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USING SYSTEMATIC MONITORING TO EVALUATE AND ADAPT MANAGEMENT OF A TIGER RESERVE IN NORTHERN LAO PDR

Arlyne Johnson, Chanthavy Vongkhamheng, Santi Saypanya,
Troy Hansel & Samantha Strindberg



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USING SYSTEMATIC MONITORING TO EVALUATE AND ADAPT MANAGEMENT OF A TIGER RESERVE IN NORTHERN LAO PDR

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Abstract

Although considerable effort and resources have been dedicated to biodiversity conservation over the last three decades, the effectiveness of these conservation actions is still frequently unclear. Thus, practitioners are being called on to be ever more strategic in their use of often limited resources available for the scale of the work required. To address this problem, several frameworks have been developed to guide the practice of conservation and facilitate adaptive management. Although these frameworks now exist and monitoring is key to adaptive management, there are still relatively few detailed examples of projects that have successfully implemented monitoring plans and then analyzed the data to generate results that were in turn used to adapt management. Reasons cited for this include insufficient funding for monitoring and evaluation, inappropriate monitoring designs that are unable to generate results to answer management questions, ineffectively managed monitoring information, and institutional arrangements that do not facilitate the feedback of monitoring results (should they exist) to management. Given these challenges, there is a need for case studies that illustrate how monitoring and evaluation can be done in the context of the *Open Standards for the Practice of Conservation* to support learning and provide evidence for the effectiveness of a conservation action. This paper provides a detailed case study of adaptive management in practice. In this case the Wildlife Conservation Society's Landscape Species Approach was used over a seven-year period to plan, execute, evaluate and adapt a project to recover wild tigers *Panthera tigris* and their ungulate prey (Gaur *Bos gaurus*, Southwest China serow *Capricornis milneedwardsii*, Sambar deer *Cervus unicolor*, wild pig *Sus spp.*, and muntjacs *Muntiacus spp.*) in Lao PDR. After several iterations of the project management cycle, we assess to what degree the framework supported rigorous monitoring and evaluation that was used to inform and adapt management and what conditions were present and/or needed to overcome the constraints that commonly impede the practice of adaptive management in conservation.



As part of the Law Enforcement strategy, foot patrol teams guard inside the NPA Totally Protected Zone to stop illegal hunting.
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USING SYSTEMATIC MONITORING TO EVALUATE AND ADAPT MANAGEMENT OF A TIGER RESERVE IN NORTHERN LAO PDR

Executive Summary

Although considerable effort and resources have been dedicated to biodiversity conservation over the last three decades, the effectiveness of the various conservation actions is still frequently unclear. Thus, practitioners are being called on to be ever more strategic in their use of often limited resources available for the scale of the work required. Tigers, on the verge of extinction, are one example of this challenge and part of the debate about how best to deploy limited resources to address an urgent conservation problem. To address the need for strategic planning, several frameworks including the *Open Standards for the Practice of Conservation* have been developed to guide the practice of conservation and facilitate adaptive management. Although these frameworks now exist, there are still relatively few examples of projects that have successfully implemented monitoring plans and iteratively used results to adapt management. Reasons cited for this include insufficient funding for monitoring and evaluation, inappropriate monitoring designs that are unable to generate results to answer management questions, ineffectively managed monitoring information, and institutional arrangements that do not facilitate the feedback of monitoring results to management. Given these constraints, this paper provides a case study of adaptive management in practice over a seven-year period to plan, execute, evaluate and adapt a project to recover the last known breeding population of wild tigers and their prey in the Nam Et-Phou Louey National Protected Area (NEPL NPA) in Lao PDR.

The 6,000 km² NEPL NPA is known to harbor one of the last tiger populations remaining in Indochina and is identified as one of 42 most important source sites for tiger conservation in Asia. The major threats to tigers in NEPL are illegal and unsustainable hunting of tigers and their large ungulate prey. The factors contributing to these threats are the international demand for tiger bone and the demand from urban domestic markets for ungulate meat. In response to this demand, village hunters use illegal weapons to kill tigers and their prey, which in some cases is precipitated by tiger depredation of farmers' livestock. Although national regulations exist to protect tigers and their prey, government capacity and funding to enforce the laws are lacking. Likewise, protected areas and hunting regulations are a relatively recent concept in Lao PDR and few people, including government officials, are entirely aware of or understand the importance of the regulations.

Given this situation, two major strategies - law enforcement and conservation outreach- were selected to reduce these threats to tigers and their prey in NEPL. Law enforcement includes working with communities, local governments and the military to establish and enforce NPA zoning regulations, including a Totally Protected Zone (TPZ), where access and hunting is not permitted, and a Controlled Use Zone (CUZ), where hunting for household consumption is allowed following guidelines on species, quotas, gear and seasons. Conservation outreach involves increasing knowledge and changing the attitudes and behavior of villagers, hunters and government officials to reduce illegal and unsustainable hunting of tigers and their prey.

Monitoring actions were implemented at four different spatial scales to evaluate the effectiveness of the law enforcement and outreach strategies and to assess the status of tigers and their ungulate prey. The four spatial scales included the larger landscape in which the protected area is embedded, across the NEPL-NPA, inside the TPZ, and in the human communities surrounding the TPZ.

At the landscape scale including two National Protected Areas, an occupancy-based survey for tigers and ungulate prey was used to assess a 24,300 km² area around NEPL NPA to determine if the TPZ was located in the most optimal site for conserving tigers and prey. The questionnaire survey also examined what major factors were influencing the landscape occurrence and distribution of tigers and prey that may in turn impact their long-term recovery in the NEPL NPA such as connectivity to suitable habitat occupied by other populations of tigers and large ungulates. The results showed that tigers occurred in more than 70% of the landscape area where human population and hunting pressure on prey was lower and in areas within or nearby an NPA. The results supported continuing to focus law enforcement and outreach actions inside and nearby the NEPL NPA to protect tigers and large ungulates from poaching and to maintain habitat connectivity between NPAs to secure their long-term survival.

At the scale of the 6,000 km² NEPL-NPA and proposed extensions, various monitoring designs were used to assess the abundance and distribution of tigers and their prey. Initially we did intensive camera-trap sampling in five-100 km² blocks at varying levels of human population density. The baseline results indicated that a minimum of seven and possibly as many as 23 tigers were centered in two large core areas covering 1,616 km² of the NPA. The relative abundance of large ungulate prey was low throughout area, while relative abundance of small ungulate prey was significantly higher where human density was lower. These results were used to identify the first boundaries of the TPZ in the NPA where access and hunting were prohibited.

In subsequent years, intensive camera-trap sampling was implemented to confirm the continued presence of tigers in the blocks where tigers were initially detected in Year 1. In Year 4, camera-trap sampling was expanded to cover 800 km² to detect more tiger individuals. The latter survey was unsuccessful due to low sampling effort and equipment failures, which resulted in the adaptation of the tiger monitoring approach to opportunistic scat collection for fecal DNA analysisxxxxxx. This approach was much less costly than camera trapping, but was designed to allow the project to track and estimate the minimum number of tigers present in the landscape, whether breeding was occurring and relatedness of individual tigers. The financial savings were used to expand the law enforcement

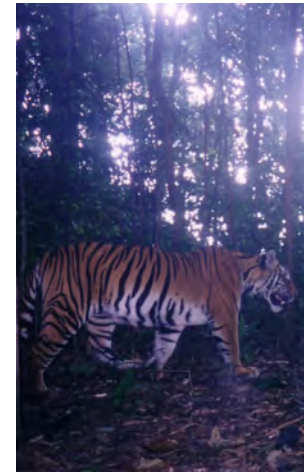
actions in the TPZ.

In Year 5, a sign-based occupancy survey was done across a 2,600 km² area inside the NPA to assess the abundance and distribution of ungulate prey and opportunistically collect large carnivore scat. The results showed that pockets of large ungulates associated with locations of breeding tigers still persisted in remote parts of the NPA with the potential to repopulate the larger area. The results were used to inform the expansion of the TPZ to 3,000 km² and the spatial coverage of law enforcement activities in the TPZ to protect the remaining areas with large ungulates and tigers.



At the scale of the TPZ inside the NPA, monitoring was conducted in each law enforcement sector. From Years 3 to 7, foot patrol teams monitored spatial patrol coverage and distance effort, hunting threats and tiger sign. This information was compiled monthly and presented to assess spatial distribution of hunting sign and determine spatial deployment of law enforcement and conservation outreach effort. Overall the results showed that collective spatial patrol coverage increased from 669 km² per annum by two part-time foot patrols in Year 3 to 3,244 km² per annum by eight full time patrol units in Year 7. With the expanded coverage, detection of illegal hunting in the TPZ increased with the majority of cases (77%, n=63) resulting in fines and some in arrests. Over time the catch per unit effort index of hunting in the TPZ declined from one hunting sign per 1.4 kilometers patrolled in Year 3 to only one hunting sign per 5 kilometers patrolled in Year 7.

Outside the TPZ mobile enforcement teams patrolled at a fixed points along a road, which could be permanent or temporary, or periodically in restaurants or markets to detect illegal trade of wildlife. Mobile teams monitored temporal patrol effort, informant reports, illegal trade and hunting. Monitoring results indicated that mobile teams were largely effective in apprehending illegal trade of small high value wildlife such as porcupines, turtles and pangolins but less effective at apprehending illegal trade of ungulates. Overall the monitoring demonstrated that less mobile patrol effort could be applied more effectively by responding to informant



Above: A tiger (*Panthera tigris*) in the morning mist of the NEPL Totally Protected Zone (2004).
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Left: The wildlife monitoring team sets a camera trap to assess tiger abundance and distribution in the NPA Totally Protected Zone.
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reports rather than conducting routine roadblocks and market checks that were generally not well-informed or productive.

In human communities bordering the TPZ, the spatial deployment of conservation outreach actions in villages and local government officers accompanied law enforcement effort and was in response to signs of illegal hunting and trade. Monitoring was conducted by outreach teams to assess change in knowledge and behavior of villagers, hunters, and government officials as a result of trainings on wildlife management and hunting regulations. Outreach monitoring designs evolved from only ex-poste surveys, to pre and post surveys to a quasi-experimental design that included a control and test site and a priori hypotheses. Overall the survey results indicated that change in knowledge, attitudes and behavior was best achieved by using an intensive social marketing approach to outreach. The greatest changes were observed with villagers, to some degree with the village hunters and to a lesser degree with government officials.

At the end of the seven-year period considered in this paper, we found that monitoring results were vital for adapting the enforcement strategy and that enforcement actions had become more effective in reducing, although not yet eliminating, illegal hunting and trade. Likewise monitoring results were needed for informing adaptation of the outreach strategy and demonstrating varying levels of success with different target audiences. As far as goals, monitoring indicates that tigers and large ungulates continue to persist at the site, and surveys are underway or being planned to assess progress towards the overall goals. Monitoring of tigers and prey was used to inform protected area zoning and spatial deployment of law enforcement and conservation outreach strategies in those zones.

When using monitoring results for adaptive management we found that the type of data and results that were important for ongoing adaptive management at the project site were quite different than those that were important to donors, upper level project management and the larger conservation community. For the latter, our estimates of tiger abundance and annual indices of hunting sign per unit effort were needed to inform priority setting, annual allocation of resources across project sites in the region and to gain political support on a broader scale. At the project site, where shorter iterations of adaptive management were occurring (e.g., decisions about where enforcement patrols were deployed each month or village trainings by the outreach teams) actions were largely informed by where relative amounts of tiger and prey sign were found and not the actual number of tigers, and also by where and what hunting or illegal trade was observed and not the index of hunting sign per unit effort. This was also true for adaptive management at the project site on an annual basis such as priorities for placement of ranger stations and patrol sectors, and the public outreach and conservation messaging that went along with that, which was informed by tiger sign (tracks, photos, and scat) and then further corroborated by ungulate sign survey results.

This project started only ten years after the country's protected area system had been declared and no formal training program for protected area management or monitoring existed at tertiary institutions. This meant that very few of the staff had experience and training in the protected area management or the technical tasks they were assigned. All training for implementation and monitoring was done on the job and continued as activities and systems evolved over the seven-year period, which likely is not atypical for projects in countries where natural resource

governance and training systems are new or lacking. We argue that most projects, including ours, underestimate how much time is needed for training to be able to turn adaptive management theory into practice in situations where capacity and experience is low. To overcome this barrier to adaptive management, practitioners and their organizations working under these conditions need to be more realistic in adequately preparing for what will very likely be a long-term and ongoing investment in training and capacity-building.

To try to overcome the usual barriers to monitoring, we relied on an assemblage of technical support, project-based mentors, and national project staff. This approach is a hybrid of the two other possible approaches where traditional academics are engaged to gather monitoring information and generate results or where the practitioners alone make these assessments. Where this hybrid approach was absent in our monitoring plan, it was more difficult to overcome the usual barriers of delivering useful and timely results to guide management.

In conclusion, we were able to identify ways to overcome many of the constraints that commonly impede adaptive management at conservation sites in countries where conservation capacity and natural resource governance is at an early stage of development. Monitoring and evaluation in the context of a framework such as the *Open Standards* did help us assess the effectiveness of our strategies and was used to adapt our conservation actions. The original conceptual model for the project included strategies that were not implemented due to technical and financial constraints. Thus we prioritized our actions to implement largely two strategies over the seven-year period. Although our monitoring indicates that we have increased the effectiveness of these two main strategies, it is still not certain if these actions will be sufficient to achieve our threat reduction objectives or the goals for our targets. Beyond our project site, our learning has contributed to larger systematic reviews of similar conservation problems and approaches with our evaluation results informing plans for tiger conservation across Laos and elsewhere in Asia.

Introduction

Although considerable time and effort have been dedicated to biodiversity conservation over the last three decades, indications are that these resources are insufficient to stem the decline in biodiversity given the scale of the problem. Moreover, it continues to be unclear which conservation activities are the most effective, which is critical given the limited resources available for conservation work. Thus, practitioners are being called on to be ever more strategic in their use of resources (Salafsky et al. 2002b, Kapos et al. 2008). Tigers, on the verge of extinction, are one example of this challenge and the ensuing debate about how best to deploy limited resources to address an urgent conservation problem (Walston et al. 2010, Wikramanayake et al. 2011). It is argued that for conservation practice to be more effective decision makers must be provided with more information on what actions do and do not work, or how effective a given action has been in achieving objectives and under what conditions (Redford & Taber 2000, Pullin & Knight 2001, Bottrill et al. 2011). In most cases, it has been difficult for conservationists to respond to this challenge as monitoring and evaluation of effectiveness is generally lacking for most conservation actions (Pullin et al. 2004, Sutherland et al. 2004, Brooks et al. 2006), which continue to be largely “experience-based rather than evidence-based” (Pullin & Knight 2001).

To address this problem, within the last decade, several frameworks have been developed to guide the practice of conservation. Some of these frameworks include:

- the *Open Standards for the Practice of Conservation* (CMP 2004, 2007) developed by the Conservation Measures Partnership to help practitioners determine if they are having an impact (status), are doing the right thing and doing it well (effectiveness);
- the Landscapes Species Approach (Sanderson et al. 2002, Didier et al. 2009) developed by the Wildlife Conservation Society (WCS) for planning landscape-scale conservation based on a set of carefully selected focal species (Coppolillo et al. 2004);
- the Cambridge Conservation Forum framework and evaluation tool that draws on the experience of past and ongoing conservation projects to systematically identify and evaluate factors that contribute to conservation success (Kapos et al. 2008);
- The Nature Conservancy’s (TNC) Conservation Action Planning (CAP) Basic Practices to identify and implement strategies, and then measure success to adapt and learn over time (TNC 2007)
- the WWF Network’s Standards of Conservation Project and Programme Management for practicing adaptive management to make projects more effective and efficient (WWF 2007)

Although these frameworks exist, there are still relatively few working examples of projects that have successfully implemented monitoring plans and then analyzed the data to generate results that were in turn used to evaluate effectiveness of conservation strategies and adapt management accordingly. Some of the com-

mon reasons cited for this are that, i) funding is insufficient to do monitoring and evaluation (Kapos et al. 2008), ii) monitoring designs are inappropriate and unable to generate results to answer management questions (Ferraro & Pattanayak 2006, Margoluis et al. 2009a) or are too ambitious to be feasibly implemented in the long-term (Salzer & Salafsky 2006, Salafsky 2012), iii) capacity and time are insufficient to effectively manage monitoring information or to complete data analysis and write up of results (Pullin et al. 2004, Kapos et al. 2008), iv) institutional arrangements do not facilitate the feedback of monitoring results to management or, v) managers are too busy to be able to digest monitoring results and apply them (Pullin et al. 2004).

Given these challenges there is a need for case studies, even if these do not constitute high quality controlled experiments, that illustrate if and how monitoring and evaluation can be done in the context of a framework such as the *Open Standards* to assess the effectiveness of a conservation action. To address this need, this paper provides a case study of adaptive management in practice using the WCS Landscape Species Approach over a seven-year period to plan, execute, evaluate and adapt a project to recover the last known breeding population of wild tigers and their prey in the Nam Et-Phou Louey National Protected Area (NEPL NPA) in Lao PDR. With less than 3,500 tigers remaining in the wild across Asia due to poaching, prey depletion and habitat loss, the tiger crisis is representative of the greater Asian biodiversity crisis (GTI 2010). The National Tiger Action Plan for Lao PDR mandates an adaptive management approach to assess the impact of various conservation actions on reducing these threats to tigers and their prey (GoL 2010). After several iterations of the project management cycle, we assess to what degree and under what conditions the framework applied to the NEPL tiger project supported monitoring and evaluation that contributed to more effective and informed management.

The framework for adaptive management in the NEPL NPA

Project area

The project is centered in the Nam Et-Phou Louey (NEPL) National Protected Area (NPA) and proposed extensions that cover 5,950 km² of mountainous terrain in northern Laos, which border Vietnam and span three provinces and seven districts (Figure 1). Unique to South-east Asia, Laos still harbors extensive natural landscapes, with a multiple-use protected area system covering 13% of the country and a human population density that is the lowest in the region, making it a potential land of opportunity for regional biodiversity conservation. Although the nation still harbors a rich fauna with numerous species of global conservation importance, many of these populations are at alarmingly low levels (Duckworth et al. 2012). The underlying causes of the decline are unregulated hunting and illegal trade (Nooren and Claridge 2001, WorldBank 2005) as well as deforestation, driven by shifting cultivation, logging for timber, and conversion of natural forests to cash crops and plantations, which is proceeding at an unprecedented rate (GoLPDR 2005).

The rugged landscape of northern Laos forms the Northern Highlands region of the country (Duckworth et al. 1999). The NEPL NPA ranks high in the national

protected area system for contributing the highest biological diversity of any protected area in this region (Davidson 1998, Ling 1999). Much of the wildlife of the Northern Highlands is akin to that of the Himalayan Palearctic region (MacKinnon and MacKinnon 1986 in Duckworth et al. 1999). NEPL is probably best known for its mammals and notably for harboring one of the most important tiger populations remaining in Indochina (Johnson et al. 2006, Walston et al. 2010). The 30,000 km² landscape surrounding the NPA, called "Tiger Conservation Landscape #35," is identified as one of 76 global priority areas for tiger conservation in Asia (Sanderson et al. 2006).



A male tiger (*Panthera tigris*) grows as a camera trap captures its photo (2005).
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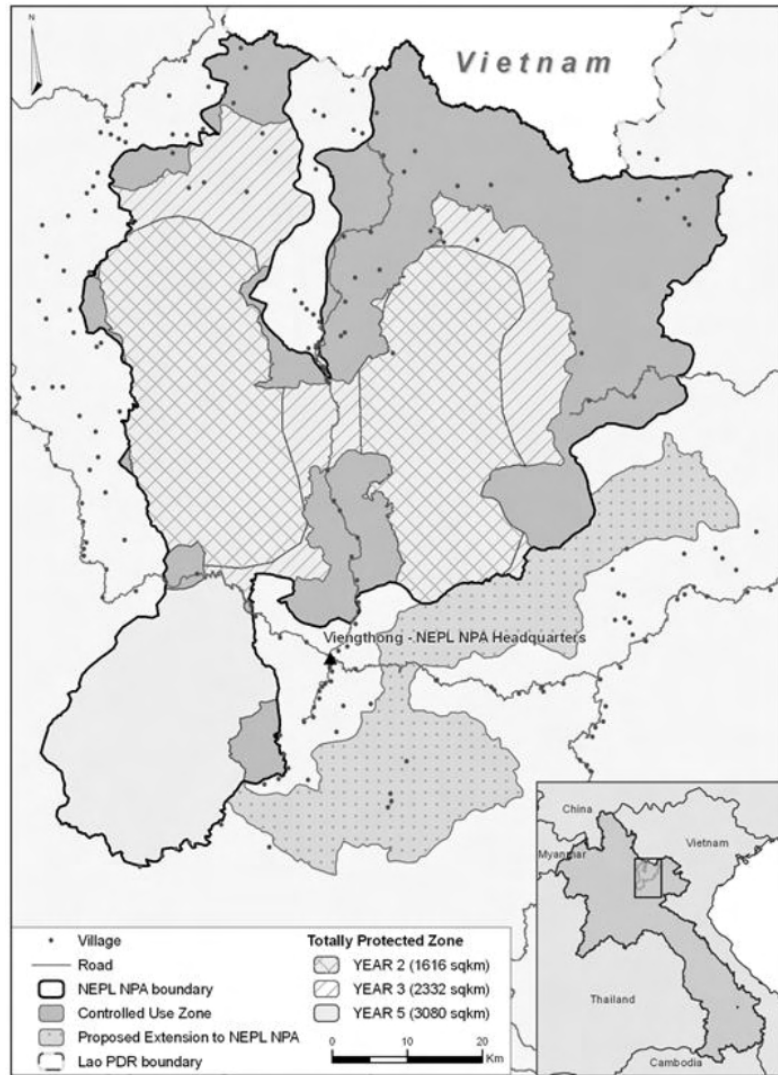


Figure 1. Nam Et-Phou Louey (NEPL) National Protected Area (NPA), management zones and villages. The totally protected zone was established in Year 2 of the project and extended in years 3 and 5. An extension to the NPA that would provide additional tiger and prey habitat has been proposed.

The NPA was established by a Prime Minister's decree in 1993 and, like other protected areas in Laos, is characterized as an IUCN Category VI Managed Resource Areas (Robichaud et al. 2001). The Forestry Law (GoL 2007a) designates that protected areas should contain two zones, a totally protected zone (TPZ), where access and harvest is prohibited, and a controlled use zone (CUZ), where pre-existing

villages are allocated land for subsistence purposes. The Wildlife Law (GoL 2007b) establishes three categories of wildlife, which include Category 1 species, which are those that are prohibited for harvest, and Category 2 and Category 3 species, which can be hunted for subsistence by the villages in the CUZ, following specific guidelines on gear and seasons for harvest. The NEPL NPA has been under active management since 2000 with ongoing international technical and financial support, first from IUCN until 2002, followed by the Wildlife Conservation Society (WCS) from 2003 to the present (Johnson 2012) (Figure 2).

The landscape within the NEPL NPA has a long history of human settlement. There are 34 villages inside the NPA and 64 villages on the NPA boundary, with a mean population of 313 people per village (Schlemmer 2002). Most families are engaged in subsistence activities with limited integration into the market economy. Rice is the staple food and is primarily produced through rotations of shifting cultivation on steep mountainous slopes. Altitudes in the NPA range from 400-2,257m with over 60% of the land area above 1,000m and 91% of the area along slopes greater than 12%. The original vegetation was primarily dry evergreen forest mixed with large areas of deciduous forest (Duckworth et al. 1999). In many areas, prolonged shifting cultivation and fire have resulted in forests being embedded today in large areas of *Imperata* grass, bamboo and other secondary vegetation. Schlemmer (2002) recorded livestock as the main source of income for most villages since the 1980's. The cattle are grazed freely in forested areas and grasslands deep inside the forest, sometimes hours away from the villages. Several surveys indicate that wild foods still play an important role in household food consumption, with most of the meat and vegetables coming from the wild, relative to foods purchased or domestically produced (Schlemmer 2002, ICEM 2003a, Johnson et al. 2010).

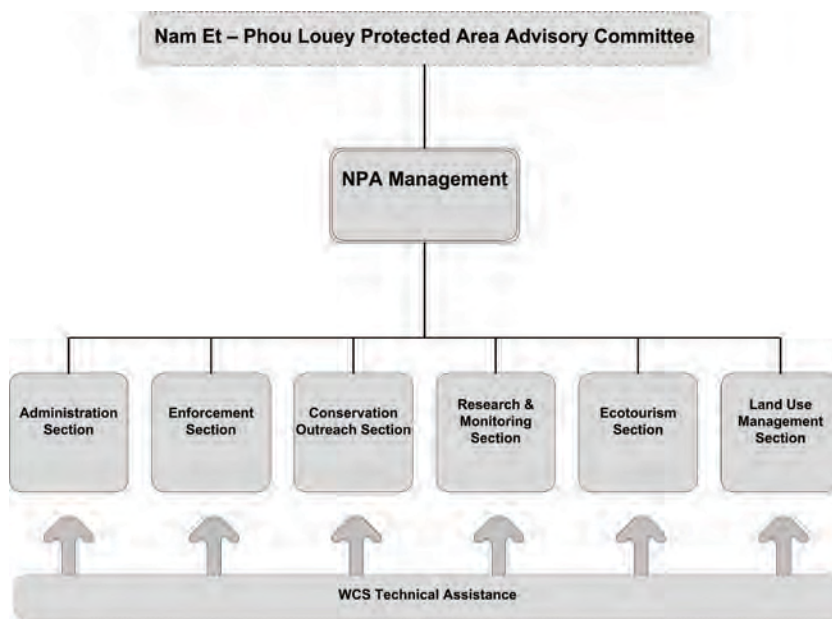


Figure 2. The structure of the Nam Et-Phou Louey National Protected Area Management Unit includes the director and deputy directors (NPA Management) that supervise technical and administrative sections. The Unit is guided by an advisory committee of authorities from the national Department of Forestry, three provincial and seven district governments to assure coordination and support across administrative units.

Framework for strategic conservation planning

From 2003 to 2010, the NEPL Tiger Project broadly followed the Landscape Species Approach (LSA), a framework for strategic conservation planning developed by WCS to guide field-based project design, management and assessment (Sanderson et al. 2002, Coppolillo et al. 2004, Didier et al. 2009). The four steps of the LSA project management cycle (WCS 2006a) are largely consistent with the steps of the more widely adopted *Open Standards for the Practice of Conservation* (CMP 2004, 2007) hereafter the *Open Standards*). From 2003 to 2010, the NEPL Tiger Project went through several iterations of the major steps of the project management cycle, which following the *Open Standards* includes: i) conceptualize the project, ii) plan actions and monitoring, iii) implement actions and monitoring, iv) analyze results and, v) capture and share learning (CMP 2007, Figure 3). In the LSA, the last two steps of this process are combined in a single phase to, “review progress and revise approach” (WCS 2006a).

Step 1: Conceptualize the project: In this first step we clarified the geographic scope of the project and determined the elements of biodiversity that the project aimed to conserve, and their status. In the *Open Standards*, these biodiversity “targets” can include species or ecosystems (CMP 2007). Following the LSA, we restricted our targets to “landscape species,” which are species that are defined by their ability to represent the major habitats, management zones and threats at the site, as well as by their use of large heterogeneous areas and their structural and functional impacts on natural ecosystems. (Coppolillo et al. 2004, Strindberg 2006). We used conceptual model diagrams (Margolius and Salafsky 1998, WCS 2006b, Margoluis et al. 2009b) to define and illustrate our assumptions about the relationship between the major factors, defined as “direct and indirect threats” (CMP 2007), that were impacting the conservation targets. We conducted baseline field surveys of tigers and their prey and of human-carnivore conflict (depre-dation and poaching) to determine the status of the conservation targets at the project site and to rank the impact of the direct threats on the viability of their population (Johnson et al. 2006).

Step 2: Plan actions and monitoring: Using the results from step 1, in this second step we developed a preliminary action plan that laid out the project goal and strategies. Strategies, referred to as “interventions” in the LSA (WCS 2006b), are combinations of management activities designed to work together to reduce threats or capitalize on opportunities to achieve the project objectives and goals (CMP 2007). We use a standardized taxonomy of conservation actions (Salafsky et al. 2008) to describe the strategies used in this project. Also in this step, project staff worked with a team of professional scientists to develop plans for quantitative and qualitative monitoring and systems for data management to evaluate trends in the status of the targets and as well as the effectiveness of the management strategies to reduce major threats to targets. Quasi-experimental or non-experimental monitoring designs were used for the quantitative evaluation.

Step 3: Implement actions and monitoring: Each year from 2004-2010, action plans and the measures of status and effectiveness were implemented as funding was available and capacity developed. Basic monitoring included tracking whether the activities constituting the various strategies were implemented as laid out in the action plan. The effectiveness of the strategies was assessed by monitoring change in contributing factors, direct threats and the status of the conservation targets themselves.

Steps 4 and 5: Analyze results, adapt strategic plan, capture and share learning: Monitoring results were analyzed and reviewed regularly at three different venues, i) at monthly meetings of the staff of the NPA Management Unit (Figure 2), ii) at the NPA annual meeting, which included NPA staff, government decision makers at the national, provincial and district level, and representatives of collaborating projects supported by international NGOs, bilateral and multilateral donors, and iii) at annual meetings of the Panthera/WCS Tigers Forever portfolio of projects (<http://www.panthera.org/programs/tiger/tigers-forever>). Operational and financial data were analyzed annually to assess the relative cost of implementing the strategies and monitoring plans. The internal and peer review of monitoring results was used to revise project assumptions and along with the assessment of operational and financial data, to adapt the strategies and monitoring plans aimed at improving project effectiveness and the status of tigers and tiger prey.

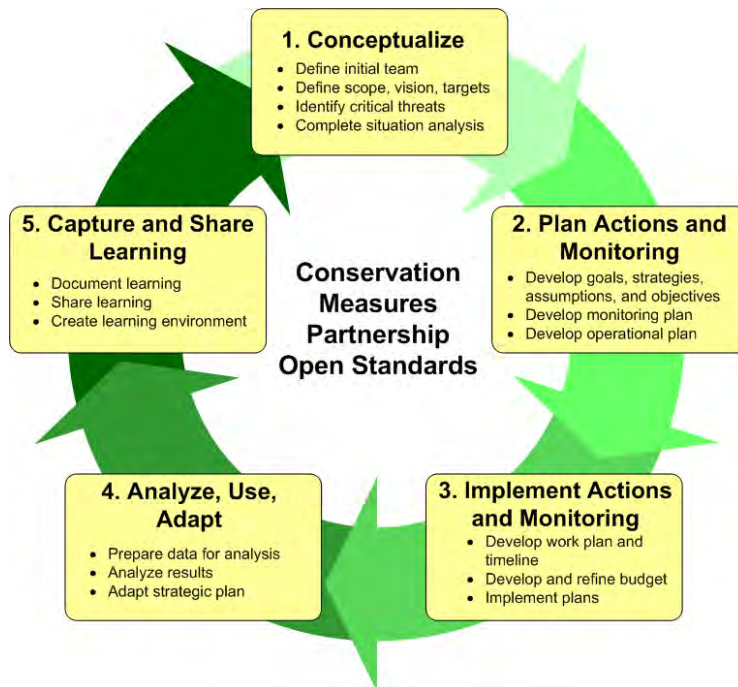
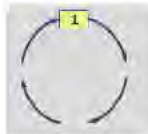


Figure 3. The project management cycle of the Open Standards for the Practice for Conservation (CMP 2007). The Wildlife Conservation Society's interpretation of the project management cycle as developed by the Living Landscapes Program follows the same general process with the exception that steps 4 and 5 are combined into a single step to, "review progress and revise approach" (WCS 2006a).

Iterations of the project cycle

Over a seven year period, from 2003-2010, the NEPL Tiger Project, hereafter called the project, went through several iterations of the major steps of the project management cycle (PMC). Unless otherwise noted, the project year generally began in May at the start of the wet season (ranging through October) and ended in April at the end of the dry season (ranging from November-April).



PROJECT YEAR 1 (2003-2004)

In the first year, we completed the conceptualization of our project (Step 1).

PMC Step 1. Conceptualize the project



In 2001, the NEPL NPA requested assistance from WCS to collect baseline data on tigers and prey and investigate farmer-reported problems of tiger depredation of livestock in the NPA. The NPA wanted to conserve tigers but also reduce the conflict that was reported to be threatening both tigers and human livelihoods. Reviewing the background literature, we found that general wildlife surveys in Laos in the 1990s indicated that tigers were still present in some areas of the country, although likely at low densities with only a few protected areas large enough to contain habitat and prey to maintain viable populations (Duckworth et al. 1999). The NEPL NPA was identified among these areas as possibly having an internationally important tiger population, as well as a relatively high incidence of attacks, presumed to be tigers, on large livestock owned by villages bordering the NPA (Davidson 1998).

To further define the context of the project area, we reviewed the background literature from earlier biological and socioeconomic surveys and management activities in the NPA (Schlemmer 2002, Vongkhamheng 2002, ICEM 2003a, b, MAF 2003a). To answer outstanding questions, we designed baseline surveys to determine the abundance and distribution of tiger and tiger prey in the NPA and the frequency and distribution of tiger-human conflict including tiger depredation of livestock and tiger and tiger prey poaching. From 2003-2004, we implemented intensive camera-trap sampling of large carnivores and their prey at varying levels of human population density and monitored carnivore depredation of livestock, tiger and tiger prey poaching across the NPA (Johnson et al. 2006).

The survey findings provided several key pieces of information that were used to conceptualize the project (Johnson et al. 2006) including:

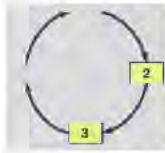
- Estimated tiger density was very low with significantly lower abundance where human population and disturbance was greater. Density ranged from 0.2-0.7 individuals per 100 km² with a minimum of seven and possibly as many as 23 tigers present in the total effective sampled area, which ranged from 952-3,548 km².

- Relative abundance of large ungulate prey for tigers was low throughout the NPA. The relative abundance of large ungulate prey (Gaur *Bos frontalis*, Southwest China serow *Capricornis milneedwardsii*, Sambar deer *Cervus unicolor*, Eurasian wild pig *Sus spp.*) was low throughout the NPA while relative abundance of small ungulate prey (muntjacs *Muntiacus spp.*) was significantly higher where human density was lower.
- The over-hunted prey base, in conjunction with free ranging large livestock inside the NPA, were likely the biggest factors contributing to tiger depredation of livestock. Tiger depredation of livestock in the NPA was not as widespread a problem as originally suspected. Chronic problems with tiger depredation of livestock were reported primarily by 12 villages in two districts. In these villages, average loss was two head of livestock per village per year and affected a maximum of only 1.7% of the total herd of the villages. The results indicated that most depredation incidents could be avoided if cattle were kept and provided with forage near the village and if wild prey populations were not over harvested.
- A lucrative market for tiger bone and large mammals existed in the area. Survey teams found explosive trip wire traps or hunting camps in all sampling blocks. Livestock kept inside the NPA near tiger populations seemed to serve as "bait" for opportunistic tiger poaching as well as a location for making camps to hunt other wildlife.
- Direct hunting of tigers in the form of opportunistic poaching, followed by depletion of their ungulate prey were the major threats affecting tiger abundance and distribution in the NPA.

Based on these results, the initial concept for the project was laid out in a written report (Johnson et al. 2004) and later in a conceptual model (Venevongphet et al. 2005). Depicting the situation analysis in a conceptual model format (Figure 4), the geographic focus (scope) of the project was initially the NEPL NPA, including the communities that border the NPA and the administrative jurisdictions that the NPA falls within (Figure 1). The initial conservation targets were tiger and five ungulate prey species with two major direct threats having the biggest impact on tiger and prey populations in the NPA. The highest rated threat was believed to be direct hunting of tigers and the large prey -gaur, sambar deer and serow - which was illegal according to the national hunting regulations in use at the time (MAF 2003b). The second highest threat was the unsustainable hunting of wild pig and muntjacs, which according to the 2003 regulations were species that could be hunted by local villagers for subsistence consumption in specified locations, seasons and with traditional gear.

The results from the baseline survey indicated that several factors were contributing to the direct threats of illegal and unsustainable hunting of tiger and prey in NEPL. Tigers were being hunted in response to the international demand for tiger bone and ungulate prey was hunted to supply domestic urban markets with wild meat. In response to this demand, some military personnel were opportunistically using military-issued guns to hunt tigers and tiger prey or they would rent guns to village hunters to hunt for this purpose. In addition to guns, village hunters were also using explosives and metal snares to kill tigers and large prey. Poaching of tiger and tiger prey was associated with the livestock grazing areas inside the NPA, which

was in some cases was precipitated by tiger depredation of livestock. Although national government regulations prohibited the commercial trade of wildlife as well as the harvest of protected species (MAF 2001), there was limited government capacity and funding in the NPA to enforce the hunting laws. Likewise, protected areas and hunting regulations were a relatively new concept and few people, even within the government, were entirely aware of or understood these regulations.



PROJECT YEAR 2 (2004-2005)

Using the project conceptualization from Step 1, in Year 2 we developed the first iteration of our action and monitoring plans (Step 2), trained field teams to begin implementing activities associated with two strategies, and continued to monitor the status of the conservation targets (Step 3).

PMC Step 2. Plan actions and monitoring



Action Plan

In Year 2, the baseline survey results and the situation analysis from Year 1 were presented and discussed at a meeting of government authorities responsible for the NEPL NPA (Johnson et al. 2004). Comparing the survey results to other evergreen forests in Southeast Asia indicated that tiger densities in NEPL could possibly be three times greater than what they were, if ungulate prey abundance could be increased. Research elsewhere has shown that the abundance of prey is a reliable predictor of tiger abundance and that tigers generally prefer large prey (Karanth and Stith 1999, Karanth et al. 2004). Although large ungulate prey (gaur, sambar, serow, and wild pig) was sporadically recorded in the NPA, abundance was consistently low across the area, which we felt was likely having a negative impact on tiger abundance. The goal of the project at that point became to increase the abundance of both tigers and prey although initially no quantitative target was set (Figure 4, Table 1 - G1 & G2).

To achieve this goal, we initially brainstormed four strategies that could potentially reduce the documented threats to tigers and prey (Johnson et al. 2004). These strategies included (Figure 4):

- 1. Law Enforcement:** Following the conservation action taxonomy (Salafsky et al. 2008) this strategy falls under the general heading of Law and Policy and in NEPL includes two major actions:
 - *Policies and legislation.* This action is about working with communities and local governments to implement zoning regulations. The survey results from Year 1 indicated that tigers were largely centered in two large core areas covering 1,616 km² of the NPA (see Figure 1 – YEAR 2). Other studies have shown that the survival of tigers is dependent on establishing large core zones where tiger and large prey are not

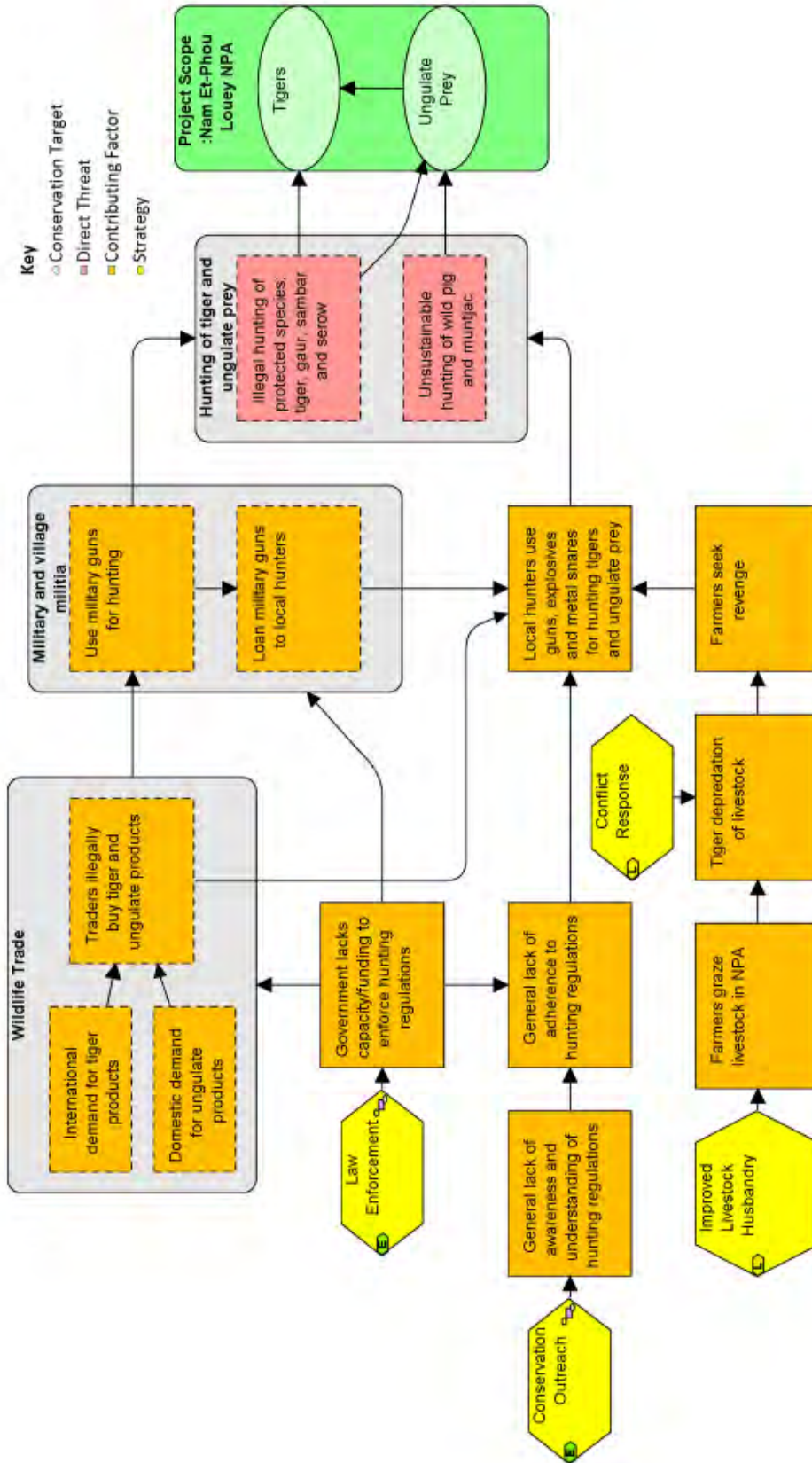


Figure 4. NEPL NPA Conceptual Model. Two strategies, Law Enforcement and Conservation Outreach, were identified as effective strategies (E) that were likely to help mitigate threats and restore targets as well as being technically feasible with some additional financial resources required. Other strategies, Improved Livestock Husbandry and Conflict Response, were identified as less effective strategies (L) because although they were equally likely to help mitigate threats and restore targets, they were technically and financially difficult to implement unless substantial additional resources were acquired.

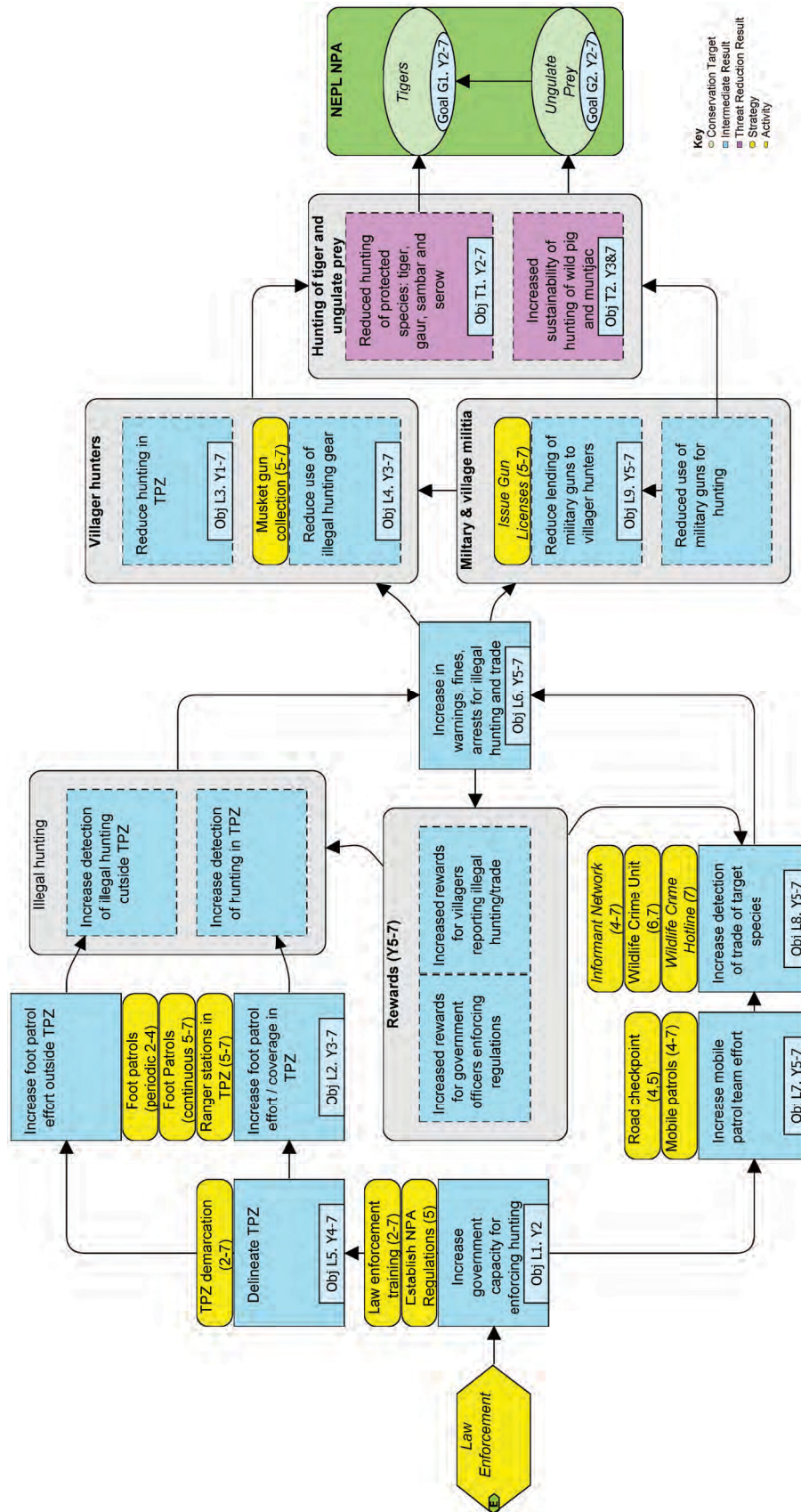


Figure 5. Results Chains for Law Enforcement Strategy. Activities shown in italics were implemented by both the Law Enforcement and Conservation Outreach teams. The figure indicates the project years for which there were goals for targets, and objectives for intermediate and threat reduction results. The project years during which activities were implemented are indicated in each yellow activity bubble.

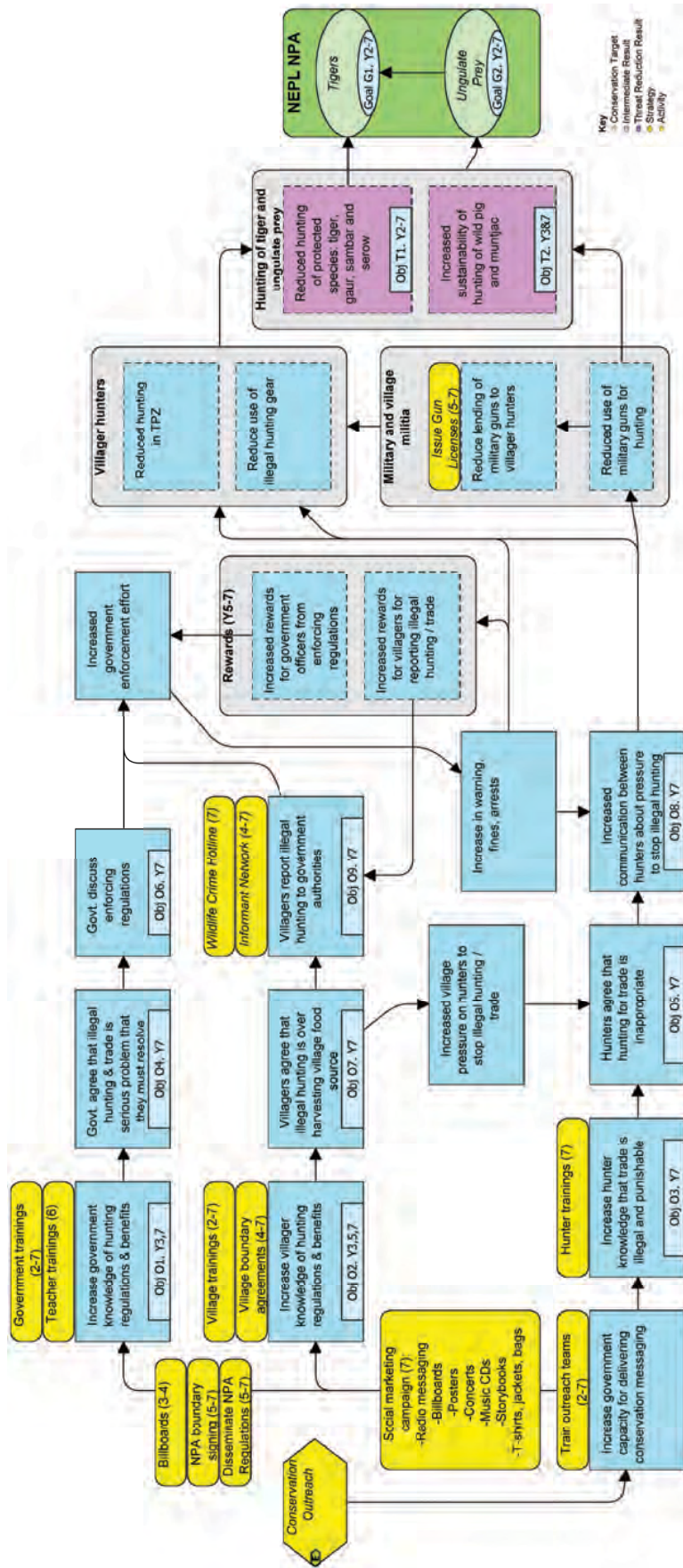


Figure 6. Results Chain for Conservation Outreach Strategy. Activities shown in italics were implemented by both the Law Enforcement and Conservation Outreach teams. The figure indicates the project years for which there were goals for targets, and objectives for intermediate and threat reduction results. The project years during which activities were implemented are indicated in each yellow activity bubble.

hunted (Rabinowitz 1999). This recommendation was consistent with Lao government regulations for protected area zoning (No. 0360/AF.2003), which called for establishing restricted areas to serve as source populations to recover threatened species (MAF 2003b). In the 2007 Forestry Law, these areas were renamed as Totally Protected Zones (TPZ) (GoL 2007a). In accordance with the national legislation, the 2004 meeting recommended that remote livestock grazing areas, which were being used for illegal hunting in the TPZ, be relocated to village areas within the Controlled Use Zone (CUZ).

- *Compliance and enforcement.* Following MAF regulation 0360, the meeting recommended establishing and training NPA enforcement teams made up of military, forestry and village officials in the two districts where tigers were detected to regularly patrol in the TPZ to enforce compliance with government laws and regulations. When hunters were encountered in the TPZ they were first warned by the patrol teams and educated about the hunting laws and regulations, and on the next encounter they were to be fined or arrested.

2. Conservation Outreach: This strategy falls under the general heading of Education and Awareness (Salafsky et al. 2008), which in this case is directed at improving understanding and changing behavior of people within the project scope to result in a reduction of threats to tigers and their ungulate prey (Figure 4). In Laos, the establishment of protected areas and guidelines for wildlife management are recent developments of the 1990s (Berkmuller et al. 1995, MAF 2003b). Given this, the project team was not surprised that people may be unaware of regulations that govern the use of wildlife and an NPA, or that people continued unsustainable resource use practices that were in place long before the establishment of the NPA (Johnson et al. 2004). To address this problem, the 2004 meeting recommended providing training, support and materials to establish conservation extension teams in the two districts where tigers were detected. The two teams were to be composed of district government and village officials who were to work in villages and urban centers to raise public awareness of the national and global significance of tiger and prey populations in the NPA, and of the national and local regulations governing the NPA that prohibited hunting of tiger and large ungulates and that managed subsistence hunting of smaller or more fecund species for sustainable use. The meeting also recommended that the extension teams should educate the local military, police and village militia on these topics.

3. Improved Livestock Husbandry: This could be classified as a type of Livelihood Incentive strategy (Salafsky et al. 2008) to provide the impetus for changing land use behavior. In the NEPL case, the aim of this strategy was to provide agricultural technical assistance to improve large livestock husbandry practices in villages with chronic depredation and tiger poaching problems (Figure 4). Loss of large livestock and low rates of production are prevalent problems throughout Lao PDR where farmers release their cattle

into forested areas to graze due to lack of forage (Phensavanh et al. 1999). In the 1990s, successful methods were developed by the Center for Tropical Agriculture (CIAT) with smallholder farmers in northern Lao PDR to reduce these problems by growing sufficient forage near the village (Horne et al. 1999). Based on these results, the meeting recommended that the NPA contact CIAT for training and support for district officers and interested farmers from villages with chronic depredation problems in the two districts that had reported depredation and poaching incidents in Year 1. The idea was that farmers who were successful as a result of the forage technology could potentially serve as a model for other farmers that were being asked by the government to relocate livestock from mountain grasslands in the TPZ to village areas outside of the TPZ.

- 4. Human-Wildlife Conflict Response.** The 2004 meeting recommended that district depredation officers continue to respond to all farmer reports of tiger depredation (Figure 4) using the standardized methods developed in Year 1, but with some improvements. District officers needed to respond more quickly and all farmers encouraged to report promptly after a depredation incident. Accurate predator verification for a possible compensation insurance scheme in the future would only be feasible if officers were able to thoroughly examine kills when fresh. This would require that livestock be kept closer to the village (through the Improved Livestock Husbandry strategy – see above) and that there be faster and more frequent communication between the village and the district office. The idea was that the district response should maintain positive public relations between the NPA and farmers while monitoring how the location and frequency of depredation had changed as management strategies were implemented.

Our assumptions about how these strategies would lead to conservation results were not initially diagrammed in results chains, as this tool was only developed and adopted more recently for the practice of conservation (CMP 2007). In contrast to a conceptual model, which illustrates the assumptions we had about how factors at the site were impacting the conservation targets (Figure 4), a results chain depicts assumptions about how a strategy will result in a change within these factors to be able to reach the conservation goal (FOS 2007).

Retrospectively depicting our early assumptions about the Law Enforcement strategy in a results chain (Figure 5), we assumed that training government officers and providing them with equipment and financial support would result in delineation of the TPZ and then increased foot patrol effort in NPA zones to increase detection of illegal hunting in areas where we had found tigers and ungulate prey in Year 1. As there had been little or no enforcement of hunting regulations in the NPA in the past, initially our objectives were simply to increase government capacity (Table 1-L1) and patrolling effort (Table 1-L2) in the TPZ, which we assumed would deter hunters from entering and hunting in the TPZ (Table 1-L3 & L4) (Venevongphet et al. 2005) (Table 1). Additional explicit assumptions and objectives about the results of law enforcement actions were not developed until Year 5 (Table 1-L5 to L9).

Depicting the assumptions of the Conservation Outreach strategy in a results chain (Figure 6), the objectives of this strategy were initially to increase the

Table 1. Monitoring Framework

No.	Description	Goals (targets) / Objectives	Indicator	Method	Who	When	Frequency	Cost (\$US)
Conservation Goals								
G1	Tiger	(Y2-4) To increase the abundance of tigers in the NPA. (Y5-7) To increase tigers (in TPZ) by 50% from 2005 to 2015.	Number of tigers/100 sq km in TPZ	Camera trapping	Wildlife monitoring teams	Years 1-4	Annual survey	100,000
			Minimum number of tigers in TPZ	Fecal DNA	Wildlife monitoring teams &	Years 5-7	Continuous survey	5,000
G2	Ungulate prey (Gaur, Sambar Deer, Serow, Wild Pigs and Muntjacs)	Y2-4) To increase the abundance of ungulate prey for tigers in the NPA. (Y5-7) To raise prey levels (in TPZ) to support a 50% increase in tigers from 2005-2015	Independent photos / 100 camera trap days in TPZ	Camera trapping	Wildlife monitoring teams	Years 1-4	Annual - part of tiger survey	
			Patch occupancy - area occupied in TPZ	Dry season forest transects	Wildlife monitoring teams	Year 5	Intermittent survey	140,000
G3	Tiger and ungulate prey	To assess the occurrence and status of tigers and large ungulates in the 24,300 km ² landscape	Patch occupancy - area occupied in landscape	Questionnaire survey	Wildlife monitoring teams	Year 6	Intermittent survey	30,000
Direct Threat Objectives								
T1	Hunting of protected species	Stop hunting of tigers and protected wildlife in and around the NPA	Number of verified reports of tigers poached per annum from in and around the NPA	Verified informant report	NPA law enforcement unit	Years 2-7	Opportunistic response to reports	150-300
T2	Sustainability of hunting of managed species	Maintain a sustainable offtake of managed species in village areas bordering the TPZ	Offtake (kg) per annum per km ² relative to estimated standing biomass	Questionnaire survey (Y3); Household offtake records (Y7)	NPA, WCS & National University	Years 3 & 7	Intermittent survey	5,000-19,000
Law Enforcement Strategy								
L1	Government capacity for enforcing hunting regulations	To increase government capacity to enforce hunting regulations	Understanding of trained law enforcement patrol and monitoring methods	Ex-poste survey	NPA law enforcement unit & WCS	Year 2	Intermittent - part of training event	
L2	Foot patrol effort/coverage	To increase foot patrol effort to apprehend illegal hunters in the TPZ.	i) Foot patrol coverage (km ²) per year in the TPZ	Patrol records / MIST ^[2]	Foot patrol teams	Years 3-7	Monthly	12,000
L3	Hunting inside the TPZ	To reduce the number of unpermitted people entering the core zone	Independent photos / 100 camera trap days in TPZ	Camera trapping	Wildlife monitoring teams	Years 1-4	Annual - part of tiger survey	
			Hunting detected per unit effort (km patrolled) in TPZ	Patrol records / MIST ^[2]	Foot patrol teams	Years 3-7	Monthly- part of foot patrol monitoring	
L4	Use of illegal hunting gear	To reduce the use of illegal weapons (guns, metal snares, and explosives) used to kill tigers, prey and protected species.	Illegal hunting gear (guns, metal snares and explosives) detected per unit effort (km patrolled) in TPZ	Patrol records / MIST ^[2]	Foot patrol teams	Years 3-7	Monthly- part of foot patrol monitoring	
			Illegal firearms confiscated outside the TPZ	Project records of village gun collections	Mobile patrol teams	Years 5-7	Intermittent - part of law enforcement event	
L5	Delineate the TPZ	To demarcate the boundary of the TPZ	Number of village agreements that result in demarcation (sign posting) of the TPZ boundary	Project records of village agreements and demarcation	Outreach and mobile patrol teams	Years 4-7	Continuous - part of outreach and patrol monitoring	
L6	Warnings, fines and arrests	To increase the proportion of enforcement cases that resulted in warnings, fines and arrests.	Number of arrests, fines, and warnings per km patrolled (foot) or person/day (mobile)	Project records of fines and MIST ^[2]	Foot and mobile patrol teams	Years 5-7	Continuous - part of foot and mobile patrol monitoring	
L7	Mobile patrol effort	To increase mobile team activity at fixed points (checkpoint, road blocks, restaurants & markets)	Number of days per mobile patrol per month	MIST ^[2]	Mobile patrol teams	Years 5-7	Monthly	5,000
L8	Trade of target species	To reduce trade of prey species from the NPA for sale in restaurants and markets.	Trade of prey species detected per unit effort (days patrolled) outside TPZ	MIST ^[2]	Mobile patrol teams	Years 5-6	Monthly - part of mobile patrol monitoring	
		To increase the number of informant reports of illegal hunting and trade	Number of villagers reporting illegal hunting and trade	Wildlife Crime Unit logbook	NPA Wildlife Crime Unit	Year 7	Continuous	2,500
L9	Lending of military guns to village hunters	By 2009, all government-issued guns in NEPL villages and military camps will have an authorization card	Government-issued guns encountered with an authorization card	Project records of licenses issued	Foot and mobile patrol teams	Years 5-7	Continuous - part of foot and mobile patrol monitoring	

No.	Description	Goals (targets) / Objectives	Indicator	Method	Who	When	Frequency	Cost (\$US)
Conservation Outreach Strategy								
O1	Knowledge: Increased government knowledge of hunting regulations & benefits	To increase the knowledge of government officials of the NPA and hunting regulations	Government knowledge of NPA and hunting regulations	Ex-poste survey	Outreach teams	Year 3	Survey	500
		The % of government officials saying that modern hunting gear is biggest threat to ungulates will increase by 13% by August 2010	% of government officials responding that modern hunting gear is the biggest threat to ungulates	Pre and post survey, control and test sites	Outreach teams	Year 7	Survey	4,000
O2	Knowledge: Increased villager knowledge of hunting regulations & benefits	To increase villagers' knowledge of the NPA and hunting regulations	Villager knowledge of NPA and hunting regulations	Ex-poste survey	Outreach teams	Year 3	Part of outreach survey	
		To increase villagers' knowledge of the NPA and hunting regulations	Villager knowledge of NPA and hunting regulations	Pre and post survey	Outreach teams	Year 5	Part of outreach survey	
		The % of villagers saying that modern gear for hunting is the the biggest threat to ungulates will increase by 12% by August 2010	% of villagers who say that modern hunting gear is biggest threat to ungulates	Pre and post survey, control and test sites	Outreach teams	Year 7	Part of outreach social marketing campaign survey	
		The % of villagers responding that muntjac & wild pig are important food will increase by 11% by August 2010.	% of villagers who respond that muntjac and wild pig are important for food	Y7- pre and post survey, control and test sites	Outreach teams			
O3	Knowledge: Increased hunter knowledge that trade is illegal and punishable	The % of potential hunters saying that modern hunting gear is biggest threat to ungulates will increase by 15% by August 2010	% of potential hunters saying that modern hunting gear is biggest threat to ungulates	Y7- pre and post survey, control and test sites	Outreach teams	Year 7	Part of outreach social marketing campaign survey	
O4	Attitude: Govt. officers agree that illegal hunting/trade is serious & needs resolving	The % of govt. officers who agree that borrowing guns to hunt should be punished will increase by 12% by August 2010.	% of govt. officers responding that borrowing guns to hunt should be punished	Y7- pre and post survey, control and test sites	Outreach teams	Year 7	Part of outreach social marketing campaign survey	
O5	Attitude: Increased agreement by hunters that hunting for trade is inappropriate	The % of potential hunters saying that illegal hunting should be punished will increase by 14% by August 2010	% of potential hunters saying that illegal hunting should be punished	Y7- pre and post survey, control and test sites	Outreach teams	Year 7	Part of outreach social marketing campaign survey	
O6	Interpersonal Communication: Govt. officers discuss enforcing regulations	The % of govt. officers reporting that they discussed with others about people being fined for illegal hunting will increase by 10% by August 2010.	% of govt. officers reporting discussions about people being fined for illegal hunting	Y7- pre and post survey, control and test sites	Outreach teams	Year 7	Part of outreach social marketing campaign survey	
O7	Interpersonal Communication: Villagers agree that illegal hunting is over-harvesting their food source	The % of villagers that reporting that they discussed with others about how to increase muntjac and wild pig populations in their village area will increase by 13% by August 2010	% of villagers that reporting discussions about how to increase muntjac and wild pig populations in their village area	Y7- pre and post survey, control and test sites	Outreach teams	Year 7	Part of outreach social marketing campaign survey	
O8	Interpersonal Communication: Increased communication between hunters about pressure to stop illegal hunting	The % of hunters reporting that they have discussed with others about being fined for illegal hunting will increase by 10% by August 2010	The % of hunters reporting conversations with others about being fined for illegal hunting	Y7- pre and post survey, control and test sites	Outreach teams	Year 7	Part of outreach social marketing campaign survey	
O9	Behavior Change: Villagers report illegal hunting	The % of villagers stating that they have reported someone for illegal hunting and trade will increase by 20% by August 2010	% of villagers stating that they have reported someone for illegal hunting and trade	Y7- pre and post survey, control and test sites	Outreach teams	Year 7	Part of outreach social marketing campaign survey	

[1] per survey event or per annum if continuous monitoring

[2] Monitoring Information System for Law Enforcement

knowledge of government officers including the military and the knowledge of local villages of the purpose and benefits of the national government's regulations on wildlife hunting (Saypanya and Vannalath 2004) (Table 1-O1 & O2). It was initially assumed that this in turn would result in villagers reporting illegal hunting and increased government enforcement of the hunting regulations. As with the Enforcement Strategy, we assumed that the consequent increase in enforcement would deter hunters and traders from engaging in illegal activities. The detailed assumptions about how increased knowledge would in turn affect attitudes, interpersonal communication and ultimately behavior change of government officers, villagers and hunters as shown in Figure 6 were not made explicit until Year 7 of the project.

NPA conservation outreach representatives meet with village authorities to demarcate the boundary between the village area and the NPA Totally Protected Zone.
© E. Briggs



The third strategy to modify livestock husbandry proved not to be financially or technically feasible for the project to implement. Likewise, the implementation of human-wildlife conflict response strategy was minimal after Year 1 due to a lack of human and financial resources.

Monitoring plan

Following the theory of change laid out in the results chains (Figures 5 and 6), the project aimed to evaluate the effectiveness of the Enforcement and Outreach strategies by measuring progress towards objectives and ultimately the achievement of the goals by monitoring the status of tigers and prey.

Monitoring the effectiveness of conservation strategies

- 1. Enforcement.** In Year 2 the project team planned to evaluate government capacity as a result of the project's first law enforcement training (Table 1-L1).

- 2. Outreach.** An ex-poste survey was planned for Year 3 to evaluate the knowledge of government officers and villagers after the first outreach activities in Year 2 (Table 1-O1 & O2).

Monitoring the status of conservation targets

The project planned to continue with a time-series monitoring design of systematic camera trapping of tiger and prey in the three sampling blocks where tiger had been detected during Year 1 and that were within the newly established TPZ (See Figure 1 – Year 2) (Johnson et al. 2006) (Table 1-G1 & G2).

PMC Step 3. Implement actions and monitoring

Y1 Y2 Y3 Y4 Y5 Y6 Y7

Implement enforcement strategy. In March 2005, the project recruited and provided the NPA's first law enforcement training for two foot patrol teams, made up of 13 protected area staff and village militia (Figure 5). The teams were trained in methods for patrolling in the TPZ (Figure 1) in the areas where tigers had been detected by the Year 1 camera trapping. The teams were also trained in boundary anti-poaching techniques and demarcation of the TPZ (Venevongphet et al. 2005).

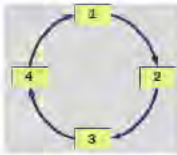
Monitor effectiveness of enforcement actions. To monitor hunting sign per unit effort using a non-experimental time series approach, foot patrol staff were trained to complete a standardized Excel data form to record patrol effort (kilometers and days patrolled) and evidence of human activity in the TPZ. Evidence recorded included people encountered, camps and campfires, weapons or gear (including explosive traps, snares, guns, fishing equipment), gun shots heard, or signs and sightings of key wildlife (including carcasses, tracks, scats and scrapes), forest clearing or burning and domestic livestock (Venevongphet et al. 2005) (Table 1-L3). After each patrol, data were entered into an Excel database and maps created in GIS to feed back to NPA management. An ex-post survey was administered to evaluate the level of trainee understanding of the material taught during the classroom and field session (Table-L1). Although training for the demarcation of the TPZ was in Year 2, monitoring of the demarcation was not started until Year 4 (Table 1-L5).

Implement outreach strategy. In October 2004, the project did outreach training for teams in two districts (14 people) that included both government officers and villagers (Figure 6). They were trained to develop and deliver interactive training programs to villages, military bases and government offices on the principles of NPA and wildlife management, the purpose and content of the national hunting regulations, the benefits of sustainable use to provide wildlife and other non-timber forest products for subsistence household consumption, and the significance of the NEPL tiger population (Saypanya and Vannalath 2004).

From November 2004 to March 2005, the two outreach teams did village trainings in 28 villages in Viengthong and Viengkham districts on the borders of the TPZ (Figure 6 and 7). The villages were chosen because they had reported tiger

poaching related to depredation attacks of livestock during Year 1. From May to July 2005, the outreach teams implemented government trainings for military camps and government offices, including 273 government officers in five military camps in the same two districts and for 60 government officers in Viengkham district (Saypanya and Venevongphet 2006) (Figure 6). The military camps were chosen because the NPA was aware that guns and ammunition from the camps had been used by poachers to hunt tigers and prey. The Viengkham district governor, an important local official, attended the trainings and instructed officers to abide by the national rules for wildlife and NPA management. Military officers said that this was the first time anyone had told them about the NPA, its purpose, the boundaries and the regulations that govern its management.

Monitor status of conservation targets. From November 2004 to April 2005, the project completed its second year of camera trapping to monitor tiger and prey species abundance and distribution in the NPA TPZ for a total of 2,611 camera trap days (Table 1-G1 & G2).



PROJECT YEAR 3 (2005-2006)

In Year 3, initial monitoring results from Year 2 were analyzed and reported at the second annual NPA meeting (Step 4). During the remainder of the year, the project continued to implement the initial action and monitoring plans that were laid out in Year 2 (Step 3). By the end of Year 3, we completed an evaluation of the effectiveness of preliminary enforcement and outreach actions, and a third round of status monitoring of tiger and prey. The results were used to report to the first annual Tigers Forever meeting in February 2006 and to review and adapt our action plan for Year 4 (Step 4).

PMC Step 4. Analyze results and adapt



In September 2005, the preliminary monitoring results from Year 2 were reported to government authorities from village, district, provincial and central level at the second annual meeting of the Tiger Project.

Report enforcement monitoring results. The ex-post evaluation of the Year 2 law enforcement training indicated that 41% of trainees (n=13) had a very good understanding and 33% an excellent understanding of the classroom session, while 39% of trainees had very good understanding and 54% an excellent understanding of the field session (Venevongphet et al. 2005) (Table 1-L1). The first foot patrols in the TPZ started in July 2005 and only two preliminary 10-day patrols were completed before the annual meeting in September. Both patrol teams reported finding signs of both past and current hunting camps in the TPZ.

Report target monitoring results. The camera trapping in Year 2 detected two individual tigers in the three sampling blocks (300 km², n=28 photos) within the

1,616 km² TPZ, including one new individual and one that had been detected in Year 1. The effort was sufficient to confirm continued tiger presence in the TPZ but insufficient to generate a density estimate (Table 1-G1). Cameras also recorded 245 independent photos of ten prey species of which 15% were large prey (sambar, serow, and wild pig). The mean relative abundance index (RAI) of ungulates in Year 2 was 4.13 photos per 100 CTD (range 1.44-7.85), similar to Year 1 (Figure 8, Table 1-G2). In addition to photos of wildlife, camera traps in the TPZ periodically captured images of hunters. In Year 2, camera traps recorded a six-fold increase in the mean RAI of humans as compared to Year 1 (Figure 8, Table 1-L3).

Adapt enforcement strategy. Based on patrol team reports and the camera trap monitoring that indicated people were entering the TPZ and hunting was still occurring, the government authorities at the annual meeting recommended increasing the frequency of the foot patrols to keep hunters out of the TPZ. To increase the area for tiger and prey protection, they recommended extending the TPZ in the north part of the NPA (part of which had previously been a district conservation area) to increase the TPZ to 2,332 km² in size (Figure 1 – YEAR 3). To increase ungulate numbers in the NPA, the meeting recommended raising funds to support the NPA to set up road checkpoints, and periodically check restaurants and markets in Viengthong district to stop trade of ungulate prey species (Figure 5). To increase tiger and prey abundance, the meeting participants recommended strengthening the NPA capacity to take enforcement action against illegal hunting and trade by establishing a district government committee made up of representatives from several sectors (military, policy, forestry, and NPA) to oversee the patrolling activities and the control of illegal trade of tiger and prey. The final recommendation was that district legislation be drafted that would allow for government officials to be punished if they were found to be involved in illegal wildlife hunting and trade.

PMC Step 3. Implement actions and monitoring

Y1 Y2 Y3 Y4 Y5 Y6 Y7

Implement enforcement strategy. During the remainder of Year 3, the two forest patrol teams did seven periodic foot patrols along pre-existing trails in the TPZ (Figure 5). The teams continued to apprehend groups of hunters and confiscate illegal firearms. In addition to information from the foot patrols, the NPA periodically received and investigated village reports of tiger poaching.

Monitor effectiveness of enforcement actions. To monitor hunting catch per effort, foot patrol teams continued to use the standardized Excel data form to record patrol effort (kilometers and days patrolled) and signs of hunting while on patrol (following Venevongphet et al., 2005) (Table 1-L3).

Implement outreach strategy. To raise public support for reducing illegal hunting and trade of tigers and prey, in February 2006 the conservation extension teams erected large billboards in 23 locations in and around the NPA (Saypanya, 2006) (Figure 6). The billboards displayed messages alerting the public that trade of tigers and their ungulate prey is illegal.

The conservation outreach teams from Viengkham and Viengthong districts were merged into one single team (five people) and conducted outreach activities in seven villages in Viengthong district and 4 villages in Viengkham district (Figure 7) where villages authorities and NPA staff were reporting evidence of illegal hunting and wildlife trade.

Monitor effectiveness of outreach actions. In October and November 2005 the project did an ex-poste evaluation where village and government trainings were done in Year 2, sampling 15% of residents in 20 villages and five military camps (n=342) to determine the extent of their knowledge of the hunting regulations that had been presented during the trainings (Saypanya et al. 2006b) (Figure 6 and Table 1-O1 & O2). The survey included 43 multiple-choice, semi-structured and open-ended questions.

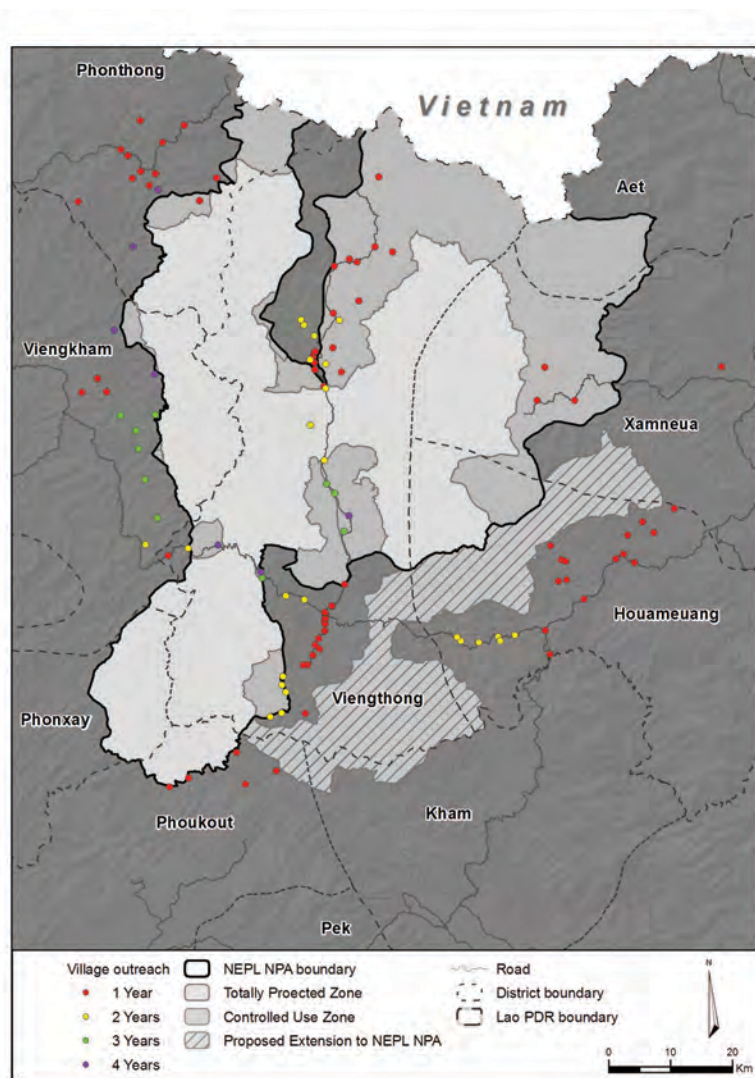


Figure 7. Map showing the location of villages and districts where conservation outreach activities (village trainings, village boundary agreements, hunter trainings) were done for one to four years over a six-year period from 2004-2010.

Monitor status of conservation targets. In October 2005, the project retrained the biological monitoring teams, which included reviewing results from Year 2 camera trapping and refining techniques for Year 3 (Table 1 – G1 & G2). From November to May, the teams completed the third systematic camera trap survey of the same three sampling blocks cover 300 km² in the TPZ for a total of 2,290 CTD.

PMC Step 4. Analyze results and adapt



Report enforcement monitoring results. From July 2005 to April 2006, the two foot patrol walked a total of 498 km inside the TPZ for an average of only 2.1 days of patrol effort per team per month. Total patrol coverage for Year 3 (July - June) was 669 km² of the NPA (Figure 9, Table 1-L2). Detection of hunting (catch) per effort in the TPZ during this first year (May - April) was 0.079 (SD =0.025, n=2 part-time teams) signs per kilometer walked (Figure 10, Table 1-L3). The monitoring indicated that when teams were not patrolling, hunters from villages bordering the TPZ opportunistically entered the area to hunt as evidenced by new camps and hunting signs found with each periodic foot patrol.

In addition to standardized foot patrol monitoring, the NPA received three village reports of tigers poached from the NPA in Years 2 and 3. Explosives in livestock carcasses in grazing areas were reportedly used to kill all of these tigers. In one case, 11 kg of tiger bones were reportedly sold for an estimated \$1,000 USD/kilo to a trader (Johnson et al. 2006). The other two reports were still under investigation at the end of Year 3 (Table 1-T1).

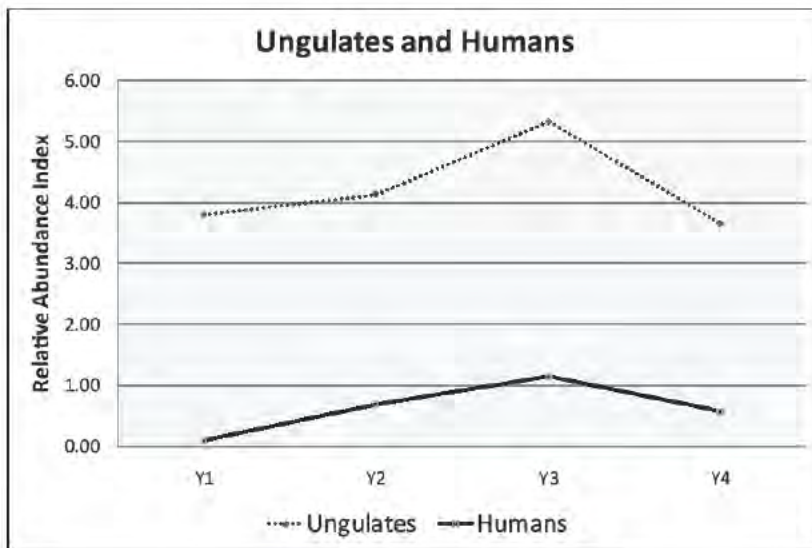


Figure 8. Mean Relative Abundance Index (photos per 100 camera trap days) of ungulates (gaur, sambar, serow, wild pig and muntjac) and humans in areas surveyed in the NEPL NPA in Years 1 to 4.

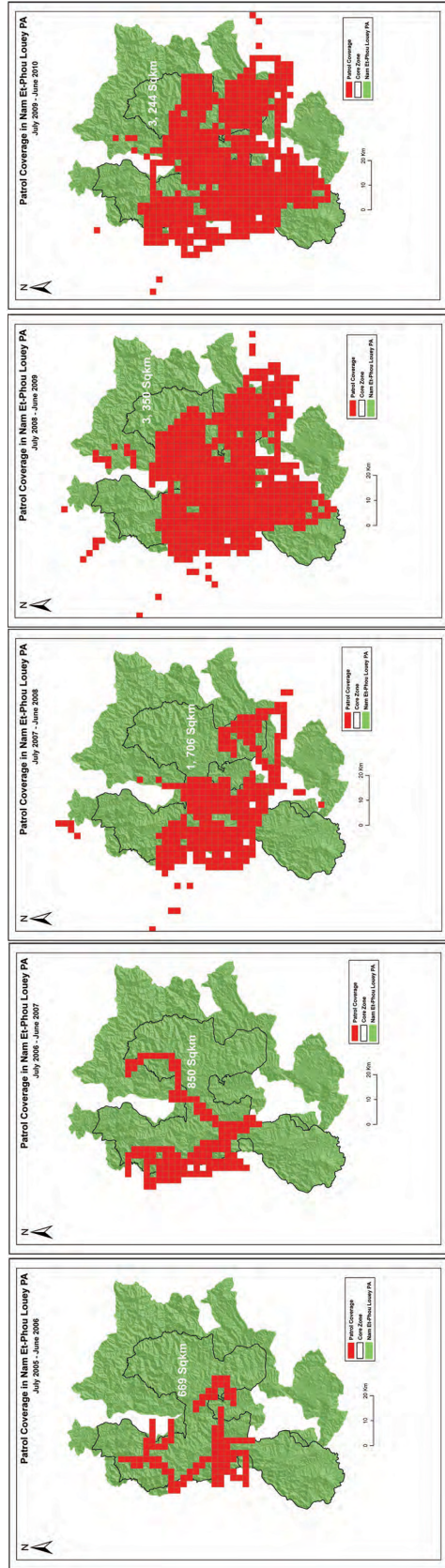


Figure 9. Annual foot patrol coverage (km²) for Years 3 to 7.

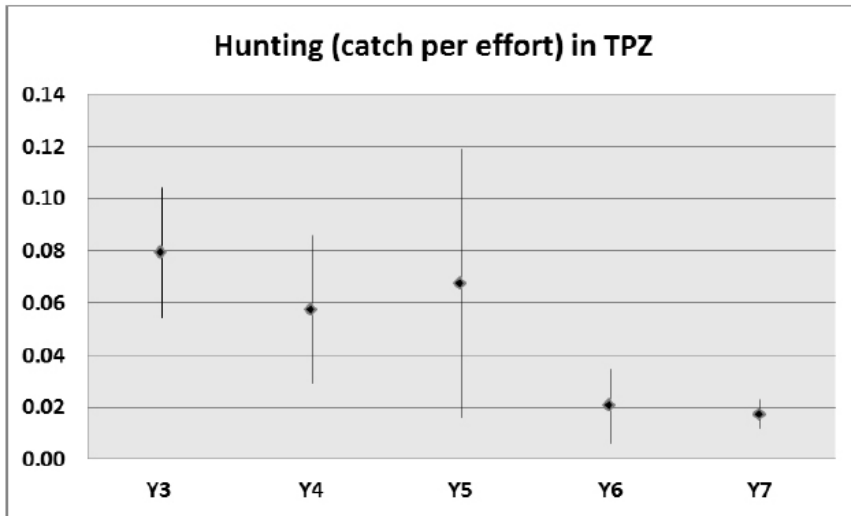


Figure 10. Catch per effort (number of signs of hunting detected per kilometer patrolled) from Years 3 to Year 7. For each patrol sector the monthly aggregate number of signs of hunting per total kilometer patrolled was calculated and then the annual mean of those values for that sector. Shown is the annual mean and 95% confidence limits across patrol sectors.

Adapt enforcement strategy. Given the continued detection of hunting and tiger poaching in the TPZ, the project began to consider modifying the periodic patrolling strategy to establish full time ranger stations in the TPZ that could accommodate and support continuous foot patrol teams in the TPZ. The revised assumption was that continuous patrol presence in the TPZ was needed to reduce hunting in the TPZ (Figure 5).

In May 2006, the project team also worked with an enforcement specialist to more closely analyze tiger and prey trade chains to further prioritize NPA enforcement actions (Lynam et al. 2006). Results from the workshop identified three different actors who were perceived to be the greatest threat to tigers. The first were the local middlemen who were hiring others to hunt and facilitating the trade in illegal wildlife. The second were the groups doing the hunting, including local villagers, militia and military. The third were Lao traders who traffic wildlife to urban centers and foreign traders who in turn traffic wildlife to neighboring countries. The assumption was that illegal trade of target species would be reduced by establishing a permanent road checkpoint on the road from the NPA to the Vietnam border and by deploying mobile patrol teams to opportunistically check suspicious vehicles on roads around the NPA (Figures 5 and 11).

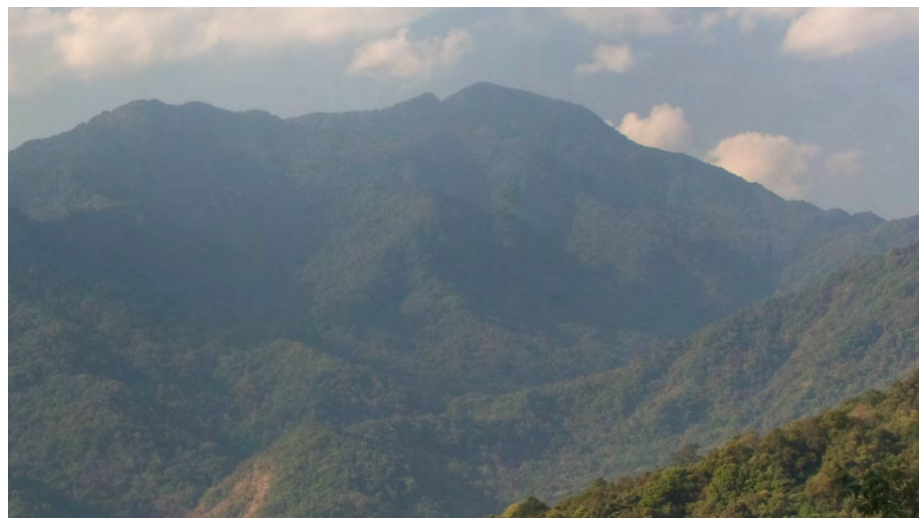
Report outreach monitoring results. The ex-poste evaluation of village and government trainings indicated that general knowledge of the hunting regulations was still low and that more awareness-raising was needed (Saypanya et al. 2006b) (Table 1-O1 & O2). Most respondents were between 19-45 years old; 74% were farmers and the rest were military soldiers (n=342). Over 88% of respondents still did not fully understand the government regulations protecting tiger and their prey, although 95% knew that wildlife trade was illegal. Respondents were divided in their attitudes about whether wildlife trade should be permitted or not, or if traders should be punished. Most respondents were still not clear about the purpose

of the TPZ and the regulations prohibiting entry into the TPZ. Eighty-four percent of respondents said that they liked tigers because they were a beautiful animal but only half of respondents knew that tigers were in danger of extinction. Four percent of respondents said they knew of someone who had killed a tiger in the last year and 3% said they knew of someone who had been punished for tiger poaching in the last three years.

Adapt outreach strategy. Given that the evaluation indicated that general knowledge of the hunting regulations remained low, the conservation extension teams prepared a three-year tiger conservation outreach strategy (2007-2009) incorporating the recommendations from the evaluation of outreach activities (Saypanya et al. 2006b) and from the recent evaluation of tiger and prey trade (Lynam et al. 2006). The three-year plan recommended that the project continue to design outreach activities with the objective to increase the knowledge of government officials and villagers about the importance of NPA and hunting regulations (Table 1 – O1 & O2). But instead of only emphasizing the need to conserve tigers, the outreach activities would also emphasize the value of enforcing the regulations to conserve other types of wildlife that had been found to be directly important to villagers' food security (e.g. managed species that could be legally hunted such as pigs, large rodents, game birds, etc.) (Krahn and Johnson 2007) (Table 1 - T2). The assumption was that this dual approach would more likely result in villagers embracing the enforcement of the regulations (Saypanya et al. 2006a).

Report target monitoring results. In Year 3, camera traps detected two new individual tigers in the three sampling blocks in the TPZ. The monitoring confirmed that tigers were still present in the TPZ but data were insufficient to generate a density estimate to determine if tiger abundance had changed (Table 1 - G1). The mean RAI of ungulates was 5.33 photos per 100 CTD (range 3.91-6.68), slightly higher than in Years 1 and 2 (Figure 8 and Table 1 - G2). The mean RAI of humans detected in the TPZ was 1.14 photos per 100 CTD in Year 3, a 65% increased from Year 2 (Figure 8 and Table 1 - L3).

Dry evergreen forests cloak Phou Louey mountain in the NPA Totally Protected Zone
© E. Briggs



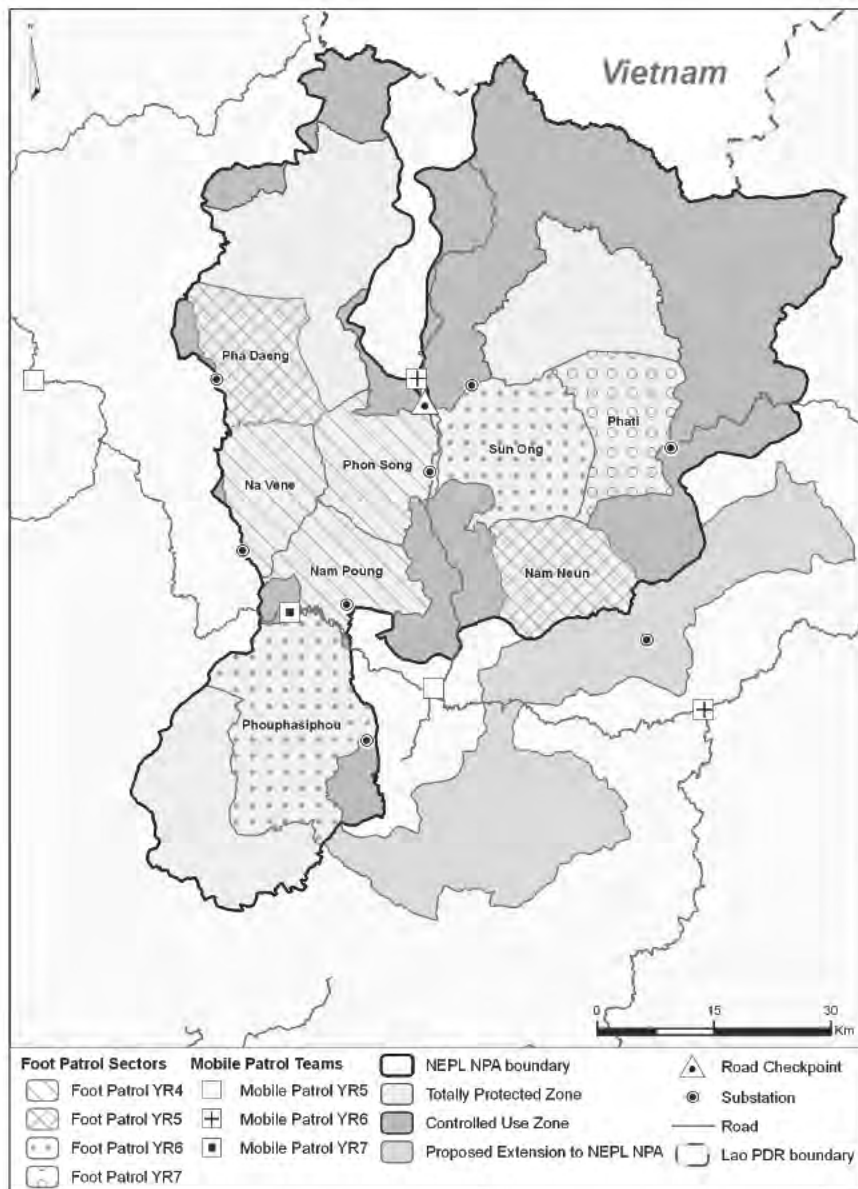
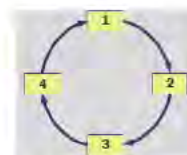


Figure 11. Spatial distribution of enforcement strategy actions from Years 4 to 7, including establishment of ranger stations and foot patrol sectors, mobile patrol team bases and a road checkpoint.

PROJECT YEAR 4 (2006-2007)

In Year 4, monitoring results and recommendations from Year 3 were used to adapt monitoring and implement enforcement and outreach actions (Steps 2 and 3). At end of Year 4, results were used to report to the third annual project meeting in February 2007, the second annual Tigers Forever meeting in July 2007 and to review and adapt our action plan for Year 5 (Step 4).



PMC Step 2. Plan actions and monitoring

Y1 Y2 Y3 Y4 Y5 Y6 Y7

Target monitoring. Based on the camera trapping results and baseline research that had shown the individual tiger home ranges in NEPL may be up to 200 km² in size (Johnson et al. 2006), the project worked with tiger monitoring specialists to review and adapt the design of our monitoring (following Karanth et al. 2006) to expand the survey area from an area covering a total of 300 km² to a survey area covering a total 1,200 km² in the 2,332 km² TPZ (See Figure 1- YEAR 3) . By expanding our sample area in Year 4, we assumed that we would capture more individual tigers and could generate an estimate of tiger density for the NPA. We also began discussing ways to expand and improve our analysis of trends in the relative abundance of ungulate prey by incorporating detection probability in the analysis using new occupancy-based methods that had been recently developed by Mackenzie et al. (2002, 2003).

PMC Step 3. Implement actions and monitoring

Y1 Y2 Y3 Y4 Y5 Y6 Y7

Implement enforcement strategy. Two part-time foot patrol teams completed 8 foot patrols in the TPZ in areas where tigers were detected by target monitoring in Years 2 and 3 (Figures 1 and 5). Hunting parties encountered in the TPZ were reported to district authorities for prosecution, guns were confiscated and hunting camps destroyed. When foot patrol teams were not in the forest, this year the teams periodically did opportunistic mobile patrols in district markets and restaurants to discourage bush meat trade.

As part of the ongoing law enforcement training, in March 2007, enforcement team leaders and government authorities traveled to the Seima Biodiversity Conservation Area in Cambodia, another WCS Living Landscapes site, to observe and discuss wildlife enforcement methods that were being successfully used there and to evaluate their potential utility in the NEPL NPA. As the enforcement monitoring in Year 3 had indicated that foot patrol effort was very low (mean of 2.1 days per team per month) and hunting was still present in the TPZ, it was decided that as funding became available, the project would begin to establish full time ranger stations in the TPZ to house foot patrol teams (Figure 5). In April 2007, the project worked with an enforcement specialist to determine the future placement of the stations. The team identified “doors” in the rugged topography that hunters entered to hunt tigers and prey in the TPZ. The entry points to the TPZ, where detection of tigers and large prey from the camera trap monitoring was highest, were selected for eventual placement of the stations. Plans were also finalized to construct a permanent road checkpoint to better detect wildlife trade along the main road going north through the NPA to Vietnam (Figure 11).

Monitor effectiveness of enforcement actions. Data on threats encountered (snares, hunting camps, explosive traps, guns, hunters) continued to be

systematically recorded by foot patrol teams on a standardized data form following methods developed and taught in Year 2 (Table 1 – L2 & L3). No standardized monitoring protocol was yet in place to track opportunistic mobile team patrolling in Year 4.



Figure 12. Village use zones and TPZ boundaries (superimposed black lines) that were identified in Years 4 to 7 by village authorities with NPA outreach teams and then demarcated by village representatives and NPA enforcement teams.

Implement outreach strategy. From October to February 2006, conservation outreach teams revisited 16 villages in Viengthong and Viengkham districts, which had received village trainings in Year 2, to develop village boundary agreements that formalized an agreement between the NPA, the district government and the village about the boundary between the village area and the TPZ and the implementation of hunting regulations in the NPA (Saypanya et al., 2007) (Figures 6, 7 and 12). After the agreements were finalized, the law enforcement teams and village authorities together demarcated the TPZ boundary along access trails from the village into the core zone (Figures 5 and Figure 12). In February, the outreach teams met with authorities in five villages bordering the NPA core zone to determine how to organize village informant networks to guard against tiger poaching in the NPA as a way to increase village involvement in both tiger protection and NPA management (Figure 6). At the request of district authorities, 15 more tiger conser-

vation billboards were set up in district centers and along access roads in the NPA to increase public knowledge of the importance of tiger and prey conservation and the hunting regulations.

Monitor effectiveness of outreach actions. Village agreements and maps showing TPZ boundary demarcation were co-signed by village and NPA authorities (Table 1-L5).

Monitor status of conservation targets. In December 2006, biological monitoring teams were retrained in the revised camera trapping sampling methods and equipment (Karanth et al. 2006). From December to April, teams deployed cameras across 800 km² of the TPZ where tigers and large prey had been detected from Years 1 to 3 (Table 1-G1). We continued to evaluate the feasibility of using line transects or an occupancy-based sign survey methods to improve long-term monitoring of prey abundance.

PMC Step 4. Analyze results and adapt

Y1 Y2 Y3 Y4 Y5 Y6 Y7

Results from implementation of the action and monitoring plans were presented at the third annual project meeting in February 2007, and at the Tigers Forever annual meeting in July 2007. Participants at the annual project meeting included representatives from the National Department of Forestry, Forestry Offices from three provinces and six districts, District Governor's offices, Provincial Tourism offices, NEPL NPA staff and villagers working with the wildlife monitoring, conservation education, and enforcement teams, and representatives from villages in the NPA.

Report enforcement monitoring results. From July 2006 to June 2007, the two part-time foot patrol teams walked a total of 1,005 km inside the TPZ for an average of 3.67 days of patrol effort every months and total patrol coverage of 850 km² (Figure 9 and Table 1-L2). This represented a 100% increase in km walked and a 27% increase in coverage as compared to the previous year. Detection of hunting sign per unit effort in the TPZ had dropped slightly from 0.07 signs per km walked in Year 3 to 0.057 (SD=0.028, n=2 part-time teams) signs per kilometer walked in Year 4 (Figure 10 and Table 1-L3). In addition to an increase in patrol effort and coverage, part of the decline in hunting sign was attributed to the absence of old

Camera traps for monitoring tigers also record the presence of hunters with illegal weapons inside the NEPL Totally Protected Zone .
© WCS Lao PDR / NEPL NPA



hunting camps that were being removed by foot patrol teams relative to the appearance of new hunting camps. During the days that teams were not patrolling in the TPZ, the evidence of new hunting camps indicated that poachers continued to opportunistically enter the area to hunt. Opportunistic mobile patrols of markets and restaurants for illegal wildlife trade were irregular and no systematic monitoring was yet in place to assess effectiveness.

In February 2007 wildlife monitoring teams found tiger remains in the TPZ near the site of a metal spring snare baited with a wild pig (Table 1-T1). At the site, enforcement officers found shells from a relatively unique brand of automatic gun that was used to kill the tiger. A gun of this brand was later located in a village on the edge of the TPZ. Although evidence was gathered on the case by police and a village informant reported knowing the identity of the poachers, prosecution was never achieved because the informant would not report without assurance of a substantial financial reward of several hundreds of dollars.

Adapt enforcement strategy. As soon as funding could be secured, the project aimed to deploy full time ranger stations to increase patrol effort and coverage in the TPZ and also full time mobile teams to intercept wildlife trade. In Years 3 and 4, limited human and financial resources meant that analysis of patrol monitoring data was slow and sometime it took two or three months to provide NPA management with information on patrol effort and coverage. As part of the new Tigers Forever initiative, the project planned to access technical assistance and training for the NPA to upgrade the existing Excel-based law enforcement monitoring (LEM) system to a more robust MIST (Management Information SysTem developed by Ecological Software Solutions) database system. The GIS capability of MIST would allow project staff to more rapidly map and analyze patrolling results to make enforcement actions more effective.

Report outreach monitoring results. Village agreements led to TPZ boundary demarcation in eight villages in Viengthong district and eight villages in Viengkham district (Table 1-L5, Figure 12) (Saypanya et al. 2007).

Report target monitoring results. The camera trapping survey for Year 4 across the larger 800 km² of the TPZ did not photograph any tigers (Table 1-G1). Given observations of large felid tracks with pad widths ≥ 7.5 cm, it was assumed that tigers were still present in the area but were not photographed due in part to some camera failure and in part because camera trapping effort was too low (<150 CTD per 100 km²). The results confirmed that the project would need to revert to a minimum of 300 CTD of effort per 100 km² (as used in Years 1-3) over a larger geographic area to detect a sufficient number of tiger individuals to be able to generate a density estimate.

In Year 4, the mean RAI of ungulates dropped to 3.65 photos per 100 CTD (range 2.14-5.19) (Figure 8 and Table 1-G2). The mean RAI of humans detected in Year 4 (0.56 photos per 100 CTD) was lower than in Year 3, but similar to that detected in Year 2 and five times higher than in Year 1 suggesting that there was still human activity in the TPZ that posed a potential threat to tigers and their prey (Figure 8 and Table 1-L3).

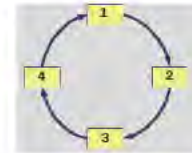


Adapt the goal and the method for monitoring conservation targets. In 2007, after several years of status monitoring and in collaboration with the Tigers Forever portfolio of projects, the project modified the goal for the conservation target of tigers to specify that the project aimed to increase the tiger population in the TPZ by at least 50% by 2015 with an ungulate prey population to support this increase (Table 1-G1 & G2). Beyond, 2015 the longer-term goal of the project was to reach a population of 25 breeding females in the 3,000 km² TPZ. Although tiger numbers in NEPL were low, this long-term goal was adopted based on the known high resilience and fecundity of tigers, which indicated that there was enormous potential for significantly increasing tiger density in the future. Through this analysis, we assumed that if adequate funding was secured to protect the entire 3,000 km² NEPL core zone, the habitat would be suitable for achieving a 15-fold increase in tigers, which would be an increase from the estimated 7-23 individuals in Year 2 (Johnson et al., 2006) to potentially 150 individuals in the very long term.

Given the cost of extensive camera trapping for tigers, after consultation with other technical experts the project opted to change the tiger monitoring approach to opportunistic scat collection for fecal DNA analysis (Table 1- G1). Scats could be collected by existing foot patrol teams in the TPZ with some periodic assistance from wildlife monitoring teams. The fecal DNA method was much less costly than camera trapping and would allow the project to track and estimate the minimum number of tigers, and their relatedness, in the TPZ rather than absolute density. The financial savings would be used to deploy the full time ranger stations and mobile teams to protect tigers by combating the continued threats of hunting and trade. At the same time, the project team in consultation with scientists and donors made a plan to undertake a sign-based occupancy survey in the TPZ in Year 5 to assess the status of the ungulate prey base as a proxy for determining how many tigers could be supported at the site (Table 1-G2).

PROJECT YEAR 5 (2007-2008)

In Year 5, monitoring results and recommendations from previous years were used to modify the way we trained and deployed our enforcement staff and how we monitored both our patrol effort and our target species (Step 3). By the end of Year 5, the monitoring results provided us with a preliminary assessment of the effectiveness of the expanded enforcement effort, a rigorous baseline estimate of ungulate prey occupancy throughout the TPZ, and an estimate of the minimum number of tigers in the TPZ through the fecal DNA analysis of carnivore scats (Step 4).



PMC Step 3. Implement actions and monitoring



Implement enforcement strategy. From July 2007 to February 2008, the NPA recruited and provided law enforcement training for 42 permanent enforcement officers (Lynam and Venevongphet 2007), which was more than a three-fold increase from the number of officers in the two previous years. This included 31 staff in five ranger station sectors covering 1,612 km² of the TPZ (Figures 5 and 11). Each station housed 6-8 full-time staff (foresters and military) that did continuous foot patrols in their respective sectors of the core zone (average of 236 km² per sector). Outside the TPZ, three “fixed point” patrols were established. This term is used to describe patrolling at a fixed point along a road, which could be permanent or temporary, or periodically in a restaurant or market. Three staff were deployed at a permanent road checkpoint built along the main road from the NPA to Vietnam to record and check vehicles passing through the checkpoint and to respond to informant reports of wildlife trade (Figure 11). Eight staff were deployed in two mobile patrol teams with one team checking roads and the urban center near the NPA headquarters and the other team patrolling roads and centers on the west side of the NPA. The mobile teams set up temporary roadblocks at strategic locations – frequently at night - along major roads to stop and search vehicles, including buses that frequently carried wildlife to urban markets. The mobile teams also patrolled for wildlife trade in markets or restaurants and periodically worked with villages to collect and destroy illegal homemade muskets used for hunting.

To increase government capacity in law enforcement, outreach and enforcement staff worked together with district and provincial governors to draft, ratify and disseminate the first NEPL NPA regulations (Figures 5 and 6). Three districts finalized and signed the regulations into effect in early 2008. The regulations are based on the recent national Forestry and Wildlife Laws (GoL 2007b, a), but are specific to the NEPL NPA, showing a map with the boundaries of the NPA TPZ and the controlled use zone (CUZ) and what species can be hunted in the CUZ during what seasons and with what gear (GoL 2008). Each district outlined detailed procedures for issuing warnings and for collecting and distributing fines. A reward system from the fines collected was set up. It was assumed that the rewards would stimulate the public to report illegal activity and for government officers to respond to reports (Figure 5).

At the time, we estimated that there were approximately 500 military-issued weapons held in the nine military camps around the TPZ and approximately 500 more held by village militia in the 98 villages around the NPA. The latter were for the stated purpose of village and national security. To control the use of military weapons, which were used to kill tigers and large ungulates the NPA (Figure 4), the NPA secured permission from district and provincial military authorities for enforcement and outreach staff to work with the military to issue gun licenses identifying the officer authorized to use each military weapon (Figures 5 and 6). The license would show the name and photo of the registered user. The intent of this was to allow NPA enforcement teams to easily check if people carrying military weapons were authorized to do so. It was assumed that having gun licenses would reduce the lending of military weapons to village hunters in return for part of the wildlife harvested.

Monitor effectiveness of enforcement actions. In Year 5, we adopted the MIST law enforcement monitoring system (<http://www.ecostats.com/>) to better monitor many of our law enforcement objectives (Table 1), and to more efficiently store and analyze the expanding law enforcement activity by foot patrols, mobile patrols and the road checkpoint in the NPA. The data forms and database were designed in November 2007. Enforcement data from the Excel database in Years 3 and 4 were integrated into the new MIST database. In February 2008, foot patrol and mobile patrol teams were trained in the revised data collection methods. The systematic MIST data forms were designed to allow each team to collect relevant data on people encountered (seen, not caught, confronted), animals (seen, confiscated, released, destroyed), weapons/gears (seen, confiscated, destroyed), camps (abandoned, used; seen, destroyed), and gun shots (heard). Completed data forms and GPS spatial data were brought to the NPA headquarters at the end of each month by a team representative, where it was checked and entered into the MIST database by a NPA enforcement officer. Team representatives were able to immediately present their spatial patrol coverage and a summary of observations at the monthly meeting of NPA management unit. The results were used by the NPA management and team leaders to plan enforcement action and routes before they returned to their respective field stations the following day.

Implement outreach strategy. Given what we had learned in the first four years of the project we assumed that public support for and compliance with the increased law enforcement was unlikely to happen unless outreach teams were present in each district to actively and regularly engage with all the villages and districts bordering the TPZ. Thus, wherever we expanded law enforcement effort, we also deployed outreach teams with the objective of increasing village and government knowledge of hunting regulations and of the incentives for villagers to report illegal hunting and for government officers to enforce the regulations (Figure 6). Outreach staff (2-3 per district) preceded the initiation of law enforcement activities to increase the knowledge of villages and district centers of the purpose and location of NPA zoning and the NPA regulations regulating wildlife offtake and land use. The outreach team disseminated regulations through village trainings in 56 villages in four districts (Houameuang-15, Viengthong-29, Viengkham-3 and Phoukout-9) around the core zone to present the contents of the new regulations

and to engage villages to work with enforcement staff to demarcate the TPZ and their village boundary (Figure 7). The trainings included interactive activities with villagers to understand what species are protected, what gear is illegal for hunting (e.g., guns, metal snares and explosives), and that only they and not outsiders have rights to hunt in their village area during designated seasons. Ten thousand copies of a poster created by a villager that depicted these benefits of the village use zone and the TPZ were printed and given to every household as part of the interactive activities.

Working with the mobile enforcement teams, the outreach section created 200 TPZ boundary signs to accompany the corresponding village boundary agreement. The draft agreements were taken to the village committees for discussion to solicit how the NPA benefits and restricts communities from the NPA zones. The signs and final agreement were used to demarcate the TPZ.

Eight large metal NPA sign boards, in Lao, English and Vietnamese languages, demarcating the NPA at strategic points where local residents and outsiders enter the NPA, were created and erected (Figure 6). To reduce the use of military guns for hunting, outreach activities also included working with NPA enforcement staff and military authorities in two districts to register the guns held by village militia and to issue gun licenses to the authorized weapon holder.

Monitor effectiveness of outreach actions. A pre-test / post-test monitoring design was used to evaluate change in knowledge as a result of village trainings in the 56 villages in four districts (Houameuang-15, Viengthong-29, Viengkham-3 and Phoukout-9) (Table 1-O2). To improve monitoring of the demarcation of the TPZ, a protocol was established to photograph and record the coordinates of each TPZ sign as it was posted. As coordinates were received the confirmed boundary of the TPZ would be stored in the NPA GIS system (Table 1-L5).

Monitor the status of conservation targets. Based on the recommendations from Year 4, the project conducted a prey occupancy survey from January to June 2008 to record presence/absence of prey sign (pellets and tracks of gaur, sambar, serow, pig and muntjac) to assess the abundance and distribution of ungulate prey in the TPZ (Vongkhamheng 2011) (Table 1-G2). To implement the survey, 11 eight-person teams sampled 200 13km² grid cells passing through predetermined sampling points in each of the four 3.25km² sub-grids of each grid cell along the survey route (Figure 14). Total sample effort covered 2,000 km (straight line distance) but actual effort due to the mountainous terrain totaled 4,617km walked.

To estimate minimum number of tigers in the TPZ felid scat samples were collected opportunistically during the prey occupancy survey and also by foot patrol teams in the TPZ (Vongkhamheng 2011) (Table 1-G1). Scat samples were sent to the Center for Conservation Genetics and Global Felid Genetic Program of the American Museum of Natural History, New York, for DNA extraction and identification of species, tiger individuals, sex and relatedness.

Each month, the heads of all the NPA enforcement, outreach, and target monitoring teams (Figure 2) attended a meeting with NPA management to review the enforcement monitoring results and to make recommendations for the following month's management activities. Enforcement results were cross checked with target monitoring results and used to adapt enforcement activities and to inform the outreach activities with villages and government. Results from implementation of the action and monitoring plans were presented later at the Tigers Forever annual meeting in July 2008 and at the fourth annual NPA meeting in November 2008 (Year 6).

Report enforcement monitoring results. To measure progress towards our enforcement objectives, we monitored wildlife hunting and trade using the MIST law enforcement monitoring system put into place in January 2008. With the placement of five full-time foot patrol teams in the TPZ in the last half of Year 5, total patrol effort (July 2007-June 2008) was 1,942 km and an average of 5.15 days per month per team. Total spatial effort of patrolling in Year 5 covered 1,706 km² of the NPA (Figure 9, Table 1-L2). This was twice as much patrol effort and spatial coverage as achieved in Year 4. The expanded coverage meant that this was the first year that many areas of the TPZ had been checked by foot patrol teams and observations of hunting were found throughout the area. The catch per effort index of hunting in Year 5 was 0.067 signs per km walked (SD=0.052, n=2 part-time teams and 5 full-time teams), slightly higher than recorded in the previous year (Figure 10, Table 1-L3). Foot patrols collected 91 metal spring snares and encountered four explosive traps and one spear snare in the TPZ (Table 1-L4). They encountered hunters with 49 firearms (45 muskets and 4 military weapons) and confiscated 15 muskets and 2 military weapons. A total of 89% of encounters with poachers (n=19) resulted in a confrontation (Figure 13a). Of the poachers confronted, enforcement action was taken in 94% of the cases (Figure 13b, Table 1-L6). In 75% of these cases (n=16), fines were collected that ranged from \$160-200 per case.

Mobile patrol effort ranged from an estimated 100 days each by the two teams at roadblocks, restaurants and markets and 300 days at the road checkpoint on the road to Vietnam. During the year, mobile patrols processed 37 offender cases (6 arrests, 19 fines and 12 warnings) (Table 1-L7). A new access road was being built from Vietnam to the NPA, which was aiding and encouraging wildlife crime. Although illegal wildlife trade was apprehended, it consisted largely of small high value species (54 turtles, 65 East Asian porcupines, and 18 pangolins) (Table 1-L8). Very little trade in tiger prey species was detected (muntjac 11kg, pig 8 kg and sambar antlers). While doing gun collections, the mobile teams collected and destroyed 924 homemade muskets and 11 large metal jaw traps for capturing large mammals from 38 villages around the core zone (Table 1-L4). Law enforcement monitoring also confirmed that two tigers were poached in the vicinity of village livestock grazing areas this year (Table 1-T1).

Adapt enforcement strategy. As a result of our law enforcement monitoring showing that the mobile patrol teams were detecting very little trade in large ungulates, there were doubts about the effectiveness of the teams. As the NPA increased

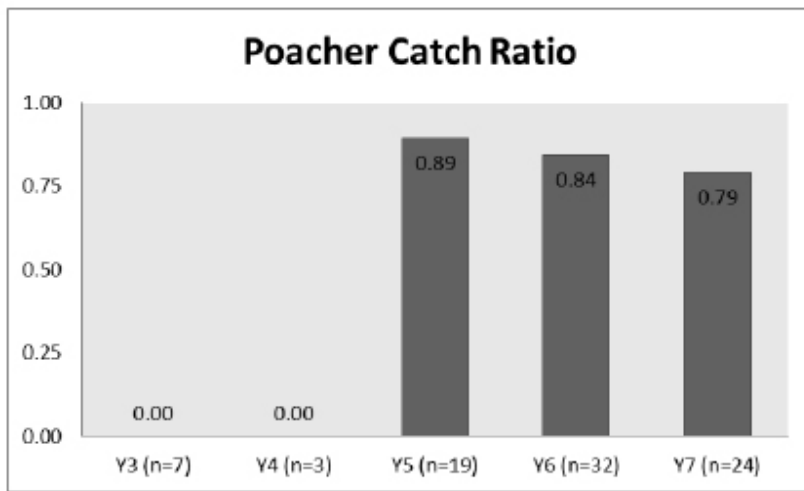


Figure 13a. Proportion of encounters of foot patrol teams with poachers in the TPZ in Years 3 to 7 (total number of encounters n on x axis) that resulted in confrontation.

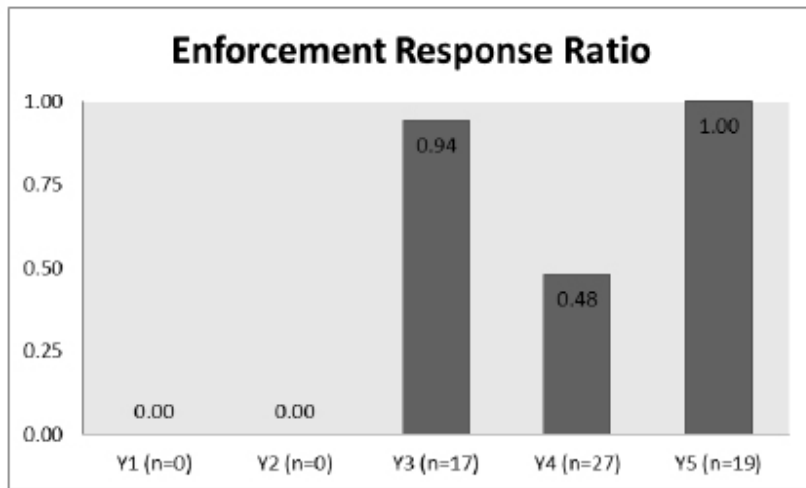


Figure 13b. Proportion of foot patrol team confrontations with poachers in the TPZ in Years 3 to 7 (total number of confrontations n on x axis) that resulted in enforcement action (warnings, fines, or arrests) being taken.

enforcement, we also observed that wildlife crime began to go underground and assumed that we needed to put more effort into engaging and receiving reliable and timely reports from village informants. Logistically, the project faced enormous challenges of coordinating implementation over a large rugged landscape and most important, adequately supervising enforcement teams to remain vigilant and honest. As the value of illegally traded wildlife products increased so did the incentives for engaging in crime. The project decided to increase the HF radio network to better monitor the daily activities of foot patrol teams. The results of the prey occupancy survey (see below) indicated that we also needed to further expand foot patrol coverage to adequately protect the remaining pockets of large prey and tigers in the TPZ.

Report outreach monitoring results. Comparison of pre-test and post-test survey responses from 56 communities (Houameuang-15, Viengthong-29, Viengkham-3 and Phoukout-9) indicated that knowledge of NEPL NPA regulations had increased by 18% (n=173 respondents). There was a 31% increase in respondents that indicated concern about the illegal use of government-issued guns for hunting in village areas and a 9% increase in those that felt it was important to stop outsiders from illegally harvesting natural resources (fish and other aquatic animals, wildlife and timber) in the village area (Table 1-O2).

Adapt outreach strategy. Given the outreach monitoring results from the 56 villages, the outreach team decided to engage in two major outreach activities in the coming years. The first was to implement formal workshops at the district level to disseminate the NPA regulations to district authorities, village headmen, militia, police and military. The second activity was to implement outreach methods in a smaller subset of villages that were aimed at strengthening village action to reduce the use of government-issued guns for illegal hunting and to prevent outsiders from illegally harvesting fish, wildlife, and timber from village areas.

Report target monitoring results. The results of the occupancy survey indicated that ungulate prey populations in the TPZ were quite low (estimated 5.25 ungulates per km²), with smaller-sized ungulates (muntjacs and wild pigs) more widely distributed than large species (serow, sambar, and gaur) (Vongkhamheng 2011) (Table 1-G2). The results were consistent with prey abundance indices estimated from Year 1, which also showed that abundance of large-sized ungulates was low, while abundance of smaller-sized prey populations were significantly higher, particularly where human density was lower (Johnson et al. 2006). The occupancy survey indicated that pockets of large ungulates still persisted in remote parts of the TPZ with the potential to repopulate the larger landscape (Vongkhamheng 2011) (Figure 14). The results indicated that the project needed to increase foot patrol coverage to protect these remaining areas with large ungulates for the recovery of both prey and tigers.

The fecal DNA from felid scats indicated that tigers still occurred in areas of the TPZ where ungulate abundance was highest but the number of individuals remained uncertain (Vongkhamheng 2011) (Figure 14 and Table 1-G1). Foot patrol and wildlife monitoring teams also recorded large felid tracks exceeding 13cm in length and width, which were likely to be tiger, in five different areas of the TPZ. The

information on spatial distribution of tigers and ungulates was used to direct and expand the geographic coverage of foot patrol effort in the TPZ.

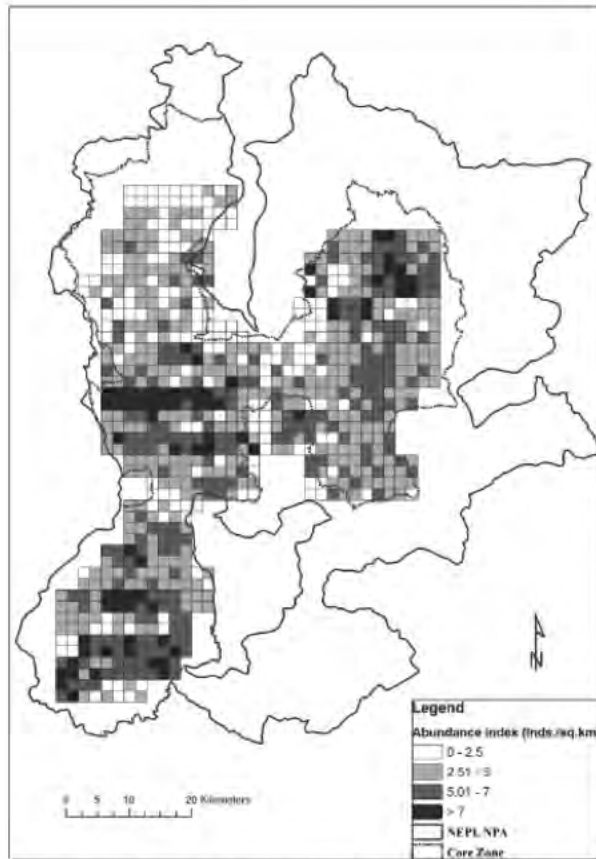
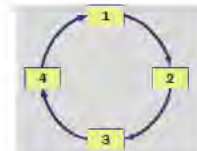


Figure 14. Map showing spatial distribution of large prey abundance (Gaur, Wild Pig, Serow, Sambar) in each 3.25km² grid cell in Year 5 (Vongkhamheng 2011). Lighter colored grids indicate lower animal abundance indices, whereas grids with darker color show higher abundance index values.

PROJECT YEAR 6 (2008-2009)

In Year 6, the project reviewed the conceptual model to try to improve the effectiveness of the outreach and enforcement actions to better address illegal hunting for trade (Step 1). Results chains and objectives were developed to illustrate assumptions of how knowledge, attitudes and behavior of villagers, illegal hunters, and government officials would change if a social marketing campaign was implemented as part of the outreach strategy (Step 2). Monitoring results and recommendations from Year 5 were used to further expand enforcement and outreach actions to protect areas of the TPZ with tigers and large ungulates. Beyond the NPA, a questionnaire survey to assess the status of tigers, ungulate prey, and threats in the wider landscape was completed (Step 3). By the end of Year 6, the monitoring results were used to evaluate the results of the expanded enforcement effort and the status of tigers and prey in the TPZ and the surrounding landscape (Step 4).



PMC Step 1. Conceptualize the project

Y1 Y2 Y3 Y4 Y5 Y6 Y7

In April and May 2009, village and district leaders from Viengthong District, which contains almost 60% of the NPA, met to review the conceptual model developed in Year 4, rate direct threats and identify how to implement a social marketing campaign and law enforcement to reduce the highest ranked threat of illegal hunting with modern weapons (guns, wire snares and explosives) for trade. The process indicated that the social marketing campaign should work on increasing informant reports of illegal activities while also increasing government enforcement of regulations in response to the reports (Saypanya 2010).

PMC Step 2. Plan actions and monitoring

Y1 Y2 Y3 Y4 Y5 Y6 Y7

To develop social marketing campaign objectives and activities that were to be implemented in Year 7, results chains were developed for three target audiences i) illegal hunters, which were identified as village militia and village police because they held automatic firearms, ii) other villagers that could report illegal hunting and trade, and iii) government officers that were sometimes part of the problem by accepting bribes, buying wildlife meat, or trading in ammunition (Saypanya 2010, Saypanya et al. In review) (see Figure 6). The slogan of the campaign promoted sustainable legal hunting for subsistence and not trade, "Hunt to eat, not to extirpation". The assumption for each target audience was that a change in knowledge would result in a change in attitude and interpersonal communications such that each group would change their behavior to in turn reduce illegal and unsustainable hunting of tiger prey.

For illegal hunters, it was assumed that punishment for illegal behavior plus peer pressure from people in the same village who had rights to legally harvest small ungulates (wild pigs and muntjacs) for food would cause them to reduce criminal activities (Figure 6). For general villagers, the assumption was that the incentive to protect ungulates that they could harvest legally for household consumption along with the rewards received from fines for reporting illegal hunting would promote villagers to report illegal hunting and trade to a NPA Wildlife Crime Unit. For government officers, it was assumed that the incentive to collect rewards from fines along with public support for enforcement would cause them to enforce the hunting regulations. Based on these assumptions, a number of explicit objectives were set to change the knowledge, attitudes, interpersonal communication and behavior of government officials, villagers and potential illegal hunters (Saypanya 2010) (Table 1-O1 to O9). A quasi-experimental pre-test and post-test monitoring design was planned for Year 7 to monitor and evaluate the effectiveness of the social marketing campaign across three target audiences at a campaign site and a control site.

PMC Step 3. Implement actions and monitoring

Y1 Y2 Y3 Y4 Y5 Y6 Y7

Implement enforcement strategy. In May 2008, two more full-time foot patrol teams were recruited, given law enforcement training and posted at ranger sta-

tions to patrol in sectors covering an additional 689 km² in the TPZ (Figures 5 and 11). These two sectors had been identified as a priority for protection based on the detection of tigers and large prey as a result of target monitoring in Year 5 (Figures 14 and 15). In Year 6, a total of 45 staff in seven foot patrol teams patrolled continuously across 1,777 km² of the TPZ.

Outside the TPZ, two more mobile patrol teams were established on the north and east sides of the NPA (Figures 5 and 10). In Year 6, a total of four mobile teams and one road checkpoint were in full operation. The mobile enforcement teams worked intermittently with village leaders to try to motivate the informant network to report to the NPA wildlife crime unit and local authorities and communities leaders to investigate people engaged in wildlife crime. When informant reports were received, mobile teams responded by setting up roadblocks and checking restaurants and markets. Foot patrol and mobile patrol team leaders went for further regional law enforcement training in Thailand in January 2009.

Monitor the effectiveness of enforcement actions. In Year 6, all enforcement staff (7 foot patrol teams, 4 mobile teams, and one road checkpoint) collected data on law enforcement effort, threats and key species using the systematic MIST data forms (Table 1-L2 to L4, L6 to L8). Results and recommendations for improvement were reported each month in the meeting of NPA management unit.

Implement outreach strategy. Outreach teams and the district governors' offices held three district-wide village trainings for village headmen and village police from 85 villages in two districts (Viengkham and Viengthong) to disseminate and discuss the content and implications of the NPA regulations. Small group discussion was focused on specific aspects of the regulations with presentation to the large group, and a large group question and answer period (Figure 6). The objective of the meetings was for village authorities to understand their rights and responsibilities towards the NPA TPZ and village use areas.

The outreach team also did village trainings in 22 villages in three districts (Houameuang – 14, Viengkham – 2, and Phonhong - 6) to discuss natural resource management, benefits of the hunting regulations and to engage villages to demarcate the TPZ and their village boundary (Figures 6 and 7). Teacher trainings were given for educators in the two high schools in Viengthong district, the largest administrative district in the NPA. Because most high school students marry and become active members of their village communities shortly after high school graduation, it was assumed that training educators how to teach students about the importance of biodiversity and endangered species conservation, and how these directly link to local people's livelihoods would lead to an increase in villager knowledge and support for NPA management (Figure 6).

Monitor the effectiveness of outreach actions. Monitoring results from Year 5 had been used to prioritize and guide the design of outreach activities in Year 6. No further monitoring of outreach actions was done in Year 6.

Monitor the status of conservation targets. In Year 6, foot patrol teams and wildlife monitoring teams continued to opportunistically collect felid scat samples to monitor the minimum number of tigers in the TPZ (Vongkhamheng 2011) (Table

1-G1). A landscape questionnaire survey was used to gather baseline information on the proportion of the 24,300 km² NEPL landscape that is occupied by tigers and large ungulates (Table 1-G3). Although the area exceeded the scope of the project, the survey aimed to assess if the TPZ was located in the most optimal site in the landscape for conserving tigers and prey and what were the major factors influencing the occurrence and distribution of tigers and prey in the landscape that may in turn impact the long-term recovery of tigers and large ungulates in the NEPL NPA (e.g., connectivity to suitable habitat occupied by other populations of tigers and large ungulates) (Vongkhamheng 2011).



Figure 15. Confirmed scat samples collected from January 2008 to May 2010 and records of tiger tracks (pad width ≥ 7.5 cm) from July 2009 to June 2010 (Vongkhamheng 2011) with survey coverage shown in Figure 11 (foot patrol sectors) and Figure 14 (prey occupancy survey).

PMC Step 4. Analyze results and adapt

Y1 Y2 Y3 Y4 Y5 Y6 Y7

The NPA continued to hold regular monthly meetings where the heads of the enforcement, outreach, and target monitoring teams met with NPA management to review enforcement monitoring results and make recommendations for the following month's management activities. Results were cross checked with target monitoring results and used to adapt enforcement activities and to inform the outreach activities. Results from implementation of the action and monitoring plans were presented at the NPA annual meeting in April 2009 and at the Tigers Forever annual meeting in July 2009.

Report enforcement monitoring results. With seven full-time foot patrol teams in place, patrol effort (compiled for July 2007-June 2008) totaled 6,181 km inside the TPZ and an average of 21.2 patrol days per month per team in Year 6, which was approximately four times more effort than in the previous year. Total spatial effort of patrolling in Year 6 covered 3,350 km² of the NPA as compared to 1,706 km² in Year 5 (Figure 9, Table 1-L2). The catch per effort index of hunting in Year 6 had dropped to 0.021 signs per km walked in the TPZ (SD=0.014, n=7 full-time teams), which was 67% lower than the index for the previous year (Figure 10, Table 1-L3). A total of 84% of encounters with poachers (n=32) resulted in a confrontation (Figure 13a). Of the poachers confronted, enforcement action was taken in 48% of the cases (Figure 13b, Table 1-L6). In cases when enforcement action was taken (n=13) it resulted in fines in 77% of cases and one arrest. A total of 67 firearms (58 homemade muskets and 9 automatic guns) as well as 2 Sambar deer and 1 muntjac were confiscated from hunters by foot patrol teams in the TPZ (Table 1-T1 and L4).

The four mobile teams patrolled for a total of 454 days in Year 6, an average of 9.46 days per month per team (Table 1-L7). The road checkpoint did random checks of vehicles when informant reports were received. During the year, the mobile patrols and the checkpoint processed 31 offender cases with 65% resulting in fines that ranged from \$6-875 per case (Table 1-L6). Most arrests and fines resulted from public reports through the informant network. As in the previous year, illegal trade of tiger prey was reported but only one case of wild pig (65kg) was apprehended (Table 1-L8). As in the previous year, trade detected was largely of other high value species (78 turtles, 13 porcupines, a set of bear paws, four leopard bones, and 2 kg of civet meat). The mobile teams worked in 84 villages in three districts (Viengkham, Huaemuang and Viengthong) to collect 859 homemade muskets (Table 1-L4). Working from the village agreements for boundary demarcation that were facilitated by the outreach teams, the mobile patrol teams and village leaders erected 40 TPZ boundary signs on the borders with 16 villages in Viengkham and Viengthong districts (Figure 12, Table 1-L5).

Adapt enforcement strategy. Based on the enforcement monitoring results, the NPA recommended that at least one more ranger station and foot patrol team be established in the northeast corner of the TPZ where ongoing fecal DNA monitoring indicated the presence of breeding tigers (Vongkhamheng 2011) (Figures 11 and 15). Monitoring results from Years 5 and 6 suggested that the road checkpoint and mobile teams were still largely ineffective in detecting and apprehending illegal trade of ungulates outside the TPZ. The updated situation analysis this year (Step 1) indicated that the principle barrier was that villagers were not well informed about how to report illegal activity to the Wildlife Crime Unit and that there was no contact person in the Unit to receive and record reports and reports were often ignored (Saypanya 2010). For this reason, the social marketing campaign in Year 7 would be aimed at stimulating public reporting of illegal hunting and trade to the NPA Wildlife Crime Unit via a widely publicized hotline along with messaging and incentives for the NPA to work with official district enforcement agencies (police and military) to increase the effectiveness of mobile patrol response to informant reports.

Adapt outreach strategy. From Years 2 to 6, the outreach team had imple-

mented conservation outreach activities in many villages across several districts over a large geographic area based on available budget, human resources and time (see Figure 7). The rationale for this was to increase village and government understanding and support for the expanding law enforcement effort in the NPA. During the planning for the social marketing campaign (Steps 1 and 2 this year), government and village authorities recommended that the frequency of visits to each village should increase to improve the likelihood that villagers would see the connection from one outreach activity to the next, and ultimately change their behavior regarding illegal hunting and trade. This recommendation supported the idea of testing a social marketing campaign approach to conservation outreach in a smaller subset of villages in Year 7.

Report target monitoring results. The results of the landscape occupancy survey for tiger and prey from interviewing local experts (n=372) found that reports of tiger presence occurred in more than 70% of 24,300 km² landscape area (Vongkhamheng 2011) (Figure 16, Table 1-G3). Tigers more often occurred in areas of the landscape where human population and hunting pressure on prey was lower and in areas within or nearby an NPA. Similar to findings from ungulate surveys in the NPA in Years 1 and 5, occupancy rates of large ungulates (gaur and sambar deer) across the entire landscape were generally lower than those of smaller prey species (serow, wild pig, and muntjacs). The results supported continuing to focus conservation efforts inside and nearby the NEPL NPA, using law enforcement and outreach activities to protect tigers and large ungulates from poaching and to maintain habitat connectivity between NPAs to secure the long-term survival of tigers. In Year 6, the fecal DNA analysis of large carnivore scats estimated that tigers still occurred in four areas of the NEPL TPZ (Vongkhamheng 2011) (Figure 15, Table 1-G1).

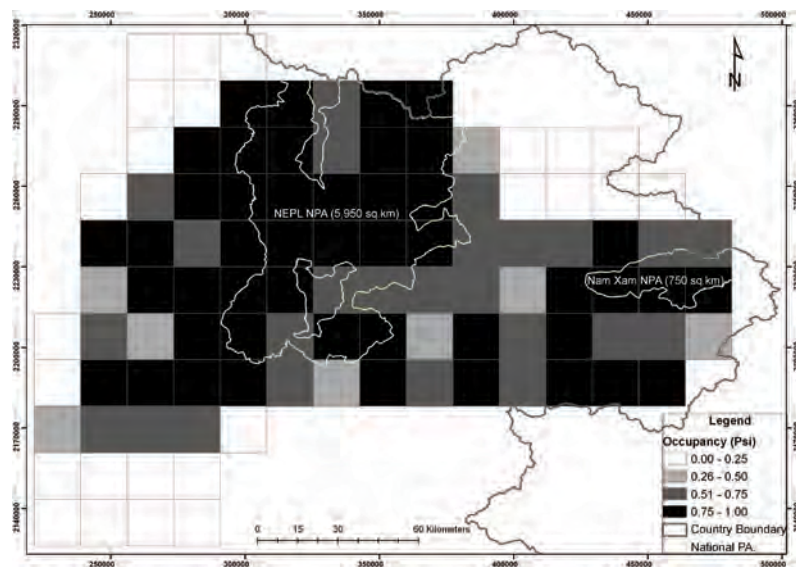
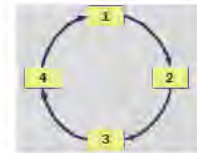


Figure 16. Estimated probability of tiger occurrence in Year 6 in 81-300 km² grid cells in the landscape surrounding the NEPL NPA including two National Protected Areas (outlined in white) (Vongkhamheng 2011). Lighter colored grids indicate lower estimated probabilities of occurrence whereas grids with darker color show higher estimated probability of occurrence.

PROJECT YEAR 7 (2009-2010)

The action plan for implementing the social marketing campaign and a wildlife crime unit, along with the results from enforcement monitoring and target monitoring from Year 6 were used to implement enforcement and outreach actions in Year 7. A quasi-experimental design was used to monitor and evaluate the effectiveness of the social marketing campaign (Step 3). Results were reported at monthly meetings of the NPA Management Unit and to the Tigers Forever annual meeting in July 2010 (Step 4). In Year 7, there were 109 project staff working with the NPA, with the majority (69%) engaged with implementation of the enforcement strategy followed by 9% of staff implementing the outreach strategy and monitoring, and 4% doing target monitoring (Figure 2).



PMC Step 3. Implement actions and monitoring



Implement enforcement strategy. At the end of Year 7 (May 2010), one more full-time foot patrol team was recruited, given law enforcement training and posted to a new ranger station in the northeast part of the TPZ to protect the breeding tigers and large prey that had been detected through status monitoring in Years 5 and 6 (Figures 5 and 11). The total area under the protection by full time foot patrol teams by the end of Year 7 covered 2,066 km². In the NPA headquarters, a technical staff person in the wildlife crime unit was trained to receive and monitor public reports of illegal hunting and trade via the wildlife crime hotline that was supported by the social marketing campaign (Figures 5 and 6; see outreach strategy details below). The number of full time staff in mobile patrol teams was reduced and the teams were reorganized to include only one NPA staff working with existing government officers (police, commerce, customs, forestry or military). The team was assembled to respond only as reliable reports were received by the wildlife crime unit. Informants received cash rewards from the fines that were collected from successfully apprehending the persons engaged in wildlife crime. Under the outreach strategy, actions were implemented in 36 villages in Viengthong District (see outreach strategy details below) to try to increase village reports of illegal hunting and trade to the wildlife crime hotline and to increase government response to the reports, which would in turn reduce illegal hunting and trade (Figures 5 and 6). In Year 7, the NPA repositioned one mobile patrol staff to protect the corridor where tigers and their prey crossed Highway 1 passing between the Nam Pong and Phouphasiphou sections of the NPA (Figure 11).

Monitor effectiveness of enforcement actions. In Year 7, the eight foot patrol teams and the five mobile teams continued to collect data on law enforcement effort, threats and key species using the systematic MIST data forms (Table 1). The wildlife crime hotline used an Excel data form to record the number and type of reports received from informants, the number of times that a mobile team responded to a report, and the reports that led to criminals successfully being caught and fined for their illegal activities (Saypanya 2010) (Table 1-L8).

Implement outreach strategy. Based on the action and monitoring plans developed in Year 6 (Steps 1 and 2), a social marketing campaign, linked with the wildlife crime unit under the law enforcement strategy, was implemented in 36 village areas surrounding the Viengthong NEPL NPA headquarters that bordered the NPA (Figures 6 and 16) (Saypanya 2010). A messaging theme was developed for the three target audiences, i) for illegal hunters it was to, “use the right gear to hunt managed species in the CUZ, outside of breeding season and for consumption only”, ii) for villagers it was, “the wildlife food of the villagers is almost gone – I will report every time I see illegal hunting and wildlife trade”, and for government officers, it was “I will follow up on all illegal hunting and trade cases because I am a dedicated government official who does not buy or sell wildlife.”

Activities and materials with these messages were deployed across the campaign site over a one-year period beginning in August 2009. The campaign material included billboards and awnings on commercial shops and government buildings, posters and storybooks for every household, stickers for vehicle owners, certificates that were signed by audiences after key messages, notebooks, t-shirts, tote bags, and jackets for district leaders. The campaign activities included training workshops for hunters, government and village leaders, puppet shows, village games depicting hunting regulations, a pop star concert, and radio spots.

The area surrounding the new ranger station built in Year 7 (Figure 11) was a strategic military zone during the Indochina conflict in the 1960's. Given the history of the villages in this area, the outreach team worked with military officials to do a villager training and a government training to increase the knowledge of these groups about the purpose of the NPA and the regulations for managing natural resource use. In Houameung district, villager trainings were continued by broadcasting over 100 different episodes of the “Friends of Wildlife” radio program through the public address system located at the center of the district (Figure 7). In addition, five one-minute conservation announcements were broadcast via the same system every day for the entire year.

Monitor effectiveness of outreach actions. In July 2009, a pre-survey was administered to 615 people in the social marketing campaign site (Viengthong district) and the control site (Viengkham district, west of the NPA) that was followed by a post-survey one year later after the campaign was completed (Saypanya 2010 (Figure 16 and Table 1-O1 to O9). The two sites were selected to have comparable target audiences in terms of ethnicity, age, gender, religion, and type of NPA management – both were near ranger stations with foot patrol teams and both had Wildlife Crime Units for receiving reports of illegal hunting and trade (Saypanya 2010).

Monitor the status of conservation targets. Wildlife monitoring teams conducted reconnaissance surveys throughout the TPZ to identify potential camera trapping sites with reliable tiger sign that would be used in a capture-recapture survey to estimate tiger density in the TPZ in Year 8 (Table 1-G1). Foot patrol teams and wildlife monitoring teams continued to opportunistically collect felid scat samples to monitor the minimum number of tigers in the TPZ (Vongkhamheng 2011).

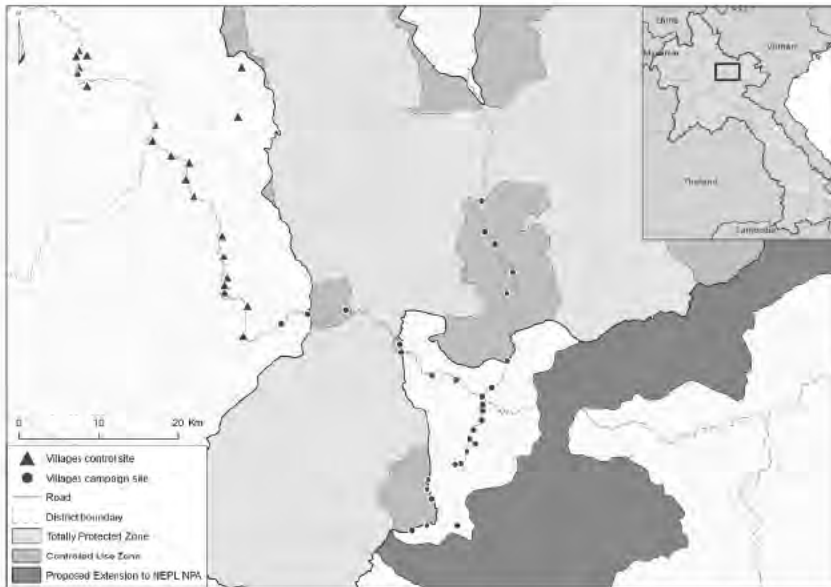


Figure 17. Social marketing campaign and control sites in the NEPL NPA in Year 7 (Saypanya 2010).

PMC Step 4. Analyze results and adapt

Y1 Y2 Y3 Y4 Y5 Y6 Y7

In Year 7, implementation and monitoring results were reported at NPA monthly meetings and at the Tigers Forever annual meeting in July 2010.

Report enforcement monitoring results. Patrol effort for the 8 foot patrol teams in Year 7 (July 2009-June 2010) totaled 5,918 km inside the TPZ and an average of 19.3 patrol days per month per team, which was similar to patrol effort per team in the previous year. With one additional ranger station and foot patrol team, total spatial effort of patrolling in Year 7 expanded to cover 3244 km² of the NPA (Figure 9, Table 1-L2). The catch per effort index of hunting in Year 7 was 0.017 signs per km walked in the TPZ (SD=0.005, n=7 full-time teams through April 2010), which was similar to the previous year for the same sectors (Figure 10, Table 1-L3). A total of 79% of encounters with poachers (n=24) resulted in a confrontation (Figure 13a). Of the poachers confronted, enforcement action was taken in all of the cases (Figure 13b, Table -L6). When enforcement action was taken (n=19) it resulted in fines in 79% of cases.

The mobile teams patrolled for a total of 213 days in Year 7, an average of 4.4 days per month per team (Table 1-L7). Although this was less than half the effort of mobile teams the previous year, it led to 22 cases where criminals were fined and arrested with two cases submitted to the Lao judicial system that resulted from 82 reports of illegal hunting and wildlife trading received via the wildlife crime hotline over a six month period from January to June 2010 (Saypanya 2006, Saypanya et al. In review) (Table 1-L6 and L8). This demonstrated that less mobile patrol effort could be applied more effectively by responding to informant reports rather than conducting routine roadblocks and market checks that were not well-informed or productive.

Adapt enforcement strategy. Based on the implementation and monitoring results, the recommended activities for the next five years (2010-2015) included, i) expanding foot patrol teams and ranger stations to cover the remaining 934 km² of the TPZ, ii) extending the social marketing campaign model to develop wildlife crime units with mobile teams to report and respond to cases of illegal hunting and trade in the seven NPA districts, iii) to complete TPZ and village boundary demarcation. The estimated total reoccurring cost of these actions was approximately \$690,000 USD (\$US 1.15 per hectare) per annum (Johnson and Vongkhamheng 2010).

Report outreach monitoring results. Pre and post campaign results were summarized for the three target audiences (Saypanya 2010). For government officials at both the campaign and the control site, no increase was detected in the percent of officers who said that modern hunting gear is the biggest threat to ungulates or that borrowing guns to hunt should be punished (Table 1-O1). There was an insignificant increase in the proportion of officers in the campaign site who reported that they had talked about people being fined for illegal hunting (Table 1-O6).

For villagers, there was an insignificant increase in percent of villagers in the campaign site who said that modern hunting gear is the biggest threat to ungulates and a significant increase in those responding that muntjacs and wild pigs are important for food (Table 1-O2). There was also a significant increase in the percentage of villagers in the campaign site reporting discussions about how to increase muntjac and wild pig populations in their village area as well as stating that they had reported someone for illegal hunting and trade, in contrast to the control site where no significant increase was detected (Table 1-O7 & O9).

For hunters, no increase was observed in the percent of hunters in the campaign or the control site saying that modern hunting gear is the biggest threat to ungulates, but there was a significant increase in both sites of the percentage of hunters saying that illegal hunting should be punished (Table 1-O3 & O5). There was also a significant increase in the percentage of hunters reporting conversations about being fined for illegal hunting in contrast to an insignificant increase at the control site (Table 1-O8).

Overall, the survey results indicated that change in knowledge, attitudes and behavior had largely been achieved with the villagers and to a lesser degree with the hunters in the campaign site.

Adapt outreach strategy. Based on evaluation results, the NPA aims to maintain the momentum of the Year 7 social marketing campaign in the 37 villages in Viengthong district. The NPA also plans to develop and extend the social marketing campaign approach to the other 29 villages in Viengthong district and villages bordering the NPA in five more districts (Viengkham, Xam Neua, Houameuang, Phonthong and PouKout) (Figure 7).

Report target monitoring results. Fecal DNA analysis of 167 large carnivore scats collected from March 2008 to May 2010 (Years 6 and 7) confirmed tiger DNA in 16 scats from five areas of the NEPL TPZ (Vongkhamheng 2011) (Figure 15, Table 1-G1), which represent an undetermined number of tiger individuals. Based on the

results to date, the recommended target monitoring activities over the next five years (2010-2015) are, i) a capture-recapture camera trap survey across the TPZ to assess change in tiger density since the baseline survey in Year 1, and ii) a prey occupancy survey across the TPZ to assess change in ungulate occurrence in each enforcement sector of the NPA since Year 5.

Discussion

The recovery of tigers and large ungulates in the NEPL NPA presents enormous opportunities as well as challenges. Relative to high-density tiger sites elsewhere in Asia, Laos with its extensive habitat offers some of the highest potential for relatively large increases in tiger numbers within the coming decade if adequate funding for protection of remaining individuals is secured. At the same time, the sheer size and ruggedness of the NEPL landscape demands careful strategic planning to direct human and financial resources towards conservation actions that will most effectively reduce critical threats to remaining pockets of breeding tigers and their prey. After several iterations of the project management cycle, we assess to what degree the planning framework that we used supported monitoring and evaluation to adapt management. We also review what conditions were present that aided us to practice adaptive management, as well as what constraints needed to be overcome that commonly impede adaptive management at project sites in countries where capacity and governance for wildlife conservation are in an early stage of development.

Defining the project context

As with most conservation projects, our project team and stakeholders came from a wide range of backgrounds and perspectives. In our case, this included several levels and sectors of government, as well as trainers and managers at the project site, in the national office and abroad. Under these conditions, defining the project scope, vision, targets and critical threats in a single image of the conceptual model (Step 1) was essential in helping our multi-lingual team arrive at common goals and assumptions about the factors impacting the conservation targets. This step was also crucial for documenting the rationale of prioritizing some strategies over others during the formation of the project team and stakeholder group in Years 1 to 3 and as the project grew and evolved in the years that followed. Although the conceptual model was reviewed and refined through the years to assess threats specific to each conservation target (Johnson and Saypanya 2007) or to develop more explicit theories of change to refine conservation actions (Lynam et al. 2006, Saypanya 2010), the assumptions about the major factors impacting the conservation targets largely remained much the same over the seven-year period. This was likely because our preliminary analysis of the factors contributing to the decline of tigers and their prey accurately represented the conditions of the project site and were not dissimilar from trends found at sites across many of the tiger range states (Sanderson et al. 2006). The bigger questions for our project were what strategies

and actions were potentially most effective in reducing threats to tigers and their prey under these conditions.

The original conceptual model for the project included strategies that were not implemented due to technical and financial constraints (Figure 4). One of these was improving large livestock husbandry to reduce human-tiger conflict. After several years of fundraising, in Year 7 technical assistance was finally attained from a partner organization to initiate this strategy under the Land Use Management section of the NPA Management Unit (Figure 2). Another strategy was to respond to farmer reports of carnivore depredation of livestock to verify the validity of the report and to test methods for reducing conflict. This was trialed in the first years of the project but confronted two major barriers. The first was to win the confidence of farmers that reporting livestock loss to government offices would be worth their time and effort. The second was getting government officers to consistently respond to farmer reports, which was unlikely if the officer lacked a supervisor's mandate, transport and/or per diems for field work. This is a very different scenario from conservation projects in more developed countries where relatively well-funded and trained government agencies are established to fulfill this role whereas in Laos the agency had to be both established and funded as part of the project action plan.

In designing the conservation outreach strategy, the project frequently discussed how to prioritize the time and resources spent on changing the knowledge, attitudes and behavior of various potential audiences. These potential audiences ranged from villages at the project site to levels of government ranging from the district administrative offices up to the headquarters of the national Prime Minister. In the earlier years of the project most threats originated at the project site and outreach was focused accordingly. In the later years, larger infrastructure and land use projects have begun to loom as potential threats in the NEPL landscape. The latter may require that audiences for the conservation outreach strategy be reprioritized or expanded in the future to include other sectors and higher levels of government.

Planning and implementing monitoring – at the heart of adaptive management

To manage adaptively requires monitoring. The three most frequently reported barriers to planning and implementing monitoring are that, i) designs are inappropriate for answering management questions (Ferraro and Pattanayak 2006, Margolis et al. 2009a), ii) plans are too ambitious to be feasibly implemented (Salzer and Salafsky 2006, Salafsky 2012), or iii) the time or capacity is lacking to effectively manage monitoring information, complete the data analysis and write up the results (Pullin et al. 2004, Kapos et al. 2008). To overcome these barriers, we relied on an assemblage of technical support, project-based mentors, and national project staff. Technical support was usually from WCS scientists or partner organizations that provided intermittent training for our project-based mentors in monitoring design and analysis. Project-based mentors are technical staff (national and expatriate) located in country at the project site or in the national office that trained and guided national project staff to do the monitoring at the project site and oversee the systems for data processing, storage and analysis. This approach is a hybrid of

the two other possible approaches where, i) traditional academics are engaged to gather this information and generate results or, ii) where the practitioners alone make these assessments (Salafsky et al. 2002a). In our situation, this hybrid approach seemed to achieve the best results. Where this approach was absent in our monitoring plan, it was more difficult to overcome the usual barriers of delivering useful and timely results to guide management.

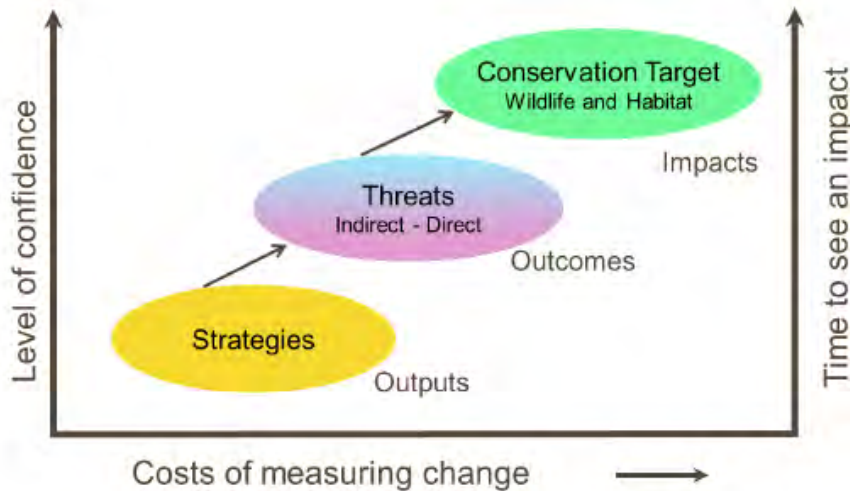


Figure 18. The anticipated tradeoffs in costs and time to see results and the level of confidence that conservation investments are effective (WCS 2002).

Setting goals and objectives

Lack of clear objectives is identified as a common shortfall of designing appropriate monitoring (Kapos et al., 2008). We did lack precise goals and objectives in the early years of the project, and instead only identified variables that we aimed to increase, decrease or maintain. As we acquired a better understanding of the status of different variables (e.g., abundance of tigers or prey, indices of hunting or levels of knowledge) we were able to make our goals and objectives more specific, and in turn refine our monitoring design. Likewise, it was much easier to illustrate assumptions about our actions and develop clear objectives when eventually working from a results chain rather than directly from our conceptual model as we did in the earlier years of the project.

Designing monitoring to answer management questions

Given that professional experience and capacity were limited, we used WCS technical specialists and strategic partnerships with other organizations to help us develop appropriate (i.e., feasible and affordable) monitoring designs that would answer our management questions. This assistance included determining not only what data we would collect and how, but also guidance on data management and analysis options. From previous experience, we found that if data management and analysis were considered only after data collection was underway, it was more

likely that data were misplaced or that analysis was lacking or untimely and thus, less useful for management. Given that our conservation targets are rare, difficult to detect and more expensive to measure than our objectives (Table 1), which is generally the norm (see Figure 18), we invested quite a lot of time and technical expertise in carefully reviewing the most feasible options for target monitoring that were appropriate for our conditions.

Although we identified the need to also monitor the effectiveness of our strategies early in the project, we initially had less expertise and tools available to do so. Over time however this changed. For example, with additional guidance and financial support we were able to eventually apply a quasi-experimental design to assess the effectiveness of our outreach strategy that included control and test sites and a priori hypotheses. Although such a design was not feasible or practical for assessing all actions, evaluation of the effectiveness of our training and capacity building activities could have been easily improved with a relatively small amount of financial and human support for using a pre-test / post-test monitoring design (see Margoluis et al., 2009a).

Implementing monitoring plans – a lot more than data collection

In the early years of the project staff experience in research skills was limited or absent and considerable time was devoted to training and supervision to achieve good quality data collection. For example, we found that mentoring enforcement staff that were unfamiliar with data collection to consistently and accurately record multiple details of hunting sign (e.g., investigation of camps and their contents including types and number of gear) on a dataform while on patrol required frequent follow up and guidance. Here, lack of attention to detail, fatigue or even fraud had to be vigilantly guarded against.

Monitoring plans as developed in most of the frameworks for conservation planning mistakenly emphasize only what data will be collected, by whom and when. In fact, we found that equal attention must be paid to the entire process including who and how will data be processed, stored, and analyzed, as well as how and when results will be presented to management. Without an explicit project plan for these steps, data accumulates, but analysis and feedback to management is often delayed or sometimes never occurs (Pullin et al. 2004). In some cases, we were aided by the development of tools and software that helped to facilitate this process as the project developed. One example is that in the first years spatial data to map monthly foot patrol coverage had to be hand carried to a GIS lab at the national office in the capital for processing because of slow or non-existent internet and lack of GIS capacity at the project site. The installment of the MIST law enforcement monitoring system with its in-built GIS functionality and technical support to train staff at the project site in the software meant that patrol routes and summaries could be presented to management as soon as data reached the NPA office from the field. The location of hunting threats could be entered and displayed within days rather than weeks, which facilitated rapid uptake of information and potential response from management.

Analyzing monitoring data and using results for management

When using monitoring results for adaptive management we found that the type of data and results that were important for ongoing adaptive management at the project site were quite different than those that were important to donors, upper level project management and the larger conservation community. For the latter, our estimates of tiger abundance and annual indices of hunting sign per unit effort were needed to inform priority setting, annual allocation of resources across project sites in the region and to gain political support on a broader scale. At the project site, where shorter iterations of adaptive management were occurring (e.g., decisions about where enforcement patrols were deployed each month or village trainings by the outreach teams) actions were largely informed by where relative amounts of tiger and prey sign were found and not the actual number of tigers, and also by where and what hunting or illegal trade was observed and not the index of hunting sign per unit effort. This was also true for adaptive management at the project site on an annual basis such as priorities for placement of ranger stations and patrol sectors, and the public outreach and conservation messaging that went along with that, which was informed by tiger sign (tracks, photos, and scat) and then further corroborated by ungulate sign survey results.

Once results are obtained, many projects have reported challenges with institutional arrangements and a lack of time for managers to access and use monitoring results (Pullin et al. 2004). Perhaps one of the advantages of working with newly developed institutions was that we were able to successfully schedule time monthly with the NPA project management unit and annually with the NEPL advisory committee and stakeholders to present and discuss monitoring results and recommendations for management. As the project developed and information about the location of tigers and other high value wildlife increased, we also became aware of both the necessity and difficulty of managing sensitive information so as not to jeopardize the wildlife, which added to the complexity of communicating results to stakeholders.



An NPA conservation outreach officer works with two village authorities to map the boundary between the village area and the NPA Totally Protected Zone.
© Santi Saypanya / WCS

Monitoring options and needs

Given the capacity-building that is needed for monitoring, the biological characteristics of the targets as well as the extent and severity of threats to these targets, we arrived at several recommendations about monitoring for adaptive management under these conditions:

- For projects where targets are rare or elusive, it may be advisable to monitor the targets to obtain absolute estimates of density less frequently but on a schedule that facilitates fundraising for what are typically large investments (e.g. every five years for tigers and three years for prey). This recommendation may be relevant to sites where expected population growth of biological targets is limited by fecundity or the level/impact of threat.
- If a certain level of data quality can be guaranteed and some decent spatial coverage of the area of interest assured, then one could consider maintaining complimentary more feasible and affordable ongoing monitoring of target sign (e.g., tiger fecal DNA and tracks; large prey signs and sightings) to inform project adaptive management based on, for example, location of tigers and prey and evidence of tiger breeding. In the NEPL project, this monitoring was done in one of two ways, i) along with the law enforcement monitoring, which was feasible because tiger and large prey signs were encountered very infrequently such that teams were not distracted from their primary law enforcement duties, or ii) by supplementing the law enforcement monitoring with the deployment of wildlife monitoring teams to search for sign in areas of the TPZ that were not covered by law enforcement teams. Where law enforcement teams were used for this purpose, we also periodically sent out wildlife monitoring staff with law enforcement teams to assure that tiger and prey sign was accurately and consistently collected. It is important to note that systematic probabilistic survey design is not achieved via this monitoring approach, as the main focus for the law enforcement teams are human signs and follow-up activities once human sign are detected. Thus, the type of data will differ from that generated by a dedicated wildlife survey. While this is not the ideal, it may be the only feasible option in some cases.
- To improve monitoring overall, it is imperative to provide technical assistance to projects in the form of tools, approaches and training that are both relevant and affordable given the conditions of each project site. As evidenced in our project, this is needed to evaluate the effectiveness of strategies as much as to assess the status of the conservation targets. For example, law enforcement is a strategy that many projects use to address illegal and/or unsustainable extraction of resources. Although using MIST was an advance over our initial law enforcement monitoring system, it was still difficult for project staff to extract and interpret the results from the software without technical assistance and it did not include systems for tracking some indicators such as repeat offenders, status of fines or the licensing

and collection of guns. Law enforcement monitoring could be improved by making revisions to the system to meet these needs as well as investing more time on training staff at the project site on data analysis and interpretation of results. To address these challenges, a Spatial Monitoring and Reporting Tool (SMART) is under development by WCS and other conservation partners that aims to provide practitioners with a more comprehensive tool to monitor and evaluate standard law enforcement actions.

In another example, over the past decade Rare has continued to test and improve approaches and tools for practitioners to design and monitor conservation outreach actions (Jenks et al. 2010). The system is still relatively complex and practitioners enroll in a lengthy training program to learn how to apply the approach. Could the training for application and use of these social marketing tools be modified or expanded to allow a wider audience of conservation projects to access and use this approach for designing and evaluating their outreach actions? Likewise, following the taxonomy of conservation actions (Salafsky et al. 2008) it may be beneficial for conservation practitioners to have a reference of standardized approaches and tools that have been used to successfully monitor the effectiveness of the most commonly applied strategies (e.g., capacity-building, linked enterprises, livelihood alternatives, etc.).

Capacity building for adaptive management

In the first seven years of the project, the project team grew from a handful of staff involved in baseline target and threat surveys during the first year to over 100 staff by Year 7. The Year 7 staffing ratio (~17 per 1,000 km²) is still lower than the average global protected area staffing ratio of 27.6 per 1,000 km² for developing countries (James et al. 1999). The project started in 2003, only ten years after the national protected area system had been declared and no formal training program for protected area management or monitoring existed at tertiary institutions in the country. This meant that very few of the staff had experience and training in the protected area management or the technical tasks they were assigned. For many, it was the first time working in an NPA or even their first job after graduation from a technical school or university. Thus, all training for implementation and monitoring had to be done on the job when they joined the project team and training continued as activities and systems evolved over the seven-year period. Most of the biodiversity conservation terms and concepts were still relatively novel in the Lao context and this required time consuming translation for both training and on-the-job implementation. Normal turnover of staff as well as staff fatigue due to the remote and at times physically difficult or dangerous working conditions of the field site meant additional training was required as new recruits joined the project team.

The need for ongoing and long-term investment in training for adaptive management that we encountered is not atypical for projects in countries where natural resource governance and training systems are new or lacking, and takes time and other resources even under the best of project conditions (Grantham et al. 2009). Where governance and training systems were lacking, designing and implementing monitoring activities in addition to action plans was especially challenging.

Given that every aspect of the action or monitoring plan design and implementation required capacity building, training was grossly under-represented in our conceptual model and results chains (Figures 4-6), but perhaps better exemplified in the structure of the overall NPA Management Unit (Figure 2). The latter illustrates how technical assistance in the form of training and capacity building was provided to all technical sections, including for overall protected area management and administration. We argue that most projects, including ours, underestimate how much time is needed for training to be able to turn adaptive management theory into practice in situations where capacity and experience is low. To overcome this barrier to adaptive management, practitioners and their organizations working under these conditions need to be more realistic in adequately preparing for what will very likely be a long-term and ongoing investment in training and capacity-building.

A camera trap photograph of a tiger (*Panthera tigris*) on Phou Louey mountain (2003).
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Progress towards goals and objectives

Status of conservation targets

At the end of Year 7 our biological monitoring indicated that tigers were still present and breeding in pockets of the NEPL TPZ. As a result of monitoring tigers over the seven-year period, our knowledge of tiger distribution inside the NPA and in the larger landscape is much greater than at the start of the project (Figures 15 and 17). We have a baseline estimate of tiger abundance from Year 1 and a survey is underway in Year 9 to determine progress towards the goal of increasing tigers in the TPZ by 50% by 2015.

For ungulates, we also have a good baseline estimate of abundance and distribution in the TPZ and an estimate of occupancy across the larger landscape (Figure 14). Funding is being sought to repeat the ungulate survey of the TPZ to determine progress towards the goal of raising prey levels to support a 50% increase in tigers. The results of occupancy surveys in Years 5 and 6 along with camera trapping surveys in Years 1 to 4 concur that larger ungulates (gaur, sambar, and serow) persist in remote pockets of the TPZ and the surrounding landscape. They also agree that smaller or more fecund ungulates (wild pigs and muntjacs) are more abundant,

especially in areas where human population and associated hunting pressure is less.

Effectiveness of the law enforcement strategy

Inside the TPZ, the index of hunting per unit effort over time indicates that the foot patrols have been effective in reducing but not eliminating the threat of hunting in the TPZ (Figure 10). At least one report of tiger poaching was confirmed each year. Since establishing full-time foot patrol effort in the TPZ, detection of illegal hunting cases has increased with the majority of cases (77%, n=63) resulting in fines and some in arrests (Figure 13). Monitoring illustrated that the part-time foot patrols were largely ineffective in limiting access to the TPZ and confirmed that guarding tigers, large ungulates and other high value wildlife in the NPA (e.g. bears, pangolins, porcupines) requires full time protection. This needed protection demands investing in considerable supervision, financial and human resources over a large spatial area. The results of the biological monitoring were instrumental in guiding management decisions about how best to systematically deploy limited resources towards spatial placement of law enforcement effort in the TPZ.

Outside the TPZ, monitoring results helped us to test and adapt deployment of mobile patrol teams and the development of a wildlife crime hotline to improve effectiveness in detecting illegal trade (especially of non-ungulate species). This ultimately resulted in an increase in reports of illegal trade and cases that were prosecuted. Our monitoring indicates that the objective of licensing all government-issued guns to control potential use of military weapons for hunting has not yet been achieved and remains a challenge. Results of preliminary surveys in Years 3 and 7 in villages indicate that hunter effort to secure larger managed species (>1kg in size) is steadily increasing over time suggesting that hunting in village areas is unsustainable (Krahn and Johnson 2007, Johnson et al. 2010). To achieve the objective of increased sustainability of hunting the project must expand its work with villages to better manage offtake and to stop the illegal trade of managed species. A survey of ten villages in Year 9 identifies community-based management actions that can be tested to work towards this objective (Johnson et al. 2012).

Effectiveness of the conservation outreach strategy

Monitoring results at the onset of the project illustrated shortcomings in the outreach strategy that were used to improve actions over time. Later monitoring indicates that the social marketing campaign approach to conservation outreach was more effective in achieving the objectives of increasing knowledge, attitudes, and interpersonal communication of villagers, and to some degree hunters, about the importance of hunting regulations that contributed to increased reporting of illegal hunting by villagers. Quantitative monitoring results were less conclusive about the effectiveness of the outreach strategy to achieve similar objectives with government officials. Although a significant change in the knowledge and attitudes of government officials about enforcing against illegal wildlife trade was not observed via the outreach monitoring, the law enforcement monitoring indicated that there was an increase in actual cases of government enforcement against illegal wildlife trade in Year 7 during the social marketing campaign than in previous

years.

As far as demarcation of the TPZ boundary with village use areas, monitoring results show that this has been achieved for at least 31% of the 98 villages bordering the TPZ. The mapping also indicates that six villages overlap with designated corridor areas of the NPA, which still needs to be resolved through negotiation (Figure 12).

Iterations of the project management cycle

While many projects report that incentives and motivation for evaluation are limited (Kapos et al. 2008), we found that having donor funding linked to monitoring performance, as well as project managers that were committed to adaptive management were key to overcoming this constraint. For example, as a recipient of Panthera funding through the 10-year Tigers Forever program, the project was required to annually analyze and present progress towards the project goal and enforcement strategy objectives. At the annual meeting, the results of implementing the action and the monitoring plan were presented and peer reviewed by technical experts and other projects that shared the same goal and similar strategies. Recommendations were discussed for adapting the action and monitoring plan for the following year, and funding was dependent on the continued presence of tigers at the project site as well as progress towards implementation of both the action and the monitoring plan.

Another barrier to adaptive management is that it may take a decade or more to achieve conservation goals, which is outside most project time frames and funding cycles (Kapos et al. 2008). This is especially true under conditions where experience and capacity in biodiversity conservation is low and where protected area systems have only recently been declared such as in Laos. The first seven years of our project illustrate the time required to begin putting adaptive management systems in place, for results to occur, and the necessity to make a long-term commitment that goes well beyond typical project time frames and donor cycles. Results chains are especially useful to help projects and funding agencies visualize and anticipate this (Margoluis et al. 2009b).

To capture the process, results, and adaptations that occur we learned that it was important to document project iterations regularly in a document such as this one. Without a central repository for the strategic plan, Miradi files, and monitoring data, information instead tends to be stored in a myriad of software, documents and locations with a whole host of people. This makes it much more difficult and less likely that lessons will be retained in the institutional memory of the project or that they will be applied going forward.

In conclusion, we found that we have been able to identify ways to overcome many of the constraints that commonly impede adaptive management at conservation sites in countries where capacity and governance is at an early stage of development. Monitoring and evaluation in the context of a framework such as the *Open Standards* did help us assess the effectiveness of our strategies, the status of our targets and was used to adapt our conservation actions. As a result of our monitoring, there is evidence that we have reduced but not yet eliminated all of the threats to the wild tigers and their prey in the Nam Et-Phou Louey landscape.

The original conceptual model for the project included strategies that were not implemented due to technical and financial constraints. Thus we prioritized our actions to implement largely two strategies over the seven-year period. Although our monitoring indicates that we have increased the effectiveness of these two main strategies, it is still not certain if these actions will be sufficient to achieve our threat reduction objectives or the goals for our targets. Beyond our project site, our learning has contributed to larger systematic reviews of similar conservation problems and approaches (Pullin and Stewart 2006), with our evaluation results continuing to inform planning for tiger conservation across Laos (GoL 2010) and elsewhere in Asia (GTI 2010, Walston et al. 2010).

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