

MONITORING BIODIVERSITY AND FOREST COVER

In Nam Et-Phou Louey National Protected Area, Lao PDR

Biodiversity and Forest Cover Monitoring is central to effective Protected Area (PA) operations, and must be integrated with other PA management functions. Monitoring programs should be designed to both provide PA managers with up-to-date information regarding the presence of deforestation threats within the landscape, as well as provide longer-term data to determine the trends in wildlife populations, and forest cover. In addition, monitoring is important to determine the effectiveness of the range of management interventions undertaken to protect biodiversity and forests.

The Wildlife Conservation Society (WCS) has been supporting the Management Unit of the Nam Et-Phou Louey (NEPL) National Protected Area (NPA) in Houaphan Province, Lao PDR (Laos) since 2003, and has assisted with the development of the ongoing monitoring programs. During this time, the monitoring program has been updated and adapted to better align with both improving technologies and techniques, and changing management objectives.

This brief describes the NEPL - WCS monitoring model, and through examples explains the advantages and disadvantages of the different approaches, so that this experience may be applied in different PA in Laos and abroad.

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1. Introduction to Nam Et – Phou Louey National Protected Area

The NEPL NPA is located in the north-east of Lao PDR and is the largest protected area in country (410,720 hectares). Spanning nine districts across three provinces (Houaphan, Luang Prabang and Xieng Khouang provinces), the protected area is marked by steep mountainous topography, with elevation ranging from 336 to 2257 m. The NEPL NPA is remarkable for its rich wildlife biodiversity with a wide range of species, many endangered, including Tigers, Leopards, Golden Cats, Dholes, Northern White Cheeked Gibbons, Phayres Langur, Sun Bears, Asiatic Sun Bears, Binturongs, Otters, Hornbills, and numerous species of civets, pangolins, and other primates. Altogether there are 19 carnivore species including six species of wild cats, roughly fifty species of mammals and 299 species of birds.



Living inside or immediately adjacent to the NPA are 30,000 villagers from 98 communities, many in some of the poorest districts of the country. There is a long history of human settlement in and around NEPL, with local people relying heavily on natural resources for their subsistence. To balance the protection of biodiversity, and the needs of local communities, the protected area is split into 2 primary zones: the Total Protection Zone (TPZ), where strict conservation is the primary objective, and no activities or access are allowed without permission, and the Controlled Use Zone (CUZ), where many villagers practice agriculture and day to day village activities.

WCS has been providing technical assistance to support the NEPL Management Unit since 2003. During this time WCS and NEPL have gained valuable experience regarding a range of management activities including: law enforcement and ranger patrolling, ecotourism development and promotion, outreach activities for community engagement, and monitoring of wildlife, forest cover, and threats.



2. Biodiversity Monitoring

2.1. The importance of Biodiversity and Threat Monitoring

Biodiversity monitoring is a central component of any comprehensive PA program. The monitoring program must be coordinated with, and support the other management functions of the PA, and insights gained must be incorporated into day to day and strategic PA planning. For example, biodiversity monitoring is crucially important for forewarning of impending species declines and extinctions, for creating triggers for management interventions, for assessing the effectiveness of management actions designed to preserve biodiversity, and for accumulating the data necessary to produce metrics representing the status of biodiversity

As conservation of wildlife is a primary stated objective, it is necessary to monitor changing population status over time. However, measuring change in biological populations is often a long-term effort. Given the assumed causal connection between wildlife populations, specific threats such as hunting, and the interventions designed to abate these threats, monitoring threats makes it possible to measure conservation progress over the short to medium term. Thus, monitoring should be conducted on multiple levels; for both threats and for wildlife populations.

2.2. The Biodiversity Monitoring Approach at NEPL NPA

Following the Landscape Species Approach, the tiger was initially selected as an umbrella species for NEPL. The presence of tigers at the site was very important as it is believed to be the home to the last population of tigers in Laos. Also, because tigers require a large area of forest as habitat and due to their role as a top predator in the ecological system, their protection extends to the protection of other wildlife species. However, because tigers have been poached heavily in the past, their population has severely declined. A decreased detection probability through accepted monitoring methods makes it hard to monitor the population changes over time. Therefore, the monitoring focus at NEPL has shifted to small to medium carnivores such as clouded leopard, golden cat, dhole as well as bear and gibbon. These species have been considered as indicators to measure the success of conservation works in NEPL, across a range of habitats. Recent and ongoing studies regarding these species include repeated surveys of camera trapping blocks and gibbon listening post surveys.



Clouded Leopard (*Neofelis nebulosa*)



Northern white-cheeked gibbon (*Nomascus leucogenys*)



Dhole (*Cuon alpinus*)



Sun Bear (*Ursus mayalanas*)

2.3. Key Biodiversity Monitoring techniques

A range of monitoring techniques are employed at NEPL to accommodate the different target species, habitats and topography, and available resources including funding and time. The main methods currently and previously used include camera trapping, occupancy surveys, and data collected from ranger patrols through the SMART system. In addition to these primary monitoring approaches, other techniques have been used such as detailed questionnaires of local villagers on species locations and abundance, scat analysis to determine both species (through DNA) and the prey that was eaten (through scat examination), gibbon listening post surveys, and species presence data from permanent ecotourism camera traps.

CAMERA TRAPPING

Camera trapping involves the use of motion sensitive cameras, set up at strategic locations within large, long term monitoring blocks in key biodiversity areas. Data obtained from camera trapping can be used to estimate density, abundance and the occupancy rates of particular species. Over 13 years, different camera trap survey designs were used in the TPZ, depending on the objectives and target species. Since 2013, repeated camera trapping has been conducted in a set of four, approximately 200 km² blocks, using 80 pairs of camera traps and over 50 days of monitoring for each monitoring occurrence.

CAMERA TRAPPING SURVEYS - AT A GLANCE

Survey team required:

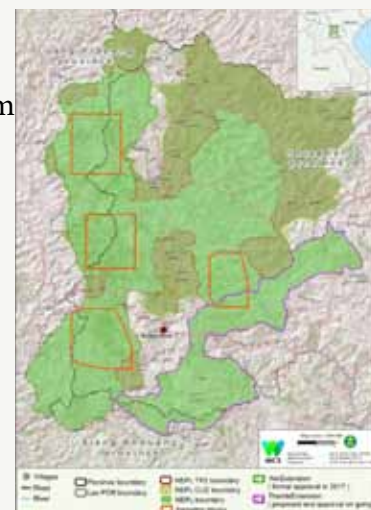
- 2 - 4 survey teams of 4 people and at least 2 well-trained people in each team
- 3 -5 porters per team
- 40 – 60 days (10 -15 days/team) to conduct survey in each block

Advantages

- Gold-standard method
- Pictures obtained have additional political value
- Wide range of species can be included

Disadvantages

- Only suitable for species which can be uniquely identified
- A high number of captures of a large proportion of the population is necessary for density estimation
- Detection depends on optimal camera-placement which requires experienced field personnel
- Camera loss can be a problem and adds to cost



SIGN-BASED OCCUPANCY SURVEY

Sign based surveys can provide information on the spatial distribution and abundance of target species across a wide area. At NEPL, a sign-based occupancy survey was done across a 2,600 km² area to assess the abundance and distribution of ungulate prey, including gaur, sambar, muntjac, serow and wild pig.

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. Ungulates act as good indicators of management effectiveness because they are indicators of hunting pressure.

The survey design included the area being divided into 13 km² grid cells, with four 3.25 km² sub-grids, in which nine equally spaced (600 m apart) destination points were specified. The survey could deviate from the geometrically rigid sampling route by as much as 100 m either side of the straight line due to impassable topography, and passed through at least five points, including the center point of each sub-grid cell. The field team must search thoroughly for signs of prey including fresh tracks and fresh dung (less than 2 weeks old).

Survey team

- ## Advantages

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Disadvantages

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SMART (Spatial Management And Reporting Tool) is a software tool specifically designed for PA managers. In the field, forest rangers and mobile team members record all observations of offences under NPA regulations, threats to biodiversity, as well as wildlife signs using special SMART forms to specify the necessary details of these encounters. These forms along with GPS tracks and waypoints are delivered to the office once a month by substation teams and after every patrol by the office based teams. In the office, the WCS data technician inputs these data into the SMART software.

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Survey Team

- ## Advantages

- ## Disadvantages

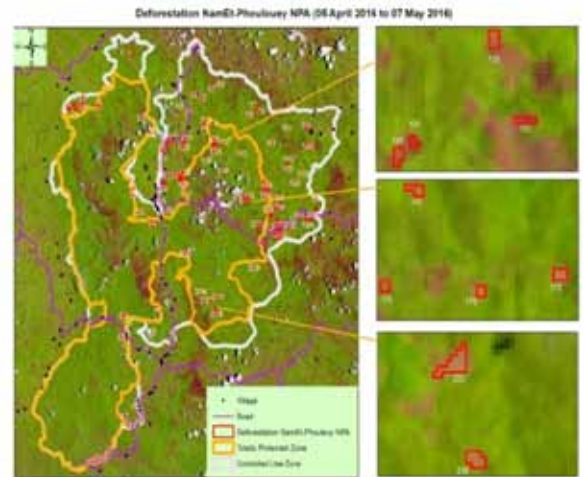
- Limitations of confidence in data
- Limited scientific use
- Depends on ranger training and experience

3. Forest Cover and Deforestation Monitoring

WCS and the NEPL Management Unit employ a range of short and long-term techniques to monitor the state and extent of forest cover in the PA, as well as identify activities that lead to deforestation, such as agricultural encroachment, and illegally set fires. This monitoring is conducted to both provide management with up to date information regarding emerging deforestation threats to the integrity of the PA, as well as provide an understanding of the long-term trends and effectiveness of activities to reduce deforestation. The three main activities include the monthly deforestation analysis, fire hotspot monitoring, and intensive forest classification assessment conducted every 5 years.

3.1. Monthly Deforestation Analysis

The monthly deforestation analysis conducted for NEPL involves accessing free satellite imagery, conducting a change analysis to identify and quantify deforestation, and reporting the results monthly to the NEPL Management Unit. Free satellite imagery such as Sentinel and LandSat is now available on relatively short cycles, and can allow this analysis to be conducted without the need for expensive imagery purchases. Analysis includes comparing two images from different time points (ideally each month if cloud cover allows).



Monthly Deforestation Assessment

By showing the two images on screen and switching repeatedly between them a computer operator can visually identify areas of change, supported by additional information such as the Fire Information for Resource Management System (FIRMS) data. With training, the operator can pick out changes due to deforestation, as opposed to seasonal changes such as leaf fall, grass fires or flooding. The operator can then demarcate those suspected deforestation areas on a map, produce a list of grid reference points and pass them on to a PA manager who can arrange a response. At the end of each year, the images, hotspots and documented responses should form part of the annual reporting for the site.

The following steps are undertaken to conduct deforestation monitoring with satellite data:

1. Obtain Suitable imagery
2. Process imagery
3. Conduct change analysis
4. Communicate results to PA managers



3.2. Fire hotspot monitoring with FIRMS MODIS data



Illegal forest clearing in the Total Protection Zone

FIRMS is a free and easily accessible tool that integrates remote sensing and GIS technologies to deliver global MODerate Resolution Imaging Spectroradiometer (MODIS) hotspot/active fire locations to natural resource managers and other stakeholders around the world. Each hotspot/active fire location represents the center of a 1km pixel (approximately) flagged as containing one or more actively burning hotspots/fires within that pixel. The hotspots/fires are detected using data from the MODIS instrument, which is currently installed on two satellites, using a specific fire detection algorithm that makes use of the thermal band detection characteristics of the sensor.

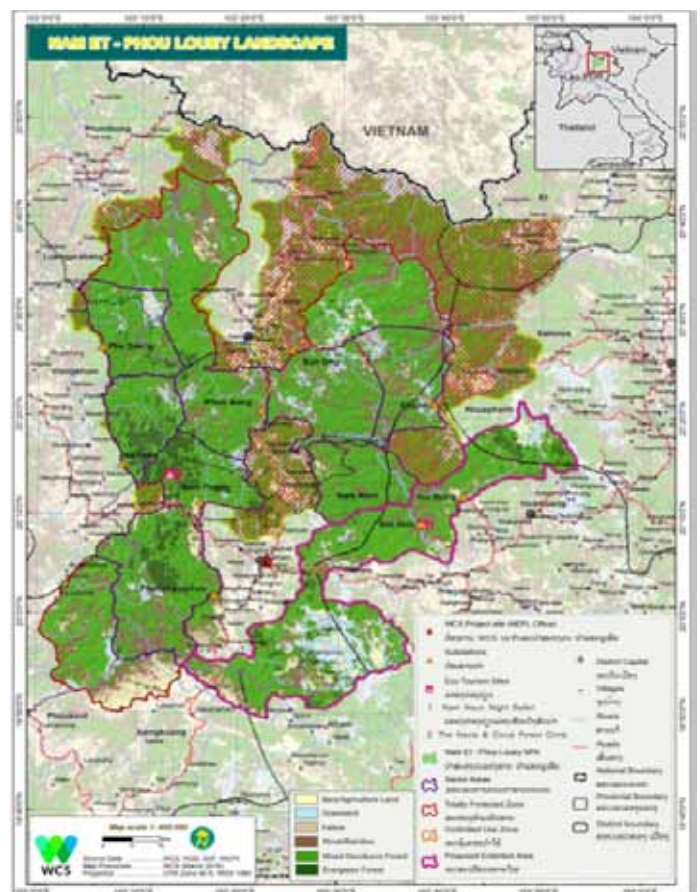
The three step process to be conducted on a monthly basis is as follows:

1. Obtain FIRMS MODIS data
2. Map and analyze location of fire hotspots
3. Communicate results to PA managers

3.3. Forest Classification

The most recent forest classification for NEPL NPA was conducted in 2013, and followed the Lao national classification land cover classes used by the Forest Inventory and Planning Division (FIPD) of the Department of Forestry. FIPD is currently conducting a new classification for the whole of Laos, which will be available in late 2017. The forest classes in NEPL NPA are:

- **Current agriculture, bare land or burnt areas** (low and upland areas including paddy fields, upland rice and corn)
- **Fallow** (up to 4 years after shifting agricultural practice)
- **Grassland** (high elevation and plateau grassland)
- **Shrub/Bamboo** (old fallows > 4 years after shifting agricultural practice, and stable bamboo forest)
- **Mixed Deciduous Forest - Low Density** (canopy cover >20% with small trees and/or mixed with bamboo)
- **Mixed Deciduous Forest - High Density** (large trees and a lower proportion of bamboo)
- **Evergreen Forest** (dense forest with large trees)



Most recent Forest Classification conducted for NEPL.

The classification process involves processing satellite imagery using GIS software, and conducting an analysis using additional software. The output of the assessment is a GIS layer.

4. Conclusions and Lessons Learned

As highlighted in this brief, monitoring is a central component of any comprehensive PA management program. Without monitoring, it is difficult if not impossible for PA managers to understand the results and impacts of their activities on achieving their objectives, specifically the conservation of biodiversity, and protection of important forest areas.

Over the past 14 years, a number of key insights and lessons learned have been gained:

- All monitoring to be conducted, both biodiversity and forest cover monitoring, must be directly linked with achieving PA management objectives, and must inform management regarding the effectiveness of natural resource protection activities
- Monitoring systems must provide information to PA managers quickly, and in real time when possible. This allows for management actions to be taken quickly in response to current and emerging threats
- The biodiversity monitoring program undertaken will typically depend on available resources. Programs should be designed so that during times of limited funding, the PA can still gain critical information regarding the distribution of key wildlife populations, and the intensity and spatial distribution of threats
- A comprehensive forest cover and deforestation assessment program should involve both short and long-term timeframes and approaches – the costs of which are decreasing rapidly with the increasing availability of free high quality satellite imagery.

DEVELOPED BY:



NAM ET-PHOU LOUEY NATIONAL PROTECTED AREA AND WILDLIFE CONSERVATION SOCIETY LAOS

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