system

There are 21 established national protected areas, covering 14% of the country's land area, as well as provincial protected areas that can serve as core habitat for source populations of tigers and prey in tiger conservation landscapes.

Existence of key prey

Ungulates such as gaur, sambar deer, serow, wild pig, and muntjacs persist in most NPAs. Although ungulate population densities throughout the country are relatively low at present, protection of large prey from all hunting and of small prey from hunting for trade, which is illegal, will allow ungulate populations to rebound relatively quickly as habitat and other required resources (i.e. food) are still available.

The role of tigers in economic development and environmental protection

As a top predator, the existence of a viable population of tiger indicates a healthy ecosystem, which is important to human well-being in forms of "ecological services", food, medicine, and shelter provided by a healthy ecosystem. Economically, tourism is one of the fastest growing industries in the country, contributing substantially to the overall growth of the national economy of Laos. Ecotourism development is a government priority50 and there are initiatives underway in some protected areas (e.g., Nam Ha, Xe Pian, Nam Et-Phou Louey and Nam Kading NPAs) that could provide incentives for protection of wild tigers and their habitats.

Good legislation.

Law on aquatics and wildlife is already promulgated, providing important guidelines in management and conservation of wildlife in the country. Tigers and key large prey (gaur, sambar, and serow) are listed as Category 1 -protected species44. In addition, Laos as a signatory to the CITES, agreed to prevent any trade in endangered species, which includes tiger.

Public attractiveness/support.

As they are perceived as powerful and charismatic, tigers are used for selling several commercial products such as Lao beer, water, Tiger beer as well as ecotourism products (e.g. Tiger Trails). Gaining support from these companies to ensure the survival of tigers in the wild may be possible.

5.2 Current constraints for tiger conservation

Beside opportunities, there are several important issues that we need to address to achieve our conservation goal for tigers; they include:

Lack of baseline data on tigers and prey

There is a lack of information on the population status and distribution of tigers and prey in existing TCLs and particularly in most provincial and national protected areas that could serve as source populations for tigers and prey. The paucity of this data makes conservation planning difficult.

Weak law enforcement

The policy, laws and regulations governing tiger and prey are sufficient. However, weak law enforcement and poor management of protected areas results in tiger poaching and illegal hunting of prey for the domestic and international wildlife trade.

A high demand for tiger parts in the international market

The demand for traditional Chinese medicine is driving poaching of tigers for trade. Cross-border cooperation to tackle this problem is urgently needed. A high demand for prey in domestic and international markets encourages illegal poaching of prey by local villagers to support the trade.

Limited human resources and financial support

Although there are 21 established national protected areas across the country and several more provincial protected areas, very few of these are currently being managed and are dependent on financial support from international organizations. The currently estimated level of support for the protected area system (national and provincial protected areas) is only $US0.09/hectare. It is estimated that at least eleven times that amount ($US1.00/hectare) is needed to achieve a minimum level of management in Lao's protected areas. As a result of limited financial support, all protected areas are understaffed and many of the staff lack training in the skills required to effectively manage the protected area and to recover and conserve wild tigers and their habitats.

Lack of cooperation and coordination among government agencies.

Weak law enforcement is mainly the result of a lack of cooperation and coordination among enforcement agencies including foresters, police, military, commercial and custom officers, and justice. In addition, although national sustainable development strategy shows clear links between biodiversity and poverty reduction, unplanned development activities

undermine biodiversity conservation, for example, building roads through NPAs, land concessions for cash crop plantations in NPAs, etc. They take little regard to the value of environmental protection and protected areas in economic development.

Weak understanding of linkages between poverty reduction, economic development goals and the status of the environment.

Although the government of Lao PDR considers the environment as an important component of socio-economic development45 and recognizes that poverty and biodiversity are intimately linked, most funding however is allocated to development of infrastructure and other social sectors with little regard to the future consequences of the impacts on the environment. High priority is given to development activities such as road construction, hydropower, mining and plantation development, without serious consideration of real costs to the environment. It may be that the conceptual link between biodiversity and development is misunderstood by several high level decision makers who play key roles in planning and investment.

6. STATUS OF TIGER RESEARCH AND CONSERVATION ACTIVITIES IN LAO PDR

6.1 Past research and conservation (prior to 2000)

Research and monitoring

There was no specific research or monitoring of tigers in Lao PDR before 2000. Most records of tigers in Laos come from village questionnaires and general wildlife surveys during a period of 1990s (see more details in Section 2.1). For example, Salter (1993) conducted village interviews in all 18 established national protected areas across Laos between 1988 and 1993, provided baseline data on tiger occurrence and major threats to tigers. From 1992 – 1998, preliminary wildlife surveys conducted in most NPAs and some PNPAs provided confirmed data on tiger presence based on sightings, signs and local reports.

Conservation

During 1980s, tigers and other species were largely protected throughout the forest of Laos because the country was closed to international markets and the human population was low. During the 1990s, tigers may have benefited by legal establishment of 21 national protected areas, and by national decrees and laws addressing management of several species including tigers (see section 4). Also, during this time period, management initiatives took place in several NPAs for a few years, with technical and financial support provided by a range of international organizations in up to 19 of the 21 national protected areas46. After these projects ended, those NPAs that received financial support from government continued some conservation activities such as enforcement but a lack of monitoring systems made it difficult to assess conservation progress or success.

6.2 Current research and conservation (2000 to present)

6.2.1 Research and monitoring

Nam Et-Phou Louey NPA (2003-present)

From 2003-2004, the first systematic study on tigers and prey in the country was made by WCS-Lao Program in NEPL NPA, using camera traps. Following the first results, WCS-Lao has worked with the NEPL NPA\ management unit to initiate conservation interventions to ensure a protection for tigers and prey populations in the NPA, and to continue monitoring of tigers and prey. In 2008, an occupancy survey was conducted to assess tiger prey populations including gaur, sambar, serow, wild pig and muntjac in the NPA. Additional studies are focused on tiger diet to determine what prey are key to tiger survival in NEPL NPA and estimate a minimum number of tigers based on DNA extraction from large carnivore scats.

Nakai-Nam Theun NPA (2005-present)

In 2005, the WCS-Lao Program assisted the Watershed Management and Protection Authority (WMPA) to establish a wildlife monitoring program in the NT2 watershed including the NNT NPA32. The objective of the wildlife monitoring program is to provide a baseline for monitoring change in key wildlife populations (including tigers and prey) in the watershed as a result of management. A project from 2005-2007 was implemented to develop capacity within the NT2-WMPA and its monitoring staff and teams so that the protocols, data collection and analyses can be done within the WMPA.

Monitoring is focused on a subset of key species of wildlife in the watershed that are exploited by hunting for domestic consumption,internal trade and unregulated export. The aim of the monitoring program is to detect improvement (positive changes)

in wildlife populations exploited by hunting as a result of WMPA interventions to control wildlife harvest. The protocol for monitoring large terrestrial vertebrates (including tigers and prey) employs camera traps over 800 km2 of the NNT NPA with one-200 km2 sampling block surveyed annually. Since 2007, the WMPA has continued to implement this monitoring program with annual reports on the status of wildlife populations in the NPA[48].

Nam Kading NPA (2007-present)

In 2006, the WCS-Lao Program assisted the NKD NPA to establish a wildlife monitoring program47. The objective of the wildlife monitoring program is to detect change in the abundance of key species of wildlife (including tigers and prey) as a result of management. A project from 2007-2009 was implemented to develop capacity within the NKD NPA to implement the monitoring protocols, data collection and analyses. The protocol for monitoring large terrestrial vertebrates (including tigers and prey) employs camera traps over 400 km2 of the NNT NPA with one-200 km2 sampling block surveyed annually.

Xe Piane NPA and Dong Hua Sao (2007-present)

Since 2007, WWF-Laos has provided financial support to conduct preliminary tiger field surveys in these two NPAs25.

6.2.2 Conservation

Nam Et-Phou Louey NPA (2000-present)

The NEPL NPA has been under active management since 2000 with ongoing international technical and financial support, first from IUCN until 2002, followed by WCS from 2003 to the present. In NEPL NPA, the goal is to increase tigers by 50% from 2005-2015 and the prey to support this increase[33]. Since 2004, WCS-Lao has worked with the NEPL NPA management unit to provide technical and financial support for the NPA Management unit to implement conservation interventions to reach this goal by ensuring the protection of tigers and prey populations in the NPA. The principle management activities include:

Enforcement: the NPA has set up patrol substations in the forest (consisting of 6-7 rangers per substation) to conduct patrols over the 3,000 km2 core zone, and 4 mobile teams of 3-4 officers to control illegal trade of wildlife to markets.

Outreach and land use planning: the NPA conducts public education and outreach in villages inside/outside NPA to build better understanding for local communities about NPA's regulations, the role of wildlife linked to local livelihoods, land use zoning and demarcating the boundaries of NPA's managed and core zones.

Livestock management to reduce tiger-human conflict: the NPA works with farmers to monitor incidents of carnivore depredation of livestock and assist farmers to relocate livestock grazing areas from the core zone to the village area. The NPA also coordinates with livestock development sectors to improve livestock husbandry techniques that maximize productivity without causing human-tiger conflict.

Ecotourism linked to wildlife protection: following a feasibility study of ecotourism in NEPL NPA42, a business plan was developed to analyze the potential to generate economic benefits for NPA management and local communities. The plan is now being implemented to develop ecotourism products that are designed to improve local livelihoods, support NPA management, and provide incentives for the recovery and protection of wild tigers and their habitat.

Nakai-Nam Theun NPA (2005-present)

The Watershed Management and Protection Authority has implemented conservation interventions in the NNT NPA since 2005, primarily funded by a contribution from the Nam Theun 2 power company of US$ 1 million per annum. The goal is to maintain biodiversity in NNT NPA and reservoir. The management activities include:

Enforcement: NPA staff conduct patrols in Nam Theun reservoir, work with village conservation units to conduct forest patrols to reduce poaching of wildlife in the NPA. They work and coordinate with enforcement agencies to respond to reports of illegal activities and set up check points to stop trade in wildlife.

Outreach: the WMPA conducts public education activities for villages inside and outside the NPA to increase public understanding and support.

Land-use planning: the WMPA has conducted land allocation for villages inside the NPA, and set up village conservation unit to guard their designated areas. NPA core zones and managed zone are being established and will be complete by 2011.

Village micro-development: the WMPA provides financial and technical supports to villages inside and adjoining the NPA and reservoir in horticulture and livestock development.

Ecotourism: the NPA has conducted preliminary studies in ecotourism potential in NNT and the reservoir and has completed a strategy for ecotourism development.

Nam Kading NPA (2005-present)

In the NKD NPA, the stated goal is to increase the tiger population by 20% from 2005-201051. Since 2005, WCS-Lao has worked with the NKD NPA management unit to provide technical and financial support for the NPA Management unit to implement undertake landscape level planning to design and implement conservation interventions to ensure protection for landscape species (including tigers and prey) in the NPA. The management activities include:

Enforcement*:* foot-patrols are conducted to reduce poaching of wildlife in the NPA. The NPA works with enforcement agencies to respond to wildlife crimes in townships, along roads, and other key checkpoints.

Outreach and land use planning: the NPA has an extensive conservation education and outreach program that conducts public education in villages inside and adjoining the NPAs, and in schools. This includes land use zoning and demarcating the boundaries of NPA's managed and core zones.

Village non-timber forest management: the NPA provides technical support to villages inside and adjoining the NPA to manage for sustainable offtake of non-timber forest projects.

Research and Training Center: the NPA has established the Tad Vanfong Training Center on the Nam Kading River to support scientific research and ecotourism in the NPA.

Xe Piane NPA (2000-present)

From 1998 to 2002, the FOMACOP project developed an NPA management plan, supported enforcement and outreach activities, village microdevelopment such as banks of rice and buffalo, and ecotourism. After the project ended, the government continued to support enforcement activities including checkpoints, mobile patrolling team to respond to wildlife crimes along the roads and target villages. Since 2007, WWF-Lao PDR has provided financial support to develop ecotourism products and conduct occasional enforcement foot-patrols. An expansion of tiger research and conservation activities is planned for this NPA and others in southern Laos (TCL#27).

PART 2

TIGER ACTION PLAN

1. INTRODUCTION

Tigers once occurred widely in most forested areas across Lao PDR, but today they have disappeared from many places of the country due to the direct killing of tigers, unsustainable over-harvesting of their prey, and loss of habitat. Since 2005, tigers have only been confirmed by camera trap photos and genetic analysis of scat from one location in the country, the Nam Et-Phou Louey NPA, while the persistence of tigers in other parts of the country is provisional from reports of animal signs but the certainty of tiger presence remains unknown (see Table 1). If the current threats carry on and the downward trend of the tiger population continues, tigers will disappear from forest ecosystem of Lao PDR within the next few years and in the interim, shrink to the point of "ecological extinction" – where their numbers are too few to play their role as a top predator in the ecosystem. This would represent not only a significant loss for Lao PDR but for all of Indochina, where Lao PDR represents the greatest hope for tiger recovery, and for the Asia, where less than 3,500 tigers remain in the wild today[54].

This Tiger Action Plan aims to provide basic guidelines for all stakeholders at multiple levels ranging from policy makers to field practitioners to secure the future for the Indochinese tiger in Lao PDR. The Action Plan describes a focused conservation strategy that lays out detailed actions needed for the next 10 years (2010-2020) to overcome the major threats that are driving tiger population decline. The overall goal is to elevate the existing tiger numbers to the level of viable breeding populations in the most promising Tiger Conservation Landscapes (TCLs) and maintain connectivity within/between all TCLs throughout the country (see map in Appendix 4).

The Tiger Action Plan was developed within the Lao government's existing framework for environmental and biodiversity conservation, and national social and economic development. This framework includes the National Growth and Poverty Eradication Strategy35, the National Forest Strategy55, National Biodiversity Strategy and Action Plan56, and the National Socio-Economic Development Plan57. The overall principles in these national strategies provide basic guidelines for identifying the priorities that need to be addressed. The Tiger Action Plan is in line with these national policies in that, (i) it promotes maintenance/increase in forest cover and connectivity of those fragmented forests for better protection of national environment and biodiversity, upon which national economic development depends; (ii) assists the government to address poverty eradication by providing economic incentives for local development through sustainable use of biological resources; and (iii) assists the Lao government to implement obligations made as signatories to international conventions including Biological Diversity (CBD), International Trade in Endangered Species (CITES), and Climate Change (UNFCCC) and as members of international initiatives such as the ASEAN Wildlife Enforcement Network (ASAEN-WEN).

The Tiger Action Plan was drafted by participants in the National Tiger Action Plan Workshop in December 2009 (see list in Appendix 5). After reviewing the Status of Tigers and their Conservation in Lao PDR58 (Part 1 of this document), the participants worked in TCL groups to identify and discuss the following components of the Action Plan (see agenda in Appendix 6):

Vision - a short inspirational statement describing the desired future state of tigers in Lao PDR over the long term (>50 years), including the desired range and abundance of the species, its ecological role and its relationship with humans.

Goal - a short specific statement describing the desired state of tigers in Lao PDR by 2020, including the desired range and abundance of the species.

Direct threats – these are human activities that physically result in undesirable changes in tiger abundance, distribution, movement, and quality and extent of their habitat. Indirect threats –these are the factors that are thought to be leading to the direct threats.

Interventions –these are actions taken to achieve the objective to reduce direct or indirect threats to wild tigers, their prey, and their habitat.

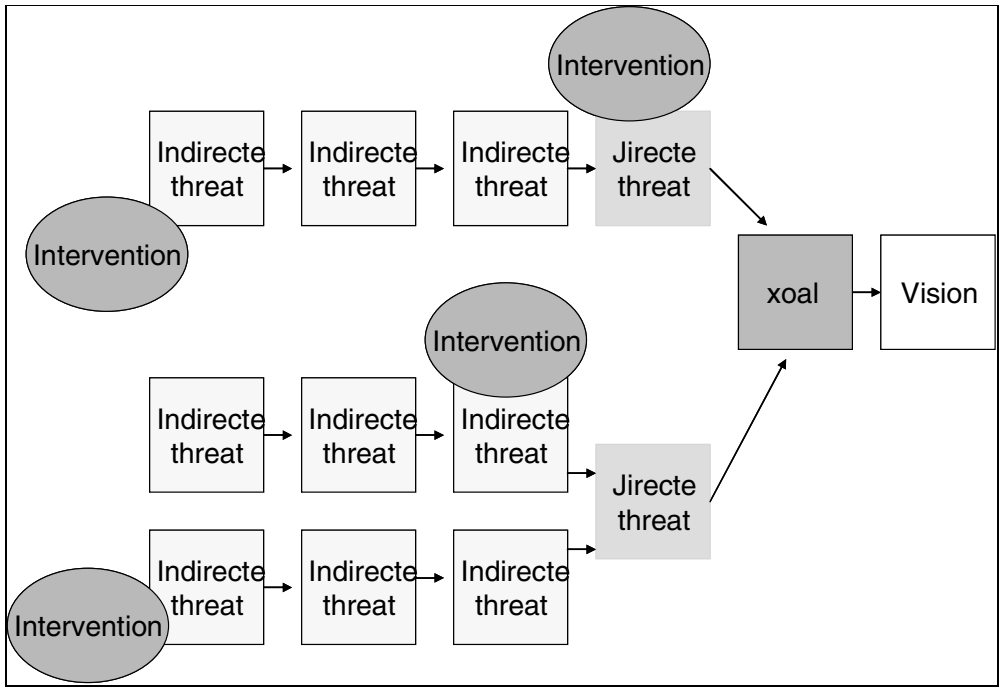

Figure 5 shows the components of a conceptual model illustrating how the causal chains of threats are contributing to the decline of tigers, tiger prey and their habitats. Interventions are management actions selected to reduce threats and reverse the decline.

Objectives - are broad statements describing the desired outcomes of the Action Plan to reduce the indirect and direct threats to reach the goal.

Through the course of the workshop, participants systematically compiled these components to produce a "conceptual model" (Figures 5,6 and 8) to serve as a visual representation of what the participants collectively thought were the key factors – direct and indirect - that were leading to undesirable impacts on wild tigers and their prey in Lao PDR. Based on the model, participants then identified the priority actions that they feel are needed from 2010-2020 to reduce the threats to wild tigers and their prey to be able to achieve the goal and vision of this Action Plan (Figure 7).

2. VISION

A Lao PDR with large functioning forest ecosystems where tigers thrive forever, which provides sustainable social, economic and environmental benefits to the people of Lao PDR

Lao PDR has a rich biodiversity, harbors several species of fauna and flora that are of global and regional conservation significance. There are at least 8,000 species of flowering plants, 100 species of large mammals, and over 700 species of birds, 90 known species of bats, and 500 species of fish. Alongside the rich biodiversity, Lao PDR is also home to dozens of indigenous tribes and cultures, with 47 ethnic minorities and over 230 spoken languages. Over 80% of the population lives in rural areas and relies heavily on the forest resources and wildlife for their subsistence. Biodiversity offers the people of Lao PDR a wide range of options for sustainable economic activities and for human welfare. Hydropower, ecotourism, non-timber forest products, wildlife, wood products contribute significantly to the country's economy. For this reason, the government of Lao PDR emphasizes that maintenance of healthy and productive forest ecosystems, and the sustainable use of natural resources are key to achieving the government's development goals for sustainable economic growth and poverty eradication.

Currently, over 41% of land is forested, of which 13% is declared as national protected areas where the objective is to protect natural areas of flora and fauna, and maintain ecological stability and watershed functions. In this way, the national protected area system can serve as core habitat for the long-term survival of tigers. The existing forest cover across the country is the most important habitat to tigers, encompassing approximately 99,612 km2 and

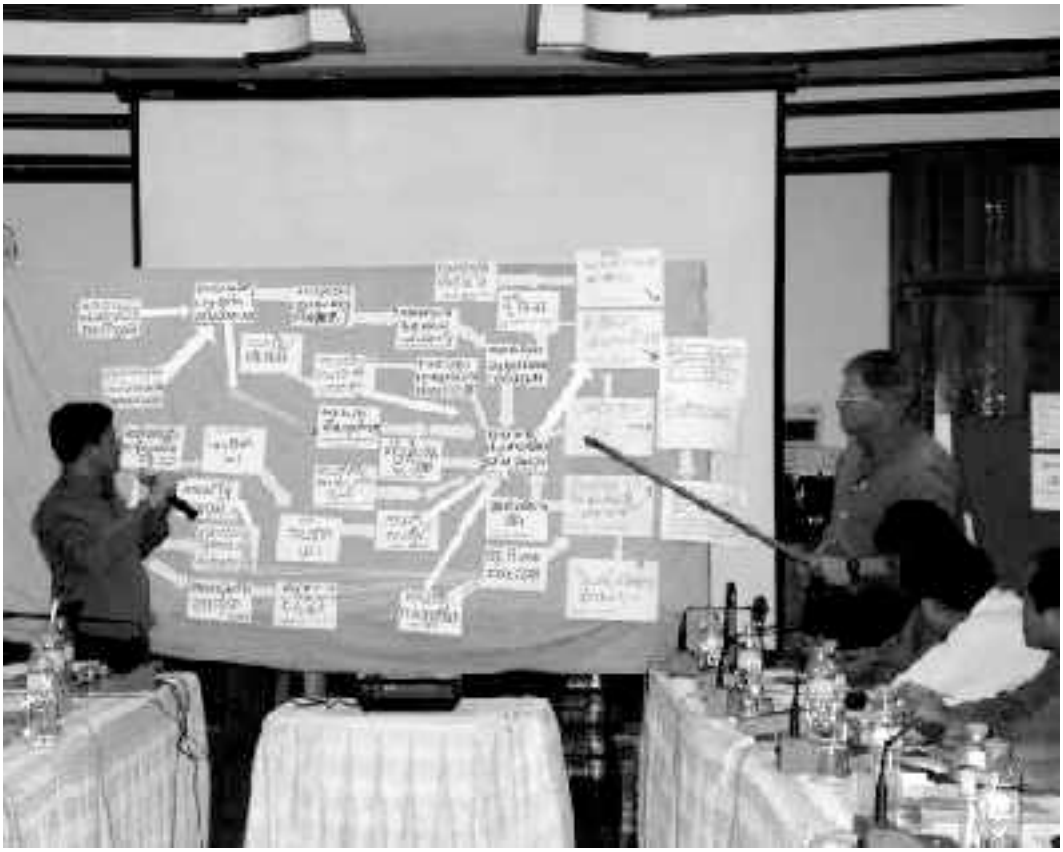

Figure 6. Workshop participants assemble the components of a conceptual model illustrating how the causal chains of threats are contributing to the decline of tigers, tiger prey and their habitats.

Figure 7. Workshop participants working in landscape groups to design the interventions - management actions –to reduce threats and reverse the decline of wild tigers, their prey and habitats in their respective landscape.

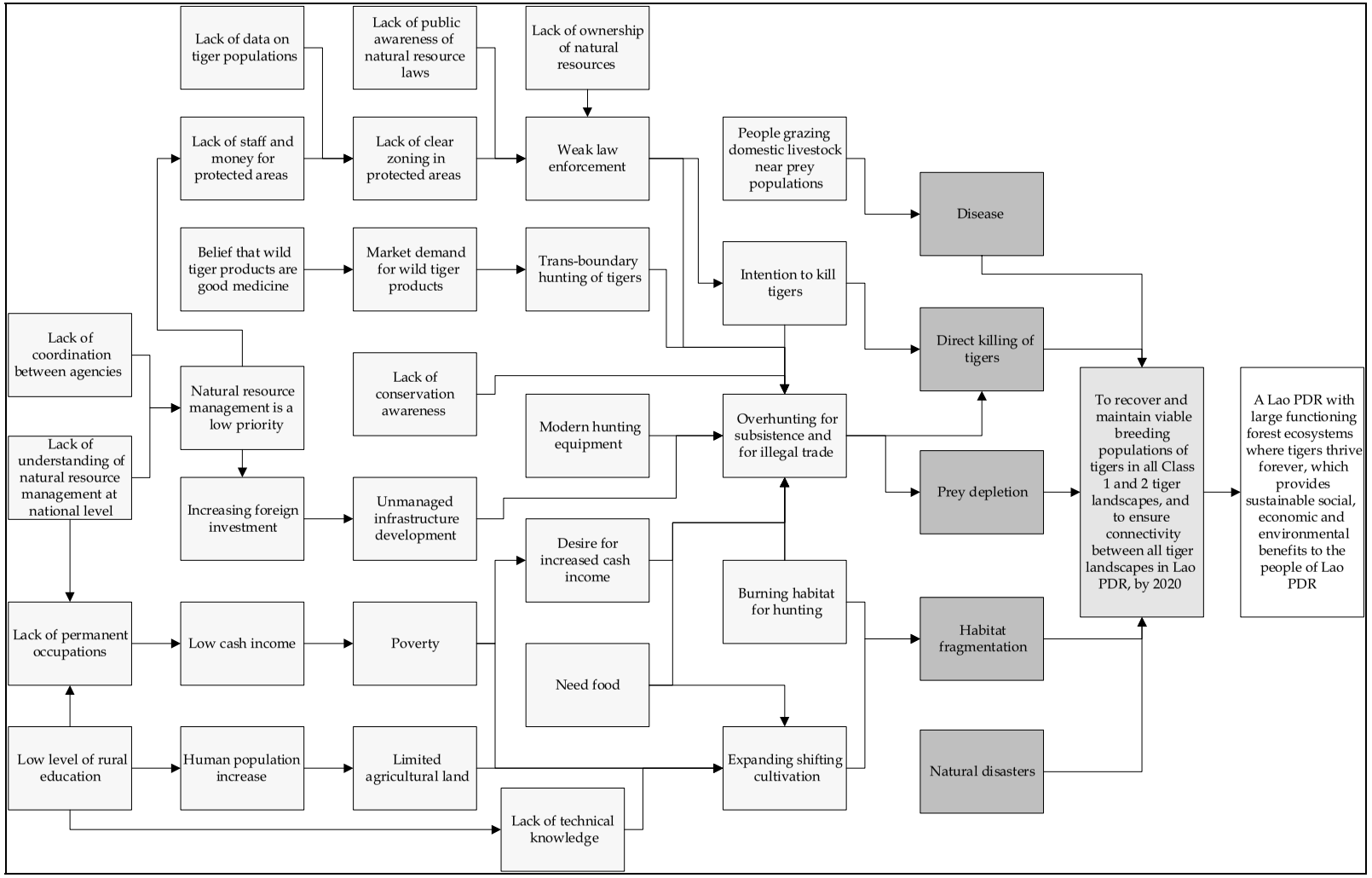

Figure 8. The conceptual model assembled by workshop participants illustrates the causal chains of threats believed to be contributing to the decline of tigers, thier prey and habitats in Lao PDR. From left to right, indirect threats are shown in yellow, leading to direct threats (green), which need to be reduced to reach the goal(blue) and ultimately, the vision (white).

classified into different levels of conservation significance for tigers (see Part 1, Section 2 and Appendix 4). Tigers are a conservation-dependent species. They require an adequate prey base, sufficient land area, and protection from killing. In order for tigers to survive, all their basic needs need to be taken into account. As top predator, tiger plays a role as an icon of the Lao forest ecosystem such that the protection of tigers symbolizes the protection of all national forest and biodiversity, which will provide benefits, in the forms of direct and indirect services provided by healthy ecosystem, to enhance the quality of life and health of the people of Lao PDR.

Policy statement and guiding principles

The overall goal of the Lao PDR development strategy is to ensure the balance in economic development, social/cultural development, and the conservation of natural resources. All of the objectives and actions needed to address the existing threats to tigers in Lao PDR, which are included in this Tiger Action Plan are based on the underlying principles of the National Biodiversity Strategy and Action Plan56, National Forest Strategy55, National Growth and Poverty Eradication Strategy35, national legislation, and international conventions (Part 1, Section 4). The principles of this framework that are adopted for guidance include:

I. Biodiversity is a national heritage and must be used in a sustainable manner today to be conserved for future generations.
ii. The national development process must reflect ecological, economic, social, cultural and spiritual values of the local people.
iii. The sustainable use of biodiversity is a key element of livelihood strategies.
iv. The knowledge, innovations and practices of local people should be respected and their use and maintenance of biodiversity carried out with the support and involvement of their people.
v. Biodiversity is best conserved in-situ[4].
vi. The conservation and sustainable use of biodiversity resources require co-operation at all levels, namely local, national, regional and global and also a sharing of knowledge, costs and benefits.
vii. The formulation and implementation of policies and the establishment of a legal framework are necessary as effective measures against biodiversity depletion.
viii. Education and the raising of public awareness are essential in ensuring the conservation and sustainable use of biodiversity resources. In line with a range of government policies (Table 4), the Tiger Action Plan seeks to address the following urgent issues from 2010-2020:
    1. Protect threatened species and habitat (e.g. wild tigers and their prey)
    2. Strengthen the development and management of national protected areas.
    3. Maintain healthy and productive forests through conservation, protection and sustainable use.
    3. Improve local livelihoods through sustainable use of biological resources.
    4. Improve and develop laws and regulations, securing their effective enforcement.
    5. Enhance education and public awareness on the significance of biodiversity and the importance of it's conservation

Table 4. National policy statements regarding to natural resource management and sustainable development

Policy	Policy statements
NEPES[1]	Economic growth must be based on sound management of natural resources and enhanced social and cultural development
NBSAP[2]	Maintain the diverse biodiversity as one key to poverty alleviation and protect the current asset base of the poor as support to the implementation of the government's priority programs
NSEDP[3]	The rich natural resources of the Lao PDR play a vital role in the country's socio-economic development. It is therefore important that they are protected and exploited in a sustainable manner.
NFS[4]	The objective of National Protected Areas/Biodiversity Conservation areas is to protect natural areas for conservation

[4] "In-situ" is defined as in its original natural habitat (e.g. not in captive-bred facilities).

	of flora and fauna, maintenance of ecological stability and watershed functions, and to preserve historically, aesthetically, culturally or scientifically valuable sites. Objectives should be achieved through local participatory management benefiting NPA residents.
NESAP[5]	To sustainably utilize natural resources and protect and conserve the environment to ensure the sustainable development of the country while reducing poverty and enhancing the quality of life and health of Lao People
WL Law[6]	The tiger is the protected species in Category 1; hunting of tiger, trading, and keeping of tiger parts is prohibited. Violation of this law will be seriously punished.

[1] National Growth and Poverty Eradication Strategy 2004
[2] National Biodiversity Strategy to 2020 and Action Plan to 2010
[3] National Socio-Economic Development Plan
[4] National Forestry Strategy to the Year 2020.
[5] National Ecotourism Strategy and Action Plan 2005-2010
[6] Wildlife Law 07; 24 December 2007.

Table 5. Scale-dependent geographic specific goals and costing

		Temporal (2010-2020)	
Spatial		**2010-2015**	**2016-2020**
	Tigers confirmed (NEPL)	Increase tiger numbers by 50%, and sufficient prey to support this increase, in 3,000 km2 TPZ by 2020. **Cost[1]:** Minimum of US$ 1.8 million for reoccurring operating costs per annum in addition to a one-off minimum investment of US$ 4.7 million for infrastructure and equipment	Manage to increase tiger and prey populations to viable levels in the TPZ and secure movement corridors to ensure a source for reintroductions to other priority source sites **Cost:** Minimum of US$1.8 million for reoccurring operating costs per annum
Priority source sites	Tigers likely in Class 1 and 2 landscapes (Nam Xam, Xe Sap, Dong Ampham, Dong Huasao, Xe Piane, Nakai- Nam Theun)	Confirm the occurrence of tigers at the site; manage to stabilize prey populations **Cost[2]**: Minimum of US$640,000 for baseline field surveys including landscape questionnaire survey and camera trapping at source sites. [1], Minimum of US$3.3 million for reoccurring operating cost per annum in addition to infrastructure investment	At sites where tigers were confirmed present, identify and secure TPZ for tiger breeding habitats and movement corridors; At sites where tigers were absent, manage site to reduce threats, stabilize prey populations and enhance connectivity with sites where tigers are confirmed present **Cost:** Minimum of US$3.3 million per annum for reoccurring operating costs.

3. GOAL

To increase size of breeding population of tigers at source site, Nam Et-Phou Louey, ensure connectivity between all tiger landscapes, and obtain baseline data on tiger populations for all TCLs in Lao PDR, by 2020.

The remaining tigers in Lao PDR appear scattered across various Tiger Conservation Landscapes (see map in Appendix 4 and Table 1), but they are at low numbers. At present, tigers are only confirmed in the Nam Et-Phou Louey NPA whereas their presence in other places remains provisional. Thus, in order to ensure long-term survival and conservation of tigers in Lao PDR, we need to elevate existing tiger numbers to secure a viable breeding population in sites where tigers are confirmed to, while also working to confirm the occurrence of tiger in other potential sites, particularly in all Class 1 and Class 2 TCLs. Where tigers are confirmed in these other potential sites, immediate action must be taken to reduce threats to allow tigers to increase to the level of a viable breeding population. For the purpose of this Plan, a viable population is defined as a minimum of 25 breeding tiger females in each confirmed source site as a viable population capable of sufficient reproduction to maintain the population
over time[11].

Given the existing data on tiger population status, we therefore developed site specific goals that vary in terms of their implementation in space and time (Table 5). The national goal is further broken into two spatial scales including priority source sites and landscapes, and two temporal scales including a period between 2010-2015, and 2016-2020. For the purpose of this Plan, priority source sites are defined as areas embedded within a TCL that currently have confirmed or likely reports of tiger in a designated protected area (Table 1), which also have the potential to serve as a Totally Protected Zone (TPZ) within a designated Protected Area following the guidelines of the National Forestry Law50 for maintaining a viable source population of tigers (e.g., the NEPL NPA has an estimated population of 7-23 tigers within the NPA TPZ[13]).

4. THREATS

At the national Tiger Action Plan workshop, the participants identified five direct threats and numerous underlying factors (indirect threats) that they felt are contributing to the decline of tigers, their prey and their habitat (Figure 8). The direct threats included direct poaching of tigers, depletion of prey, habitat loss and fragmentation, and to a lesser degree, wildlife disease and natural disasters.

Direct killing of tigers is attributed largely to, (i) killing tigers with an intent to make money, and (ii) killing tigers in revenge for livestock loss, which can be associated with farmers using livestock to lure tigers in to poach them. The key factors driving these illegal activities are believed to be the high demand and price for tiger parts on the international market because people believe tiger parts will cure illnesses through traditional medical practices. Low income villagers are encouraged to engage with traders given a desire for cash income that is lacking because rural people often have a low level of education and thus find it difficult to obtain permanent employment. However, overall it was felt that weak law enforcement was at the root of all of the direct threats. Weak enforcement is thought to stem from poor land-use planning and management of protected areas, which is the result of inadequate staff and financial support for management. The paucity of support for protected area management was attributed to an inequality in national government investment in biodiversity conservation and socio-economic development, despite the fact that national strategies clearly state that poverty and biodiversity are intimately linked (see Table 4). This inequality was thought to stem from a lack of clarity at the national planning and investment level about the conceptual linkages between biodiversity conservation and economic development.

Depletion of prey is attributed to over-hunting of large prey species for both subsistence and for trade. The many factors contributing to overhunting were identified as:

i) Weak law enforcement associated with poor land use planning or poor management of protected areas because of a shortage of funding and staff, which is the result of limited integration of biodiversity conservation with national economic development. As a result, participants felt that funding is allocated to development of infrastructure and other social sectors with little support for biodiversity conservation. The weak understanding of the conceptual link between biodiversity conservation and economic development at the national planning and investment level was thought to be rooted in weak coordination and cooperation between the various sectors of relevant government agencies;

ii) A lack of public awareness about biodiversity conservation, particularly among rural

Tiger Conservation Landscapes	Tigers likely in Class 3 or Potential landscapes (Nam Khan, Nam Ha, Hin Nam Nor, Phou Xanghe, Xe Bangnouan, Phou Xiengthong, Nam Phoun, Phou Dendin)	Confirm occurrence of tigers and prey populations **Cost2:** Minimum of US$640,000 for baseline field surveys including landscape questionnaire survey and camera trapping at source sites.	At sites where tigers were confirmed present, identify and secure TPZ for tiger breeding habitats and movement corridors; At sites where tigers were absent, manage site to reduce threats, stabilize prey populations and enhance connectivity with sites where tigers are confirmed present **Cost:** Minimum of US$3.3 million per annum for reoccurring operating costs.
	Class 1 (TCL#35)	Expand breeding populations inside the tiger landscape **Cost3: M**inimum of US$100,000 per annum for operating cost	Enhance zones of connectivity within and between this and other landscapes. **Cost:** Minimum of US$100,000 per annum for operating cost
	Class 1 & 2 (TCL#27,34,26)	Manage to reduce threats to recover source tiger populations **Cost3:** Minimum of US$100,000 per annum for reoccurring operation costs	Enhance zones of connectivity within and between Class 1 and Class 2 landscapes. **Cost:** Minimum of US$100,000 per annum for reoccurring operation costs.
	Class 3 (TCL#33,#36)	Manage to reduce threats to recover source tiger populations **Cost3:** Minimum of US$100,000 per annum for reoccurring operation costs.	Enhance connectivity to Class 1 and 2 landscapes **Cost:** Minimum of US$100,000 per annum for reoccurring operation costs.
	Potential landscapes	Identify any unprotected breeding tiger populations remaining in Laos **Cost3:** Minimum of US$100,000 per annum for reoccurring operation costs.	Enhance their connectivity to existing tiger landscapes **Cost:** Minimum of US$100,000 per annum for reoccurring

Notes:

[1.] Estimate of minimum annual reoccurring operating costs at US$ 300 per square kilometer or US$ 3 per hectare. This includes support for law enforcement, public outreach, ongoing tiger and prey monitoring, land-use planning, boundary demarcation, and protected area office management

[2.] Estimate of baseline monitoring costs based on US$45 per square kilometer to conduct camera trap baseline survey, and US$3 per square kilometre to conduct baseline landscape questionnaire occupancy survey.

[3.] Estimated minimum needed to support reoccurring operating costs for activities at landscape level (including district and provincial level activities such as law enforcement to stop illegal wildlife trade and habitat loss, inter-sectoral coordination, workshops, and training).

communities, is leading to violations of the law and little understanding or support for conservation;

iii) Increased access to forested areas is resulting from poorly planned infrastructure development projects that do not include safeguards to limit the impact of the development on the environment, which in turn contributes to unregulated illegal hunting of wildlife for trade along these unmanaged access routes;

iv) Modern weapons allow rural people to hunt tiger prey species more effectively, which is contributing to a more rapid decline in prey populations than in the past;

v) The growing need for cash income associated with a high demand and price of wild meat encourages rural villagers to hunt more ungulates for trade rather than for subsistence.

vi) The need for food encourages rural people to hunt for wild meat to supplement household food consumption, which alone may be sustainable but when coupled with illegal trade of wild meat is surely unsustainable;

vii) As a result of the high demand and price of prey parts at international markets, driven by beliefs in the value of traditional medicine, there is also cross-border hunting by people from neighboring countries,. The problem occurs in several TCLs along the country's international boundaries, such as in Phou Dendin and Nakai Nam Theun NPAs.

Habitat loss and degradation is attributed largely to shifting cultivation and burning of forest for game hunting. The factors behind these problems are:

i) The demand for food or for income from cash crops results in clearance and burning of land for growing staples (e.g., rice, corn, cassava) and sometimes burning of the forest for hunting ungulates for subsistence consumption or for trade;

ii) The limited availability of agricultural land given the country's mountainous terrain, which is further complicated by increasing human population in rural areas, due to a lack of birth control and education, which results in people encroaching into tiger habitat;

iii) The lack of technical skills by rural farmers, which can result in improper use of chemicals causing negative impacts on the environment as well as low agricultural productivity such that more land is cleared to meet the growing demands for food and cash;

iv) Unmanaged infrastructure projects without environmental safeguards were identified as contributing to habitat loss and fragmentation.

Disease was identified as a cause of decline in tiger prey in cases where infectious diseases are transmitted from domestic animals to wild ungulates where livestock grazing areas in close proximity to wildlife inside protected areas.

Natural disasters were identified as a factor contributing to the loss and fragmentation of tiger habitat, especially in areas of intense shifting cultivation, which in turn was attributed to a lack of technical skills and limited land for agricultural production.

5. OBJECTIVES AND INTERVENTIONS

In order to reduce the threats outlined in the previous section and achieve the goal, "to recover and maintain viable breeding populations of tigers in all Class 1 and 2 Tiger Landscapes, and to ensure connectivity between all tiger landscapes in Lao PDR, by 2020", several objectives and interventions are identified in this Plan. For each objective to be achieved, specific actions must be taken at different administrative levels, ranging from priority sites, to landscapes, and at the national level, to address the indirect and direct threats that are leading to the decline to wild tigers, their prey and habitats (see Table 6). At priority sites, actions will focus on reducing the threats that occur within the protected areas that harbor source tiger populations. Examples of these types of threats include direct poaching of tigers and prey, controlling the hunting of Categories 2 and 3 managed prey species (muntjac and wild pig) and encroachment into tiger habitat inside a protected area TPZ. At the landscape level, key actions focus largely on threats that occur beyond protected areas at the district or provincial level. Examples of these threats include wildlife trade, habitat loss and unmanaged infrastructure development. At the national level, the major actions focus on issues that occur beyond the landscapes at both national and international levels. Examples of these threats are lack of institutional capacity, legislation, financial and technical support, and international cooperation to address the problems facing wild tigers, their prey and habitats.

In this section, we describe the seven major objectives of the Tiger Action Plan. In Table 6, each objective is broken down into specific interventions at priority sites, at landscapes and at the national level. For each intervention, agencies responsible for implementation are identified, as well as indicators

and a means of verification to identify if the intervention has been completed.

Objective 1: Increase public awareness and support for the recovery and conservation of wild tigers and their habitats

If tiger conservation is to be successful or not depends on public support and involvement. So, it is crucial to raise public understanding of how tiger conservation may benefit the citizens of Lao PDR, what is the legislation relevant to tiger conservation, and how the public must engage in tiger conservation. Over the last decades, methods for implementing outreach and education activities have advanced considerably, such as formal education, social marketing campaigns, conflict mitigation, and natural resource planning. At the present time, national capacity to design and deliver public outreach programs specific to the conservation of wild tigers and prey is limited. Only three protected areas (NNT, NK and NEPL) have outreach units that are actively engaged in design and delivery of programs to increase public awareness and support for the conservation of wildlife; only the NEPL outreach unit is focused on land use planning and management issues specifically related to wild tigers and their prey.

Our target groups include a wide range of people, which includes local villagers who live nearby the priority sites or within the TCLs, officials at all levels of government, and the private sectors. To achieve this objective, activities at priority sites will focus on;

(i) building PA staff capacity to design, deliver and evaluate outreach activities,

(ii) support outreach activities in target villages inside/nearby protected areas to disseminate PA regulations, to inform villagers on land-use zoning and demarcation, resolving human-wildlife conflict, the role of local involvement in conservation and resource management.

At landscapes, outreach and education activities will focus on building knowledge and support in villages outside PA to increase their understanding about national laws controlling wildlife crime and the consequences of engaging in wildlife crime, and how increased wildlife populations will benefit people.
At the national level, the outreach activities will aim at building knowledge and support for within/among government sectors about national laws, and tiger significance in sustainable economic development and environment protection. Of particular importance, tiger conservation needs to be integrated into national socio-economic planning and investment.

Objective 2: Identify and demarcate totally protected zones (TPZs) in protected areas and corridors for connectivity between TPZs in tiger conservation landscapes.

In compliance with the national forestry law, land-use zoning will include demarcation of,

(I) TPZs – that are core breeding areas where human activity is prohibited,

(ii) Managed Zones (MZs) – that are areas where sustainable use of natural resources by local communities for subsistence is allowed, and

(iii) corridors – habitat connectivity within and between protected areas that allow movement or dispersal of tigers and prey within/between TCLs.

The law states that all hunting is prohibited in the TPZ whereas harvest of tigers and large prey (e.g. gaur, banteng, sambar and serow) is illegal throughout the country. At the present time, only two protected areas (NEPL and NKD) within two of the priority landscapes have demarcated and are protecting TPZs, while one other (NNT) is in the process of demarcating TPZs. So, we need to extend this activity to other NPAs as well as across TCLs in order to strengthen the effectiveness of our conservation interventions, particularly law enforcement.

To achieve this objective, activities at the priority site and landscape level will first focus on collection of baseline data on status of wild tigers and prey, and their habitat as well as socio-economic information on villages in PAs and TCLs. The baseline results will be used along with national policies and national economic development plans to guide land-use zoning that will accommodate both biodiversity conservation and socio-economic development. At the national level, activities must ensure that land-use planning in TCLs is integrated into national socio-economic development and investment strategies. At core breeding sites, no infrastructure development will be permitted.

Objective 3: Increase and make effective the enforcement of national regulations and international conventions to stop killing of tigers and to regulate illegal harvest and trade of tiger prey.

It is evident that traditional hunting for subsistence has been replaced by commercial hunting, causing severe decline in wildlife populations including tigers. If the current trend continues, they may disappear from the forest ecosystem of Lao PDR within a decade. The major factors behind this

problem are mainly weak law enforcement and poor management of protected areas. Therefore, building capacity within and between enforcement agencies, and providing supports for "on the ground" action is necessary to tackle these illegal activities.

The 2007 Wildlife Law provides good guidelines for the management of wildlife resources, including the control of wildlife crime. The law allows for sustainable harvest of category II (muntjac) and category III (wild pig) species in areas outside TPZs and corridors for family consumption only, but not for trade. Tigers and other large ungulates (e.g. gaur, sambar, banteng, serow), that are Category 1 species, are totally protected from hunting. Hunting of these Category I species for both subsistence and trade is prohibited, and any violation of these regulations will result in a severe penalty, ranging from a fine to jail.

To achieve this objective, implementation will take place at multiple levels. At the priority sites, attempts will focus on building capacity and support for PA staff and local district/provincial enforcement agencies to conduct regular routine and responsive patrols in the tiger core breeding sites to stop poaching of tigers and prey. At the landscape level, attempts will focus on building capacity and support for district/provincial enforcement agencies to stop wildlife trade in markets, restaurants, along roads and at international border checkpoints. At national level, attempts will aim at strengthening the institutional capacity of enforcement agencies, such as Department of Forest Investigation (DOFI), CITES Management and Scientific Authorities and other concerned agencies such as police and custom offices, to enforce the existing laws and strengthen international cooperation to stop cross-border wildlife crime

Objective 4: Increase national cross-sectoral cooperation for the recovery and conservation of wild tigers and their habitats

The National Biodiversity Strategy of Lao PDR emphasizes that conservation and sustainable use of biodiversity resources require co-operation at all levels of government and within Lao society. Therefore, for all management interventions proposed in this Tiger Action Plan to be achieved will require cooperation among all government agencies. Therefore, to achieve this objective, a priority will be to strengthen the capacity of staff to coordinate cross-pectoral actions. A series of meetings/workshops will be held at various levels, namely village, district, province, and national, to increase support and participation in the decisionmaking process.

At the priority sites, activities will focus on strengthening cooperation and coordination among district and provincial government sectors to be aware of and support conservation interventions on the ground (e.g. law enforcement, outreach, land-use planning, etc.), and to ensure that all socio-economic development plans are in compliance with PA regulations. At the landscape level, attempts will focus more on strengthening cooperation between government sectors within/between provinces to ensure connectivity between PAs within a landscape, proper land-use planning and increased local support. At the national level, activities will aim at strengthening cooperation and coordination within and among ministries in order to ensure that conservation of tigers and prey is integrated into national development planning and investment. Of particular concern, no concessions or infrastructure development will be permitted in the core breeding sites for tigers.

Objective 5: Increase international cooperation to reduce the illegal trade of tiger and prey to neighboring countries.

As a signatory to CITES, Lao PDR agrees that any trade in tigers and other endangered species is banned. However, illegal trade in tigers due to the high demand for their body parts for traditional medicine still exists. This is a major cause for the decline of wild tiger populations across tiger range countries, particularly in Lao PDR. Geographically, Lao PDR is located in the heart of Indochina, a landlocked country sharing borders with Thailand and Myanmar to the west, China to the north, Vietnam to the east and Cambodia to the south. Given this setting, strengthening international cooperation with neighbors is critical to control cross-border wildlife trade. Lao PDR has already signed international conventions, including CITES, and is a member of ASEAN-WEN for a number of years and has agreed to control illegal wildlife trade. In order for this objective to be achieved, activities at the priority sites will focus on strengthening cooperation and coordination among local enforcement agencies to stop illegal cross-border wildlife trade along international borders. NPAs also need to work cooperatively with other relevant agencies to develop "Village Development Fund" that may come from sale of NTFPs, park services, ecotourism, and other national/international supports for livelihood improvement. This may demonstrate villagers how tiger conservation is significant to local livelihood and their involvement in conservation. At the national level, attempts will focus on building national capacity for all enforcement sectors to strictly control illegal cross-border wildlife trades at international

checkpoints, and work cooperatively with international enforcement network such as ASEAN-WEN to increase effectiveness of law enforcement.

Objective 6: Monitor and reduce human-tiger conflict in tiger conservation landscapes.

Human-tiger conflict due to tiger depredation of livestock and sometime direct confrontation with humans is a major cause of tiger decline in many tiger range countries. As a top predator, the tiger's requirements may overlap with those of human populations (e.g. diet, land tenure). The conflict generally occurs more commonly inside and around protected areas where cultivation and grazing areas are located inside/nearby the protected area. However, the problem becomes exacerbated if natural prey populations have declined and natural habitats are invaded by human for settlement and agriculture.

In Lao PDR, national protected areas are categorized as multiple-use, IUCN Category VI protected areas, where people are allowed to live within the protected area. Under these circumstances, human-wildlife conflict is possible.
For example, in NEPL NPA, even though tiger numbers are relatively low at present, tiger depredation of livestock is reported by villagers, but the certainty of those reports is not always known. Therefore, it is important to utilize a systematic method to better understand the problem and find ways how to reduce human-tiger conflict. At the priority sites, activities will focus on building capacity for protected area staff to systematically respond to and investigate carnivore-human conflict reports and maintain a carnivore-human conflict database. Also, protected area staff will work with and support farmers to ensure "tiger friendly" livestock management practices, and ensure that those farmers are being trained on technical skills in livestock husbandry. At landscape and national levels, activities will focus on supporting PA regulation, providing technical guidelines to PA staff and farmers, and ensure application of a standardized protocol for all tiger priority sites.

Objective 7: Strengthen PA organization, capacity and sustainable financing to effectively implement management activities to reduce threats to tigers and prey at priority source sites in Class 1 and 2 tiger conservation landscapes.

Following up from Prime Minister' agreement No. 25/PM, dated on 3rd April, 2007, the Provincial NPA Management Unit (PPAMU) was newly established in each province throughout Lao PDR. The mandate of PPAMU is to strengthen PA management in each province in order to protect and conserve forest, wildlife, and watershed resources. In addition, this agreement has emphasized that each NPA must be assigned at least 15 government staff, provided sufficient equipment, vehicles and financial support to implement management interventions.

Up to now, only two protected areas (NEPL and NK) in two Tiger Conservation Landscapes have management plans designed to reduce threats specific to the conservation of wild tigers and prey. A site-specific management plan is urgently needed for each priority site or landscape. The plan should set the goal and objectives clearly, lay out all key threats to tigers, their prey, and their habitats and all key interventions that tackle those problems. Due to inadequate financial support, only a few of the 21 NPAs throughout Lao PDR with technical and financial assistance from international organizations or industry are under proper management at the present time, namely NEPL, NKD, NNT. A sustainable financing mechanism in each priority site or tiger landscape is needed to secure long-term financial support.

To achieve this objective, activities will aim at building staff capacity of PPAMU at priority sites or landscapes to

I) identify and rank threats to wild tigers and prey,
ii) design management activities that will reduce the greatest threats, and
iii) implement site-specific plans for conservation of wild tigers and prey. Technical training provided to NPA or PPAMU staff need to include;
    a) principles of tiger ecology and conservation and of wildlife management,
    b) how to integrate wildlife management with rural livelihoods and development,
    c) group leadership, communication and coordination skills, as well as conflict resolution for mitigating resource disputes and stakeholder disagreements,
    d) tools for financial and administrative management of TCLs, including budgeting, fundraising, and reporting.

In addition, at each site attempts should focus on creating an "NPA Management Fund", which generated revenue from ecotourism, fines, research fees, and gifts to support the management. This may be an option for long-term sustainable financing mechanism for each priority site or landscape. At national level, attempts should ensure that national funding is allocated to NPA management, and to work together with international partners to consider REDD project sites as an option for sustainable long-term financing for NPA management in tiger landscapes.

Table 6. Scale-dependent implementation of interventions.

	Interventions	Leading agency	Collaborate agency	Indicator	Means of verification	Short-term 2010-2015	Mid-term 2016-2020
Objective 1: Increase public awareness and support for the recovery and conservation of wild tigers and their habitats							
Tiger Source Sites	**Intervention 1.1.** Establish and train protected area outreach units to design, deliver and evaluate the effectiveness of outreach activities.	**NPAs**	**PAFO, DAFO**	**Number of NPA outreach staff trained**	**Roster of trained NPA staff**		
	Intervention 1.2. Compile and disseminate national laws, PA regulations and zoning to source site communities and authorities.	**NPAs**	**PAFO, DAFO**	**Awareness program and materials**	**Report on awareness materials and their distribution.**	X	
	Intervention 1.3. Develop and ratify village contracts that ensure compliance with laws and regulations to protect tigers and sustainably manage the use of tiger prey species and habitats.	**NPAs**	**PAFO, DAFO, Law agency**	**Number of villages contracted**	**Published reports listing completed village contracts**	X	
Tiger Landscapes	**Intervention 1.4.** Disseminate national laws and PA regulations that protect tigers and sustainably manage their prey and habitats to communities and authorities across Class 1 and Class 2 TCLs.	**NPAs, DAFO**	**PAFO, Media agencies**	**Awareness programs implemented, and materials**	**Media pick up; Report on awareness materials and their distribution.**	X	X
Nationa	**Intervention 1.5.** Conduct outreach activities to raise awareness of national agencies and authorities of the importance of wild tigers and their conservation.	**DFRC**	**MAF, Media agencies**	**Awareness programs**	**Media pick up, meetings, published reports on awareness materials and their distribution**	X	X

Table 6. Scale-dependent implementation of interventions.

	Interventions	Leading agency	Collaborate agency	Indicator	Means of verification	Short-term 2010-2015	Mid-term 2016-2020
Objective 2: Identify and demarcate totally protected zones (TPZs) in protected areas and corridors for connectivity between TPZs in tiger conservation landscapes.							
Tiger Source Sites	**Intervention 2.1.** Increase knowledge on the status of tigers and prey in NPAs using scientificsound methods	NPAs	DAFO, PAFO	Completion of rigorous science- based field surveys	Published technical reports	X	
	Intervention 2.2. Compile land use and socioeconomic data to inform the demarcation of PA zones.	NPAs	PAFO, DAFO	Completion of rigorous science- based field surveys	Published technical reports	X	
	Intervention 2.3. Identify and demarcate PA boundaries of source sites.	NPAs	PAFO, DAFO	Boundary demarcation signs, maps	Published technical reports with boundary maps	X	
	Intervention 2.4. Following, the 2007 National Forestry Law, within PAs identify and demarcate large areas, at least 1,500 km2 in size, of TPZs, and corridors between TPZs.	NPAs	PAFO, DAFO, LMU	Land use map showing PA TPZ	Published technical reports with PA and TPZ maps	X	
	Intervention 2.5. Conduct village land-use planning and allocation in PA controlled use zones to ensure public compliance with NPA zoning.	NPAs,	PAFO, DAFO, LMU, village	Village meetings, regulations	Official village land use planning agreements and maps	X	
Landscape	**Intervention 2.6.** Identify and demarcate protected corridors of habitat connectivity to facilitate dispersal of tigers between source sites within TCLs and between TCLs.	NPAs	PAFO, DAFO, LMU, village	Established corridors	Published technical reports with corridor maps	X	X
	Intervention 2.7. Conduct village land-use planning and allocation outside of PA boundaries to ensure compliance with PA zoning and corridors within TCLs.	NPAs	PAFO, DAFO, LMU, village	Number of villages with land use maps	Official village land use planning agreements and maps	X	

Table 6. Scale-dependent implementation of interventions.

	Interventions	Leading agency	Collaborate agency	Indicator	Means of verification	Short-term 2010-2015	Mid-term 2016-2020
Objective 2: Identify and demarcate totally protected zones (TPZs) in protected areas and corridors for connectivity between TPZs in tiger conservation landscapes.							
National	**Intervention 2.8**. Approve PA management plans to ensure crosssectoral compliance with PA TPZs and corridors.	**DFRC**	**DOF, MAF**	**Approved management plans**	**Number of PA management plans completed and approved**	**X**	
	Intervention 2.9. Manage land concessions and infrastructure development in TCLs to comply with PA management plans and zoning.	**DOF**	**MAF,DCPI, MI, MEM, MT**	**Infrastrucutre and concession management plans that comply with PA regulations**	**Infrastructure and concession management plans endorsed and regulated.**	**X**	
Objective 3: Increase and make effective the enforcement of national regulations and international conventions to stop killing of tigers and to regulate illegal harvest and trade of tiger prey.							
Tiger Source Sites	**Intervention 3.1**. Establish, train, and coordinate a multisectoral law enforcement team to effectively implement PA regulations, CITES and CBD international conventions at source sites.	**NPAs**	**DAFO,PAFO, Military, police, justice, custom, provincial and district government**	**Number of staff trained and actively serving on this task**	**Reports on enforcement of PA regulations and international conventions.**	**X**	
	Intervention 3.2. Develop and implement PA protection strategies that identify threats to wild tigers and prey at source sites and target enforcement activities to reduce threats.	**NPAs**	**PAFO, DOF, DOFI**	**Level of threats and enforcement**	**Reports on the results of threat and enforcement monitoring**	**X**	
	Intervention 3.3. Establish and support effective foot patrols within PA TPZs and corridors to stop illegal poaching of tigers and prey.	**NPAs,**	**PAFO, DOF, DOFI, DAFO, military, police, custom,**	**Foot patrol effort n and level of illegal poaching**	**Reports on the results of threat and enforcement monitoring**	**X**	**X**

	Interventions	Leading agency	Collaborate agency	Indicator	Means of verification	Short-term 2010-2015	Mid-term 2016-2020
Landscape	**Intervention 3.4.** Build village informant networks to support enforcement to stop illegal poaching of tigers and prey at source sites	**DFRC**	**DAFO, police, military, custom**	**Informant reports that lead towildlife seizures**	**Reports on the results of threat and enforcement monitoring**	X	X
	Intervention 3.5. Install PA law enforcement monitoring systems (e.g. MIST) to systematically monitor, evaluate and adapt law enforcement activities.	**DOF**	**DFRC, WCS**	**Installation of MIST**	**Reports on the results of threat and enforcement monitoring**	X	
	Intervention 3.6. Following the 2007 Wildlife Law, manage for the sustainable harvest of Category 2 and 3 tiger prey in areas outside of PA TPZs and corridors.	**NPAs**	**DAFO, PAFO, Military, Police, Custom, Commerce**	**Sustainability of the harvest of tiger prey**	**Off take monitoring; abundance of tiger prey**	X	X
	Intervention 3.7. Strengthen and coordinate between enforcement agencies at district and provincial levels to stop illegal trafficking of tigers, prey and other wildlife along roads and at restaurants and markets.	**NPAs**	**DAFO, PAFO, Provincial/district gov, Customs, Police, Commerce**	**Level of illegal trafficking and enforcement**	**Reports on the results of threat and enforcement monitoring**	X	X
National	**Intervention 3.8.** Strengthen national capacity and international cooperation at border crossings to adhere to CITES and stop illegal cross-border trade in tiger parts and tiger prey.	**DFRC**	**NPAs, PAFO, DOF, MAF, Custom, Commerce, Police**	**Number of staff trained and actively serving on this task**	**Reports on enforcement at border crossings**	X	X
	Intervention 3.9. Strengthen the capacity and increase effectiveness of the CITES Management and Scientific Authorities to regulate trafficking of tigers and their prey.	**DOFI**	**DOF, MAF**	**Workshops; number of staff trained and actively serving on this task**	**Manuals, reports on staff trained and regulation activities.**	X	X

	Interventions	Leading agency	Collaborate agency	Indicator	Means of verification	Short-term 2010-2015	Mid-term 2016-2020
	Intervention 3.10. Closely monitor and regulate facilities that hold captive tigers and prey to assure compliance with CITES regulations and national wildlife laws.	DOFI	DOF, MAF	Level of monitoring and regulation	Published reports on monitoring, regulation and compliance.	X	X
Objective 4: Increase international cooperation to reduce the illegal trade of tiger and prey to neighboring countries.							
Tiger Source Sites	**Intervention 4.1.** Increase coordination between national government authorities at source sites and nearby border enforcement agencies to monitor and reduce the illegal cross-border trade of tigers and prey.	NPAs	DAFO, PAFO, Custom, Police, Commerce	Level of threats and enforcement	Reports on the results of threat and enforcement monitoring, media pick up	X	X
	Intervention 4.2. Raise the awareness of customs authorities and other relevant border enforcement agencies of the CITES, related national wildlife legislation and regulations, the nature of tiger and prey trade regionally, and how to identify, confiscate and handle illegally traded tigers and prey.	DFRC	PAFO, DOFI, DOF, MAP	Number of staff trained and actively serving on this task	Reports on training and enforcement at border crossings	X	X
Landscape	**Intervention 4.3.** Convene relevant border enforcement agencies to develop strategies for trans-boundary collaboration to control the illegal trade of tigers and prey between Laos and neighboring countries.	DOFI	DOF, Custom, Police, Commerce	Workshops	Published workshop reports and resulting strategies	X	X

	Interventions	Leading agency	Collaborate agency	Indicator	Means of verification	Short-term 2010-2015	Mid-term 2016-2020
	Intervention 4.4. Increase collaboration between national officials responsible for tiger conservation with the ASEAN Wildlife Enforcement Network, TRAFFIC and CITES to strengthen, and monitor change in, the enforcement capacity and effectiveness of customs authorities and other relevant border enforcement agencies to reduce illegal trafficking of tigers and prey.	DOFI	DOF-DFRC, MAO, Custom, Police, Commerce	Workshops, enforcement capacity, wildlife seizures	Reports from enforcement and trade monitoring, media pick up	X	
Objective 5: Increase national cross-sectoral cooperation for the recovery and conservation of wild tigers and their habitats							
Tiger Source Sites	**Intervention 5.1.** Convene regular forums within and between all government sectors at the district and provincial level to raise awareness, compliance with and support for national and PA regulations and zoning to reduce threats to wild tigers, prey and their habitat at source sites.	NPAs	DAFO, PAFO, Military, Police, Custom, Health, Infrastructure, Commerce	Meetings; awareness and compliance with regulations and zoning	Meeting minutes, reports on levels of awareness, compliance and support.	X	X
	Intervention 5.2. Increase coordination between PAs and provincial tourism offices to assure that ecotourism activities at tiger source sites generate financial support for PA management and communities resulting in incentives for the conservation of wild tigers and their habitats.	NPAs	DAFO, PAFO, Provincial/district gov., Tourism	Financial support from tourism for conservation of tigers	Reports on distribution of tourism revenue in PAs	X	X

	Interventions	Leading agency	Collaborate agency	Indicator	Means of verification	Short-term 2010-2015	Mid-term 2016-2020
Landscape	**Intervention 5.3**. Work in partnership with concerned agencies and other development sectors to develop "Village Development Fund" in target villages.	NPAs	DAFO, PAFO, Forest Development Fund, Tourism	# of set-up funds and cash in each village	Participation in conservation, reports, media pick up	X	X
	Intervention 5.4. Assign a multidisciplinary team to systematically assess large-scale land concessions and infrastructure development projects to minimize the impact on wild tigers and their habitats at source sites in the landscape.	PAFO	PAFO,DOF, Provincial/ national LMU/ Planning & Investment	Land use maps and regulations to minimize impact	Published regulations and maps	X	X
Nationa	**Intervention 5.5.** Create and convene a forum for regular dialog within and among all government ministries to integrate awareness and conservation of wild tigers and their habitats into national planning and investment.	DOF- DFRC	MAF, Other sectors	National meetings, national planning and investment plans that consider wild tigers and habitat	Published planss, media pick up	X	X
	Intervention 5.6. Increase national, provincial and district capacity to coordinate crosssectoral management for conservation and recovery of wild tigers and their habitats.	DOF- DFRC	MAP, Other sectors	Workshops. Cross-sectoral management plans	Workshop reports, cross-sectoral plans, media pick up	X	
	Intervention 5.7. Increase government and private sector support in the ecotourism industry for the conservation and recovery of wild tigers and their habitats.	DOF- DFRC	Tourism-government and private sectors, Media agencies	Level of support from tourism for conservation of wild tigers	Reports on tourism support for tiger conservation	X	X

	Interventions	Leading agency	Collaborate agency	Indicator	Means of verification	Short-term 2010-2015	Mid-term 2016-2020
Objective 4: Increase international cooperation to reduce the illegal trade of tiger and prey to neighboring countries.							
Tiger Priority Sites	**Intervention 6.1.** Train and equip all PA field staff to systematically respond to and investigate carnivore-human conflict reports and to maintain a carnivore-human conflict database.	NPAs	DAFO, PAFO	Workshops number of staff trained and actively engaged on this task, database	Report on results of human-carnivore conflict monitoring and response	X	X
	Intervention 6.2. Regulate livestock management in PA controlled use zones to ensure livestock are attended by day and corralled at night.	NPAs	DAFO, PAFO	Livestock raising techniques	Maps of grazing areas	X	X
	Intervention 6.3. Train and support farmers to implement "tiger-friendly" livestock management practices at tiger source sites.	NPAs	DAFO, PAFO	Training workshops; management practices	Reports, manuals	X	X
	Intervention 6.4. Support livelihood alternatives for farmers to reduce hunting pressure on wild ungulates	NPAs	DAFO, PAFO, Forest Deve- lopment Fund, INGOs, Development sectors				
Landscape & national	**Intervention 6.5.** Develop and promote agricultural techniques in tiger conservation landscapes that increase productivity while reducing human-tiger conflict and loss of tiger habitat.	NPAs	DAFO, PAFO	Training workshops; level of conflict and habitat loss	Reports on workshops and results of conflict and habitat monitoring	X	X

	Interventions	Leading agency	Collaborate agency	Indicator	Means of verification	Short-term 2010-2015	Mid-term 2016-2020
Objective 7: Strengthen PA organization, capacity and sustainable financing to effectively implement management activities to reduce threats to tigers and prey at priority source sites in Class 1 and 2 tiger conservation landscapes.							
Tiger Priority sites and Landscapes	**Intervention 7.1.** Strengthen the capacity and organization of provincial PA management units at source sites to i) identify and rank threats to wild tigers and prey, ii) design management activities that will reduce the greatest threats, and iii) implement site-specific plans for conservation of wild tigers and prey.	NPAs	PAFO, DOF	Strategic planning workshops, site-specific plans	Site-specific plans	X	X
	Intervention 7.2. Train provincial PA offices and PA management units at priority sites in: principles of tiger ecology and conservation and of wildlife management, how to integrate wildlife management with rural livelihoods and development, group leadership, communication and coordination skills, conflict resolution for resource disputes and stakeholder disagreements, tools for financial and administrative management of TCLs, budgeting, fundraising, and reporting	NPAs	PAFO, DOF	Staff trained, level of capacity	Published reports on staff trained and capacity	X	X
	Intervention 7.3. Establish PA Management Fund from fines, ecotourism and research fees, and gifts to support site management.	NPAs	DAFO, PAFO, Provincial/dist ricts authori-ties, Energy & Mining, Forest Development fund	PA Management Fund	Published reports on establishment and management of fund	X	X

	Interventions	Leading agency	Collaborate agency	Indicator	Means of verification	Short-term 2010-2015	Mid-term 2016-2020
National	**Intervention 7.4.** Secure financial support for source sites to implement Prime Minister's agreement No. 25/PM, dated 3rd Apr 2007, including recruitment of staff, building of facilities, and equipment procurement for PA management.	MAF	DOF, Forest Development fund	Government funding for PA management	PA annual reports	X	X
	Intervention 7.5. Increase government and private sector support from large-scale infrastructure projects for the conservation and recovery of wild tigers and their habitats at source sites.	DOF	MAF, INGOs, Forest Development Fund	Financial support, development plans	Published reports	X	X
	Intervention 7.6. Investigate the feasibility of long-term support for priority site management from international initiatives such as REDD (Reducing Emissions from Deforestation and Forest Degradation).	DOF	MAP, INGOs,	Research programs to investigate long-term support	Published feasibility studies	X	X

6. IMPLEMENTATION OF THE ACTION PLAN

6.1. Adaptive Management

A successful Tiger Action Plan should broadly speaking apply the following adaptive management steps (Figure 9):

Define the Context: The Plan defines where we want to work and what we want to conserve, also identifying the most important threats and where they occur within the landscape of interest. Developing a conceptual model for the Plan is a useful tool for determining what actions to take to address the threats to reach the goal.

Design Approach and Measures of Success: In the Plan, we strategically identify our interventions so we are confident that they will help abate the most critical threats, while putting in place a process for measuring the effectiveness of our conservation actions by monitoring indicators through various means of verification (Table 6), and using this information to guide our decisions.

Implement Actions and Measure Effectiveness: Following the Plan, we develop and implement interventions taking account the available resources and capacity. We collect and analyze the data to assess how well the interventions are being implemented, to what degree the threats are being successfully mitigated and whether wild tigers, their prey and habitats are doing as well as we hoped.

Review Progress and Revise Approach: Based on the monitoring results, we adapt the interventions and refine the monitoring design to achieve the goal and vision of the Plan.

6.2. Accountability

All participants working to stabilize and recover tiger populations in Lao PDR as described in the goal and objectives of this Plan will be held accountable for their actions by their peers and superiors. Lines of reporting should reflect the existing structure of different teams responsible for implementing interventions. At priority sites, teams of staff working on various activities, ranging from management, enforcement, to outreach and tiger and prey

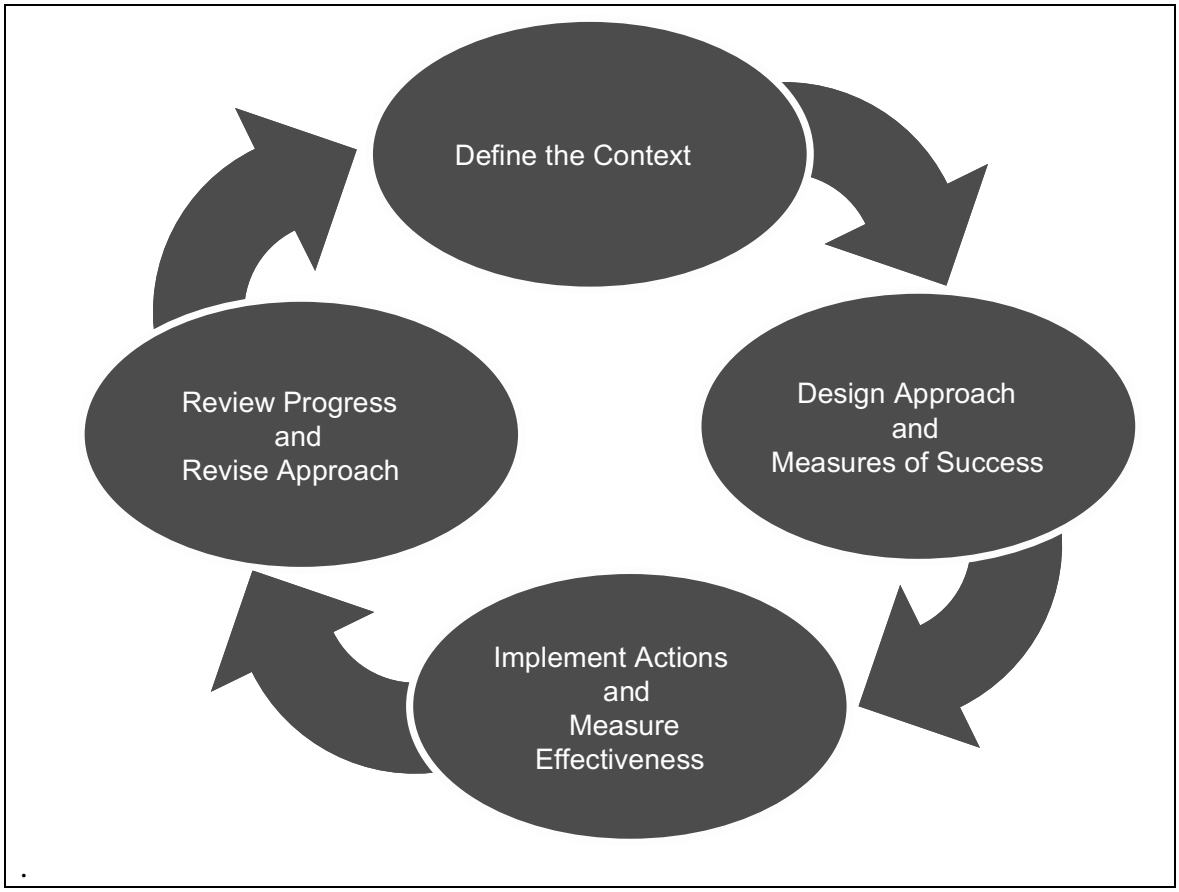

Figure 9: The adaptive management cycle 59

monitoring are needed. Progress reports shared between the entire team is critical. This allows each team leader to report on their progress and difficulties in attaining their objectives to the entire management team. Having team members report to and be accountable in this manner can help create a truly high performance team.

At the landscape level, administrative authorities such as DAFOs, PAFOs and PPMUs are directly responsible for cooperation and coordination with concerned agencies at both central and local levels to implement the activities on the ground. They are accountable to one another by the binding pledge to work together towards the unified vision and goals of this Plan, and monitor movement towards accomplishment of those goals.

At national level, this Plan is developed in parallel to various national policies, which contribute to achieving national development goal and commitment to international community through multilateral environmental agreements. Central government agencies like MAF, DOF, and DFRC are directly responsible for cooperation and coordination with central concerned agencies, and other international bodies. They need to ensure that government funding is appropriately allocated to PA management and work together with implementing agencies to ensure they link their budget, annual performance measures to the goal and objectives of this Plan. For example, this would include linking annual performance measures of progress towards reducing the threat of poaching on wild tigers.

6.3. Monitoring Mechanism

Monitoring will track progress over time towards achieving the goals and objectives laid out in this Plan. Monitoring is a crucial component of good conservation management. It allows us to assess whether or not threats are decreasing, and if tiger and prey populations and their habitat are increasing or remaining stable. Through monitoring we can test our assumptions as to whether our interventions actually lead to what we want to achieve, or are if they wasted effort. Monitoring tracks changes over time and this distinguishes it from a survey, which estimates conditions at a single point in time. Instead, monitoring uses survey results at many instances in time.

Looking at the components of our conceptual model (Figure 5), ideally we should monitor all of the following to get the most information about the effectiveness of our actions: the interventions, the threats and the conservation targets-which are wild tigers, prey and their habitat. We should monitor our interventions to make sure that they are being implemented as we planned. For example, are trained forest guards patrolling in the Totally Protected Zone of the NPA? Since our interventions are chosen to reduce the levels of threats to tigers, prey and their habitat, we should also monitor our success in reducing threats to assess whether or not our interventions were worthwhile. For example, is there a reduction in the number of metal snares in the area being patrolled? Lastly, we look at the status of tigers, prey and their habitat that form our conservation targets to see whether they improve when our interventions are implemented successfully, and threats are reduced. For example, are tiger numbers increasing as a result of the reduction of snares?

The improved state of wild tigers is the ultimate indicator of success of this plan and knowing what that state of tigers is gives us the greatest level of confidence that we might be doing the right thing, yet this is usually the most difficult monitoring to do, costs the most, and may have longer lag-times (see Figure 9). If we monitor the intervention results and threat reductions as proxies for our progress there are definite tradeoffs. The time frame to seeing results and the costs of monitoring decline as we move from directly monitoring changes in tigers, prey and their habitats, to monitoring reduction in threats, to monitoring whether or not our interventions were implemented as planned. However, using these proxies that change within a shorter time frame also lowers our level of confidence in whether the information informs us meaningfully about our actual conservation success to recover and maintain viable tiger populations at our source sites and landscapes.

Monitoring the conservation target: wild tigers and their prey Wild tigers are the primary beneficiary of this plan so the success of any conservation action will be reflected in their population status (e.g. distribution and abundance) and dynamics. The indicator of success is measured in tiger occupancy across landscapes and population sizes or densities in priority areas. At landscape level, the occupancy survey will determine the distribution of and the proportion of existing habitats occupied by not only wild tigers but also all key prey mammals that can be detected by signs. In priority areas, such as NEPL NPA, where tiger presence has been confirmed, absolute population abundance will be determined using intensive-camera trapping surveys. With improved protection of tigers, their prey, and their habitats, in those priority sites, we expect to see increase in tiger abundance in those priority sites and occupancy of the landscape by 2020. A monitoring system in place nationwide, will follow this basic

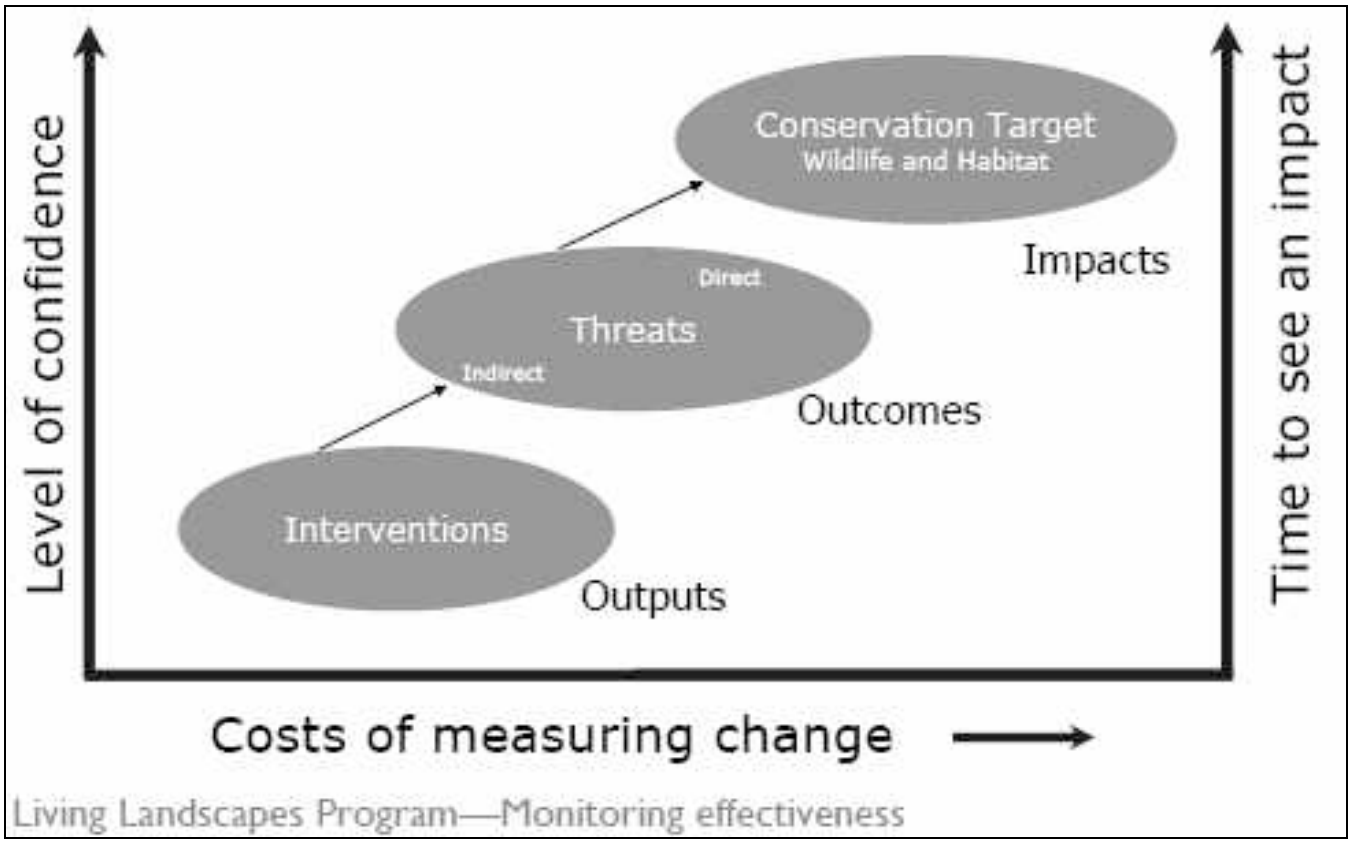

Figure 9: The relationship between confidence, cost and time to results for the different conceptual model components that could be monitored over time. Monitoring interventions, threats or conservation targets is frequently referred to measuring our outputs, outcomes and impacts, respectively. (Source: Wilkie et al., 2006).

sampling framework using standardized internationally accepted scientific methods to measure change in the status of wild tigers and their prey over time.

6.4. Monitoring wild tigers and prey at priority sites

i) Intensive camera trapping survey to obtain a tiger population estimate

The most reliable way of assessing tiger population recovery at a priority site is to directly measure tiger densities (number of tigers/100 km2) in the area of interest. This can be accomplished through capture-recapture analysis using camera trapping or fecal DNA from tiger scats. To do such a survey, it is critical to engage in sound survey designs and analyses by collaborating with experienced scientists who can advise the process to assure that funding is well spent to get the information desired. Some useful guidelines for designing tiger surveys are laid out by Karanth and Nichols (2002, 2010). They emphasize that it is critical that the area surveyed is large enough to capture as many individual tigers as possible and that sufficient effort is employed to increase the probability of detecting tigers if they are present. In Laos, where tiger densities are extremely low, the effort required to detect tigers is considerable (a minimum of 500 camera trap days per 100 square kilometers surveyed) and, ultimately, expensive. Monitoring should be conducted at regular intervals to measure how tiger abundance is changing over time as a result of your interventions.

ii) Occupancy surveys to obtain a prey population estimate Ideally it is desirable to be able to estimate prey densities using line transect distance sampling methods. However, because of the rarity of sightings of animals in the forests of Laos due probably to low number of animals, wariness of human presence, and the rugged mountainous terrain found in many areas the direct count of animals using distance sampling is impractical. This method requires numerous sightings of prey species, which is not yet feasible at most locations in the Laos. Instead a repeated sign-based presence/absence survey that is conceptually similar to a capture-recapture scheme developed by McKenzie (2002) is likely

possible to assess the population dynamics of ungulates. The method is based on a model and likelihood-based approach in estimating rates of sites being occupied by species of interest when detection probabilities are less than one. At the present time, the occupancy survey is the most reliable way to monitor change in large ungulate populations at source sites in Laos based on encounter rates of prey signs (tracks and dung) derived from field surveys conducted in an occupancy modeling and estimation framework64. Given the estimated ratio of tigers to prey (1 tiger for every 500 large ungulates) the abundance of ungulates can also be used to indirectly estimate the potential carrying capacity for tigers of a site65.

Monitoring threats and interventions

In this Plan, Table 6 outlines key objectives and interventions for achieving the goal of recovering wild tigers, their prey and habitats in Laos. For each intervention, indicators and a means of verification are suggested for determining if your intervention was successfully completed to achieve the objective. Depending on the threats and interventions present at each site, this Plan identifies appropriate monitoring activities to assist managers to evaluate if the interventions being implemented are effective at reducing key threats to tigers, prey and their habitat at the site.

In addition to the indicators shown in Table 6, this Plan also recommends that law enforcement monitoring be conducted at priority sites to provide regular information about the status of threats to tigers, prey and their habitat at sites (e.g., hunting, logging, shifting cultivation, wildlife trade) and the capacity of management to effectively respond to these threats In Laos, MIST (Management Information System) is an information management tool that is designed for ranger-based law enforcement monitoring, which is being used successfully at several NPAs including Nam Et-Phou Louey, Nam Kading and Nakai-Nam Theun. For example, changes in illegal activity are reflected in shifts in the spatial distribution of encounters with poachers and illegal camps, snaring or trapping incidents, illegal logging or forest clearance. Accurate and timely reporting via MIST helps to inform and alert PA managers of these changes, allowing them to alter their enforcement strategy through changes in the allocation of resources to the new hotspots. Walston et al. (2010) provide further detailed guidelines on establishing a law enforcement monitoring system for tiger source sites.

Stakeholder Engagement

A National Tiger Action Plan committee will be established to secure sustainable funding, oversee the implementation of interventions, and monitor progress towards achieving goals in priority source sites and Tiger Conservation Landscapes. The committee will work to ensure the continued involvement of all stakeholders at the site, landscape and national level in the recovery program for tigers.

At priority sites: Here the National Protected Area management units (NPAMU) will take a lead in cooperation and coordination with other local government agencies, e.g. police, customs, military, DAFO, tourism, and international conservation agencies and donors to implement management interventions on the ground. Alongside these management activities, the NPAMU is responsible for measuring the progress of project activities using internationally accepted scientific methods.

At landscape level: DAFO, PAFO, and the Provincial Protected Area management units (PPMU) are responsible for cooperation and coordination between government agencies at provincial and central levels, providing supervision to NPAMU on technical perspective to ensure the on-ground interventions are on the right track, and work together with other agencies to suppress illegal trade of tigers and their prey, and to ensure connectivity within/between landscapes.

At national level: MAF, DOF, and DFRC are directly responsible for cooperation and coordination with central government agencies and other international organizations to ensure that the Plan is;

i) integrated into national development plan and investment,
ii) is in compliance with other international agreements,
iii) is supported by donors, and
iv) taken into the on-the-ground implementation.

Public Reporting

In order to gain support for the recovery of wild tigers, their prey and habitats in Lao PDR, The NTAP committee will regularly update stakeholders and the general public of the results and outcomes of interventions made under the NTAP, via radio announcements, newsletters and newspapers. An NTAP website will be designed, maintained, and regularly updated to facilitate dissemination of information about the implementation of the Plan

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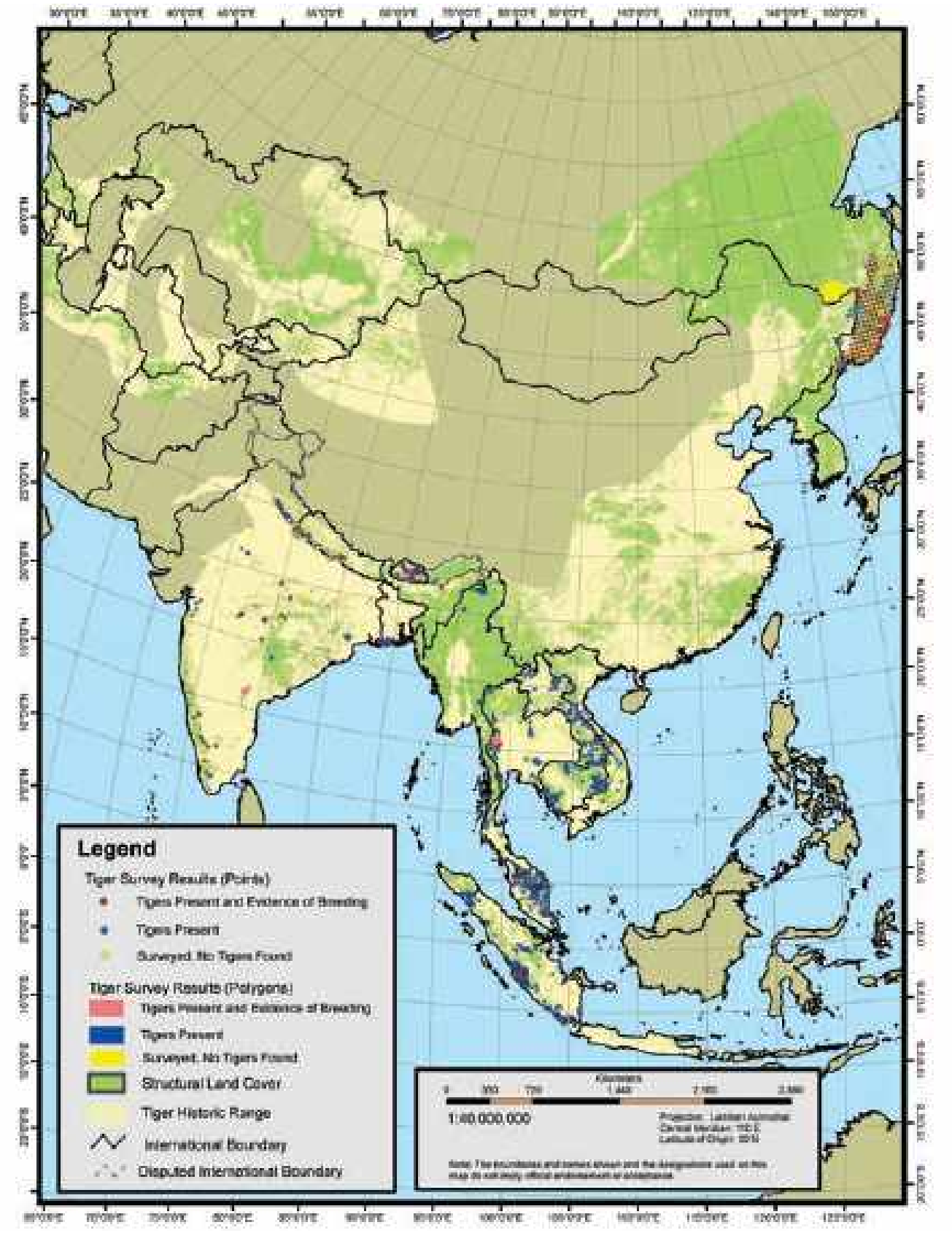
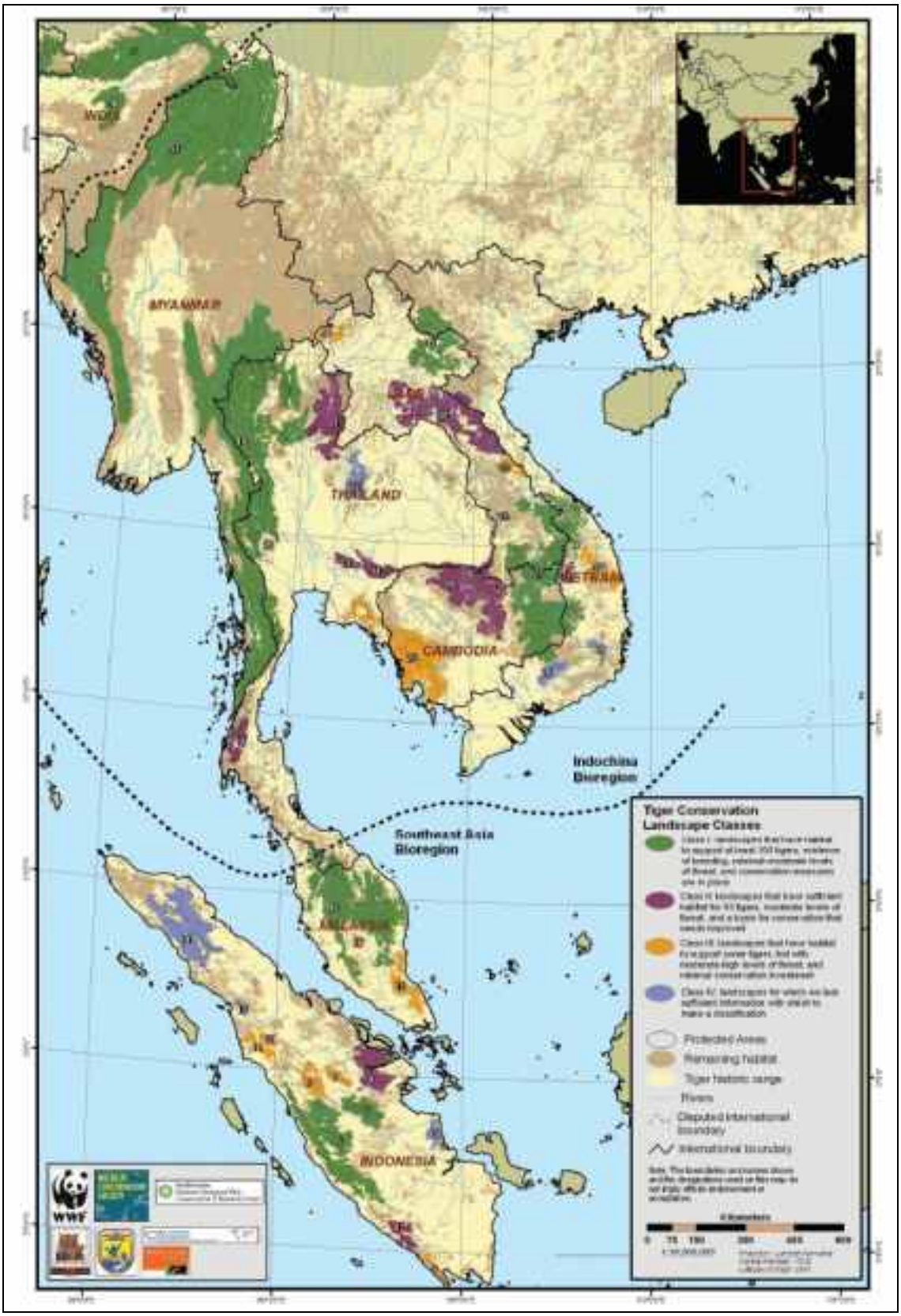
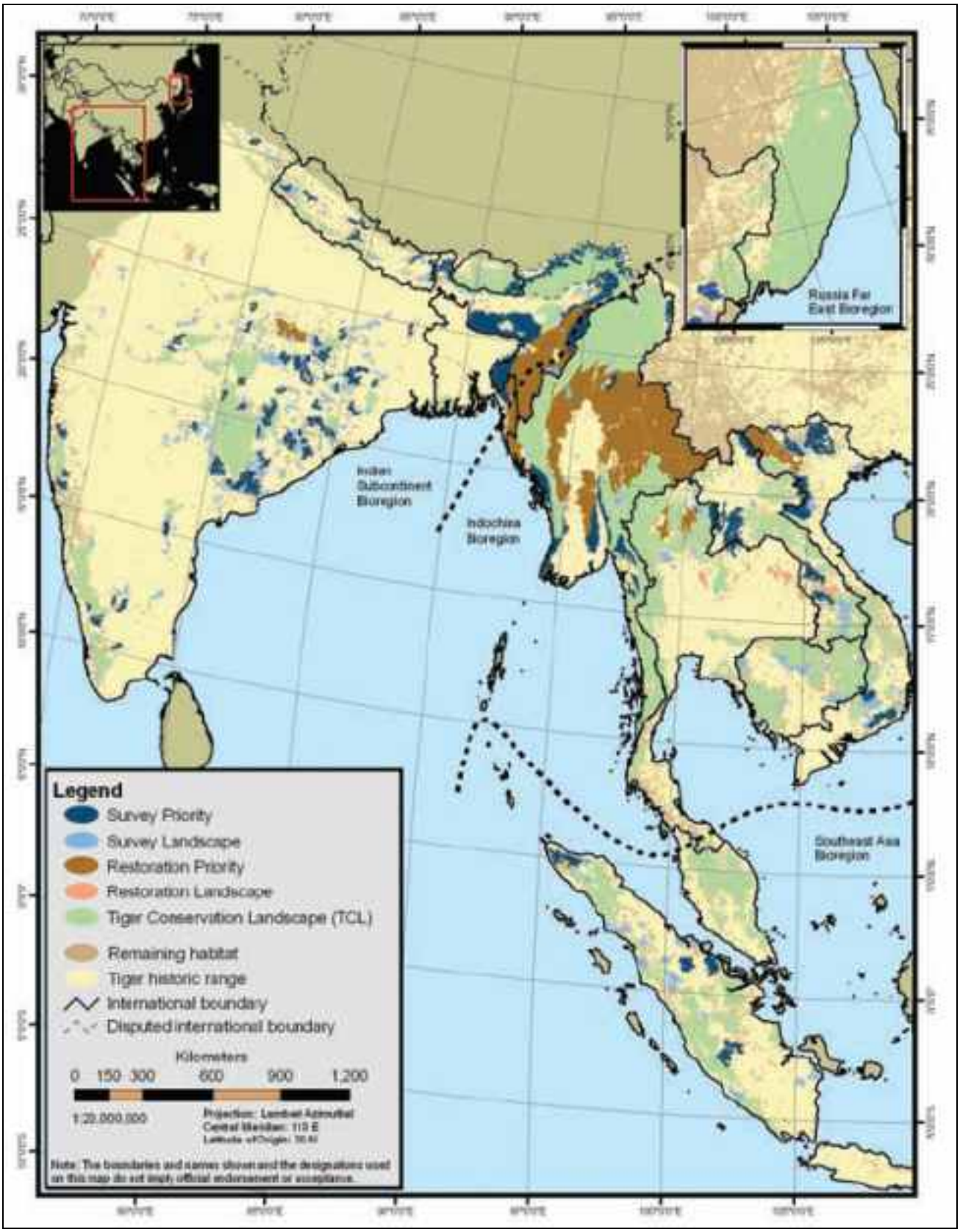


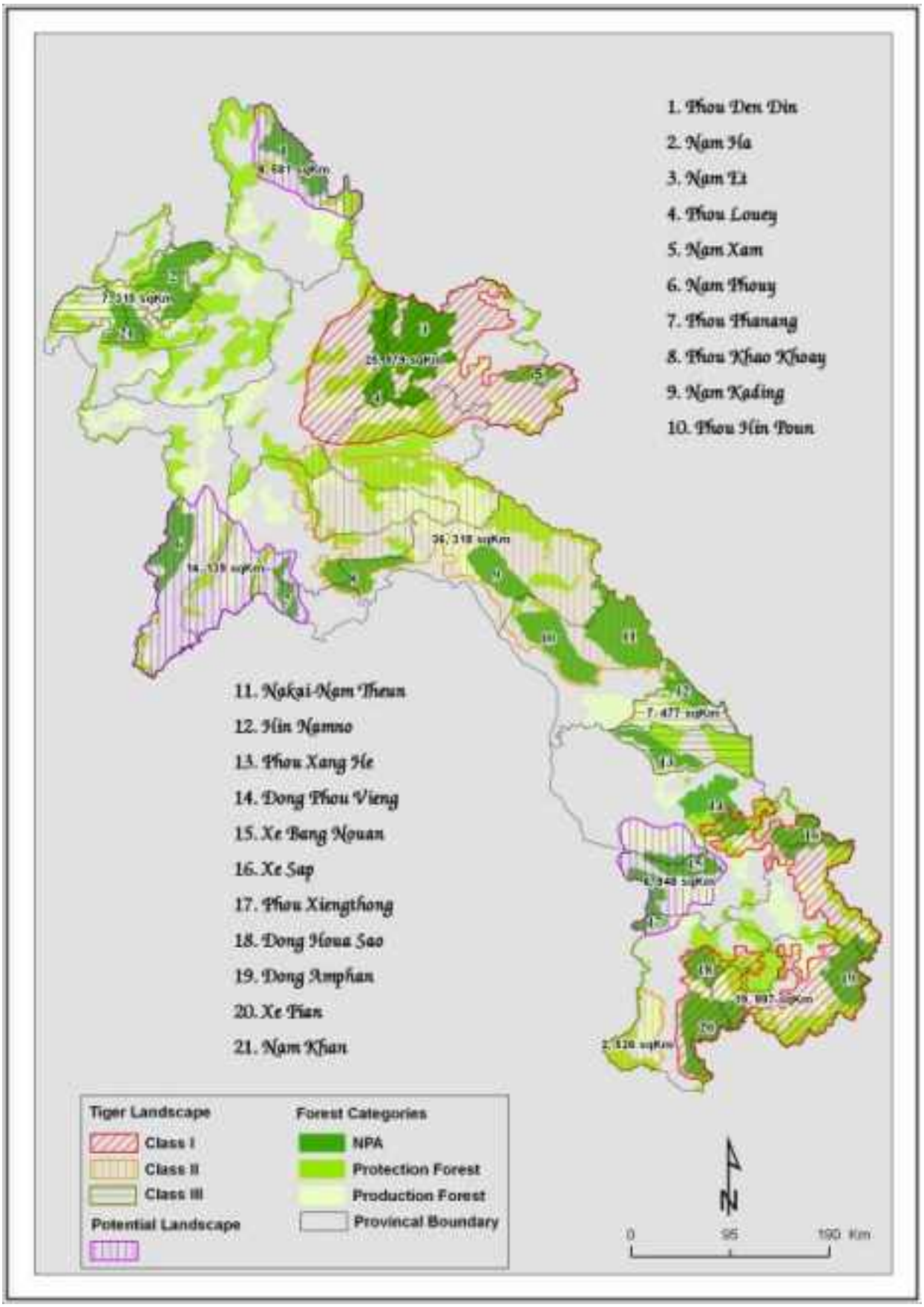
Appendix 1. Tiger survey reports (1995-2005)
(Source: Sanderson *et al.* 2006)



Appendix 2. Tiger Conservation Landscape Prioritization based on tiger records from 1995-2005.
(Source: Sanderson *et al.* 2006).



Appendix 3. Survey and restoration priorities based on tiger records from 1995-2005. (Source: Sanderson et al. 2006)



Appendix 4. National protected areas and tiger conservation landscapes in Lao PDR.

Appendix 5. Lao PDR Tiger Conservation Workshop 2009 Participants

Appendix 6. Agenda of Tiger Conservation Workshop 2009

Time		Items	Responsible agency
8:00-8:30	30	Registration	DFRC
Day 1			
8:30-8:45	15	Opening Speech	DFRC (Khamphan)
8:45-9:00	15	Introduce participants	DFRC (Bouaphan)
9:00-9:30	30	Introduce steps in preparing Tiger National Action Plan; workshop objectives	DFRC (Bouphanh)
9:30-10:15	45	Status of tigers in Lao PDR (Background Notes sections 1-3)	WCS (Chanthavy)
10:15-10:30	15	Break	
10:30-11:15	45	Status of tiger conservation in Lao PDR (Background Notes sections 4-7)	WCS (Chanthavy)
11:15-11:35	20	Tiger Action Plan: Nam Et-Phou Louey National Protected Area	WCS (Venevongphet)
11:35-12:00	25	Smart Infrastructure	World Bank(Sombat)
12:00-13:00	60	Lunch break	
13:00-13:30	30	National Tiger Action Plan: Methods and Terms	WCS
13:30-14:15	45	Vision and goal for tigers in Lao PDR	WCS; participants
14:15-14:30	15	Direct threats	WCS; participants
14:30-14:45	15	Break	
14:45-16:15	90	Indirect threats (landscape working groups)	WCS; 8 working groups
16:15-16:30	15	Closing afternoon session	DFRC (Bouaphanh)
18:00		Reception & Dinner	All participants
Day 2			
8:00-8:30	30	Registration	DFRC
8:30-8:45	15	Review of Day 1	DFRC (Bouphanh)
8:45-10:00	75	Interventions-select actions to reduce threats	WCS; 8 working groups
10:00-10:15	15	Break	
10:15-12:00	45	Interventions-select actions to reduce threats	WCS; 8 working groups
12:00-13:00	60	Lunch break	
13:00-14:00	60	Interventions-select actions to reduce threats	WCS; 8 working groups
14:00-14:30	30	Groups report results (10 minutes each)	3 working groups
14:30-14:45	15	Break	
14:45-15:35	50	Groups report results(10 minutes each)	5 working groups
15:35-16:15	30	Review of Day 2 and next steps	
16:15-16:30	15	Workshop closing	DOF (Khamphanh)

Appendix 7. Lao PDR Tiger Conservation Workshop 2009 Participants

No	Name and surname	Organization Agency	Telephone
1	Mr Subanh	Phoukhaokouay NPA – army	3320065
2	Mr Sut Thiphong Vongsaiya	Scientific Authority (CITES), Science and Technology Agency, Prime Minister' Office	9895550
3	Mr Bounthan Pilachan	Division of Forest Resources Conservation (DFRC), Department of Forestry (DOF)	2401099
4	Mr. Olavanh Dengdaravong	DFRC, DOF	6229784
5	Mr Sivone Sonemany	Viengkham DAFO, Luangprabang Province	5296461
6	Mr Somephan Thumavong	Forest Inventory, DOF, Ministry of Agriculture and Forestry (MAF)	9802802
7	Mr Boubpha Vongkhamchan	DOF, MAF- Administration	5612824
8	Mr Viengsavanh Phomasane	Khammuan Limestone National Protected Area	5850441
9	Mr Homkham Xaykosinphinit	Hin Nam Nor National Protected Area	5815387
10	Mr Thongpat Ladsavong	Department of Customs, Ministry of Finance	5517062
11	Mr Khamtan Amkhavong	Dong Houa Sao National Protected Area	2207162
12	Mr Savai Sithinalongsy	Phou Xang He National Protected Area	5743801
13	Mr Sitha Phongsuphane	DFRC, DOF	
14	Mr Chandy Chanthavong	Nam Poui National Protected Area	2988678
15	Mr Sang Somethina	Nam Xam National Protected Area	5093190
16	Mr Bounsou Sophavanh	DFRC, DOF	5494255
17	Mr Bounlup Sidavong	Dong Ampham National Protected Area	6573000
18	Mr Khanthalay	Xe Sup National Protected Area	5448413
19	Mr Souliya Sengdala	Phou Dendine National Protected Area	5932185
20	Mr Hongthong Ampaichit	Protection Forest Division, DOF, MAF	2444825
21	Mr Thong Et Phaivan	Nakai Nam Theun National Protected Area	2324419
22	Ms Somesanouk Akhavong	Faculty of Forestry, National University	2245039
23	Mr Somsanith Chanthanasin	Department of Livestock and Fisheries, Ministry of Agriculture and Forestry	5687438
24	Mr Lummone	Xa Bang Nuan National Protected Area	5044200
25	Mr Sakhone	Tiger Farm representative	2330216
26	Mr Bounpone Phoudthavong	Ministry of Agriculture and Forestry - Chair	021216921
27	Mr Bounpheng Phengchanh	Luang Prabang PAFO	5770175
28	Mr Dalin Xaysaksi	Production Forest Division, DOF, MAF	5444983
29	Mr Souksan Phonpadith	Nam Ha National Protected Area	2390210
30	Mr Onta Bouaviset	Xepian National Protected Area	5439908
31	Mr Bounthop Praxaysombath	Faculty of Science, National University	2212699
32	Mr Bounsuan Phonphichit	Planning & Investment, DOF, MAF	229790
33	Mr Khamkhoun Khounbolin	WWF representative	4388239
34	Mr Ounkeo	Dong Phou Vieng National Protected Area	2325506

35	Mr Xaysongkham Sukhathammavong	Department of Planning and Investment. Ministry of Planning and Investment	7722239
36	Mr Vasanoon	Houaphan PAFO	5664710
37	Mr Xaiyasin Xongyongya	Nam Et - Phou Louey National Protected Area	4482345
38	Mr Dakhom Vilayvanh	Nam Khan National Protected Area	5884458
39	Mr Pimphet Dakham	Viengthong (Houaphan Prov) Department of Agriculture and Forestry	5748023
40	Ms Chanmaly	Phou Bia Minning	2497030
41	Mr Amone	Phou Bia Minning	2213829
42	Mr Somephong	Department of Planning, Ministry of Agriculture and Forestry	5562299
43	Mr Phaivanh Phiapalath	IUCN representative	
44	Mr keovongdeun Phanthanousy	Nam Kading National Protected Area	2337548
45	Mr Somesanouk	Department of Forestry, Ministry of Agriculture and Forestry - Forest Development Fund	5444499
46	Mr Sangvan Buavong	DFRC, DOF, MAF	5478797
47	Mr Renea Stenhouse	World Bank Representative	2221351
48	Mr Phaiveng Vongkhamheng	WWF representative	6588428
49	Mr Thavisouk Saithongdam	WWF representative	5017735
50	Mr Houmphan Rattanavong	Lao Biodiversity Association	5537187
51	Mr. Troy Hansel	WCS-Lao PDR	21-215400
52	Mr. Chanthavy Vongkhamheng	WCS-Lao PDR	21-215400
53	Mr. Vene Vongphet	WCS-Lao PDR	21-215400
54	Dr. Arlyne Johnson	WCS-Lao PDR	21-215400